The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

ABSTRACT BOOK

MAY 20-21, 2025
PATTAYA, THAILAND

Welcoming Massage from
Dean of the Faculty of Engineering, Khon Kaen University

Good morning, ladies and gentlemen, and distinguished guests. On behalf of the Faculty of Engineering at Khon Kaen University, it is my distinct honor to welcome you to the 34th Thai Institute of Chemical Engineering and Applied Chemistry International Conference 2025 (TIChE2025). We are truly delighted to host this prestigious international event at the Dusit Thani Pattaya Hotel, Chonburi, Thailand, in collaboration with TNChE Asia 2025. This year, we are pleased to welcome a diverse group of participants from academia, research institutions, and industry, both from Thailand and abroad. Your presence here today reflects our shared commitment to advancing the fields of chemical engineering and applied chemistry. TIChE2025 serves as a vital platform for knowledge exchange, research collaboration, and innovation, especially at a time when sustainable development and technological transformation are crucial to our global future. The themes and sessions of this year's conference cover a wide range of topics, ranging from green technologies, energy and environmental solutions, materials and nanotechnology, to advanced chemical processes and education in engineering. The discussions and insights shared over the next two days will undoubtedly contribute to the development of impactful solutions to address pressing challenges in our world today.

I would like to take this opportunity to express my sincere appreciation to the organizing committee for their unwavering dedication and outstanding coordination in making this event a success. I also extend my heartfelt thanks to our sponsors, collaborators, and institutional partners whose generous support has made TIChE2025 possible.

Most importantly, I wish to thank all of you, our valued participants, for your contributions, enthusiasm, and engagement. Your active participation is what drives the spirit of this conference and ensures its continued success. I hope that over these two days, TIChE2025 will inspire new perspectives, cultivate meaningful partnerships, and spark innovations that will lead us toward a more sustainable and resilient future. Welcome to TIChE2025.

I wish you a productive, enjoyable, and memorable experience.

Assoc. Prof. Dr. Ratchaphon Suntivarakorn
Dean of Faculty of Engineering,
Khon Kaen University, Thailand

Welcoming Massage from TIChE2025 Organizing Chair

On behalf of the organizing committee, it is my distinct honor to welcome you to the 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference 2025 (TIChE2025). We are delighted to host this esteemed international event at the Dusit Thani Pattaya Hotel, Chonburi, Thailand, from May 20-21, 2025, in collaboration with TNChE Asia 2025. This year, TIChE2025 brings together a diverse group of researchers, academics, industry professionals, and students from Thailand and around the world. Your participation underscores our collective commitment to advancing the fields of chemical engineering and applied chemistry. The conference serves as a dynamic platform for knowledge exchange, fostering interdisciplinary collaboration and innovation. The conference is held under the theme: "Navigating the Future: Challenges and Innovations for Sustainable Green Technologies", reflecting our shared vision of driving sustainable growth through research, technology, and international collaboration. The technical program of TIChE2025 covers a broad spectrum of topics, particularly in areas such as catalysis and reaction engineering, sustainable and green chemistry, advanced materials and nanotechnology, biochemical and environmental engineering, process engineering and digital technologies, energy and fuels, industrial applications and case studies.

We are honored to welcome our Plenary Lecturer, Dr. Ken-ichi Aika, and our distinguished Invited Speakers: Hiroshi Uyama, Ravin Narain, Taketoshi Minato, Nurak Grisdanurak, Tawatchai Charinpanitkul, Katsutoshi Nagaoka, Kieran N. Twaddle, Xiaohong Tan. We also extend our sincere appreciation to Assoc. Prof. Dr. Ratchaphon Suntivarakorn, Dean of the Faculty of Engineering, Khon Kaen University, and Mr. Surachate Chalothorn, President of The Thai Institute of Chemical Engineering and Applied Chemistry, for their continuous support and encouragement throughout the organization of this conference.

I would like to thank the organizing committee, sponsors, and partners whose dedication and contributions have been instrumental in bringing TIChE2025 to fruition. Most importantly, thank you to all participants. Your engagement and enthusiasm are the driving forces behind the success of this conference. We hope that TIChE2025 provides you with valuable insights, fosters meaningful collaborations, and inspires innovative solutions for a sustainable future.

Welcome to TIChE2025

Assoc. Prof. Dr. Kitirote Wantala
Conference Chair of TIChE2025
Faculty of Engineering, Khon Kaen University, Thailand

Welcoming Massage from
President of The Thai Institute of Chemical Engineering and Applied Chemistry

On behalf of The Thai Institute of Chemical Engineering and Applied Chemistry (TIChE), I extend our heartfelt gratitude to each of you for your invaluable contributions to the success of the 34th Annual TIChE Conference, themed “Navigating the Future: Challenges and Innovations for Sustainable Green Technologies.” The 34th Annual TIChE Conference (TIChE2025), organized by The Thai Institute of Chemical Engineering and Applied Chemistry (TIChE) in collaboration with the Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, will be held on May 20-21, 2025, at the beautiful Dusit Thani Pattaya, Chonburi, a vibrant beach city known for its scenic beauty and warm hospitality. This year, TIChE2025 will feature a special joint opening ceremony and plenary lecture with TNChE Asia 2025, a premier regional event that gathers industry professionals and experts in chemical engineering and applied chemistry from across Asia and beyond. By co-locating TIChE2025 with TNChE Asia 2025, participants from both events will have the unique opportunity to join sessions, exhibitions, and networking events across both conferences, enriching their experience and fostering wider collaboration.

In addition to an exciting lineup of technical sessions, keynote speeches, and networking opportunities, TIChE2025 will offer a dynamic platform for exchanging innovative ideas, showcasing cutting-edge research, and building meaningful collaborations. We are confident that this gathering will inspire new approaches to address global challenges and advance sustainable solutions. We also extend our deepest appreciation to our esteemed keynote and plenary speakers, whose expertise and passion will illuminate our discussions and spark innovative thinking, and to our sponsors and supporters, whose generous contributions make this event possible.

As we convene by the serene shores of Pattaya, I am filled with optimism for the transformative conversations, collaborations, and friendships that will emerge. Together, we have the power to shape a brighter, greener future for generations to come. Once again, thank you for your dedication, enthusiasm, and unwavering commitment to environmental sustainability and academic excellence. Your presence enriches our community and strengthens our collective resolve to build a better world.

With deepest gratitude and warm regards

Surachate Chalothorn

Mr. Surachate Chalothorn
President of The Thai Institute of Chemical Engineering and Applied Chemistry

COMMITTEE

ORGANIZERS

Kitirote Wantala (Chair)	Khon Kaen University	Thailand
Sutasinee Neramittagapong (Co-chair)	Khon Kaen University	Thailand
Ratchaphon Suntivarakorn (Patron)	Khon Kaen University	Thailand
Surachate Chalothorn (Patron)	The Thai Institute of Chemical Engineering and Applied Chemistry	Thailand

ORGANIZING COMMITTEE

Arthit Neramittagapong	Khon Kaen University	Thailand
Khanita Kamwilaisak	Khon Kaen University	Thailand
Pornnapa Kasemsiri	Khon Kaen University	Thailand
Duangkanok Tanangteerapong	Khon Kaen University	Thailand
Chaiyaput Kruehong	Khon Kaen University	Thailand
Varinrumpai Seithtanabutara	Khon Kaen University	Thailand
Kaewta Jetsrisuparb	Khon Kaen University	Thailand
Methus Suwannaruang	Khon Kaen University	Thailand
Shawn C. Rood	Khon Kaen University	Thailand

INTERNATIONAL SCIENTIFIC COMMITTEE

Ken-ichi Aika	Tokyo Institute of Technology	Japan
Kazuhiro Takanabe	The University of Tokyo	Japan
Takeshi Furusawa	The University of Osaka	Japan
Katsutoshi Nagaoka	Nagoya University	Japan
Junichi Ryu	Chiba University	Japan
Shogo Kumagai	Tohoku University	Japan
Taketoshi Minato	National Institute of Natural Science	Japan
Yu-Chuan Lin	National Cheng Kung University	Taiwan
Ren-Xuan Yang	National Taipei University of Technology	Taiwan
Chitsan Lin	National Kaohsiung University of Science and Technology	Taiwan
Ravin Narain	University of Alberta	Canada
Keonakhone Khounvilay	National University of Laos	Laos
Behzad Shahmoradi	Kurdistan University of Medical Sciences	Iran
Harikaranahalli Puttaiah Shivaraju	JSS Academy of Higher Education and Research	India
Sumaiya Zainal Abidin	Universiti Malaysia Pahang	Malaysia
Thunyaluk Pojtanabuntoeng	Curtin University	Australia
Giang Le	Duy Tan University	Vietnam

LOCAL SCIENTIFIC COMMITTEE

Kanyarat Holasut	Khon Kaen University	Thailand
Arthit Neramittagapong	Khon Kaen University	Thailand
Apichart Artnaseaw	Khon Kaen University	Thailand
Chaiyaput Kruehong	Khon Kaen University	Thailand
Sutasinee Neramittagapong	Khon Kaen University	Thailand
Yuvarat Ngernyen	Khon Kaen University	Thailand
Khanita Kamwilaisak	Khon Kaen University	Thailand

Kitirote Wantala	Khon Kaen University	Thailand
Pornnapa Kasemsiri	Khon Kaen University	Thailand
Duangkanok Tanangteerapong	Khon Kaen University	Thailand
Panomkorn Kwakhong	Khon Kaen University	Thailand
Tinnakorn Kumsaen	Khon Kaen University	Thailand
Varinrumpai Seithtanabutara	Khon Kaen University	Thailand
Kaewta Jetsrisuparb	Khon Kaen University	Thailand
Oranat Chuchuen	Khon Kaen University	Thailand
Atip Laungphairojana	Khon Kaen University	Thailand
Methus Suwannaruang	Khon Kaen University	Thailand
Shawn C. Rood	Khon Kaen University	Thailand

LOCAL ORGANIZING COMMITTEE

Sutthada Songjorhor	Khon Kaen University	Thailand
Wimonporn Iamamornphanth	Khon Kaen University	Thailand
Pakpoom Athikaphan	Khon Kaen University	Thailand
Tanabodee Leela	Khon Kaen University	Thailand
Plaisuda Janthabut	Khon Kaen University	Thailand
Pimpattra Krongkehung	Khon Kaen University	Thailand
Makhamas Chatkasemwong	Khon Kaen University	Thailand
Sirirat Thammasang	Khon Kaen University	Thailand
Areelak Humarj	Khon Kaen University	Thailand
Natthakrit Montri	Khon Kaen University	Thailand
Natthaphong Lertna	Khon Kaen University	Thailand
Nattapon Banditsean	Khon Kaen University	Thailand
Papol Pimsri	Khon Kaen University	Thailand
Naritsara Suwatsrisakun	Khon Kaen University	Thailand
Nannapat Kaewsaenmaung	Khon Kaen University	Thailand
Pimpisa Pimpaeng	Khon Kaen University	Thailand
Sirikanya Pimsaran	Khon Kaen University	Thailand
Jakkapat Saehkow	Khon Kaen University	Thailand
Noppanan Putdon	Khon Kaen University	Thailand
Wasu Jantapa	Khon Kaen University	Thailand
Waranya Yosburi	Khon Kaen University	Thailand
Siriyakorn Theprat	Khon Kaen University	Thailand
Kritsanan Jareerut	Khon Kaen University	Thailand
Pimchaya Trisong	Khon Kaen University	Thailand
Paemika Pimphatam	Khon Kaen University	Thailand
Kanokwan Panmak	Khon Kaen University	Thailand

PEER REVIEW COMMITTEE

Siriporn Damrongsakkul	Chulalongkorn University	Thailand
Suttichai Assabumrungrat	Chulalongkorn University	Thailand
Tawatchai Charinpanitkul	Chulalongkorn University	Thailand
Apinan Soottitantawat	Chulalongkorn University	Thailand
Paravee Vas-Umnuay	Chulalongkorn University	Thailand
Tharathon Mongkhonsi	Chulalongkorn University	Thailand
Akawat Sirisuk	Chulalongkorn University	Thailand
Chalida Klaysom	Chulalongkorn University	Thailand
Palang Bumroongsakulsawat	Chulalongkorn University	Thailand

Manunya Okhawilai	Chulalongkorn University	Thailand
Benjapon Chalermsinsuwan	Chulalongkorn University	Thailand
Napida Hinchiranan	Chulalongkorn University	Thailand
Nattaya Pongstabodee	Chulalongkorn University	Thailand
Pornpote Piumsomboon	Chulalongkorn University	Thailand
Sirilux Poompradub	Chulalongkorn University	Thailand
Somkiat Ngamprasertsith	Chulalongkorn University	Thailand
Teerawat Sema	Chulalongkorn University	Thailand
Jitti Kasemchainan	Chulalongkorn University	Thailand
Manaswee Suttipong	Chulalongkorn University	Thailand
Anusith Thanapimmetha	Kasetsart University	Thailand
Kandis Sudsakorn	Kasetsart University	Thailand
Manop Charoenchaitrakool	Kasetsart University	Thailand
Maythee Saisriyoot	Kasetsart University	Thailand
Nanthiya Hansupalak	Kasetsart University	Thailand
Paweena Prapainainar	Kasetsart University	Thailand
Waleeporn Donphai	Kasetsart University	Thailand
Supacharee Roddecha	Kasetsart University	Thailand
Khemmathin Lueangwattanapong	Kasetsart University	Thailand
Suthasinee Watmanee	Kasetsart University	Thailand
Thidarat Imyen	Kasetsart University	Thailand
Pornsawan Assawasaengrat	King Mongkut's Institute of Technology Ladkrabang	Thailand
Yaneeporn Patcharavorachot	King Mongkut's Institute of Technology Ladkrabang	Thailand
Pongsert Sriprom	King Mongkut's Institute of Technology Ladkrabang	Thailand
Chaiwat Prapainainar	King Mongkut's University of Technology North Bangkok	Thailand
Patcharin Worathanakul	King Mongkut's University of Technology North Bangkok	Thailand
Santi Chuetor	King Mongkut's University of Technology North Bangkok	Thailand
Supak Tontisirin	King Mongkut's University of Technology North Bangkok	Thailand
Wanwitoo Wanmolee	King Mongkut's University of Technology North Bangkok	Thailand
Anawat Sungpet	King Mongkut's University of Technology Thonburi	Thailand
Somnuk Jarudilokkul	King Mongkut's University of Technology Thonburi	Thailand
Supaporn Therdthianwong	King Mongkut's University of Technology Thonburi	Thailand
Saiwan Nawalertpanya	King Mongkut's University of Technology Thonburi	Thailand
Kantharakorn Macharoen	King Mongkut's University of Technology Thonburi	Thailand
Krittin Korkerd	King Mongkut's University of Technology Thonburi	Thailand
Atthapon Srifa	Mahidol University	Thailand

Chularat Sakdaronnarong	Mahidol University	Thailand
Poomiwat Phadungbut	Mahidol University	Thailand
Wanida Koo-amornpattana	Mahidol University	Thailand
Warangkana Pornputtapitak	Mahidol University	Thailand
Woranart Jonglertjunya	Mahidol University	Thailand
Kulchanat Prasertsit	Prince of Songkla University	Thailand
Pakamas Chetpattananondh	Prince of Songkla University	Thailand
Sininart Chongkhong	Prince of Songkla University	Thailand
Parinya Khongprom	Prince of Songkla University	Thailand
Pornsiri Kaewpradit	Prince of Songkla University	Thailand
Songtham Photaworn	Prince of Songkla University	Thailand
Natacha Phetyim	Rajamangala University of Technology Thanyaburi	Thailand
Thirawat Mueansichai	Rajamangala University of Technology Thanyaburi	Thailand
Weraporn Pivsa-Art	Rajamangala University of Technology Thanyaburi	Thailand
Rinlada Sirisangsawang	Rajamangala University of Technology Thanyaburi	Thailand
Sarawut Jitpinit	Rajamangala University of Technology Thanyaburi	Thailand
Sasiradee Jantasee	Rajamangala University of Technology Thanyaburi	Thailand
Weerinda Mens	Rajamangala University of Technology Thanyaburi	Thailand
Choowong Chaisuk	Silpakorn University	Thailand
Mutsee Termtanun	Silpakorn University	Thailand
Veerayut Lersbamrungsuk	Silpakorn University	Thailand
Weerawat Patthaveekongka	Silpakorn University	Thailand
Wasu Chaitree	Silpakorn University	Thailand
Chanchira Jubsilp	Srinakharinwirot University	Thailand
Atichat Wongkoblap	Suranaree University of Technology	Thailand
Lek Wantha	Suranaree University of Technology	Thailand
Asadullah Baloch	Suranaree University of Technology	Thailand
Terasut Sookkumnerd	Suranaree University of Technology	Thailand
Nurak Grisdanurak	Thammasat University	Thailand
Piyachat Wattanachai	Burapha University	Thailand
Chakkrit Umpuch	Ubon Ratchathani University	Thailand
Chatchai Kunyawut	Ubon Ratchathani University	Thailand
Supatpong Mattaraj	Ubon Ratchathani University	Thailand
Wipada Dechapanya	Ubon Ratchathani University	Thailand
Channarong Puchongkawarin	Ubon Ratchathani University	Thailand
Idtisak Paopo	Ubon Ratchathani University	Thailand
Karnika Ratanapongleka	Ubon Ratchathani University	Thailand
Natthaya Punsuwan	Ubon Ratchathani University	Thailand
Natwat Srikhao	Ubon Ratchathani University	Thailand
Suparat Sasrimuang	Ubon Ratchathani University	Thailand
Rujira Jitrwung	Thailand Institute of Scientific and Technological Research	Thailand
Apichart Artnaseaw	Khon Kaen University	Thailand
Arthit Neramittagapong	Khon Kaen University	Thailand

Chaiyaput Kruehong	Khon Kaen University	Thailand
Duangkanok Tanangteerapong	Khon Kaen University	Thailand
Kanyarat Holasut	Khon Kaen University	Thailand
Khanita Kamwilaisak	Khon Kaen University	Thailand
Kitirote Wantala	Khon Kaen University	Thailand
Pornnapa Kasemsiri	Khon Kaen University	Thailand
Sutasinee Neramittagapong	Khon Kaen University	Thailand
Yuvarat Ngernyen	Khon Kaen University	Thailand
Kaewta Jetsrisuparb	Khon Kaen University	Thailand
Oranat Chuchuen	Khon Kaen University	Thailand
Panomkorn Kwakhong	Khon Kaen University	Thailand
Tinnakorn Kumsaen	Khon Kaen University	Thailand
Varinrumpai Seithtanabutara	Khon Kaen University	Thailand
Atip Laungphairojana	Khon Kaen University	Thailand
Methus Suwannaruang	Khon Kaen University	Thailand
Shawn C. Rood	Khon Kaen University	Thailand

SPONSORS

KHON KAEN UNIVERSITY

Research Center for Environmental and Hazardous Substance Management

SCGC

HMC Polymers

ptt

GC

GGC
GLOBAL GREEN CHEMICALS

OVERALL PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

May 20-21, 2025

May 20-21, 2025	
08:00 – 09:00	**Registration Open**

Tuesday, May 20, 2025

Time	Program (Parallel)	
09:00 – 10:30	**Opening Ceremony** Join with TNChE Asia 2025	**TIChE Senior Project Contest 2025** (Poster Competition)
10:30 – 12:00	**Plenary Lecture** Join with TNChE Asia 2025	
12:00 – 13:00	**Lunch**	
13:00 – 16:30	**TIChE2025 Oral Presentation** (Session 1-12)	**TIChE Senior Project Contest 2025** (Final Pitching)
16:30 – 18:30	**Networking & Happy Hour at Exhibition Zone Gathering** Join with TNChE Asia 2025	

Wednesday, May 21, 2025

Time	Program (Parallel)		
09:00 – 12:00	**TIChE2025 Oral Presentation** (Session 13-24)	**TIChE High School Project Contest 2025** (Poster Competition)	
12:00 – 13:00	**Lunch**		
13:00 – 14:30	**TIChE2025 Oral Presentation** (Session 25-28, 30)	**TIChE2025 Poster Presentation**	**Meeting of Head of Departments**
14:30 – 16:00	**Meeting on Process Simulation Software for Academic Use**	**TIChE Plant Design Competition 2025**	
16:00 – 16:15	**Award Ceremony for the 2nd TIChE-AVEVA Simulation Contest 2025**		
16:15 – 17:00	**Award and Closing Ceremony**		

Important Notes for All Participants

- All participants for the TIChE2025 are welcome to attend all conference sessions, including joint sessions with TNChE Asia 2025, such as the Opening Ceremony, Plenary Lecture, and Networking & Exhibition Gathering.
- Please note that lunch and coffee break services for the TIChE2025 participants are available exclusively on the 5th floor of the Dusit Thani Pattaya Hotel. These services are separate from those provided for TNChE Asia 2025, which are located on the 4th floor.

INFORMATION FOR PRESENTERS

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

May 20-21, 2025

Presentation Code (Abstract Code)

For all participants, including invited speakers, senior project presenters, high school project contestants, and those giving poster or oral presentations, you can obtain your presentation code from your registered account on the TIChE2025.

TIChE-IV-xx	Invited Speaker
TIChE-AM-xx	Presenter in Advanced Materials and Nanotechnology (AM) Session
TIChE-BE-xx	Presenter in Biochemical and Environmental Engineering (BE) Session
TIChE-CR-xx	Presenter in Catalysis and Reaction Engineering (CR) Session
TIChE-EF-xx	Presenter in Energy and Fuels (EF) Session
TIChE-SG-xx	Presenter in Sustainable and Green Chemistry (SG) Session
TIChE-IA-xx	Presenter in Industrial Applications and Case Studies (IA) Session
TIChE-PE-xx	Presenter in Process Engineering and Digital Technologies (PE) Session
TIChE-SE-Axx	TIChE Senior Project Contest 2025 in Applied Research Category
TIChE-SE-Bxx	TIChE Senior Project Contest 2025 in Basic Research Category
TIChE-HS-xx	TIChE High School Project Contest 2025

Instruction for Oral Presentation

For all oral presentation speakers, including invited speakers and general presenters, please be informed that sessions will take place in rooms **Dusit 4, 5, 6, 7, 11, 12 and 13, 5th floor of the Dusit Thani Pattaya Hotel**. There will be a total of 29 sessions, with 5 presenters per session.

- **Invited Speakers** are allocated 30 minutes, including time for Q&A.
- **General Presenters** are allocated 10 minutes for presentation and 5 minutes for Q&A.

Please ensure that your presentation file is installed on the session computer before your session begins.

Instruction for Poster Presentation

For all poster presenters, the poster session will take place on **May 21, 2025, from 13:00-15:00, at the Activity Hall, 5th floor of the Dusit Thani Pattaya Hotel**. Presenters are kindly requested to install their posters between 12:00-12:45 prior to the session. Poster panels and necessary mounting materials will be provided by the organizing committee. Please ensure that your poster is mounted at the designated panel displaying your assigned presentation code (Abstract Code).

TECHNICAL PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 1 : May 20, 2025

08:00 – 09:00	Registration	📍 Registration Area (5th Floor)
09:00 – 12:00	**TIChE Senior Project Contest 2025 (Parallel)** Opening Ceremony & Poster Competition	📍 Dusit 11 & Activity Hall (5th Floor)
09:00 – 11:00	**Opening Ceremony (Join with TNChE Asia 2025)** MC: Asst. Prof. Dr. Pornchai Bumroongsri	📍 Napalai D, E (4th Floor)
09:00 – 10:30	**Welcome Speech** by Mr. Surachate Chalothorn, President of the Thai Institute of Chemical Engineering and Applied Chemistry (TIChE) **Opening Ceremony** of TNChE Asia 2025, TIChE2025 & Guided tour of exhibition booths by Mr. Cholanat Yanaranop, Directors of SCG & SCGC	
10:30 – 11:00	Networking Break (Coffee Break)	📍 Refreshment Zone (5th Floor)
11:00 – 12:00	**Plenary Session (Join with TNChE Asia 2025)** Session Chair: Assoc. Prof. Dr. Thumrongrut Mungcharoen	📍 Napalai D, E (4th Floor)
11:00 – 11:20	**Plenary Lecture I**	**Global Climate Technology and Technology Transfer Mechanism** **Dr. Surachai Sathitkunarat** President of the Office of the National Higher Education, Science, Research and Innovation Policy Council, Thailand & Executive Director, The APEC Center for Technology Foresight
11:20 – 11:40	**Plenary Lecture II**	**Key Factors for Establishing Green Ammonia Industry: Aiming CO_2 Free Fuel World** **Emeritus Prof. Dr. Ken-ichi Aika** Green Ammonia Research Center, National Institute of Technology (KOSEN), Numazu College, Japan
11:40 – 12:00	**Plenary Lecture III**	**Embracing Uncertainty: Unleashing Value in the Evolving Industry Landscape** **Mr. Kshitij Dua & Mr. Eren Cetinkaya** Director, Legal Operations at HashiCorp & Partner at McKinsey & Company
12:00 – 13:00	**Lunch**	📍 Dusit 1, 2, 3 (5th Floor)
13:00 – 16:30	**TIChE Senior Project Contest 2025 (Parallel)** Final Pitching & Award Ceremony	📍 Dusit 11 & Activity Hall (5th Floor)
13:00 – 14:15	**TIChE2025 Oral Presentation (Parallel)**	📍 Dusit 4, 5, 6, 7, 12, 13 (5th Floor)

Room	Dusit 4	Dusit 5	Dusit 6	Dusit 7	Dusit 12	Dusit 13
Session	**Session 1**	**Session 2**	**Session 3**	**Session 4**	**Session 5**	**Session 6**
13:00 – 13:15	**TIChE-AM-01**	**TIChE-BE-01**	Invited Speaker **TIChE-IV-03**	**TIChE-EF-01**	Invited Speaker **TIChE-IV-01**	**TIChE-IA-01**
13:15 – 13:30	**TIChE-AM-02**	**TIChE-BE-02**		**TIChE-EF-03**		**TIChE-IA-03**
13:30 – 13:45	**TIChE-AM-04**	**TIChE-BE-03**	**TIChE-CR-02**	**TIChE-EF-04**	**TIChE-SG-07**	**TIChE-IA-04**
13:45 – 14:00	**TIChE-AM-05**	**TIChE-BE-20**	**TIChE-CR-03**	**TIChE-EF-05**	**TIChE-SG-08**	**TIChE-PE-01**
14:00 – 14:15	**TIChE-AM-34**	**TIChE-BE-28**	**TIChE-CR-32**	**TIChE-EF-06**	**TIChE-SG-13**	**TIChE-PE-03**

14:15 – 14:30	Networking Break (Coffee Break)	📍 Refreshment Zone (5th Floor)

Continued on next page

14:30 – 15:45	**TIChE2025 Oral Presentation (Parallel)**				📍 Dusit 4, 5, 6, 7, 12, 13 (5th Floor)	
Room	**Dusit 4**	**Dusit 5**	**Dusit 6**	**Dusit 7**	**Dusit 12**	**Dusit 13**
Session	**Session 7**	**Session 8**	**Session 9**	**Session 10**	**Session 11**	**Session 12**
14:30 – 14:45	**Invited Speaker** **TIChE-IV-02**	**TIChE-BE-04**	**Invited Speaker** **TIChE-IV-06**	**TIChE-EF-02**	**TIChE-SG-02**	**TIChE-PE-06**
14:45 – 15:00		**TIChE-BE-05**		**TIChE-EF-09**	**TIChE-SG-03**	**TIChE-PE-08**
15:00 – 15:15	**TIChE-AM-03**	**TIChE-BE-07**	**TIChE-CR-01**	**TIChE-EF-10**	**TIChE-SG-06**	**TIChE-PE-11**
15:15 – 15:30	**TIChE-AM-06**	**TIChE-BE-08**	**TIChE-CR-08**	**TIChE-EF-13**	**TIChE-SG-10**	**TIChE-PE-12**
15:30 – 15:45	**TIChE-AM-07**	**TIChE-BE-11**	**TIChE-CR-11**	**TIChE-EF-17**	**TIChE-SG-17**	**TIChE-PE-13**
15:45 – 18:30	**Networking & Happy Hour at Exhibition Zone Gathering** (Join with TNChE Asia 2025)				📍 Napalai A, B, C, D, E (4th Floor)	
END OF DAY 1						

TECHNICAL PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 2 : May 21, 2025

08:00 – 09:00	Registration				📍 Registration Area (5th Floor)	
09:00 – 12:00	**TIChE High School Project Contest 2025 (Parallel)** Opening Ceremony, Poster Competition & Award Ceremony				📍 Activity Hall (5th Floor)	
09:00 – 10:15	**TIChE2025 Oral Presentation (Parallel)**				📍 Dusit 4, 5, 6, 7, 11, 12&13 (5th Floor)	
Room	**Dusit 4**	**Dusit 5**	**Dusit 6**	**Dusit 7**	**Dusit 11**	**Dusit 12 & 13**
Session	**Session 13**	**Session 14**	**Session 15**	**Session 16**	**Session 17**	**Session 18**
09:00 – 09:15	zoom **TIChE-AM-09**	**TIChE-BE-06**	**Invited Speaker** **TIChE-IV-08**	**TIChE-EF-15**	**TIChE-SG-01**	**Invited Speaker** **TIChE-IV-04**
09:15 – 09:30	zoom **TIChE-CR-30**	**TIChE-BE-09**		**TIChE-EF-14**	**TIChE-SG-18**	
09:30 – 09:45	**TIChE-AM-10**	**TIChE-BE-12**	**TIChE-CR-09**	**TIChE-PE-07**	**TIChE-SG-19**	**TIChE-PE-09**
09:45 – 10:00	**TIChE-AM-12**	**TIChE-BE-13**	**TIChE-CR-16**	**TIChE-PE-15**	**TIChE-SG-23**	**TIChE-PE-16**
10:00 – 10:15	**TIChE-AM-15**	**TIChE-BE-14**	**TIChE-CR-20**	**TIChE-PE-17**	**TIChE-SG-24**	**TIChE-PE-18**
10:15 – 10:30	Networking Break (Coffee Break)				📍 Refreshment Zone (5th Floor)	

Continued on next page

10:30 – 11:45	**TIChE2025 Oral Presentation (Parallel)**				📍 Dusit 4, 5, 6, 7, 11, 12&13 (5th Floor)	
Room	**Dusit 4**	**Dusit 5**	**Dusit 6**	**Dusit 7**	**Dusit 11**	**Dusit 12&13**
Session	**Session 19**	**Session 20**	**Session 21**	**Session 22**	**Session 23**	**Session 24**
10:30 – 10:45	Invited Speaker **TIChE-IV-07**	**TIChE-BE-10**	**TIChE-CR-17**	**TIChE-AM-14**	Invited Speaker **TIChE-IV-05**	**TIChE-PE-10**
10:45 – 11:00		**TIChE-BE-15**	**TIChE-CR-21**	**TIChE-AM-19**		**TIChE-PE-19**
11:00 – 11:15	**TIChE-AM-11**	**TIChE-BE-16**	**TIChE-CR-28**	**TIChE-AM-21**	**TIChE-SG-15**	**TIChE-PE-20**
11:15 – 11:30	**TIChE-AM-13**	**TIChE-BE-23**	**TIChE-CR-29**	**TIChE-AM-24**	**TIChE-SG-21**	**TIChE-PE-23**
11:30 – 11:45	**TIChE-AM-16**	**TIChE-BE-25**	**TIChE-CR-33**	**TIChE-AM-26**	**TIChE-SG-34**	**TIChE-PE-25**
11:45 – 13:00	**Lunch**				📍 Dusit 1, 2, 3 (5th Floor)	
13:00 – 15:00	**TIChE2025 Poster Presentation (Parallel)**				📍 Activity Hall (5th Floor)	
13:00 – 14:15	**TIChE2025 Oral Presentation (Parallel) & Meeting**				📍 Dusit 4, 5, 6, 7, 11, 12&13 (5th Floor)	
Room	**Dusit 4**	**Dusit 5**	**Dusit 6**	**Dusit 7**	**Dusit 11**	**Dusit 12&13**
Session	**Session 25**	**Session 26**	**Session 27**	**Session 28**	**Session 29**	**Session 30**
13:00 – 13:15	**TIChE-AM-08**	**TIChE-BE-19**	**TIChE-CR-04**	**TIChE-AM-20**	**Meeting of the Heads of Chemical Engineering Departments of Thailand**	**TIChE-SG-30**
13:15 – 13:30	**TIChE-AM-22**	**TIChE-BE-26**	**TIChE-CR-22**	**TIChE-AM-38**		**TIChE-SG-32**
13:30 – 13:45	**TIChE-AM-25**	**TIChE-BE-27**	**TIChE-CR-23**	**TIChE-BE-30**		**TIChE-SG-38**
13:45 – 14:00	**TIChE-AM-28**	**TIChE-BE-36**	**TIChE-CR-26**	**TIChE-SG-20**		**TIChE-SG-40**
14:00 – 14:15	**TIChE-AM-36**	**TIChE-BE-37**	**TIChE-CR-31**	**TIChE-SG-28**		**No Event**
14:15 – 14:30	Networking Break (Coffee Break)				📍 Refreshment Zone (5th Floor)	

Continued on next page

14:30 – 16:15	**TIChE Plant Design Competition 2025, Award & Meeting**				📍 Dusit 11, 12&13 (5th Floor)	
Room	**Dusit 4**	**Dusit 5**	**Dusit 6**	**Dusit 7**	**Dusit 11**	**Dusit 12&13**
Session	**No Event**	**No Event**	**No Event**	**No Event**	**Session 31**	**Session 32**
14:30 – 16:00	**No Event**	**No Event**	**No Event**	**No Event**	**Meeting on Process Simulation Software for Academic Use**	**TIChE Plant Design Competition 2025**
16:00 – 16:15					**No Event**	**Award Ceremony for the 2nd TIChE-AVEVA Simulation Contest 2025**
16:15 – 17:00						**Award and Closing Ceremony**

END OF DAY 2

END OF TIChE2025 CONFERENCE

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 1 : Tuesday, May 20, 2025

Session 1 : Advanced Materials and Nanotechnology (AM)

📍 **Dusit 4 (5th Floor)**
🕒 **13:00 – 14:15**

Chair : **Assoc. Prof. Dr. Lek Wantha**
School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology, Thailand
Co-Chair : **Assoc. Prof. Dr. Tharathon Mongkhonsi**
Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Thailand

Time	Abstract Code	Title	Presenter
13:00 – 13:15	**TIChE-AM-01**	Removal of heavy metal ions (Pb^{2+}, Hg^{2+}) from water using N-doped activated carbon derived from bamboo waste: Equilibrium study	**Mr. Chaisawat Rattanadon** Suranaree University of Technology, Thailand
13:15 – 13:30	**TIChE-AM-02**	Enhanced CO_2 photoreduction in synthetic seawater using black TiO_2 nanowires: Synthesis, characterization, and performance	**Mr. Kongphoom Khumsupa** Mahidol University, Thailand
13:30 – 13:45	**TIChE-AM-04**	Synthesis, swelling behavior, and niacinamide release of 1,4-butanediol diglycidyl ether-crosslinked levan hydrogels from *Bacillus siamensis*	**Asst. Prof. Dr. Cherdphong Seedao** Burapha University, Thailand
13:45 – 14:00	**TIChE-AM-05**	Dry gel conversion of CHA zeolite for direct air capture (CO_2): Screening of optimal synthesis conditions	**Mr. Weerawit Luewanichwong** Chulalongkorn University, Thailand
14:00 – 14:15	**TIChE-AM-34**	Development of self-adhesive biopolymer hydrogel for strain sensors crosslinked with tannic acid	**Mr. Noppanan Putdon** Khon Kaen University, Thailand
14:15 – 14:30	Networking Break (Coffee Break)		📍 Refreshment Zone (5th Floor)

Session 2 : Biochemical and Environmental Engineering (BE)

📍 **Dusit 5 (5th Floor)**
🕒 **13:00 – 14:15**

Chair : **Prof. Dr. Manop Charoenchaitrakool**
Department of Chemical Engineering, Faculty of Engineering, Kasetsart University, Thailand
Co-Chair : **Asst. Prof. Dr. Xiaohong Tan**
Department of Chemistry, Bowling Green State University, United States

Time	Abstract Code	Title	Presenter
13:00 – 13:15	**TIChE-BE-01**	Comparative study of methylene blue adsorption using calcium oxide derived from chicken eggshells and calcium oxide standard	**Miss Pinchaphat Poka** **Miss Woravarun Unkaew** Samsenwittayalai School, Thailand
13:15 – 13:30	**TIChE-BE-02**	Removal of Pb(II) and Hg(II) from water on activated carbon: An insight into multicomponent adsorption	**Mr. Thanyakorn Sangoondee** Suranaree University of Technology, Thailand
13:30 – 13:45	**TIChE-BE-03**	Development of composite scaffolds derived from palm kernel shell ash with curcumin encapsulation for tissue engineering applications	**Mr. Manutchai Eiamniyom** Mahidol University, Thailand
13:45 – 14:00	**TIChE-BE-20**	Enhanced desalination through capacitive deionization: Synthesis and performance evaluation of rubberwood-derived activated carbon	**Ms. Nannapat Kaewsaenmaung** Khon Kaen University, Thailand
14:00 – 14:15	**TIChE-BE-28**	Nutrient release from struvite-biochar composites prepared by co-precipitation	**Mr. Wasu Jantapa** Khon Kaen University, Thailand
14:15 – 14:30	Networking Break (Coffee Break)		📍 Refreshment Zone (5th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 1 : Tuesday, May 20, 2025

Session 3 : Catalysis and Reaction Engineering (CR)

Dusit 6 (5th Floor)
13:00 – 14:15

Chair : **Dr. Taketoshi Minato**
Institute for Molecular Science, National Institute of Natural Science, Japan
Co-Chair : **Assoc. Prof. Dr. Chaiyaput Kruehong**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
13:00 – 13:30	Invited Speaker **TIChE-IV-03**	Reaction mechanisms in rechargeable batteries for next-generation energy technology	 **Dr. Taketoshi Minato** Institute for Molecular Science, National Institute of Natural Science, Japan
13:30 – 13:45	**TIChE-CR-02**	Development of magnesium aluminate supported nickel catalyst in dry reforming of methane reaction	**Mr. Pongsaporn Poosri** Kasetsart University, Thailand
13:45 – 14:00	**TIChE-CR-03**	Effect of graphene nanoplatelets addition during electroless plating of ABS on the properties of copper-nickel-chromium coated ABS	**Miss Wantana Chuakamhod** Chulalongkorn University, Thailand
14:00 – 14:15	**TIChE-CR-32**	Fabrication of Fe-TiO$_2$ loaded on mesoporous activated carbon and improved by Fe$_3$O$_4$ for reusing on photocatalytic degradation of reactive red 120 under visible light irradiation	**Mr. Jakkapat Saehkow** Khon Kaen University, Thailand
14:15 – 14:30	Networking Break (Coffee Break)		Refreshment Zone (5th Floor)

Session 4 : Energy and Fuels (EF)

Dusit 7 (5th Floor)
13:00 – 14:15

Chair : **Prof. Dr. Somkiat Ngamprasertsith**
Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Thailand
Co-Chair : **Asst. Prof. Dr. Varinrumpai Seithtanabutara**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
13:00 – 13:15	**TIChE-EF-01**	Unlocking the potential of semi-clathrates for gas storage: Synergistic enhancement of TBAF with amino acids	**Mr. Chakorn Viriyakul** Chulalongkorn University, Thailand
13:15 – 13:30	**TIChE-EF-03**	Feasibility of hydrogen production from crude glycerol via photocatalysis using TiO$_2$-based photocatalysts	**Mr. Thanapol Sutthiphong** Mahidol University, Thailand
13:30 – 13:45	**TIChE-EF-04**	Effect of cation type and carrageenan structure on the formation and electrochemical properties of bio-gel electrolytes	**Mr. Dedy Firmansyah** Thammasat University, Thailand
13:45 – 14:00	**TIChE-EF-05**	Regeneration by electrodialysis of secondary spent monoethanolamine solution obtained after mineralization of captured carbon dioxide with calcium sulfate	**Miss Ketwarang Nimnualrat** Chulalongkorn University, Thailand
14:00 – 14:15	**TIChE-EF-06**	One-dimensional simulation of an alkaline-acid direct glycerol fuel cell	**Miss Papitchaya Chaloeypanit** King Mongkut's University of Technology Thonburi, Thailand
14:15 – 14:30	Networking Break (Coffee Break)		Refreshment Zone (5th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 1 : Tuesday, May 20, 2025

Session 5 : Sustainable and Green Chemistry (SG)

Dusit 12 (5th Floor)
13:00 – 14:15

Chair : **Prof. Dr. Hiroshi Uyama**
Department of Applied Chemistry, The University of Osaka, Japan
Co-Chair : **Assoc. Prof. Dr. Pornnapa Kasemsiri**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
13:00 – 13:30	Invited Speaker **TIChE-IV-01**	Material design and degradation engineering for plastics and textile recycling	 **Prof. Dr. Hiroshi Uyama** Department of Applied Chemistry The University of Osaka, Japan
13:30 – 13:45	**TIChE-SG-07**	A study of the self-heating propensity of raw and torrefied biomasses	**Dr. Kyaw Thu** King Mongkut's University of Technology Thonburi, Thailand
13:45 – 14:00	**TIChE-SG-08**	Preparation of bio-based polyol from soybean meal for polyurethane foam production	**Miss Jidapa Klinputt** Thammasat University, Thailand
14:00 – 14:15	**TIChE-SG-13**	Bio-based coating from chitosan and ethyl cellulose for oil- and water-resistant paper packaging	**Miss Oraya Sraphaengnoi** Chulalongkorn University, Thailand
14:15 – 14:30	Networking Break (Coffee Break)		Refreshment Zone (5th Floor)

Session 6 : Industrial Applications and Case Studies (IA)
Process Engineering and Digital Technologies (PE)

Dusit 13 (5th Floor)
13:00 – 14:15

Chair : **Assoc. Prof. Dr. Chatchai Kunyawut**
Department of Chemical Engineering, Faculty of Engineering, Ubon Ratchathani University, Thailand
Co-Chair : **Asst. Prof. Dr. Veerayut Lersbamrungsuk**
Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Thailand

Time	Abstract Code	Title	Presenter
13:00 – 13:15	**TIChE-IA-01**	Prediction of latent heat of vaporization of binary mixture using COSMO-SAC model	**Mr. Natamorn Kamlue** King Mongkut's Institute of Technology Ladkrabang, Thailand
13:15 – 13:30	**TIChE-IA-03**	Feedforward control of pulsed bed adsorption column for colorant removal in sugar syrup at different flow rates	**Dr. Terasut Sookkumnerd** Suranaree University of Technology, Thailand
13:30 – 13:45	**TIChE-IA-04**	The impact of learner characteristics on learning outcomes and time to degree completion	**Asst. Prof. Dr. Idtisak Paopo** Ubon Ratchathani University, Thailand
13:45 – 14:00	**TIChE-PE-01**	Development of computational fluid dynamics modeling of packed bed membrane reactor for dimethyl ether production from carbon dioxide	**Miss Kannika Lhongbangplee** Mahidol University, Thailand
14:00 – 14:15	**TIChE-PE-03**	Graph neural network for descriptor-free CO_2 solubility prediction in aqueous amines	**Mr. Apri Wahyudi** Chulalongkorn University, Thailand
14:15 – 14:30	Networking Break (Coffee Break)		Refreshment Zone (5th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 1 : Tuesday, May 20, 2025

Session 7 : Advanced Materials and Nanotechnology (AM)

📍 Dusit 4 (5th Floor)
🕓 14:30 – 15:45

Chair : **Prof. Dr. Ravin Narain**
College of Natural and Applied Sciences, University of Alberta, Canada
Co-Chair : **Assoc. Prof. Dr. Khanita Kamwilaisak**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
14:30 – 15:00	Invited Speaker TIChE-IV-02	Polymer based nanosystems and hydrogels for biomedical applications	 **Prof. Dr. Ravin Narain** College of Natural and Applied Sciences, University of Alberta, Canada
15:00 – 15:15	TIChE-AM-03	Synthesis and characterizations of triethanolamine-copper black titanium photocatalyst for carbon dioxide photoreduction	**Mr. Poomipat Chotngamkham** Mahidol University, Thailand
15:15 – 15:30	TIChE-AM-06	Effects of titanium nitride nanoparticles on the properties of light-responsive polybenzoxazine/epoxidized soybean oil copolymer	**Mr. Jeremiah Otokpa Oja** Chulalongkorn University, Thailand
15:30 – 15:45	TIChE-AM-07	Antioxidant sugar from cocryatallization of sucrose, erythritol and vitamin C	**Miss Norramon Sathanasaowaphak** Suranaree University of Technology, Thailand
15:45 – 18:30	**Networking & Happy Hour at Exhibition Zone Gathering** (Join with TNChE Asia 2025)		📍 Napalai A, B, C, D, E (4th Floor)

Session 8 : Biochemical and Environmental Engineering (BE)

📍 Dusit 5 (5th Floor)
🕓 14:30 – 15:45

Chair : **Assoc. Prof. Dr. Santi Chuetor**
Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Thailand
Co-Chair : **Asst. Prof. Dr. Methus Suwannaruang**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
14:30 – 14:45	TIChE-BE-04	Simultaneous saccharification and fermentation (SSF) of corncobs for bioethanol production using *saccharomyces cerevisiae* SC90	**Mr. Peerawat Suyatar** Kasetsart University, Thailand
14:45 – 15:00	TIChE-BE-05	Optimization of bovine serum albumin concentration and diafiltration via tangential flow filtration	**Mr. Worrawich Boonpan** King Mongkut's University of Technology Thonburi, Thailand
15:00 – 15:15	TIChE-BE-07	Techno-economic analysis of *Ulva spp*. cultivation for capturing CO_2 emissions from natural gas power plants in Thailand	**Mr. Kantaphan Punnaanan** Chulalongkorn University, Thailand
15:15 – 15:30	TIChE-BE-08	*Centella asiatica* active ingredients extraction using ultrasonic-assisted extraction and maceration	**Miss Nichapa Areepong** Thammasat University, Thailand
15:30 – 15:45	TIChE-BE-11	The occurrence of polycyclic aromatic hydrocarbons (PAHs) and halogenated PAHs in Chao Praya River in dissolved phase	**Ms. Kanyanat Aunachad** Mahidol University, Thailand
15:45 – 18:30	**Networking & Happy Hour at Exhibition Zone Gathering** (Join with TNChE Asia 2025)		📍 Napalai A, B, C, D, E (4th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 1 : Tuesday, May 20, 2025

Session 9 : Catalysis and Reaction Engineering (CR)

Dusit 6 (5th Floor)
14:30 – 15:45

Chair : **Prof. Dr. Katsutoshi Nagaoka**
Department of Chemical Systems Engineering, Nagoya University, Japan
Co-Chair : **Assoc. Prof. Dr. Sutasinee Neramittagapong**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
14:30 – 15:00	Invited Speaker **TIChE-IV-06**	Boosting ammonia synthesis under mild conditions by control of the BaO-metal interface	 **Prof. Dr. Katsutoshi Nagaoka** Department of Chemical Systems Engineering, Nagoya University, Japan
15:00 – 15:15	**TIChE-CR-01**	Autonomous Lorentz force-powered chiral encoded metal rotors for enantioselective synthesis	**Mr. Wanmai Srisuwanno** Vidyasirimedhi Institute of Science and Technology, Thailand
15:15 – 15:30	**TIChE-CR-08**	A comparative study of commercial- and hydrothermal-synthesized TiO_2 nanoparticles for photocatalytic silver recovery from jewelry plating effluent	**Ms. Midori Tanaka** Mahidol University, Thailand
15:30 – 15:45	**TIChE-CR-11**	Double perovskite enhanced with exsolved Ni-Co particles in $Sr_{1.95}TiMo_{1-x}(NiCo)_xO_{6-\delta}$ as anode for direct-fed ammonia solid oxide fuel cell	**Ms. Solida Oun** Chulalongkorn University, Thailand
15:45 – 18:30	**Networking & Happy Hour at Exhibition Zone Gathering** (Join with TNChE Asia 2025)		Napalai A, B, C, D, E (4th Floor)

Session 10 : Energy and Fuels (EF)

Dusit 7 (5th Floor)
14:30 – 15:45

Chair : **Assoc. Prof. Dr. Nakorn Worasuwannarak**
The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, Thailand
Co-Chair : **Asst. Prof. Dr. Kaewta Jetsrisuparb**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
14:30 – 14:45	**TIChE-EF-02**	Effect of diverse cation-anion salt combinations on methane hydrate formation	**Mr. Teerapat Pongpuak** Chulalongkorn University, Thailand
14:45 – 15:00	**TIChE-EF-09**	Enhancing drying efficiency of STR20 block rubber production using hot air pre-drying treatment	**Mr. Jirapat Kongsong** Prince of Songkla University, Thailand
15:00 – 15:15	**TIChE-EF-10**	Reduction and capture of chlorine in Napier grass using microwave torrefaction	**Asst. Prof. Dr. Prodpran Siritheerasas** Thammasat University, Thailand
15:15 – 15:30	**TIChE-EF-13**	Four-zone modelling of modified downdraft gasifier for performance prediction: Case study of semi-batch operation	**Mr. Kantapat Palawat** King Mongkut's University of Technology North Bangkok, Thailand
15:30 – 15:45	**TIChE-EF-17**	Development of low-cost Ag-based ORR electrodes via electrodeposition on carbon cloth for AEM fuel cells	**Mr. Natthaphon Sirireak** King Mongkut's University of Technology Thonburi, Thailand
15:45 – 18:30	**Networking & Happy Hour at Exhibition Zone Gathering** (Join with TNChE Asia 2025)		Napalai A, B, C, D, E (4th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 1 : Tuesday, May 20, 2025

Session 11 : Sustainable and Green Chemistry (SG)

Dusit 12 (5th Floor)
14:30 – 15:45

Chair : **Mr. Kieran N. Twaddle**
London Centre for Nanotechnology, University College London, United Kingdom
Co-Chair : **Assoc. Prof. Dr. Duangkanok Tanangteerapong**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
14:30 – 14:45	**TIChE-SG-02**	Continuous production of 5-hydroxymethylfurfural using monophasic solvents for pharmaceutical applications	**Miss Kritsanalak Thongkan** Mahidol University, Thailand
14:45 – 15:00	**TIChE-SG-03**	Sub-seafloor carbon sequestration as hydrates: Experimental study on CO_2 hydrate formation in clay-rich marine sediments	**Ms. Viphada Yodpetch** Chulalongkorn University, Thailand
15:00 – 15:15	**TIChE-SG-06**	Process simulation of syngas production through glycerol reforming with carbon dioxide and steam for methanol synthesis	**Mr. Patcharapol Chaladthunyakij** King Mongkut's Institute of Technology Ladkrabang, Thailand
15:15 – 15:30	**TIChE-SG-10**	Off-grade epoxy resin and waste tire composites for CO_2 adsorption	**Mr. Teerapat Inudom** Chulalongkorn University, Thailand
15:30 – 15:45	**TIChE-SG-17**	Ethanol-assisted CO_2 hydrogenation to methanol in a trickle-bed reactor	**Mr. Pattarapol Akeakkharanusorn** Chulalongkorn University, Thailand
15:45 – 18:30	**Networking & Happy Hour at Exhibition Zone Gathering** (Join with TNChE Asia 2025)		Napalai A, B, C, D, E (4th Floor)

Session 12 : Process Engineering and Digital Technologies (PE)

Dusit 13 (5th Floor)
14:30 – 15:45

Chair : **Dr. Terasut Sookkumnerd**
School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology, Thailand
Co-Chair : **Assoc. Prof. Dr. Kitirote Wantala**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
14:30 – 14:45	**TIChE-PE-06**	Comparative analysis of machine learning models for predicting operating condition in a pentane-hexane distillation column with limited data	**Mr. Jirapat Romkaew** Chulalongkorn University, Thailand
14:45 – 15:00	**TIChE-PE-08**	Performance of combination ESN and LSTM in prediction of temperature in magnetic heating reactor	**Mr. Rasiq Dipta Alkindi** Chulalongkorn University, Thailand
15:00 – 15:15	**TIChE-PE-11**	Simulation of desulfurization in natural gas by using ferrous oxide	**Assoc. Prof. Dr. Satok Chaikunchuensakun** Thammasat University, Thailand
15:15 – 15:30	**TIChE-PE-12**	Modification of the syngas production process using fluidized-bed twin reactor system and chemical looping gasifier	**Mr. Sutanon Krataipo** Silpakorn University, Thailand
15:30 – 15:45	**TIChE-PE-13**	Reinforcement learning control for optimal ethanol production from microbial fermentation	**Asst. Prof. Dr. Bundit Boonkhao** Nakhon Phanom University, Thailand
15:45 – 18:30	**Networking & Happy Hour at Exhibition Zone Gathering** (Join with TNChE Asia 2025)		Napalai A, B, C, D, E (4th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 2 : Wednesday, May 21, 2025

Session 13 : Advanced Materials and Nanotechnology (AM)
Catalysis and Reaction Engineering (CR)

📍 Dusit 4 (5th Floor)
🕘 09:00 – 10:15

Chair : **Prof. Dr. Hiroshi Uyama**
Department of Applied Chemistry, The University of Osaka, Japan

Co-Chair : **Assoc. Prof. Dr. Pornnapa Kasemsiri**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
09:00 – 09:15	zoom **TIChE-AM-09**	Flexible piezoresistive sensor based on natural rubber/chitosan/graphene composites for healthcare applications	**Mr. Supakorn Suwanphiphat** Chulalongkorn University, Thailand National Taiwan University, Taiwan
09:15 – 09:30	zoom **TIChE-CR-30**	Synthesis of Al-doped MCM-41 for molecular sieve and catalysis application	**Mr. Nathatchapong Burong** Chulalongkorn University, Thailand National Taiwan University, Taiwan
09:30 – 09:45	**TIChE-AM-10**	Development of self-healing polymers from bio-based benzoxazine blended with poly (ethylene glycol)	**Miss Pharaporn Yodkum** Chulalongkorn University, Thailand
09:45 – 10:00	**TIChE-AM-12**	Cellulose nanocrystals from bagasse pulp for oil powder production	**Miss Pimpisa Pimpaeng** Khon Kaen University, Thailand
10:00 – 10:15	**TIChE-AM-15**	Influence of CaO on the durability of geopolymer in acidic environments	**Asst. Prof. Dr. Cherdphong Seedao** Burapha University, Thailand
10:15 – 10:30	Networking Break (Coffee Break)		📍 Refreshment Zone (5th Floor)

Session 14 : Biochemical and Environmental Engineering (BE)

📍 Dusit 5 (5th Floor)
🕘 09:00 – 10:15

Chair : **Prof. Dr. Ravin Narain**
College of Natural and Applied Sciences, University of Alberta, Canada

Co-Chair : **Asst. Prof. Dr. Panarat Rattanaphanee**
School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology, Thailand

Time	Abstract Code	Title	Presenter
09:00 – 09:15	**TIChE-BE-06**	Thermo-responsive PVDF-*grafted*-PVNCL membranes with switchable wettability for efficient oil-water separation	**Miss Supakorn Janmunee** King Mongkut's University of Technology Thonburi, Thailand
09:15 – 09:30	**TIChE-BE-09**	*Carthamus tinctorius* L. flower antioxidant extracts from subcritical ethanol extraction	**Mr. Tanapat Wangsomboonsiri** **Mr. Peerapong Srinukul** Thammasat University, Thailand
09:30 – 09:45	**TIChE-BE-12**	Enhancing absorption under load in alginate-based superabsorbent polymers for sustainable disposable diapers	**Miss Nadiya Abdulroman** Mahidol University, Thailand
09:45 – 10:00	**TIChE-BE-13**	Electrochemical improvement of mangosteen peel extract	**Mr. Teradon Loypipan** Kasetsart University, Thailand
10:00 – 10:15	**TIChE-BE-14**	Temperature effects on phosphorus transformations in P-enriched biochars	**Miss Sreypov Yoem** Khon Kaen University, Thailand
10:15 – 10:30	Networking Break (Coffee Break)		📍 Refreshment Zone (5th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 2 : Wednesday, May 21, 2025

Session 15 : Catalysis and Reaction Engineering (CR)

Dusit 6 (5th Floor)
09:00 – 10:15

Chair : **Asst. Prof. Dr. Xiaohong Tan**
Department of Chemistry, Bowling Green State University, United States
Co-Chair : **Assoc. Prof. Dr. Kitirote Wantala**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
09:00 – 09:30	Invited Speaker **TIChE-IV-08**	Dual-handed recognition: Targeting a single protein with two chemical ligands	 **Asst. Prof. Dr. Xiaohong Tan** Department of Chemistry, Bowling Green State University, USA
09:30 – 09:45	**TIChE-CR-09**	Photocatalytic silver recovery from cyanide-based plating effluent via TiO_2 nanoparticles synthesized by microwave-assisted method	**Mr. Auttawit Thoumrungroj** Mahidol University, Thailand
09:45 – 10:00	**TIChE-CR-16**	Simulation of dry and steam reforming of methane over a nickel-based catalyst in a fixed-bed tube reactor using COMSOL	**Mr. Krissadang Khamma** King Mongkut's University of Technology Thonburi, Thailand
10:00 – 10:15	**TIChE-CR-20**	Development of core-shell $LaNi_{0.8}Fe_{0.2}O_3$ catalysts with $CeZrO_2$ shells for carbon-resistant dry reforming of methane	**Miss Suchayamon Kaewprasert** Chulalongkorn University, Thailand
10:15 – 10:30	Networking Break (Coffee Break)		Refreshment Zone (5th Floor)

Session 16 : Energy and Fuels (EF)
Process Engineering and Digital Technologies (PE)

Dusit 7 (5th Floor)
09:00 – 10:15

Chair : **Prof. Dr. Mali Hunsom**
Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Thailand
Co-Chair : **Assoc. Prof. Dr. Khanita Kamwilaisak**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
09:00 – 09:15	**TIChE-EF-15**	Photocatalytic green hydrogen production by gold-decorated TiO_{2-x} photocatalyst	**Prof. Dr. Mali Hunsom** Mahidol University, Thailand
09:15 – 09:30	**TIChE-EF-14**	Improvement of electrocatalytic activities of Ag-based catalysts in oxygen reduction and oxygen evolution reactions	**Miss Phatcharanan Pipatnawakit** King Mongkut's University of Technology Thonburi, Thailand
09:30 – 09:45	**TIChE-PE-07**	Techno-economic analysis of hydrogen production pathways for carbon dioxide to methanol conversion process	**Mr. Gantaphon Manimon** Chulalongkorn University, Thailand
09:45 – 10:00	**TIChE-PE-15**	Performance evaluation of combined torrefaction and gasification process of lignocellulosic biomass	**Mr. Aphiwat Lakkhanasombat** King Mongkut's University of Technology North Bangkok, Thailand
10:00 – 10:15	**TIChE-PE-17**	Optimal input variables for an artificial neural network to predict evaporation efficiency in detergent production process	**Mr. Baramee Imsin** Burapha University, Thailand
10:15 – 10:30	Networking Break (Coffee Break)		Refreshment Zone (5th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 2 : Wednesday, May 21, 2025

Session 17 : Sustainable and Green Chemistry (SG)

📍 Dusit 11 (5th Floor)
🕘 09:00 – 10:15

Chair : **Dr. Taketoshi Minato**
Institute for Molecular Science, National Institute of Natural Science, Japan
Co-Chair : **Dr. Shawn C. Rood**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
09:00 – 09:15	**TIChE-SG-01**	Enhancing non-catalytic biomass pyrolysis yield predictions using machine learning and data augmentation	**Miss Anchalee Chaichanavongsaroj** Kasetsart University, Thailand
09:15 – 09:30	**TIChE-SG-18**	Thermal, morphological and mechanical properties of recycled Al film label/LLDPE composites	**Miss Siriwan Naknoy** Burapha University, Thailand
09:30 – 09:45	**TIChE-SG-19**	Sustainable synthesis of monolaurin via esterification of lauric acid using TPA-modified biochar derived from coconut shells	**Miss Junyanat Woraphasphaiboon** Chulalongkorn University, Thailand
09:45 – 10:00	**TIChE-SG-23**	Development of fibroin-based solid electrolyte for electrochromic windows	**Mr. Akarawin Pimarnthisakorn** Burapha University, Thailand
10:00 – 10:15	**TIChE-SG-24**	Development and characterization of bioplastic from banana peel and chitosan: A sustainable alternative for eco-friendly packaging	**Miss Ulia Fitrass** Thammasat University, Thailand
10:15 – 10:30	Networking Break (Coffee Break)		📍 Refreshment Zone (5th Floor)

Session 18 : Process Engineering and Digital Technologies (PE)

📍 Dusit 12&13 (5th Floor)
🕘 09:00 – 10:15

Chair : **Prof. Dr. Nurak Grisdanurak**
Department of Chemical Engineering, Faculty of Engineering, Thammasat University, Thailand
Co-Chair : **Assoc. Prof. Dr. Racha Dejchanchaiwong**
Department of Chemical Engineering, Faculty of Engineering, Prince of Songkla University, Thailand

Time	Abstract Code	Title	Presenter
09:00 – 09:30	Invited Speaker **TIChE-IV-04**	Mechanical process of lithium-ion batteries recycling and its safety concerns	 **Prof. Dr. Nurak Grisdanurak** Department of Chemical Engineering, Thammasat University, Thailand
09:30 – 09:45	**TIChE-PE-09**	Techno-economic insights and limitation analysis of CO_2 capture via monoethanolamine (MEA) absorption	**Miss Manisa Mahahing** Chulalongkorn University, Thailand
09:45 – 10:00	**TIChE-PE-16**	Process simulation of synthetic fuel production from palm oil mill waste	**Mr. Worawit Morin** King Mongkut's University of Technology North Bangkok, Thailand
10:00 – 10:15	**TIChE-PE-18**	Effect of ethanol on the crystallization of DL-methionine polymorphs	**Miss Lamphoun Inthavideth** Suranaree University of Technology, Thailand
10:15 – 10:30	Networking Break (Coffee Break)		📍 Refreshment Zone (5th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 2 : Wednesday, May 21, 2025

Session 19 : Advanced Materials and Nanotechnology (AM)

Dusit 4 (5th Floor)
10:30 – 11:45

Chair : **Mr. Kieran N. Twaddle**
London Centre for Nanotechnology, University College London, United Kingdom
Co-Chair : **Assoc. Prof. Dr. Soipatta Soisuwan**
Department of Chemical Engineering, Faculty of Engineering, Burapha University, Thailand

Time	Abstract Code	Title	Presenter
10:30 – 11:00	Invited Speaker **TIChE-IV-07**	In-situ pollution detection capability via robust diamond SERS	 **Mr. Kieran N. Twaddle** London Centre for Nanotechnology, University College London, UK
11:00 – 11:15	**TIChE-AM-11**	Toughness improvement of polybenzoxazine by blending with glycidyl methacrylate-grafted natural rubber	**Miss Yadapa Wasikarat** Chulalongkorn University, Thailand
11:15 – 11:30	**TIChE-AM-13**	Cellulose nanocrystals produced from bagasse pulp for drug delivery applications	**Miss Sirikanya Pimsaran** Khon Kaen University, Thailand
11:30 – 11:45	**TIChE-AM-16**	Preparation of N, S co-doped activated carbon from rice straw for high performance supercapacitor	**Mr. Tippapon Tocuweang** King Mongkut's University of Technology Thonburi, Thailand
11:45 – 12:00	Lunch		Dusit 1, 2, 3 (5th Floor)

Session 20 : Biochemical and Environmental Engineering (BE)

Dusit 5 (5th Floor)
10:30 – 11:45

Chair : **Dr. Wanwitoo Wanmolee**
Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Thailand
Co-Chair : **Asst. Prof. Dr. Kaewta Jetsrisuparb**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
10:30 – 10:45	**TIChE-BE-10**	Lignin extracted from rice straw and coconut coir	**Miss Supapohn Pohnanothai** Thammasat University, Thailand
10:45 – 11:00	**TIChE-BE-15**	Effects of cultivation temperature on alpha-amylase production from wild-type rice callus suspensions	**Ms. Worapicha Daungtongcome** King Mongkut's University of Technology Thonburi, Thailand
11:00 – 11:15	**TIChE-BE-16**	Lysine production from sugarcane molasses using *Corynebacterium glutamicum*	**Miss Phatthariya Phromngulueam** Suranaree University of Technology, Thailand
11:15 – 11:30	**TIChE-BE-23**	Sustainable production of drinking water from saltwater	**Miss Zu Zu Aung** Mahidol University, Thailand
11:30 – 11:45	**TIChE-BE-25**	Role of magnesium in phosphorus transformations during biomass pyrolysis	**Dr. Jesper Knijnenburg** Khon Kaen University, Thailand
11:45 – 12:00	Lunch		Dusit 1, 2, 3 (5th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 2 : Wednesday, May 21, 2025

Session 21 : Catalysis and Reaction Engineering (CR)

Dusit 6 (5th Floor)
10:30 – 11:45

Chair : **Asst. Prof. Dr. Choowong Chaisuk**
Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Thailand
Co-Chair : **Dr. Suparat Sasrimuang**
Department of Chemical Engineering, Faculty of Engineering, Ubon Ratchathani University, Thailand

Time	Abstract Code	Title	Presenter
10:30 – 10:45	**TIChE-CR-17**	Promotional effect of Fe in the Cu/TiO_2 catalyst on the liquid-phase selective hydrogenation of furfural to furfuryl alcohol	**Miss Jenjeera Sathukan** Silpakorn University, Thailand
10:45 – 11:00	**TIChE-CR-21**	Integrated absorption-mineralization	**Miss Wannida Lilathanakiad** Chulalongkorn University, Thailand
11:00 – 11:15	**TIChE-CR-28**	Hydroconversion of biodiesel over Ni/beta zeolite catalysts prepared by glycine-assisted impregnation for sustainable aviation fuel production	**Mr. Witchakorn Jankool** Chulalongkorn University, Thailand
11:30 – 11:45	**TIChE-CR-29**	Optimization of biodiesel synthesis from waste cooking oil by transesterification reaction	**Miss Chariyaporn Thanyathippipat** King Mongkut's Institute of Technology Ladkrabang, Thailand
11:15 – 11:30	**TIChE-CR-33**	Catalytic activity in dry reforming of methane over Ce modified Ni/silica fiber catalyst	**Assoc. Prof. Dr. Chanatip Samart** Thammasat University, Thailand
11:45 – 12:00	Lunch		Dusit 1, 2, 3 (5th Floor)

Session 22 : Advanced Materials and Nanotechnology (AM)

Dusit 7 (5th Floor)
10:30 – 11:45

Chair : **Asst. Prof. Dr. Idtisak Paopo**
Department of Chemical Engineering, Faculty of Engineering, Ubon Ratchathani University, Thailand
Co-Chair : **Assoc. Prof. Dr. Duangkanok Tanangteerapong**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
10:30 – 10:45	**TIChE-AM-14**	Molecular insights into cationic surfactant adsorption on Fe(110): A combined MD and DFT study for corrosion inhibition	**Mr. Sitthikiat Boonchoo** Chulalongkorn University, Thailand
10:45 – 11:00	**TIChE-AM-19**	Effects of oxygen, nitrogen, and sulfur doped hard carbons derived from longan seed as anode material for sodium ion batteries	**Miss Sutida Tammanoi** Suranaree University of Technology, Thailand
11:00 – 11:15	**TIChE-AM-21**	Development of a microencapsulation process of phase change materials from palm oil derivatives in large-scale melamine formaldehyde encapsulation process	**Mr. Tawatchai Punhapol** Chulalongkorn University, Thailand
11:30 – 11:45	**TIChE-AM-24**	Modification of recycled polyethylene terephthalate membrane by using graphene oxide to enhance antifouling properties for protein separation	**Mr. Thanapol Meeiam** King Mongkut's University of Technology Thonburi, Thailand
11:15 – 11:30	**TIChE-AM-26**	Effect of glycerol on xyloglucan-chitosan film preparation and its properties	**Miss Kanjana Manamoongmongkol** King Mongkut's Institute of Technology Ladkrabang, Thailand
11:45 – 12:00	Lunch		Dusit 1, 2, 3 (5th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 2 : Wednesday, May 21, 2025

Session 23 : Sustainable and Green Chemistry (SG)

📍 Dusit 11 (5th Floor)
🕓 10:30 – 11:45

Chair : **Prof. Dr. Tawatchai Charinpanitkul**
Department of Chemical Engineering, Chulalongkorn University, Thailand
Co-Chair : **Assoc. Prof. Dr. Arthit Neramittagapong**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
10:30 – 11:00	Invited Speaker **TIChE-IV-05**	Synthesis of carbonaceous nanomaterials from renewable agro-industrial waste	 **Prof. Dr. Tawatchai Charinpanitkul** Department of Chemical Engineering, Chulalongkorn University, Thailand
11:00 – 11:15	**TIChE-SG-15**	Chitosan-fibroin-based coating solution for prolonging the shelf life of bananas	**Miss Wannida Sawangarunporn** Burapha University, Thailand
11:15 – 11:30	**TIChE-SG-21**	Enhancement of CO_2 capture performance of alcohols on MEA-IL-based biphasic solvents	**Miss Rimping Prathumpitak** Chulalongkorn University, Thailand
11:30 – 11:45	**TIChE-SG-34**	In situ thermal solvent-free synthesis of zeolitic imidazolate frameworks with high crystallinity and porosity for effective adsorption and catalytic applications	**Dr. Somboon Chaemchuen** Mahidol University, Thailand
11:45 – 12:00	Lunch		📍 Dusit 1, 2, 3 (5th Floor)

Session 24 : Process Engineering and Digital Technologies (PE)

📍 Dusit 12&13 (5th Floor)
🕓 10:30 – 11:45

Chair : **Assoc. Prof. Dr. Yaneeporn Patcharavorachot**
Department of Chemical Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Thailand
Co-Chair : **Asst. Prof. Dr. Channarong Puchongkawarin**
Department of Chemical Engineering, Faculty of Engineering, Ubon Ratchathani University, Thailand

Time	Abstract Code	Title	Presenter
10:30 – 10:45	**TIChE-PE-10**	Computational fluid dynamics (CFD) analysis of cooling water temperature profiles in high temperature operation heat exchangers	**Ms. Suwapat Thiaranatron** Chulalongkorn University, Thailand
10:45 – 11:00	**TIChE-PE-19**	Process simulation of lactic acid esterification in reactive distillation column: Effects of reboiler duty and alcohol	**Assoc. Prof. Dr. Anawat Sungpet** King Mongkut's University of Technology Thonburi, Thailand
11:00 – 11:15	**TIChE-PE-20**	Design and simulation of the coffee drying unit using solar thermal energy and ambient air circulation	**Mr. Rittichai Preungchana** King Mongkut's University of Technology Thonburi, Thailand
11:15 – 11:30	**TIChE-PE-23**	Machine learning-assisted multi-objective optimization of furfural production from lignocellulosic biomass hydrolysate	**Mr. Patcharapuek Pattaramanon** Silpakorn University, Thailand
11:30 – 11:45	**TIChE-PE-25**	Enhancing low-carbon hydrogen production from biomass gasification via machine-learning-aided multi-objective optimization with TOPSIS	**Mr. Kitti Kamolram** Kasetsart University, Thailand
11:45 – 12:00	Lunch		📍 Dusit 1, 2, 3 (5th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 2 : Wednesday, May 21, 2025

Session 25 : Advanced Materials and Nanotechnology (AM)

📍 Dusit 4 (5th Floor)
🕓 13:00 – 14:15

Chair : **Assoc. Prof. Dr. Piyachat Wattanachai**
Department of Chemical Engineering, Faculty of Engineering, Burapha University, Thailand
Co-Chair : **Dr. Natwat Srikhao**
Department of Chemical Engineering, Faculty of Engineering, Ubon Ratchathani University, Thailand

Time	Abstract Code	Title	Presenter
13:00 – 13:15	**TIChE-AM-08**	Polybenzoxazine blended with modified natural rubber by graft copolymerization with 2-hydroxyethyl acrylate for shape memory applications	**Miss Chanokkan Buakhlee** Chulalongkorn University, Thailand
13:15 – 13:30	**TIChE-AM-22**	Fabrication of polyphenylsulfone (PPSU) electro-spun nanofiltration membrane	**Miss Ornpreeya Pongpan** Chulalongkorn University, Thailand
13:30 – 13:45	**TIChE-AM-25**	Development of PVA-PNVCL-Fe_3O_4 composite nanofibrous for drug delivery in cancer treatment	**Mr. Sirawit Suknaisilp** King Mongkut's University of Technology Thonburi, Thailand
13:45 – 14:00	**TIChE-AM-28**	Surface modification of activated carbon from tamarind shell for tartrazine adsorption	**Miss Tinutda Phonlam** King Mongkut's Institute of Technology Ladkrabang, Thailand
14:00 – 14:15	**TIChE-AM-36**	Biocompatibility of hydrogel film blended jellyfish gelatin	**Miss Nongnapas Luecha** Burapha University, Thailand
14:15 – 14:30	Networking Break (Coffee Break)		📍 Refreshment Zone (5th Floor)

Session 26 : Biochemical and Environmental Engineering (BE)

📍 Dusit 5 (5th Floor)
🕓 13:00 – 14:15

Chair : **Prof. Dr. Katsutoshi Nagaoka**
Department of Chemical Systems Engineering, Nagoya University, Japan
Co-Chair : **Asst. Prof. Dr. Bundit Boonkhao**
Division of Mechanical Engineering, Faculty of Engineering, Nakhon Phanom University, Thailand

Time	Abstract Code	Title	Presenter
13:00 – 13:15	**TIChE-BE-19**	Reduction of acid usage in chitosan production process from white shrimp shell using electro-chemical activation	**Mr. Pat Thongphet** King Mongkut's University of Technology Thonburi, Thailand
13:15 – 13:30	**TIChE-BE-26**	Study of biomass productivity of phosphate-solubilizing bacteria using rice bran oil as an alternative media	**Miss Pim-orn Thongpanchang** King Mongkut's Institute of Technology Ladkrabang, Thailand
13:30 – 13:45	**TIChE-BE-27**	Removal of styrene and pyrene in a fixed bed adsorption column using rhamnolipid-modified alumina	**Miss Emma Asnachinda** Burapha University, Thailand
13:45 – 14:00	**TIChE-BE-36**	Valorization of pineapple leaf fiber industry waste: Optimization of alkali pretreatment for fermentable sugar production	**Dr. Khemmathin Lueangwattanapong** Kasetsart University, Thailand
14:00 – 14:15	**TIChE-BE-37**	Residue extraction on artificial knee surfaces using ultrasonic techniques	**Ms. Thitima Naovong** Suranaree University of Technology, Thailand
14:15 – 14:30	Networking Break (Coffee Break)		📍 Refreshment Zone (5th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 2 : Wednesday, May 21, 2025

Session 27 : Catalysis and Reaction Engineering (CR)

Dusit 6 (5th Floor)
13:00 – 14:15

Chair : **Dr. Wasu Chaitree**
Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Thailand
Co-Chair : **Dr. Shawn C. Rood**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Time	Abstract Code	Title	Presenter
13:00 – 13:15	**TIChE-CR-04**	Electrooxidation of glycerol on electrolessly deposited carbon-supported CoNiBi electrocatalysts	**Dr. Wasu Chaitree** Silpakorn University, Thailand
13:15 – 13:30	**TIChE-CR-22**	Titania incorporated into magnetite mesoporous silica for removal of ciprofloxacin under UV radiation	**Miss Dwita Widyawati** Chulalongkorn University, Thailand
13:30 – 13:45	**TIChE-CR-23**	Electrochemical reduction and regeneration of carbamate	**Miss Nattiya Jumpadib** Chulalongkorn University, Thailand
13:45 – 14:00	**TIChE-CR-26**	Synthesis of biolubricant from waste cooking oil methyl ester by transesterification reaction via ethylene glycol	**Mr. Atipong Paikamnam** King Mongkut's Institute of Technology Ladkrabang, Thailand
14:00 – 14:15	**TIChE-CR-31**	Methane dry reforming of calcium carbonate from carbamate mineralization	**Miss Nattanan Watcharasawat** Chulalongkorn University, Thailand
14:15 – 14:30	Networking Break (Coffee Break)		Refreshment Zone (5th Floor)

Session 28 : Advanced Materials and Nanotechnology (AM) Biochemical and Environmental Engineering (BE) Sustainable and Green Chemistry (SG)

Dusit 7 (5th Floor)
13:00 – 14:15

Chair : **Assoc. Prof. Dr. Tharathon Mongkhonsi**
Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Thailand
Co-Chair : **Assoc. Prof. Dr. Chanatip Samart**
Department of Chemistry, Faculty of Science and Technology, Thammasat University, Thailand

Time	Abstract Code	Title	Presenter
13:00 – 13:15	**TIChE-AM-20**	Development of shape memory UV curable 3D-print resin based on acrylated epoxidized soybean oil (AESO)	**Mr. Phuttiphong Wongsombun** Chulalongkorn University, Thailand
13:15 – 13:30	**TIChE-AM-38**	Utilization of lignin from agricultural waste for enhancing performance of natural rubber composite	**Miss Phatcharin Porat** King Mongkut's University of Technology Thonburi, Thailand
13:30 – 13:45	**TIChE-BE-30**	Numerical simulation of zinc ion migration in scaled-up electrokinetic remediation using COMSOL Multiphysics	**Assoc. Prof. Dr. Saiful Azhar Ahmad Tajudin** Universiti Tun Hussein Onn Malaysia, Malaysia
13:45 – 14:00	**TIChE-SG-20**	Mineralization in monoethanolamine solution with calcium chloride solution	**Mr. Ratipuk Chung-in** Chulalongkorn University, Thailand
14:00 – 14:15	**TIChE-SG-28**	Effect of co-solvents on the oxidative cleavage of oleic acid under ambient pressure	**Miss Chakreeya Santhadklang** Chulalongkorn University, Thailand
14:15 – 14:30	Networking Break (Coffee Break)		Refreshment Zone (5th Floor)

ORAL PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Day 2 : Wednesday, May 21, 2025

Session 30 : Sustainable and Green Chemistry (SG)

Dusit 12&13 (5th Floor)
13:00 – 13:40

Chair : **Assoc. Prof. Dr. Chaiyaput Kruehong**
Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Thailand

Co-Chair : **Assoc. Prof. Dr. Pailin Ngaotrakanwiwat**
Department of Chemical Engineering, Faculty of Engineering, Burapha University, Thailand

Time	Abstract Code	Title	Presenter
13:00 – 13:15	**TIChE-SG-30**	Synthesis of monolaurin through glycerol esterification with lauric acid using 12-tungstophosphoric acid	**Miss Kanchisa Chandit** Rajamangala University of Technology Thanyaburi, Thailand
13:15 – 13:30	**TIChE-SG-32**	Development of internally circulating fluidized bed reactor performance for enhancing direct air CO_2 capture	**Ms. Munyapa Limahksohn** Chulalongkorn University, Thailand
13:30 – 13:45	**TIChE-SG-38**	Sustainable ethylene synthesis via photocatalytic conversion of succinic acid over metal-TiO_2 photocatalysts	**Miss Suttida Pomsri** Suranaree University of Technology, Thailand
13:45 – 14:00	**TIChE-SG-40**	Improvement of process layout and increase productivity of new model (Cargo Extender Process) by Kaizen	**Ms. Natthakritta Nokkhum** Walailak University, Thailand
14:00 – 14:30	Networking Break (Coffee Break)		Refreshment Zone (5th Floor)

END OF ORAL SESSION

POSTER PRESENTATION PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Wednesday, May 21, 2025

Poster Session: Advanced Materials and Nanotechnology (AM)

Activity Hall (5th Floor)
13:00 – 15:00

Abstract Code	Title	Presenter
TIChE-AM-17	Production of graphene from graphite via flash joule heating process	**Mr. Siranut Sirathanutworakan** Chulalongkorn University, Thailand
TIChE-AM-23	Plastic waste-derived porous carbon as precursors for supercapacitors	**Asst. Prof. Dr. Panarat Rattanaphanee** Suranaree University of Technology, Thailand
TIChE-AM-27	The development of an electrochemical sensor for silver ions and silver nanoparticle detection	**Mr. Phurin Surachotimong** Suranaree University of Technology, Thailand
TIChE-AM-30	Effect of essential oils in encapsulated chitosan nanoparticles on encapsulation efficiency and antimicrobial activity	**Assoc.Prof.Dr.Paweena Prapainainar** Kasetsart University, Thailand
TIChE-AM-31	Development of electrode production for supercapacitors from activated carbon derived from pomelo peels by steam activation	**Asst. Prof. Dr. Wanida Koo-amornpattana** Mahidol University, Thailand
TIChE-AM-32	Non-toxic quantum dots sensitized solar cells based on $TiO_2/AgInS_2$	**Miss Atcharaporn Botalo** Mahidol University, Thailand
TIChE-AM-33	Structural transformation of bismuth titanate synthesized via the solvothermal method for wastewater application: Effect of temperature synthesis	**Mr. Nattapon Banditsean** Khon Kaen University, Thailand
TIChE-AM-37	Influence of reaction parameters on the exsolution of Ni-Ru bimetallic alloy in GEO-inspired perovskite oxide	**Dr. Somchate Wasantwisut** Mahidol University, Thailand

Poster Session: Biochemical and Environmental Engineering (BE)

Activity Hall (5th Floor)
13:00 – 15:00

Abstract Code	Title	Presenter
TIChE-BE-17	Enhanced extraction of bioactive compounds from *Aloe vera* leaf skin using natural deep eutectic solvents	**Miss Sopita Chanmee** Chulalongkorn University, Thailand
TIChE-BE-18	Comparative characterization of microplastics from conventional wastewater treatment plants between inland and island of tourism area in Thailand	**Ms. Charintorn Molee** Climate Change and Environmental Research Center, Thailand
TIChE-BE-21	Pressure vessel for ethanol extraction of mitragynine from Kratom leaves	**Assoc. Prof. Dr. Ampai Chanachai** King Mongkut's University of Technology Thonburi, Thailand
TIChE-BE-24	Hydrogel-forming microneedles with epigallocatechin gallate and 4-(hydroxymethyl)-phenylboronic acid for antibacterial wound healing and drug release	**Miss Naritsara Suwatsrisakun** Khon Kaen University, Thailand
TIChE-BE-29	Developing a deep neural network model to predict PM2.5 concentration based on key factors affecting air pollution in Bangkok	**Mr. Tanawut Poothong** Kasetsart University, Thailand

Abstract Code	Title	Presenter
TIChE-BE-31	Enhanced air filtration with antibacterial cellulose composites: A sustainable solution for hospital environments	**Miss Sopanat Sawatdee** Mahidol University, Thailand
TIChE-BE-32	Sustainable synthesis of nanocellulose via enzymatic and mechanical treatments	**Miss Cholaphan Deeleepojananan** Mahidol University, Thailand
TIChE-BE-35	Electrochemical sensors for residual organophosphate pesticide detection from pineapple leaf derived cellulose and nickel-containing composite	**Asst. Prof. Dr. Supacharee Roddecha** Kasetsart University, Thailand

Poster Session:
Catalysis and Reaction Engineering (CR)

Activity Hall (5th Floor)
13:00 – 15:00

Abstract Code	Title	Presenter
TIChE-CR-05	Valorization of biodiesel plant-derived glycerol for 1-propanol synthesis over zeolite-supported iridium and rhenium oxides	**Miss Chanoknun Kalvibool** Chulalongkorn University, Thailand
TIChE-CR-06	CO_2 methanation using nickel-based catalysts over alumina-ceria support prepared by sol-gel method	**Miss Jitsinee Leetrakul** Chulalongkorn University, Thailand
TIChE-CR-07	Kaolin-based geopolymer as an alternative low-cost adsorbent for biodiesel purification	**Mr. Aphirak Tharanuvet** Chulalongkorn University, Thailand
TIChE-CR-10	Effect of activation method on biochar supported nickel catalysts performance in steam reforming of biomass-derived tar	**Miss Nutcha Jirundorn** Chulalongkorn University, Thailand
TIChE-CR-14	Optimization of biodiesel production from waste cooking oil via transesterification using calcium oxide catalyst	**Assoc. Prof. Dr. Pornsawan Assawasaengrat** King Mongkut's Institute of Technology Ladkrabang, Thailand
TIChE-CR-15	Effect of catalyst bed configuration on temperature profile and reactor performance for Fischer-Tropsch synthesis: A computational fluid dynamic simulation	**Mr. Natthasit Khawyen** Chulalongkorn University, Thailand
TIChE-CR-18	Study on epoxidation of vegetable oil using different acidic ion-exchange resins	**Mr. Patiphan Palachote** Kasetsart University, Thailand
TIChE-CR-19	Photocatalytic activity of N, S-CQDs/TiO_2 composites for the degradation of methylene blue (MB) under visible-light irradiation	**Miss Thanyapak Akkharaamnuay** Chulalongkorn University, Thailand
TIChE-CR-24	Loading iron/manganese/zinc/copper oxide onto TiO_2 for vanillin production from photoconversion of lignin	**Asst. Prof. Dr. Mutsee Termtanun** Silpakorn University, Thailand
TIChE-CR-25	Utilization of biomass from palm oil industry for monoglycerides production	**Mr. Sutthiphong Rangauthok** Chulalongkorn University, Thailand
TIChE-CR-27	Low-temperature methanol synthesis via ethanol-assisted approach over $Cu/ZnO/Al_2O_3$ in fixed-bed reactor	**Miss Panisara Kampaeng** Chulalongkorn University, Thailand
TIChE-CR-34	Thermal oxidative reaction of HMF to a bio-based monomer: 2,5 Furandicarboxylic Acid (FDCA)	**Assoc. Prof. Dr. Soipatta Soisuwan** Burapha University, Thailand

Poster Session: Energy and Fuels (EF)

📍 Activity Hall (5th Floor)
🕒 13:00 – 15:00

Abstract Code	Title	Presenter
TIChE-EF-07	Impact of trihexyl phosphate and dimethyl sulfoxide on LiPF$_6$-based electrolytes: A molecular dynamics study	**Miss Nudchakorn Supakamnerd** Chulalongkorn University, Thailand
TIChE-EF-08	Co-solvent engineering of deep eutectic electrolytes: A molecular dynamics study	**Mr. Pongpon Pipattanachaiyanan** Chulalongkorn University, Thailand
TIChE-EF-11	Regeneration by electrodialysis enhanced with ion-exchange resin of spent MEA solution after CO$_2$ capture and mineralization by CaSO$_4$ addition	**Miss Nathaporn Kenbubpha** Chulalongkorn University, Thailand
TIChE-EF-12	The effect of methanol and ethanol-based solvent on enhancing CO$_2$ absorption efficiency and reducing energy consumption in the desorption process	**Miss Sasiphan Deenan** Silpakorn University, Thailand
TIChE-EF-16	Cultivation of green microalga *Scenedesmus* Sp. under semi-continuous condition	**Asst. Prof. Dr. Idtisak Paopo** Ubon Ratchathani University, Thailand

Poster Session: Industrial Applications and Case Studies (IA)

📍 Activity Hall (5th Floor)
🕒 13:00 – 15:00

Abstract Code	Title	Presenter
TIChE-IA-02	Sustainable manufacturing of polycaprolactone films: Effects of processing conditions on film quality	**Miss Kitthanya Ritthichai** Chulalongkorn University, Thailand

Poster Session: Process Engineering and Digital Technologies (PE)

📍 Activity Hall (5th Floor)
🕒 13:00 – 15:00

Abstract Code	Title	Presenter
TIChE-PE-02	Analysis of carbon dioxide trapping efficiency in saline aquifer by machine learning	**Mr. Jakkai Jitkoolsamphan** Chulalongkorn University, Thailand
TIChE-PE-04	Techno-economic analysis of sequential process to valorization of rambutan seed waste by supercritical CO$_2$-ethanol and subcritical water extraction	**Mr. Kassama Utthachat** Chulalongkorn University, Thailand
TIChE-PE-05	Techno-economic analysis of crude peptides production from defective coffee beans	**Mr. Chatchaphong Nakphadungsuk** Chulalongkorn University, Thailand
TIChE-PE-14	Application of computational fluid dynamics for industrial liquid-liquid mixing tank design	**Mr. Patiphon Klongyut** Chulalongkorn University, Thailand
TIChE-PE-21	Production of wood-plastic composite from non-metallic powders recovered from printed circuit board (PCB) waste	**Assoc. Prof. Dr. Ampai Chanachai** King Mongkut's University of Technology Thonburi, Thailand
TIChE-PE-22	PID controller tuning using genetic algorithms incorporated with dynamic simulation	**Asst. Prof. Dr. Veerayut Lersbamrungsuk** Silpakorn University, Thailand
TIChE-PE-24	Optimization of solketal reaction conditions for maximum yield using Response Surface Methodology (RSM) in MATLAB®	**Mr. Sittinut Damnoensawat** Chulalongkorn University, Thailand

Poster Session:
Sustainable and Green Chemistry (SG)

Activity Hall (5th Floor)
13:00 – 15:00

Abstract Code	Title	Presenter
TIChE-SG-04	Design and development of a sustainable ethylene glycol production process via electrochemical CO_2 reduction	**Miss Nichapat Leelalertwong** Chulalongkorn University, Thailand
TIChE-SG-05	Catalytic carbon dioxide desorption from monoethanolamine solvent in fluidized stripper	**Miss Sathida Doungsri** Chulalongkorn University, Thailand
TIChE-SG-09	Syngas production from biomass/plastic waste in supercritical water gasification: Impact of CO_2 co-reaction and operating conditions	**Assoc. Prof. Dr. Yaneeporn Patcharavorachot** King Mongkut's Institute of Technology Ladkrabang, Thailand
TIChE-SG-11	Mechanical properties, physical characteristics, and biodegradation of rigid polyurethane foam synthesized from castor and palm oil-based polyols	**Assoc. Prof. Dr. Panchan Sricharoon** King Mongkut's University of Technology Thonburi, Thailand
TIChE-SG-12	Evaluating the effectiveness of antioxidants in palm oil-based bio-grease	**Ms. Eumporn Buarod** National Science and Technology Development Agency, Thailand
TIChE-SG-14	Study of calcium carbonate precipitation from CO_2-rich amine-based solution	**Miss Kannika Jongauksorn** Chulalongkorn University, Thailand
TIChE-SG-16	Synthesis of rigid polyurethane foam from modified castor oil and sugar to enhance thermal insulating properties and degradability	**Assoc. Prof. Dr. Panchan Sricharoon** King Mongkut's University of Technology Thonburi, Thailand
TIChE-SG-22	Accelerated aging testing of three types of transformer oils in 1 phase distribution transformer	**Mr. Bowornchai Chareonteraboon** National Science and Technology Development Agency, Thailand
TIChE-SG-25	Potential desalination using EDTA modified MOF	**Mr. Nattawut Krasaesueb** Climate Change and Environmental Research Center, Thailand
TIChE-SG-26	Performance assessment of monoethanolamine and N-methyl-4-piperidinol blended solvent for enhancing physical properties, kinetics, absorption capacity, and regeneration heat duty	**Miss Rattanaporn Apaiyakul** Chulalongkorn University, Thailand
TIChE-SG-27	Synthesis and scale-up of MOF using PET-derived terephthalic acid	**Dr. Natthawan Prasongthum** Khon Kaen University, Thailand
TIChE-SG-29	Demonstration of zeolite A produced from coal ash applied to CO_2 capture process for amine regeneration approach	**Miss Punyaporn Khamdaeng** Thailand Institute of Scientific and Technological Research, Thailand
TIChE-SG-31	Life cycle assessment of CO_2-to-methanol: A comparative study of conventional and alcohol-assisted hydrogenation processes	**Mr. Naphat Chansonthi** Kasetsart University, Thailand
TIChE-SG-33	Valorization of mung bean seed coat through recovery of bioactive compounds with pharmacological properties using percolation extraction	**Mr. Suthiwat Srinuch** Kasetsart University, Thailand
TIChE-SG-35	Utilization of fusel oil as a sustainable bio-based lighter fluid	**Dr. Parncheewa Udomsap** National Science and Technology Development Agency, Thailand

END OF POSTER SESSION

TIChE SENIOR PROJECT 2025 PROGRAM
The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Tuesday, May 20, 2025

Session : TIChE Senior Project Contest 2025 (Applied Research)

Activity Hall (5th Floor)
09:00 – 16:30

Project Code	Title	Contestant
TIChE-SE-A01 **CU**	Clean water production from seawater via CQDs-PVDF photothermal membrane distillation	**(1) Supawadee Worapruekjaru** **(2) Pajchimbud Aomsin** **(3) Prof. Dr. Joongjai Panpranot** **(4) Asst. Prof. Dr. Chalida Klaysom** Department of Chemical Engineering Chulalongkorn University
TIChE-SE-A02 **PSU**	Co-pelletizing solid fuel from sewage sludge-biomass and air pollutant emission analysis	**(1) Walisa Temrat** **(2) Sutthida Sangprom** **(3) Assoc. Prof. Dr. Racha Dejchanchaiwong** Department of Chemical Engineering Prince of Songkla University
TIChE-SE-A03 **CU**	Computational fluid dynamics of cyclone reactor for carbon dioxide capture	**(1) Naphat Pattanapaisarnwong** **(2) Nawaphon Piriyakulthon** **(3) Prof. Dr. Benjapon Chalermsinsuwan** Department of Chemical Technology Chulalongkorn University
TIChE-SE-A04 **MU**	Development of an affordable PMMA-based organ-on-chip platform for preclinical research	**(1) Kawinthida Pongphai** **(2) Chalunda Sornwattana** **(3) Dr. Soontorn Tuntithavornwat** Department of Chemical Engineering Mahidol University
TIChE-SE-A05 **KU**	Enhancing non-catalytic biomass pyrolysis yield predictions using machine learning and data augmentation	**(1) Anchalee Chaichanavongsaroj** **(2) Dasakorn Rungrampan** **(3) Asst. Prof. Dr. Phantisa Limleamthong** Department of Chemical Engineering Kasetsart University
TIChE-SE-A06 **KMUTNB**	Green 3D-printed lignin composites with essential oils for next-generation medical applications	**(1) Charinrat Noikoon** **(2) Boonyanuch Engkawong** **(3) Anchisa Thamrongkulpiphat** **(4) Dr. Wanwitoo Wanmolee** **(5) Dr. Bongkot Hararak** Department of Chemical Engineering King Mongkut's University of Technology North Bangkok
TIChE-SE-A07 **KMUTT**	Improving CHO-K1 cell performance: Optimization of screened supplements in serum-free conditions	**(1) Napaporn Tamiyajol** **(2) Ploychompoo Sresakulwiwat** **(3) Asst. Prof. Dr. Kantharakorn Macharoen** **(4) Dr. Pattaraporn Sasivimolphan** Department of Chemical Engineering King Mongkut's University of Technology Thonburi
TIChE-SE-A08 **KMITL**	Influence of cobalt volatilization on LSM cathode of solid oxide fuel cell	**(1) Akkarawich Laumkha** **(2) Penpitcha Achachotipong** **(3) Assoc. Prof. Dr. Patthranit Wongpromrat** Department of Chemical Engineering King Mongkut's Institute of Technology Ladkrabang

Project Code	Title	Contestant
TIChE-SE-A09 **KKU**	Optimization of lignin conversion to vanillin over Ni-Cu/Al_2O_3 using Box-Behnken design	**(1) Kitsanan Jarirat** **(2) Siriyakorn Theprat** **(3) Assoc. Prof. Dr. Arthit Neramittagapong** Department of Chemical Engineering Khon Kaen University
TIChE-SE-A10 **SUT**	Porous carbon from plastic waste for supercapacitor application	**(1) Punnapat Songsranoi** **(2) Sasitorn Chairanit** **(3) Asst. Prof. Dr. Panarat Rattanaphanee** School of Chemical Engineering Suranaree University of Technology
TIChE-SE-A11 **TU**	Sorting machine (SM-02) for separate LIBs from general battery wastes	**(1) Ichaya Sae-ung** **(2) Rungtibet Anaphol** **(3) Assoc. Prof. Dr. Pradya Prempraneerach** **(4) Prof. Dr. Nurak Grisdanurak** Department of Chemical Engineering Thammasat University
TIChE-SE-A12 **SU**	The carbon footprint evaluation of the bio-methanol production process from biogas	**(1) Kanittha Sornprasit** **(2) Napaporn Thongsookmak** **(3) Asst. Prof. Dr. Weerawat Patthaveekongka** Department of Chemical Engineering Silpakorn University

Session : TIChE Senior Project Contest 2025 (Basic Research)

Activity Hall (5th Floor)
09:00 – 16:30

Project Code	Title	Contestant
TIChE-SE-B01 **KKU**	Conductive hydrogel tailored by metal phenolic network for strain sensing and self-powered devices	**(1) Pimchaya Trisong** **(2) Premmika Pimphatum** **(3) Assoc. Prof. Dr. Pornnapa Kasemsiri** Department of Chemical Engineering Khon Kaen University
TIChE-SE-B02 **KMUTT**	Design and fabrication of workshop-ready filtration equipment for chemical engineering education	**(1) Sombat Srisuklorm** **(2) Kairawin Burapongbundit** **(3) Asadawut Naicharoen** **(4) Dr. Kiattinatapon Juengcharoenpoon** **(5) Asst. Prof. Dr. Kantharakorn Macharoen** Department of Chemical Engineering King Mongkut's University of Technology Thonburi
TIChE-SE-B03 **KU**	Ethanol conversion to light olefins over $ZnZrO_x$/beta zeolite composite: A selective route towards propylene	**(1) Chaiyakrit Phattarawansopon** **(2) Nattakit Siriwitsutar** **(3) Dr. Thidarat Imyen** Department of Chemical Engineering Kasetsart University
TIChE-SE-B04 **PSU**	Fabrication of biomaterial scaffolds for bone tissue engineering	**(1) Pansak Thitawiriya** **(2) Sakkarin Pingsiri** **(3) Assoc. Prof. Dr. Chayanoot Sangwichien** Department of Chemical Engineering Prince of Songkla University
TIChE-SE-B05 **CU**	Influence of preparation methods on properties of perovskite catalyst precursor and catalyst for methane reforming	**(1) Pisitsan Uthaisiritanon** **(2) Saripa Suchitta** **(3) Asst. Prof. Dr. Merika Chanthanumataporn** Department of Chemical Engineering Chulalongkorn University
TIChE-SE-B06 **MU**	Machine learning model for CO_2 capture on metal-organic frameworks	**(1) Kanyakorn Rittawee** **(2) Prumon Nagasara** **(3) Asst. Prof. Dr. Poomiwat Phadungbut** Department of Chemical Engineering Mahidol University

Project Code	Title	Contestant
TIChE-SE-B07 **SU**	Machine learning-driven multi-objective optimization of biomass-based methanol and power production with carbon capture and organic Rankine cycle integration	**(1) Ingon Sondit** **(2) Siriwimon Boonprasit** **(3) Asst. Prof. Dr. Nutchapon Chotigkrai** Department of Chemical Engineering Silpakorn University
TIChE-SE-B08 **TU**	Pretreatment of medium-sized lithium-ion battery (LIBs) waste prior to the disposal	**(1) Arisa Saowakhon** **(2) Nantakran Wangsamaann** **(3) Asst.Prof.Dr.Woraratana Pattaraprakorn** **(4) Prof. Dr. Nurak Grisdanurak** Department of Chemical Engineering Thammasat University
TIChE-SE-B09 **KMITL**	Process simulation of power generation from co-gasification, solid oxide fuel cell, gas turbine and waste heat recovery technologies	**(1) Nuttapat Phuengjeen** **(2) Assoc. Prof. Dr. Yaneeporn Pathcharavoraachot** Department of Chemical Engineering King Mongkut's Institute of Technology Ladkrabang
TIChE-SE-B10 **SUT**	Recycled ethylene from the degradation of plastic waste using different methods of electrolysis and photocatalysis process	**(1) Pawanrat Nanklang** **(2) Dr. Supunnee Junpirom** School of Chemical Engineering Suranaree University of Technology
TIChE-SE-B11 **UBU**	Single-step chemical vapor deposition of carbon nanotubes: Synthesis optimization using camphor and ferrocene-loaded bamboo biochar	**(1) Yanutchara Wichiantawatchai** **(2) Dr. Suparat Sasrimuang** **(3) Asst. Prof. Dr. Channarong Puchongkawarin** Department of Chemical Engineering Ubon Ratchathani University
TIChE-SE-B12 **CU**	Synthesis of MnO_2 from recycle of spent primary batteries to use in rechargeable Zn-ion batterie	**(1) Juthamas Vechasit** **(2) Piyakorn Aranyanarth** **(3) Assoc. Prof. Dr. Nisit Tantavichet** Department of Chemical Technology Chulalongkorn University

END OF TIChE SENIOR PROJECT CONTEST 2025 SESSION

TIChE HIGH SCHOOL PROJECT 2025 PROGRAM

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Wednesday, May 21, 2025

Session : TIChE High School Project Contest 2025 (Poster Competition)

📍 **Activity Hall (5th Floor)**
🕘 **09:00 – 12:00**

Project Code	Title	Contestant
TIChE-HS-01	Development of a hydrogel patch from pomelo peel for inhibiting *Staphylococcus aureus* infection found in diabetic foot ulcers	**(1) Nisulaimarn Sideh** **(2) Intouch Wareekham** **(3) Chareef Surinrach** Princess Chulabhorn Science High School Satun Satun
TIChE-HS-02	Sustainable concrete pavers using colored PET waste as sand substitute	**(1) Thaksaon Srichompoo** **(2) Phatcharakan Jirotearrayatanakun** **(3) Navarat Sodesiri** Sisaketwittayalai School, Sisaket
TIChE-HS-03	Carbon dots from coffee grounds	**(1) Watcharaboon Nakaok** **(2) Intira Kaewsai** **(3) Kodchakorn Lamsombat** **(4) Egkachai Srisupap** Kanlayanawat School, Khon Kaen
TIChE-HS-04	Extraction and refinement of microcrystalline cellulose from rice straw via physical and chemical modifications	**(1) Kotchamon Pittayarat** **(2) Auachatchaya Channamsin** **(3) Pichayut Chaitong** **(4) Usa Jeenjenkit** Mahidol Wittayanusorn School Nakhon Pathom
TIChE-HS-05	Development of electrodes using activated carbon from coffee grounds	**(1) Phemphat Pimhanam** **(2) Thanaphon Dabao** **(3) Jiratchaya Ngamprom** **(4) Kodchakorn Lamsombat** **(5) Egkachai Srisupap** Kanlayanawat School, Khon Kaen
TIChE-HS-06	Effects of mulberry leaf extract on molting acceleration in black crabs	**(1) Pitchapa Distapongpakdee** **(2) Sunisa Malee** **(3) Tihanee Arlee** **(4) Chareef Surinrach** **(5) Karun Thongprajukaew** Princess Chulabhorn Science High School Satun Satun
TIChE-HS-07	The comparison of antioxidant activities in the leaves, stems, roots, and fruits of *Morus alba*	**(1) Parwonrat Prommi** **(2) Pornchanok Sudchit** **(3) Tawanrat Ngoenyuang** **(4) Benchaya Thanathiratham** Takpittayakhom School, Tak
TIChE-HS-08	Fruit-wrapping film for delaying spoilage using carbon dots derived from eggshells	**(1) Thanyathon Phromsuwan** **(2) Naruechatr Supamala** **(3) Chareef Surinrach** Princess Chulabhorn Science High School Satun Satun
TIChE-HS-09	The study and development of activated white charcoal with magnetic properties for absorbing heavy metals from industrial wastewater	**(1) Sirawit Subongkot** Mahidol Wittayanusorn School Nakhon Pathom
TIChE-HS-10	Electrolytic precipitation in wastewater	**(1) Phongsaran Promsud** **(2) Ladapa Yingmuang** **(3) Naphassakorn Fongfung** Phichai Rattanakhan School, Ranong

Project Code	Title	Contestant
TIChE-HS-11	Chemiresistive metal oxide semiconductor-based breath acetone detection coupled with deep learning for non-invasive diabetes monitoring	**(1) Kongphop Panjatarakul** **(2) Narapat Sinsuebpol** **(3) Ratchata Chinnatsirikul** **(4) Khriangsak Nilprasith** Ayutthaya Witthayalai School Phra Nakhon Si Ayutthaya
TIChE-HS-12	Anti-inflammatory gel patch for insect bites using eugenol and chavicol extracted from betel leaves	**(1) Apichaya Decharan** **(2) Sataporn Sriyathep** **(3) Soonlaya Saman** Princess Chulabhorn Science High School Satun Satun
TIChE-HS-13	Gel for inhibiting *Staphylococcus aureus* to reduce skin infections from turmeric extract	**(1) Ratchanon Adisakpirom** **(2) Napat Promkaew** **(3) Bussarin Jitseng** Princess Chulabhorn Science High School Satun Satun
TIChE-HS-14	A hydrogel sheet formulated using Noni (*Morinda citrifolia* L.) leaf extract for muscle pain relief	**(1) Hassuna Kepan** **(2) Husvanee Bonoh** **(3) Bussarin Jitseng** Princess Chulabhorn Science High School Satun Satun
TIChE-HS-15	Effects of cold plasma on citronella essential oil extract in controlling of rice weevils (*Sitophilus oryzae*)	**(1) Apisara Kanchana** **(2) Nutupsorn Chetananon** **(3) Siraphat Wongkhankaew** **(4) Supanut Pattanasarin** **(5) Kannika Pongkan** Piriyalai School Phrae, Phrae
TIChE-HS-16	Development of soybean seed coating to increase germination rate and seedling growth efficiency	**(1) Chalisa Surawong** **(2) Chutrakoon Kulabkhao** **(3) Nunticha Pekganjai** **(4) Supanut Pattanasarin** **(5) Kannika Pongkan** Piriyalai School Phrae, Phrae

END OF TIChE HIGH SCHOOL PROJECT CONTEST 2025 SESSION

INVITED SPEAKERS

Prof. Dr. Hiroshi Uyama

Department of Applied Chemistry
The University of Osaka, Japan

Professor Hiroshi Uyama is a prominent academic in polymer and materials science, currently serving as a professor at the Department of Applied Chemistry, Graduate School of Engineering, Osaka University. He earned his B.S. from Kyoto University in 1985 and completed his Ph.D. at Tohoku University in 1991. He began his career as a researcher at Kao Corporation, then held academic positions at Tohoku University and Kyoto University before joining Osaka University in 2004. He also served as Head of the Chemistry-Biology Combined Major Program at Osaka University (2012–2016) and has been a visiting professor at Northwest University in China since 2015. Professor Uyama has received numerous honors, including the Mitsubishi Chemical Award and the Young Scientist Award from the Chemical Society of Japan. His professional journey reflects a deep commitment to research, education, and international collaboration in the field of polymer chemistry.

Prof. Dr. Ravin Narain

College of Natural and Applied Sciences
University of Alberta, Canada

Ravin Narain, PhD, P.Eng, FRSC is a Professor in the Department of Chemical and Materials Engineering, University of Alberta, Canada. Prof. Narain has made significant contributions to research on the design, fabrication, and characterization of novel carbohydrate-based materials (glycopolymers, hydrogels and nanomaterials) for a wide range of applications. His research has also covered biomaterials, nanomedicine and regenerative medicine, with an emphasis on developing advanced materials as cancer therapeutics, anti-fouling and anti-microbial uses, andcell/tissue engineering advances. He has published over 250 articles in peer-reviewed and high impact journals and has edited several books namely Engineered Carbohydrate-Based Materials for Biomedical Applications (Wiley), Chemistry of Bioconjugates (Wiley), Glycopolymers: Synthesis and Applications (Smithers & Rapra), and Polymers and Nanomaterials for Gene Therapy. He was section editor for the second edition of the book – Comprehensive Glycoscience (Elsevier). He is also on the Editorial Board for Frontiers in Chemistry (Polymer Chemistry), Polymer Chemistry (RSC), Biomacromolecules (ACS) and Polymers (MDPI). He was the recipient for a Distinguished Visiting Scientist Award from CSIRO (Manufacturing), Melbourne, Australia (2017-2018). He was also appointed as the Bualuang ASEAN Chair Professor in Research at Thammasat University, Pathum Thani, Thailand (2022-2024).

Dr. Taketoshi Minato

Institute for Molecular Science
National Institute of Natural Science, Japan

Dr. Taketoshi Minato is a scientist specializing in surface and interface science, as well as physical chemistry and chemical physics. He earned his Ph.D. in Science from the Tokyo Institute of Technology in 2005 under the supervision of Professor Ken-ichi Aika. His doctoral research focused on the electronic structure of titanium dioxide and its interactions with gold nanoclusters. Following his Ph.D., Dr. Minato was appointed as a Special Postdoctoral Researcher at Surface Chemistry Laboratory, RIKEN, where he advanced his studies on the electronic properties of metal oxides. In 2007, he joined Tohoku University as an Assistant Professor, where he applied his expertise in both theoretical and experimental techniques to the complex systems at the electrode/electrolyte interface. He subsequently held research positions at the Surface & Interface Science Laboratory, RIKEN and was appointed Associate Professor at Kyoto University, where he deepened his investigations into the mechanisms and applications of electrode/electrolyte interfacial phenomena. Since 2020, Dr. Minato has been serving as a Senior Researcher at the Institute for Molecular Science, National Institutes of Natural Sciences. His current research explores advanced energy conversion systems, extending his long-standing contributions to surface & interface science.

Prof. Dr. Nurak Grisdanurak

Department of Chemical Engineering
Thammasat University, Thailand

Nurak Grisdanurak, Prof. in ChE, Thammasat University. He earned his Bachelor of Engineering (B.Eng.) at King Mongkut University of Technology Thonburi and his PhD at Colorado School of Mines in the United States. He began his academic career at Khon Kaen University and later moved to Thammasat University. He has served on the Environmental Impact Assessment (EIA) committee for the Petrochemical and Energy sectors under the Ministry of Natural Resources and Environment for 20 years. His research initially focused on material synthesis related to catalysis work. Since 2019, his work has shifted to the recycling process of lithium-ion battery (LIB) waste. He built the first mechanical plant for LIB waste recycling in Thailand.

Prof. Dr. Tawatchai Charinpanitkul

Department of Chemical Engineering
Chulalongkorn University, Thailand

Prof. Dr. Tawatchai Charinpanitkul is a professor in chemical engineering whose expertise spans chemical engineering fundamentals, nanoparticle technology, and renewable bioresource technology. He earned his B.Eng. in Chemical Engineering from Chulalongkorn University in 1986 and continued his graduate studies in Japan, receiving his M.Eng. in 1989 and D.Eng. in Chemical Engineering in 1992 from the University of Tokyo. Dr. Charinpanitkul has been serving at the Department of Chemical Engineering, Chulalongkorn University since 1993. Throughout his academic career, he has also contributed to the leadership of various organizations including the Thai Institute of Chemical Engineering and Applied Chemistry (TIChE), the Technology Promotion Association (Thai-Japan), and the Engineering Institute of Thailand under the King's Patronage, among others. His research has been supported by both governmental and industrial funding agencies, focusing primarily on the development of advanced materials and clean energy technologies. His work has resulted in more than 160 international publications, with over 5,000 citations and an h-index of 35, reflecting his significant contributions to chemical engineering and nanotechnology research in Thailand and beyond.

Prof. Dr. Katsutoshi Nagaoka

Department of Chemical Systems Engineering
Nagoya University, Japan

Katsutoshi Nagaoka received his Doctor of Engineering from Tokyo Institute of Technology in 2001. After Post-Doctoral Researcher at the university and Humbo ldt fellow at Technical University in Muenchen, he moved to Oita University as a Lecturer in 2004. Next year he was promoted to Associate Professor. He has been appointed as a Full Professor at Nagoya University since 2019. His research interests involve heterogeneous catalysis for solving global energy and environmental issues. He was awarded The Japan Petroleum Institute Prize for Encouragement (2009) and Catalysis Society of Japan Prize for Encouragement (2010).

Mr. Kieran N. Twaddle
London Centre for Nanotechnology
University College London, UK

Kieran Twaddle was awarded an MEng in Electrical and Electronic Engineering with distinction from Heriot-Watt University (Edinburgh and Malaysia). During this, he conducted research specialising in acoustofluidics for the separation of marine microplastics, which sparked his interest in microscopic research for environmental applications. Following this, Kieran joined the Diamond Electronics Group at University College London to pursue his PhD under the supervision of Professor Richard Jackman. His research is funded by an EPSRC DTP-CASE studentship with industrial sponsorship from SLB Cambridge Research. In addition to his work with SLB, Kieran has initiated international collaborations and provided valuable work to a multimillion-pound industrial project with BAE Systems. His research focuses on 'diamond devices for extreme environmental sensing', using Surface Enhanced Raman Spectroscopy (SERS) for chemical identification. Kieran's work centres around developing robust sensors for detecting trace amounts of pollutants. He has devised a protocol to fabricate metal nanoparticles within diamond films and has presented this work at several international conferences. This method enables continuous use of the SERS substrate, as the nanoparticles are protected by the diamond coating. The approach has potential for long-term, in-situ monitoring of marine environments, facilitating rapid responses to pollutant leaks and significantly reducing environmental damage.

Asst. Prof. Dr. Xiaohong Tan
Department of Chemistry
Bowling Green State University, USA

Dr. Xiaohong Tan earned his Ph.D. from the Nanyang Technological University, Singapore. Following his postdoctoral training at the Center for Nucleic Acids Science and Technology at Carnegie Mellon University, USA, he began his independent research career in the Chemistry Department at Bowling Green State University, USA. His expertise spans nucleic acid chemistry, peptide chemistry, and protein biochemistry, with a particular focus on designing aptamer- and peptide-based probes for precise protein recognition, enabling the study of protein-protein and protein-nucleic acid interactions. Dr. Tan serves as an Associate Editor for Frontiers in Molecular Biosciences: Molecular Recognition and is also a member of the Editorial Board for Scientific Reports. His recent research has been published in high-impact journals, including Journal of the American Chemical Society, Nature Communications, Theranostics, Organic Letters, Analytical Chemistry, and Chemical Communications etc.

ABSTRACT OF
INVITED SPEAKERS

Invited Speaker **TIChE-IV-01**

Material design and degradation engineering for plastics and textile recycling

Hiroshi Uyama[1,*]

[1] Graduate School of Engineering, Osaka University, Suita 565-0871, Japan
[*] Corresponding author: uyama@chem.eng.osaka-u.ac.jp

ABSTRACT

In the pursuit of a global decarbonized society, there is a strong societal demand to reduce CO_2 emissions. Plastics, with an annual production of approximately 400 million tons worldwide, are a major source of CO_2 emissions. The importance of the circular economy has been emphasized as an approach to contribute to the realization of a decarbonized society and achieve resource circulation, particularly for plastic products and synthetic fibers, which are primarily derived from petroleum. We have developed a technology to separate and recycle cotton/polyester blended fibers. By exposing the material to microwaves for just a few minutes, the cotton undergoes mechanical reduction, while the polyester is chemically recycled to recover Bis(hydroxyethyl) terephthalate (BHET), a precursor of PET, with high purity. This was made possible by identifying a catalyst that selectively decomposes polyester into its precursor without affecting cotton, enabling the separation of blended fibers. In this technology, polyester fibers are selectively decomposed into BHET by using an appropriate catalyst in ethylene glycol. Ethylene glycol with its high boiling point is a suitable solvent for conducting chemical recycling at elevated temperatures and also acts as a substrate during PET decomposition. The selection of a suitable catalyst is critical. A safe and inexpensive chemical exhibited high catalytic activity for PET decomposition under microwave irradiation, enabling the reaction to proceed within just a few minutes. Since this catalyst does not act on cotton (cellulose), the cotton fibers remain intact in the reaction mixture and can be recovered almost quantitatively. Furthermore, high-purity BHET crystals could be obtained from the reaction mixture through a simple crystallization process, with a yield of approximately 70%.

Fig. 1. Sorting and recycling technology for cotton/polyester blended fibers.

Keywords: Plastic recycling; Microwave irradiation; Polyester; Cotton; Blended fiber

Invited Speaker **TIChE-IV-02**

Polymer based nanosystems and hydrogels for biomedical applications

Ravin Narain[1,*]

[1] University of Alberta, Department of Chemical and Materials Engineering, College of Natural and Applied Sciences, Donadeo Innovation Centre for Engineering, Edmonton, AB, Canada
[*] Corresponding author: narain@ualberta.ca

ABSTRACT

Recent developments in polymer science and organic chemistry have allowed the molecular design, engineering and fabrication of advanced and tailor-made materials for a wide range of applications. In particular, the reversible addition-fragmentation chain transfer polymerization has shown to be an excellent method to access well-defined polymers containing new functionalities for applications in drug and gene delivery, advanced biomaterials and cell/tissue engineering. This talk will focus on two aspects of current research in my laboratory. The first part of the lecture will focus on the molecular engineering of polymers for the delivery of cancer drugs and nucleic acid. We have recently shown that we can minimize the cationic groups in the copolymers by various approaches without compromising the stability, toxicity and gene knock-down efficiency of the polyplexes. In addition, we have also developed new polymer systems and nanogels for delivery of radiopharmaceuticals. The second part of the lecture will focus on biocompatible and non-toxic hydrogels via dynamic covalent chemistry. Hydrogels prepared from conventional approaches with covalent interactions seemed unable to fulfil some of the requirements of future medicine. Therefore, in recent years, more attention has focused on stimuli-responsive and self-healing hydrogel-based materials. The self-healing ability can offer better performance of the hydrogels, while the sensitivity to internal/external stimuli, such as temperature, pH, light and biomolecules enables the necessary environment for cell or tissue growth within the scaffold or be used for the controlled release of therapeutic agents. Usually, non-covalent interactions (e.g., host-guest complexations and hydrogen bonding) and dynamic covalent chemistry (e.g., Schiff base, disulfide, hydrazone, Diels-Alder reaction, and boronic ester) are the most common ways to prepare self-healing hydrogels, and the latter, appears more convenient to accomplish the simultaneous stimuli-responsiveness via dissociation of the dynamic covalent bonds. I will highlight the easy fabrication of self-healing and responsive hydrogels using polymer entities containing boronic esters with various polymers containing diols to generate materials with tunable properties.

Invited Speaker **TIChE-IV-03**

Reaction mechanisms in rechargeable batteries for next-generation energy technology

Taketoshi Minato[1,2,*]

[1] Institute for Molecular Science, National Institutes of Natural Sciences, Okazaki,
Aichi 444-8585, Japan
[2] Core for Spin Life Sciences, Okazaki Collaborative Platform, National Institutes of Natural
Sciences, Okazaki, Aichi 444-8585, Japan
[*] Corresponding author: minato@ims.ac.jp

ABSTRACT

Social interest in energy, particularly the efficient utilization of renewable energy sources, is increasing rapidly. To further advance the performance of rechargeable batteries, it is essential to understand and control the physical properties and reaction mechanisms at the electrode/electrolyte interface [1]. In this presentation, I will show recent findings on the interfacial analysis of rechargeable batteries (Fig. 1), conducted using scanning probe microscopy (SPM) alongside other surface and interface characterization techniques. During the charge-discharge process of lithium-ion batteries, the lithium-ion density within the electrode active material undergoes significant variation. Although the influence of lithium-ion density on electronic conductivity is well recognized, the impact of lithium-ion ordering within the material remains unclear. Our work demonstrates that lithium-ion ordering plays a crucial role in modulating the electronic conductivity, as revealed by local conductivity measurements using scanning tunneling microscopy/ spectroscopy (STM/STS) [2]. Furthermore, I will present insights into the reaction mechanisms of fluoride shuttle batteries, a promising next-generation system with the potential to surpass the theoretical energy density of conventional rechargeable batteries [3, 4]. In addition, I will introduce recent advancements in SPM-based studies on energy conversion systems, including interfacial analyses of electric double layers and viscosity [5], spin-selective transport in chiral molecular systems [6], and high-resolved vibrational signal detection [7].

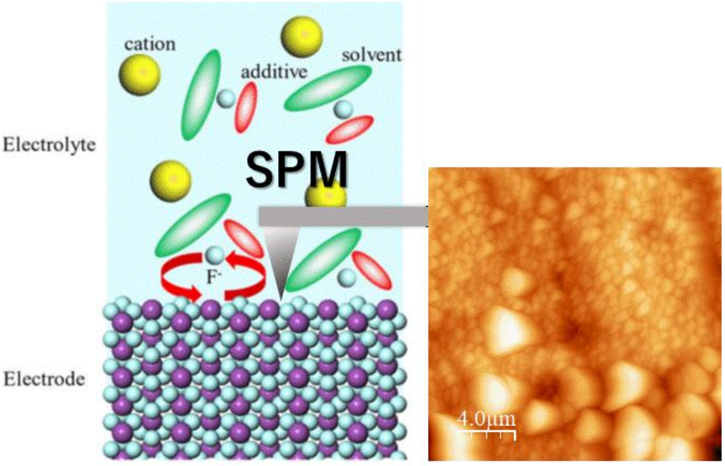


Fig. 1. A schematic illustration of the analysis of the electrolyte/electrode interface using scanning probe microscopy, along with an example image of a metal surface after fluorination.

Keywords: Surface; Interface; Scanning probe microscopy; Electrode/electrolyte interface; Rechargeable battery

References

[1] Minato T, Abe T. Surface and interface sciences of Li-ion batteries: Research progress in electrode-electrolyte interface. **Progress in Surface Science** 2017; 92(4): 240-280.

[2] Iwaya K, et al. Impact of lithium-ion ordering on surface electronic states of Li_xCoO_2. **Physical Review Letters** 2013; 111: 126104.

[3] Konishi H, et al. Influence of electrolyte composition on the electrochemical reaction mechanism of bismuth fluoride electrode in fluoride shuttle battery. **Journal of Physical Chemistry C** 2019; 123: 10246-10252.

[4] Nakano H, et al. Fluoride-ion shuttle battery with high volumetric energy density. **Chemistry of Materials** 2021; 33: 459-466.

[5] Umeda K, et al. Atomic-level viscosity distribution in the hydration layer. **Physical Review Letters** 2019; 122: 116001.

[6] Aizawa H, et al. Enantioselectivity of discretized helical supramolecule consisting of achiral cobalt phthalocyanines via chiral-induced spin selectivity effect. **Nature Communications** 2023; 14: 4530.

[7] Nishida J, et al. Sub-tip-radius near-field interactions in nano-FTIR vibrational spectroscopy on single proteins. **Nano Letters** 2024; 24: 836-843.

Invited Speaker TIChE-IV-04

Mechanical process of lithium-ion batteries recycling and its safety concerns

Nakarin Daungkaew[1], **Nurak Grisdnurak**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Thammasat University,
Pathum Thani 12120, Thailand
[*] Corresponding author: gnurak@engr.tu.ac.th

ABSTRACT

Focusing on small electric vehicle (EV) sales in our nation, projections indicate a 20-30% increase compared to sales five years ago. As a result, the end-of-life phase for their lithium-ion batteries (LIBs) will soon generate a significant volume of waste. Recognizing the potential benefits of a Green Circular Economy in response to the growing EV adoption, the Electricity Generating Authority of Thailand (EGAT) has taken a proactive role in this transition. With support from EGAT, we have developed a prototype continuous-operation unit designed for the separation of black mass from EV batteries and electronic devices. This unit has a processing capacity of 50-100 kilograms of batteries per hour. From this process, over 60% of the EV battery modules are converted into high-quality black mass. In addition, the study has yielded valuable insights into environmental impacts, economic feasibility, and occupational health considerations.

Output	Weight (g)	%
Black mass	11,298.51	43.62
Aluminium cell cover	5,808.24	22.43
Separation sheet	3,641.81	14.06
Black mass (Cu/Al)	281.93	1.09
Black mass (Dust)	156.86	0.61
Loss	10.61	0.04
Total output	21,197.96	81.85

Fig. 1. Pilot plant and its mass balance.

Safety concerns have been thoroughly evaluated during the preparation of EV batteries. The findings are now being applied at the industrial scale. Key parameters such as brine concentration, discharge time, and mass balance were analyzed to determine optimal operating conditions. Waste materials generated during the process were characterized throughout the study. The results have informed factory-scale regulations and the implementation of control measures.

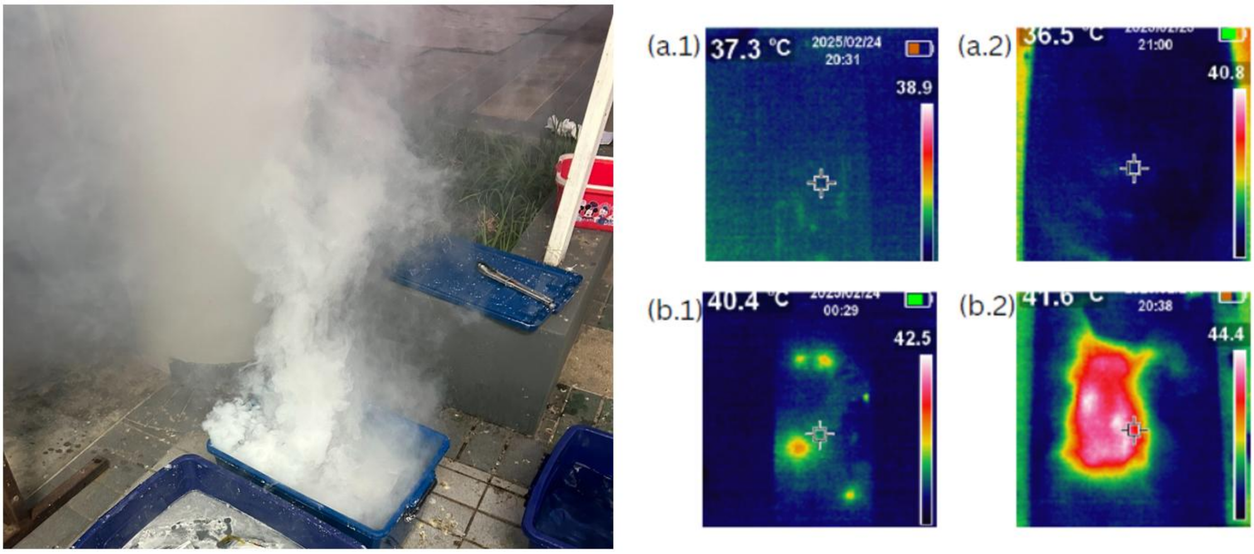


Fig. 2. Thermal reaction during EV battery pretreatment and thermal spot.

Keywords: LIBs; Safety

Invited Speaker **TIChE-IV-05**

Synthesis of carbonaceous nanomaterials from renewable agro-industrial waste

Tawatchai Charinpanitkul[1,*]

[1] Center of Excellence in Particle and Material Processing Technology, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University,
Bangkok 10330, Thailand
[*] Corresponding author: tawatchai.c@chula.ac.th

ABSTRACT

In recent years, the bio-circular and green (BCG) economy, which is focused on the rationalized utilization of renewable and recyclable resources for new emerging applications, has been set as a national agenda in many countries, including Thailand. It aligns closely with the Sustainable Development Goals of the United Nations [1-3]. Agro-industrial waste, as one category of renewable and recyclable resources, has gained attention due to its potential to be transformed into various high-value products. Our research team has set our focal point on the strategic utilization of agro-industrial waste for producing and applying carbonaceous nanomaterials. Renewable bio-resources, i.e., polysaccharides and bio-based oil, have been employed as precursors for producing carbonaceous nanomaterials, which are carbon nanotubes (CNTs), carbon nanohorns (CNHs), biochar (BCs), and relevant species. Some designated methods, especially arc-discharge, chemical vapor deposition, hydrothermal reaction, and microwave irradiation, have been employed for the scalable production of such CNMs [2,3]. Characterization and analyses of CNMs have also been thoroughly conducted to elucidate their formation mechanisms, which would play an important role in the development of their scalable production and utilization. Investigation of those CNMs in some specific applications, such as environmental remediation and platform chemical production, was also examined.

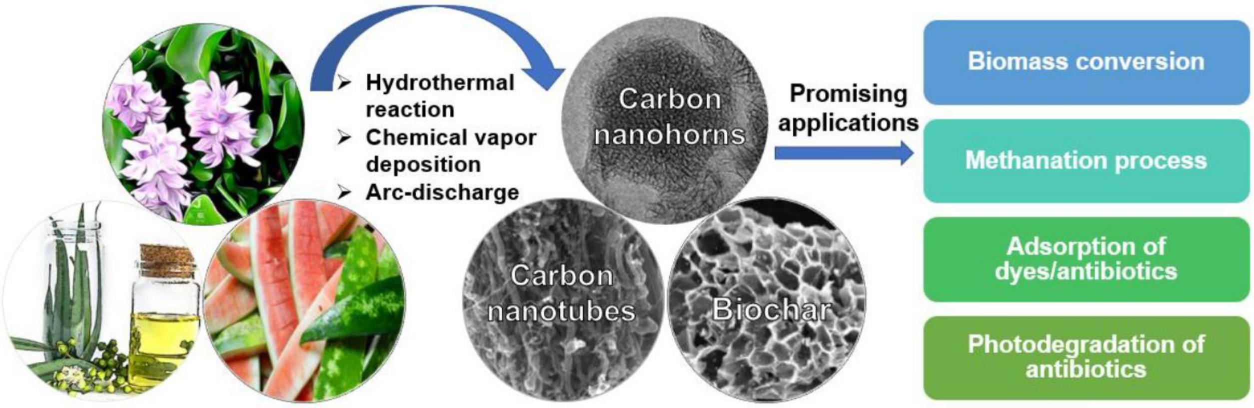


Fig. 1. Utilization of renewable agro-industrial waste for producing carbonaceous nanomaterials and their application

Our ongoing work demonstrates the significant potential of the synthesis of CNMs from renewable agro-industrial waste for their cost-effective, scalable production and diverse advanced applications. As a typical example, eucalyptus was employed as a bio-renewable feedstock for the production of CNTs via co-pyrolysis with ferrocene. Synthesizing conditions at low pyrolyzing temperature and low molar ratio of eucalyptus oil to ferrocene could provide the regulatable CNT yield of 41.38% and specific surface area of 44.1 m^2/g [3]. Such high-quality CNTs were subsequently applied as a catalyst for converting fructose to 5-HMF. It was found that a 51.6% yield of 5-HMF could be achieved. Performance of CNTs and BCs in the removal of water pollutants (antibiotics, dyes, heavy metals) also exhibited synergetic results due to adsorption and photocatalytic degradation. In addition, novel composite materials consisting of cement and CNTs were also examined. Their mechanical strength, electrical and thermal conductivity, was confirmed to be dependent upon the dispersion of CNTs within the cementitious matrix [4, 5]. Notably, the mechanical strength of mortar specimens with an optimum proportion of CNTs after exposure to elevated temperatures could be improved. In addition, when polypropylene fibers were blended in the CNT/mortar composite, the post-fire compressive strength of the composite was significantly higher than that of plain mortar.

Keywords: Carbonaceous; Nanomaterials; Renewable; Agro-industrial waste

References

[1] Vanavanichkul T, et al. Step-by-step conversion of water hyacinth waste to carbon nanohorns by a combination of hydrothermal treatment, carbonization and arc in water processes. **Diamond and Related Materials** 2021; 111: 108222.

[2] Kuptajit P, et al. A study on pore formation of high surface area activated carbon prepared by microwave-induced plasma with KOH (MiWP-KOH) activation: Effect of temperature-elevation rate. **Chemical Engineering and Processing-Process Intensification** 2021; 167: 108511.

[3] Le GTT, et al. Bio-based production of carbon nanotubes via co-pyrolysis of eucalyptus oil and ferrocene. **Journal of Analytical and Applied Pyrolysis** 2021; 158: 105257.

[4] Juengsuwattananon K, et al. Correlation between initial SiO_2/Al_2O_3, Na_2O/Al_2O_3, Na_2O/SiO_2 and H_2O/Na_2O ratios on phase and microstructure of reaction products of metakaolin-rice husk ash geopolymer. **Construction and Building Materials** 2019; 226: 406-417.

[5] Nuaklong P, et al. Hybrid effect of carbon nanotubes and polypropylene fibers on mechanical properties and fire resistance of cement mortar. **Construction and Building Materials** 2021; 275: 122189.

Invited Speaker **TIChE-IV-06**

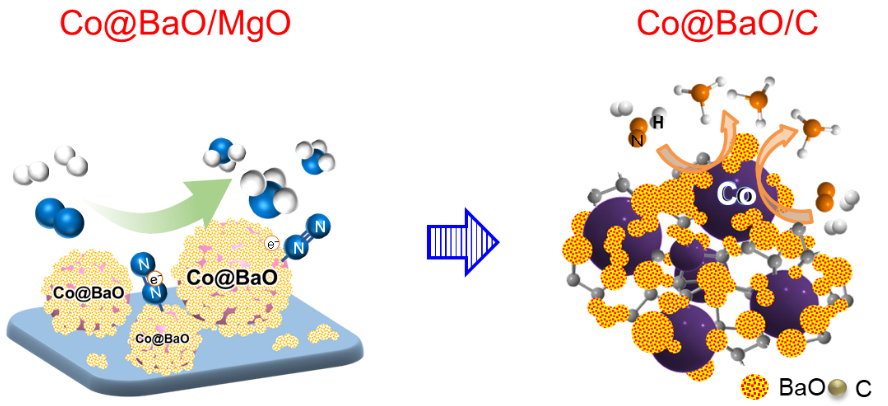
Boosting ammonia synthesis under mild conditions by control of the BaO-metal interface

Katsutoshi Nagaoka[1,*]

[1] Department of Chemical Systems Engineering, Graduate School of Engineering,
Nagoya University, Nagoya 464-8603, Japan
[*] Corresponding author: nagaoka.katsutoshi.n2@f.mail.nagoya-u.ac.jp

ABSTRACT

Ammonia has attracted great attenuations as a carbon-free fuel because CO_2 is not emitted when ammonia is combusted in power station. Ammonia is commonly produced by the Haber-Bosch process. In this process, ammonia is produced at high temperatures (>450 °C) and pressures (>20 MPa) over an iron-based catalyst and the use of fossil fuels emits large amount of CO_2. A catalyst that yields ammonia with high efficiency under mild reaction conditions (<400 °C, <10 MPa) would contribute to realization of green ammonia fuel synthesis process. We discovered that Co/BaO/MgO reduced at unusually high temperature, 700 °C, showed higher ammonia synthesis rate than bench-mark noble metal, Ru, catalysts at 350 °C and 1.0 MPa [1]. At the same temperature the ammonia synthesis rate of Co/BaO/MgO was increased drastically with increase in pressure to 3.0 MPa and was higher than that of active Ru-based catalyst. It was uncovered that the Co nanoparticles (core) are encapsulated by nano-fractions of BaO (shell) and electrons are effectively donated from the nano-fractions via Co to antibonding π-orbital of N_2, which results in weakening of N≡N bond, rate determining step for ammonia synthesis. However, pre-reduction at high temperatures, such as 700 °C, is required to reduce Co oxide, convert $BaCO_3$ to BaO, and form the active Co@BaO core-shell structure. To address these issues, we present an innovative and simple approach to preparing Co@BaO catalysts encapsulated in a carbon framework using a citric acid (CA) sol-gel method [2]. The Co/BaO/C catalyst pre-reduced at 485 °C shows an excellent NH_3 synthesis rate under conditions of 350 °C and 1.0 MPa, and also exhibits high stability. It was found that Ba is present as BaO in the catalyst precursor, and that the interaction between the Co oxide and the carbon is weak. As a result, the reduction temperature of the Co@BaO structure is lowered, which is an important advantage of this catalyst.



ACS Catal., 11 (2021) 13050.

Adv. Energy Mater., 15 (2024) 2404030.

Fig. 1. Concept of this work.

Keywords: Renewable energy; Green H_2; Ammonia fuel; Heterogeneous catalyst, Co catalyst

References

[1] Sato K, Miyahara S, Tsujimaru K, Wada Y, Toriyama T, Yamamoto T, et al. Barium oxide encapsulating cobalt nanoparticles supported on magnesium oxide: Active non-noble metal catalyst for ammonia synthesis under mild reaction conditions. **ACS Catalysis** 2021; 11: 13050-13061.

[2] de Silva KH, Sato K, Naito T, Toriyama T, Yamamoto T, Aso R, et al. Realization of ideal Ba promoter state by simultaneous incorporation with Co into carbon-protective framework for ammonia synthesis. **Advanced Energy Materials** 2024; 15: 2404030.

Invited Speaker **TIChE-IV-07**

In-situ pollution detection capability via robust diamond SERS

Kieran N. Twaddle[1,*], **Ralph J. Moors**[1], **Massimiliano L.A. Ramsay**[1],
Rebecca J. Watkins[1], **Richard B. Jackman**[1]

[1] London Centre for Nanotechnology and the Department of Electronic and Electrical Engineering, UCL (University College London), London, WC1H 0AH, UK
[*] Corresponding author: kieran.twaddle.22@ucl.ac.uk

ABSTRACT

Raman spectroscopy is an excellent technique for chemical identification, but alone it is insufficiently sensitive to detect trace levels which is vital for environmental monitoring. Surface-enhanced Raman Spectroscopy (SERS) on the other hand can be up to one-billion times as sensitive as standard Raman. However, SERS measurements are restricted to the laboratory environment due to the fragile nature of the plasmonic substrates required. Therefore, to enable SERS application in extreme environments for in-situ analysis, a robust and chemically stable plasmonic substrate is required. Conventional sensor technologies typically use materials that are unable to withstand the chemically and physically challenging environments that increasingly need sensors for environmental monitoring. Diamond possesses ideal and physical properties for this application including broad optical transparency, extreme mechanical hardness, and inertness to most chemicals. Crucially, diamond can be grown in a laboratory enabling the incorporation of plasmonic nanostructures within a diamond film. This technology enables the first truly robust SERS platform for detection of a range of species within extreme environments. Here, the successful demonstration of SERS measurements using diamond encapsulated metallic nanoparticles is presented. Diamond overgrowth of metallic nanoparticles has been achieved, fully encapsulating the plasmonic nanostructures. Both Ag and Au nanostructures in the range of 5 to 50 nm have been tested with varied conditions and thicknesses providing optimised SERS enhancement. Substrate integration in a fully robust Raman setup has realised precise in-situ sensing of target analytes, providing a practical tool for highly-sensitive analysis in extreme environments.

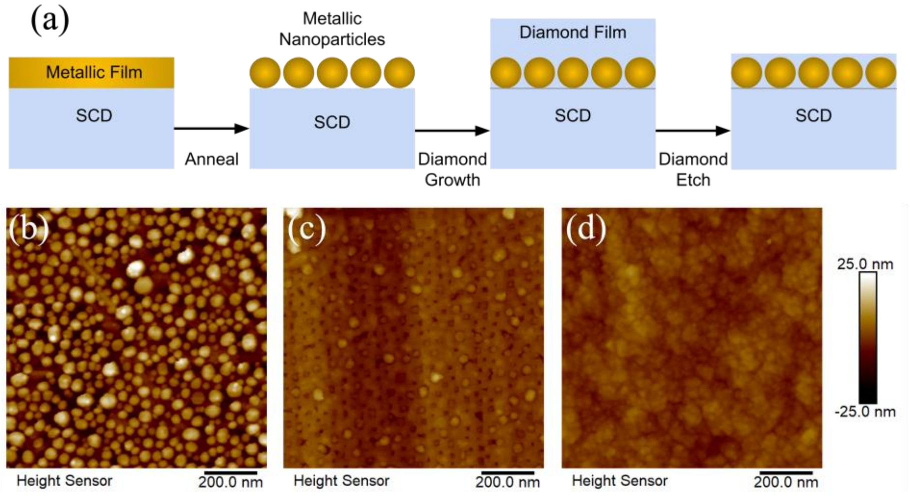


Fig. 1. Fabrication steps: (a) Process flow diagram. AFM of (b)Metallic nanoparticles on single crystal diamond (c)Nanoparticles during diamond growth phase (d)Nanoparticles fully encapsulated by diamond.

Keywords: Diamond; Plasmonics; Nanoparticles; Sensing; Raman

Invited Speaker TIChE-IV-08

Dual-handed recognition: Targeting a single protein with two chemical ligands

Xiaohong Tan[1,*]

[1] Department of Chemistry and Center for Photochemical Sciences, Bowling Green State University, Bowling Green, Ohio 43403, United States
[*] Corresponding author: tanx@bgsu.edu

ABSTRACT

Studying protein-protein interactions (PPIs) is crucial to understanding cellular processes, as proteins are the primary functional molecules within cells. Peptides and aptamers, which bridge the gap between antibodies and small molecules in terms of size and physical properties, play key roles in studying PPIs. Peptides are ideal ligands for recognizing proteins through hydrogen bonds, van der Waals forces, and ionic interactions. They can be chemically synthesized at low cost, have relatively low molecular weights, and exhibit enhanced tissue and cellular penetration. Aptamers, short single-stranded RNA or DNA molecules, can form unique spatial structures that enable them to tightly and specifically bind to a variety of targets. As an attractive alternative to antibodies, aptamers, particularly DNA-based ones, offer several advantages, such as long shelf life, low toxicity, low immunogenicity, cost-effective chemical synthesis, and the ability to tolerate diverse chemical modifications. In this talk, I will introduce bivalent protein-binding ligands, which consist of aptamers and/or peptides. These ligands are composed of two subunits, each capable of interacting with separate binding sites on a single protein, providing a new strategy for modulating PPIs and enhancing affinity, specificity and efficacy in target recognition.

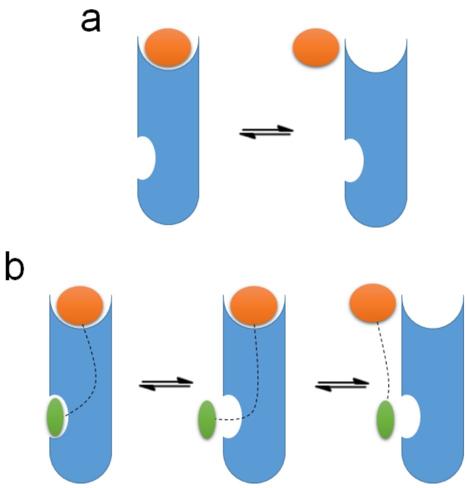


Fig. 1. Association and dissociation of (a) the monovalent form or (b) the bivalent form.

Keywords: PPI; Aptamer; Peptide

ABSTRACT OF
TIChE2025 ORAL AND POSTER PRESENTATIONS

Oral **TIChE-AM-01**

Removal of heavy metal ions (Pb^{2+}, Hg^{2+}) from water using N-doped activated carbon derived from bamboo waste: Equilibrium study

Chaisawat Rattanadon[1], **Nikom Klomkliang**[1,*]

[1] School of Chemical Engineering, Suranaree University of Technology, Nakhon Ratchasima 30000, Thailand
[*] Corresponding author: nikom.klo@sut.ac.th

ABSTRACT

Water contamination from heavy metals, especially lead (Pb^{2+}) and mercury (Hg^{2+}), is one of the most environmentally harmful issues in water sources. This research examined the removal of Pb^{2+} and Hg^{2+} from aqueous solutions using activated carbon (AC) derived from bamboo and modified with urea and KOH to achieve AC-UK. The original AC was mixed with urea in a 2:1 weight ratio and oxidized with air for 1 hour. The sample was then mixed with KOH in a 2:1 weight ratio and stirred overnight, followed by drying and activation at 650 °C under a nitrogen atmosphere (Fig. 1). The original AC oxidized with air without urea and KOH was designated as AC-Air. The series of adsorbents were characterized by BET surface area and FTIR, revealing that AC-UK showed a BET surface area of 842 m^2/g, higher than AC-Air (789 m^2/g) and AC (732 m^2/g). FTIR analysis showed that AC-UK had a significant abundance of nitrogen-containing functional groups, including N-H and C-N, compared to the other adsorbents.

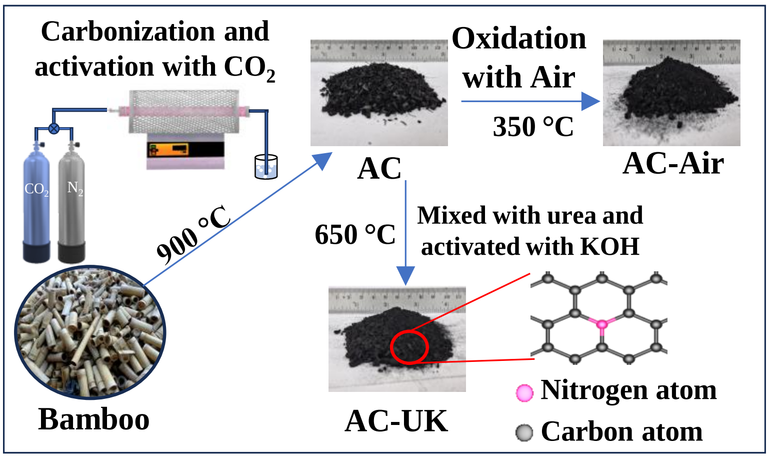


Fig. 1. Synthesis of original AC, AC-Air, and AC-UK.

Pb^{2+} and Hg^{2+} removal from aqueous solutions was conducted using single components in a batch adsorption at 25 °C. The results show that AC-UK exhibited high adsorption capacities for both Pb^{2+} and Hg^{2+}, with maximum capacities of 323 and 526 mg/g, respectively. The equilibrium adsorption was best fitted by the Langmuir adsorption isotherm. The modified AC is a promising adsorbent that demonstrated exceptional removal of Pb^{2+} and Hg^{2+} from water.

Keywords: Water treatment; Adsorption; N-doped activated carbon; Surface modification

Oral **TIChE-AM-02**

Enhanced CO_2 photoreduction in synthetic seawater using black TiO_2 nanowires: Synthesis, characterization, and performance

Kongphoom Khumsupa[1], **Poomipat Chotngamkham**[1], **Woranart Jonglertjunya**[1,2],
Poomiwat Phadungbut[1,2,*], **Sira Srinives**[1,2]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[2] Carbon Conversion Research and Technology Laboratory (CoReTech Lab), Mahidol University,
Nakhon Pathom 73170, Thailand
[*] Corresponding author: poomiwat.pha@mahidol.edu

ABSTRACT

Increased CO_2 concentration in the ocean is a vital factor for ocean acidification, affecting dissolved gas concentration, altering water temperature, and threatening marine ecosystems. An emerging approach to counter such an issue is CO_2 removal from seawater via photoreduction, which relies on photocatalysts, such as TiO_2, to convert dissolved CO_2 to other substances. A conventional TiO_2 particle was introduced for wastewater treatment due to its high stability and low toxicity with sufficient photoactivity. In this work, we enhance the photoactivity of TiO_2 and use the modified photocatalyst for CO_2 photoreduction in seawater (Fig. 1). A commercial-grade PM25 TiO_2 (Degussa) was chemically transformed to TiO_2 nanowires (TiO_2-NWs) for a lowered band gap energy and increased surface-to-volume ratio NWs, relying on hydrothermal techniques. The NWs were converted to black titanium NWs using thermochemical reduction and applied for CO_2 photoreduction. Preliminary results exhibited promising photoactivity for titanium NWs in converting CO_2 to the products, including methane, methanol, acetaldehyde, ethanol, and acetone at a total carbon consumption of 1,063.52 μmol/g_{cat}.

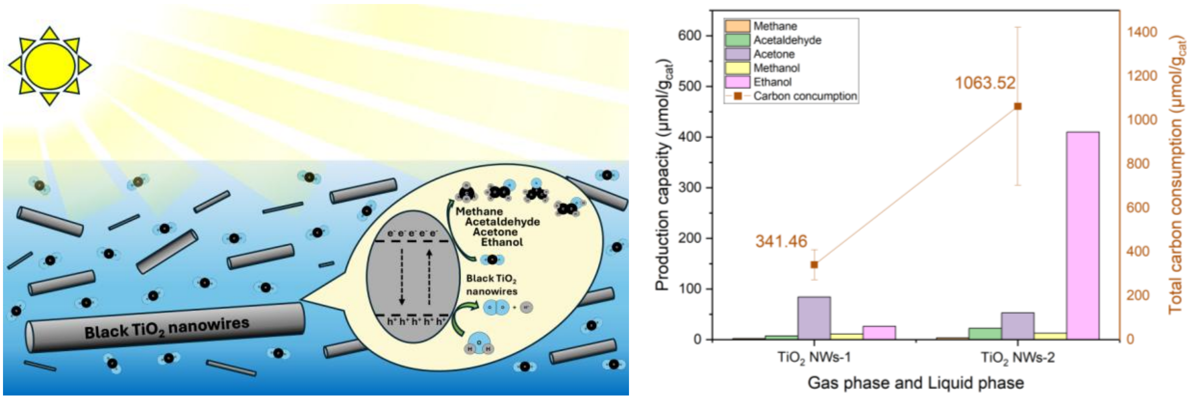


Fig. 1. Black TiO_2-NWs photo-reducing CO_2 in seawater (Left) and CO_2 photoreduction target product generation (Right).

Keywords: CO_2 photoreduction; TiO_2 nanowires; Black TiO_2

Oral **TIChE-AM-03**

Synthesis and characterizations of triethanolamine-copper black titanium photocatalyst for carbon dioxide photoreduction

Poomipat Chotngamkham[1], **Kongphoom Khumsupa**[1], **Poomiwat Phadungbut**[1,2],
Woranart Jonglertjunya[1,2,*], **Sira Srinives**[1,2]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[2] Carbon Conversion Research and Technology Laboratory (CoReTech Lab), Mahidol University,
Nakhon Pathom 73170, Thailand
[*] Corresponding author: woranart.jon@mahidol.edu

ABSTRACT

CO_2 emission is a leading cause of global warming and has become a prime public concern in recent years. Various methods were explored for CO_2 capture and storage (CCS), including amine scrubbers, solid adsorbents, and underground CO_2 storage, hoping to mitigate the emission incident. An emerging and promising alternative is CO_2 photoreduction, the artificial leaf, which employs photocatalysts to convert CO_2 into valuable products such as methane, acetaldehyde, and methanol. Titanium dioxide (TiO_2) is a notable photocatalyst in surface coating and wastewater treatment industries. In this regard, commercial-grade Degussa P25 TiO_2 was studied for its ability to convert CO_2 into high-value substances with limited photoactivity due to rapid electron-hole recombination and restricted light absorption. In this study, the P25 TiO_2 was transformed to black titanium (BT), dope with copper, and functionalized with triethanolamine (TEA). BT is an amorphous phase of TiO_2 with oxygen vacancy and Ti^{3+} active species, while copper decelerates the electron-hole recombination rate. TEA is a tertiary alkanolamine that can capture CO_2 and release CO_2 to the photocatalyst. Combining BT, copper, and TEA creates TEA-Cu-BT, providing excellent photoactivity for CO_2 photoreduction. Our best result showed TEA-Cu-BT converting CO_2 to target products in bolt gas and liquid phase, including methane, acetaldehyde, ethanol, and acetone, at a total carbon consumption of 5,760 μmol/g_{CAT}.

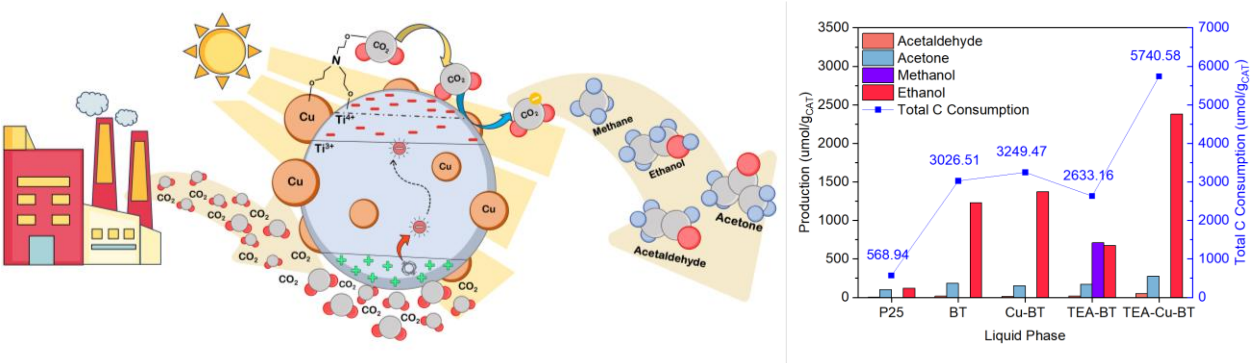


Fig. 1. Schematic diagram showing TEA-Cu-BT photo-reducing CO_2 into fuel products.

Keywords: CO_2 photoreduction; Titanium dioxide; Black titanium; Triethanolamine

Oral TIChE-AM-04

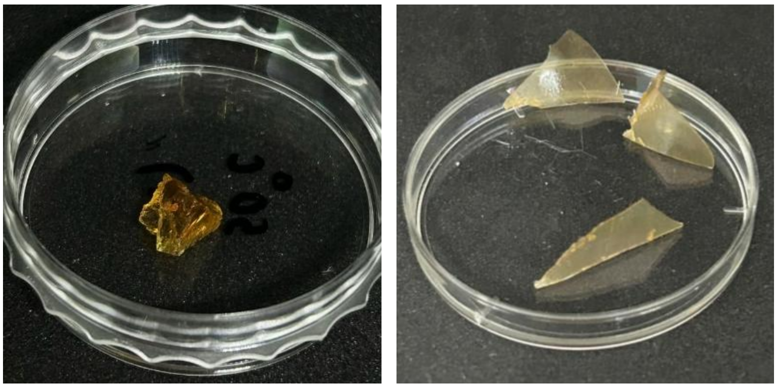
Synthesis, swelling behavior, and niacinamide release of 1,4-butanediol diglycidyl ether-crosslinked levan hydrogels from *Bacillus siamensis*

Pongtorn Phengnoi[1], **Cherdphong Seedao**[1], **Suphak Nakthongkham**[1], **Pitchayanin Intarawichai**[1],
Phumipat Saelao[1], **Witawat Jangiam**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Burapha University, Chonburi 20131, Thailand
[*] Corresponding author: witawat@eng.buu.ac.th

ABSTRACT

Levan is a fructan polysaccharide used in a broad range of applications, including cosmetics, pharmaceuticals, and medicine [1]. This study focused on the synthesis of hydrogel based on levan produced from *Bacillus siamensis* crosslinked with 1,4-butanediol diglycidyl ether (BDDE) to control niacinamide release. The swelling level of levan hydrogel was observed at different levan concentrations (5, 7, and 10%w/v), pH values (5.5, 7.4, and 9.0), and temperatures (25, 32, 37, and 50 ˚C). The results showed that levan concentrations affected both the strength of the hydrogel structure and the swelling level [2], with 10% w/v levan exhibiting the highest swelling level of 2.64. Levan hydrogel (10% w/v levan) demonstrated a higher swelling level in Tris-HCl buffer (pH 9.0) compared to phosphate-buffered saline (pH 7.4) and acetate buffer (pH 5.5). However, temperatures ranging from 25 to 50 ˚C had a minor effect on the swelling level of the levan hydrogel. In a 10%w/v levan hydrogel, niacinamide entrapment reached 31.27%, and release reached 93.83% within 35 minutes. These results indicate levan has potential in drug delivery applications. The synthesized levan hydrogel is illustrated in Fig. 1.



(a) (b)

Fig. 1. *Bacillus siamensis* levan hydrogel (a) dried and (b) swollen in water.

Keywords: Levan; Hydrogel; Niacinamide; *Bacillus siamensis*

References

[1] Demirci T, Hasköylü ME, Eroğlu MS, Hemberger J, Öner ET. Levan-based hydrogels for controlled release of Amphotericin B for dermal local antifungal therapy of Candidiasis. **European Journal of Pharmaceutical Sciences** 2020; 145: 105255.

[2] Selvi SS, Hasköylü ME, Genç S, Toksoy Öner ET. Synthesis and characterization of levan hydrogels and their use for resveratrol release. **Journal of Bioactive and Compatible Polymers** 2021; 36(6): 464-480.

Oral **TIChE-AM-05**

Dry gel conversion of CHA zeolite for direct air capture (CO_2): Screening of optimal synthesis conditions

Weerawit Luewanichwong[1,2], Vanpaseuth Phouthavong[3], Bhumin Than-ardna[1,2], Takeshi Hagio[4,5], Uthaiporn Suriyapraphadilok[1,2,*]

[1] The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok 10150, Thailand
[2] The Center of Excellence on Petrochemical and Materials Technology, Chulalongkorn University, Bangkok 10150, Thailand
[3] Department of Chemistry, Faculty of Natural Sciences, National University of Laos, Xaythany 01170, Laos
[4] Institute of Materials Innovation, Institutes of Innovation for Future Society, Nagoya University, Nagoya, Aichi 464-8601, Japan
[5] Department of Chemical Systems Engineering, Graduate School of Engineering, Nagoya University, Nagoya, Aichi 464-8603, Japan
[*] Corresponding author: hagio@mirai.nagoya-u.ac.jp, uthaiporn.s@chula.ac.th

ABSTRACT

The accumulation of carbon dioxide (CO_2) from human activities is a major driver of global warming, making it imperative to develop effective and eco-friendly technologies for CO_2 capture and mitigation. This study investigates the synthesis of CHA-type zeolite via the dry-gel conversion (DGC) method, which offers several advantages over conventional hydrothermal synthesis, including lower structure-directing agent (SDA) requirements [1], higher conversion yield, smaller reactor volume, and minimal wastewater generation [2]. The effects of seed addition, H_2O/Gel ratios (0.5-2), crystallization temperatures (140-200°C), crystallization times (1.5-24 h), and aging times (24-96 h) were systematically evaluated. Seed addition significantly improved crystallization, with an optimal H_2O/Gel ratio of 1 yielding well-defined CHA-type zeolite. The ideal crystallization temperature was 180°C, as lower temperatures led to incomplete crystallization, while higher temperatures introduced impurity phases. A crystallization time of 12 h and an aging time of 24 h was found optimal for phase-pure CHA formation. The synthesized zeolite exhibited a surface area of 71 m^2/g and a pore volume of 0.163 cc/g. CO_2 adsorption performance was evaluated under direct air capture conditions (434 ppm CO_2) at 60% relative humidity. Our DGC CHA, without any surface functionalization, demonstrated a capture capacity of 0.057-0.079 mmol CO_2/g sorbent over five cycles, maintaining structural integrity and stable performance. The partial regeneration of active sites suggests durability over repeated use. These findings highlight the potential of the environmentally sustainable DGC method for scalable CHA-type zeolite production in DAC applications.

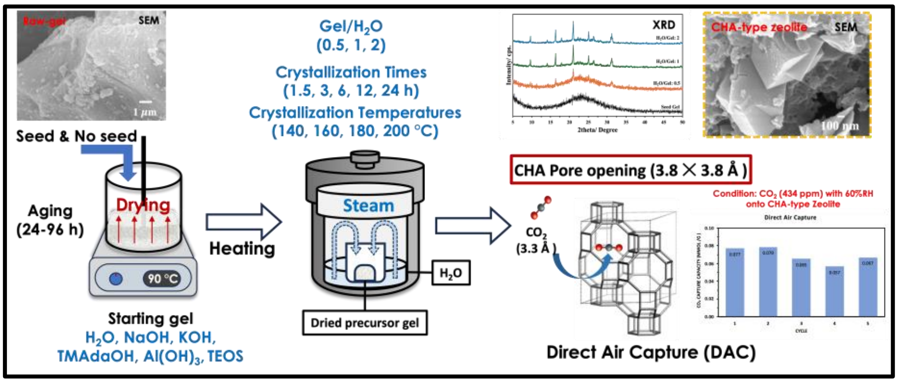


Fig. 1. Synthesis and CO_2 adsorption performance of CHA-type zeolite via dry gel conversion.

Keywords: CO_2 capture; Direct air capture (DAC); CHA-type zeolite; Dry-gel conversion

References

[1] Ma Z, Zhang Q, Li L, Chen M, Li J, Yu J. Steam-assisted crystallization of highly dispersed nanosized hierarchical zeolites from solid raw materials and their catalytic performance in lactide production. **Chemical Science** 2022; 13(27): 8052-8059.

[2] Phouthavong V, Hagio J, Park JH, Nijpanich S, Srihirunthanon T, Chantanurak N, et al. Utilization of agricultural waste to herbicide removal: Magnetic BEA zeolite adsorbents prepared by dry-gel conversion using rice husk ash-derived SiO_2 for paraquat removal. **Arabian Journal of Chemistry** 2023; 16(8): 104959.

Oral TIChE-AM-06

Effects of titanium nitride nanoparticles on the properties of light-responsive polybenzoxazine/epoxidized soybean oil copolymer

Jeremiah Otokpa Oja[1], **Ibrahim Lawan**[1], **and Sarawut Rimdusit**[1,*]

[1] Centre of Excellence in Polymeric Materials for Medical Practice Devices, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: sarawut.r@chula.ac.th

ABSTRACT

This study focused on studying the effects of Titanium nitride Nanoparticles (TiN) on the properties of light-responsive shape memory composite. Bisphenol-A benzoxazine (BA-a), Epoxidized Soybean Oil (ESO), and TiN ingredients were used to impact rigidity, flexibility, and photothermal effects in the composite, respectively. Different TiN amounts (0, 1, 3, 6, and 9 wt.%) were blended separately in the BA-a/ESO copolymer (70/30 wt.%). The blends were heated to ~130OC and stirred until homogenous mixtures were obtained. The mixtures were poured into a silicon mold and cured in an oven at 150°C/hr, 170°C/hr, 180°C/hr, and 200°C/2 hrs. Firstly, the obtained composites were characterized for flexural and viscoelastic properties using a universal testing machine and dynamic mechanical analyser. The maximum flexural strength, modulus and strain values of 176.80 ± 26.5 MPa, 5.58 ± 0.5 GPa, and 4.05 ± 4.0%, respectively were recorded with the P(70BA-a/30ESO)TiN–(wt.%) composite sample. Also, the samples' glass transition temperature (Tg) was found to be approximately 179,181,180,174, and 173°C for the respective composite samples. Secondly, the obtained Tg values of the composites were used to conduct the shape memory performance experiment with the composite samples using magnified sunlight and infrared (IR) light stimulants. Interestingly, the results achieved (Table 1) reveal that the shape fixity (R_f) and recovery (R_r) ratios and recovery time (T_r) were significantly impacted by the increase in the TiN amounts. Overall, it could be concluded that high-strength and fast light-responsive composite materials have been achieved.

Table 1 Shape memory properties of the produced composites.

Samples	R_f (%)	Magnified Sunlight Stimulant		NIR Stimulant	
		R_r (%)	T_r (Sec.)	R_r (%)	T_r (Sec.)
P(70BA-a/30ESO)TiN-(0wt.%)	82 ± 2.1	72 ± 3.6	135 ±3	79 ± 3.4	125 ± 7
P(70BA-a/30ESO)TiN-(1wt.%)	90 ± 1.11	86 ± 3.3	100 ± 6	89 ± 2.3	72 ±13
P(70BA-a/30ESO)TiN-(3wt.%)	93 ± 2.4	91 ± 4.0	76 ± 11	92 ±2.6	73 ± 16
P(70BA-a/30ESO)TiN-(6wt.%)	95 ± 1.8	93± 1.4	62 ±12	95 ±12	59 ± 4.0
P(70BA-a/30ESO)TiN-(9wt.%)	79 ± 1.8	86 ± 4.8	126 ±39	87±3.2	84 ±15

Keywords: Titanium nitride nanoparticle (TiN); Benzoxazine/epoxy copolymer; Shape memory property; Light-responsive composite; Polymer composites

Oral TIChE-AM-07

Antioxidant sugar from cocryatallization of sucrose, erythritol and vitamin C

Norramon Sathanasaowaphak[1], **Lek Wantha**[1,*]

[1] School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology,
Nakhon Ratchasima 30000, Thailand
[*] Corresponding author: lekwa@sut.ac.th

ABSTRACT

Cocrystallization is a process of producing cocrystals. The cocrystals obtained through cocrystallization exhibited improved properties, such as increased solubility, stability, and flowability. Erythritol is a sugar alcohol used as a low-calorie sweetener. In this study, sucrose, erythritol, and vitamin C (L-ascorbic acid) were co-crystallized, determined suitable ratio between sucrose and erythritol which can be sweetening and suitable with diabetic patient and delivering vitamin C benefits. The physical properties of the cocrystals were analyzed using XRD, FTIR, and SEM. From FTIR result, all of ratio was the same therefore 2:3 was selected since this ratio is reasonable for daily consumption. Antioxidant activity of cocrystals was determined by DPPH inhibition activity. An antioxidant activity of cocrystals was 86.12% whereas pure vitamin C was 87.38%. Therefore, Cocrystals can be a sweetening and antioxidant.

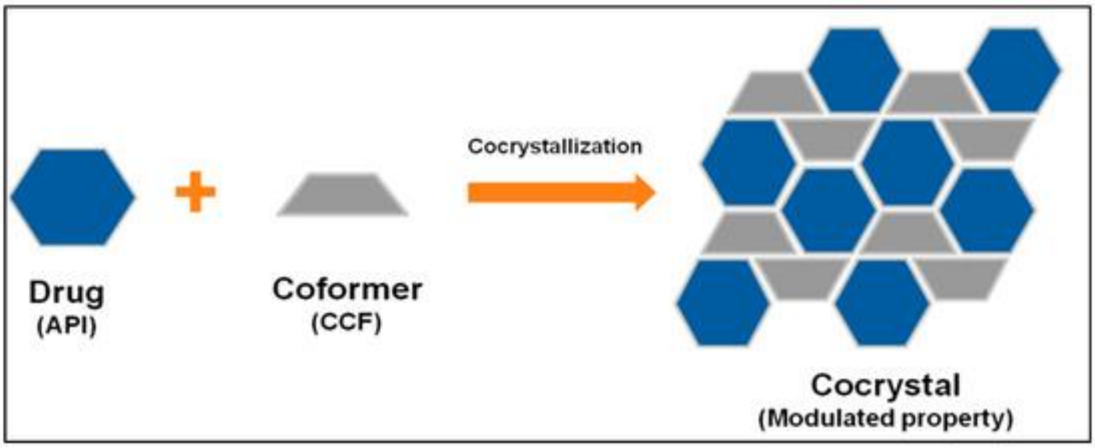


Fig. 1. Typical representation of preparation of cocrystal.

Keywords: Cocrystallization; Vitamin C; Erythritol; Antioxidant

References

[1] Thakuria R, Sarma B. Drug-drug and drug-nutraceutical cocrystal/salt as alternative medicine for combination therapy: A crystal engineering approach. **Crystals** 2018; 8(2): 101.

Oral **TIChE-AM-08**

Polybenzoxazine blended with modified natural rubber by graft copolymerization with 2-hydroxyethyl acrylate for shape memory applications

Chanokkan Buakhlee[1], Nuttinan Boonnao[1], Sarawut Rimdusit[1,*]

[1] Center of Excellence in Polymeric Materials for Medical Practice Devices, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: sarawut.r@chula.ac.th

ABSTRACT

Shape memory polymers (SMPs) consist of rigid and soft molecular segments. Polybenzoxazine-based bisphenol A-aniline (PBA-a) is a thermosetting polymer known for its high mechanical properties and heat resistance. However, its rigidity limits its applicability in shape memory applications. Therefore, incorporating the soft rubber segment with enhanced compatibility through the 2-HEA functional group in the rubber at a suitable amount may provide a twofold benefit to improved toughness of PBA-a as well as endowing PBA-a shape memory capability. This research aims to study the blending of PBA-a with modified natural rubber grafted with 2-Hydroxyethyl Acrylate (NR-g-2-HEA) to develop SMPs. BA-a monomer was melt-blending with NR-g-2-HEA at varying concentrations of 0-20 wt%. The homogenous mixings were cured in an air-circulated oven before for characterization. The successful grafting of 2-HEA monomer onto the NR backbone was confirmed by grafting efficiency and FTIR spectra. DMA analysis indicates that the rigidity of PBA-a decreases with higher NR-g-2-HEA content, as reflected by a reduced storage modulus in the glassy state. Moreover, the glass transition (Tg) of PBA-a/NR-g-2-HEA increased from 192 to 200 °C with 0-20 wt% of NR-g-2-HEA contents, indicating that possible interaction via H-bonding between hydroxyl groups of PBA-a and NR-g-2-HEA. Regarding shape memory properties, an increase in NR-g-2-HEA content led to significantly faster shape recovery, while shape fixity slightly decreased at higher concentrations. This finding demonstrates the promising potential of NR as a soft segment for shape memory properties.

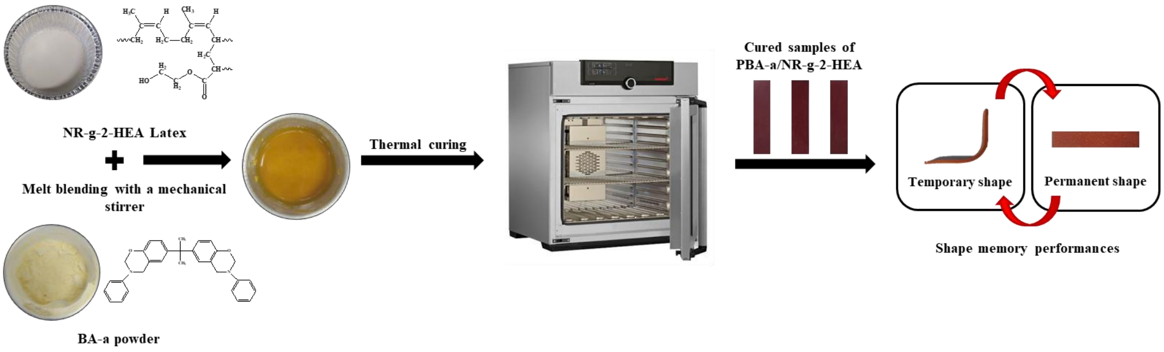


Fig. 1. Preparation of shape memory polymers from benzoxazine resin copolymerized with grafted natural rubber.

Keywords: Shape memory polymers; Polybenzoxazine; Grafting copolymerization; Modified natural rubber; 2-Hydroxyethyl acrylate (2-HEA)

Oral **TIChE-AM-09**

Flexible piezoresistive sensor based on natural rubber/chitosan/graphene composites for healthcare applications

Supakorn Suwanphiphat[1,2], Veerapat Kitsawat[1], Jia-Yu Yang[3], Cheng-Hsin Chuang[3],
Ying-Chih Liao[2,*], Muenduen Phisalaphong[1,*]

[1] Bio-Circular-Green Economy Technology & Engineering Center, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Precision Printing Technology Laboratory, Department of Chemical Engineering, National Taiwan University,
Taipei 10617, Taiwan
[3] Institute of Medical Science and Technology, National Sun Yat-sen University, Kaohsiung 80424, Taiwan
[*] Corresponding author: liaoy@ntu.edu.tw, muenduen.p@chula.ac.th

ABSTRACT

This study presents the development of flexible piezoresistive sensor based on biocomposite film incorporating graphene as a conductive filler, natural rubber as a polymer matrix, and chitosan as both a dispersant and copolymer. The sensor features a uniformly dispersed filler substrate, and a silver electrode fabricated via screen printing, ensuring reinforcement of electrical conductivity, thermal stability and mechanical properties including tensile strength, elastic modulus, and piezoresistivity. The prepared sensor effectively detected directional forces through variations in electrical resistivity and demonstrated high gauge factor. To further assess sensing performance, we systematically evaluated its long-term repeatability under cyclic loading conditions. The sensor maintained stable capability over multiple testing cycles, confirming its robustness for prolonged use. Additionally, the composite films exhibited enhanced antimicrobial activity and chemical resistance against non-polar solvent like toluene. This design optimizes reliable efficacy, offering high sensitivity, durability, biocompatibility, and potential applications in biodegradable wearable electronics such as human motion detectors.

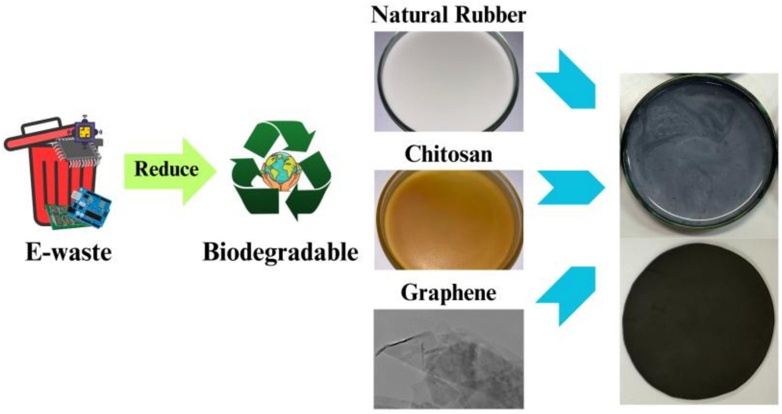


Fig. 1. Overview of biopolymer composite film replacement traditional electronics.

Keywords: Natural Rubber; Chitosan; Graphene; Piezoresistive sensor; Screen printing

References

[1] Kitsawat V, Siri S, Phisalaphong M. Electrically conductive natural rubber composite films reinforced with graphite platelets. **Polymers** 2024; 16(2): 288.
[2] Lu HC, Liao YC. Direct printed silver nanowire strain sensor for early extravasation detection. **Nanomaterials** 2021; 11(10): 2583.

Oral **TIChE-AM-10**

Development of self-healing polymers from bio-based benzoxazine blended with poly (ethylene glycol)

Pharaporn Yodkum[1], **Phattarin Mora**[2], **Krittapas Charoensuk**[1], **Sarawut Rimdusit**[1,*]

[1] Center of Excellence in Polymeric Materials for Medical Practice Devices, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Department of Chemical Engineering, Faculty of Engineering, Srinakharinwirot University,
Nakhonnayok 26120, Thailand
[*] Corresponding author: sarawut.r@chula.ac.th

ABSTRACT

Self-healing polymers have recently garnered interest in smart materials because of their ability to prolong material longevity, decrease maintenance expenses, minimize waste creation, and conserve resources. This study presents the development of self-healing polymers utilizing bio-based benzoxazine resin (E-fa resin), sourced from renewable materials, i.e. eugenol as phenolic sources, furfurylamine as amine sources, and paraformaldehyde, combined with poly(ethylene glycol) (PEG) by varying molecular weights (PEG 600, 1500, and 4000 g/mol) (see in Fig. 1). This work focusses on the influences of PEG molecular weights on curing behaviors and self-healing performances of the blended E-fa/PEG polymers. At a constant E-fa/PEG 85/15 wt/wt%, differential scanning calorimetry (DSC) confirmed that the blends were fully cured, with no significant changes in T_{onset} and T_{peak} across different PEG molecular weights compared to that of the neat E-fa (T_{onset} of 194 °C, T_{peak} of 223 °C). In addition, the surface scratching technique was utilized for evaluation of self-healing capability of the blends by observing dimensional scratch change using optical microscopy (OM) before and after thermal healing. The results suggested that increasing PEG molecular weight led to enhance self-healing efficiency, achieving greater than 90% with healing speed of blended E-fa/PEG4000 within 4 minutes. Finally, enhanced hydrophobicity of the blends was exhibited when increasing PEG molecular weights. Hence, a self-healable polybenzoxazine/PEG hybrid systems via a Diels-Alder reaction have successfully been developed in this work, offering a promising approach for sustainable smart materials.

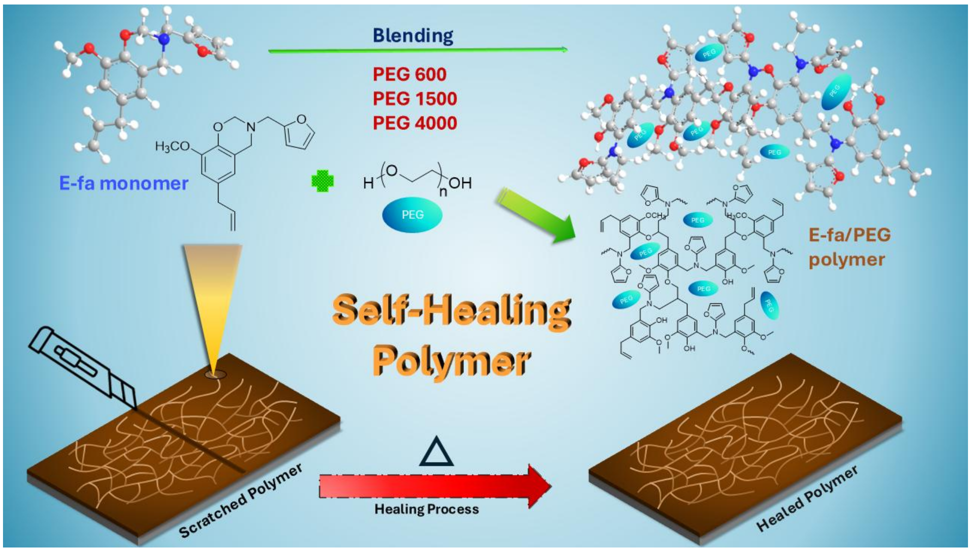


Fig. 1. Self-healable polymer based on E-fa/PEG blend.

Keywords: Self-healing polymer; Bio-based benzoxazine; Poly (ethylene glycol); Polymer blend

Oral **TIChE-AM-11**

Toughness improvement of polybenzoxazine by blending with glycidyl methacrylate-grafted natural rubber

Yadapa Wasikarat[1], Panyawutthi Rimdusit[1], Sarawut Rimdusit[1,*]

[1] Center of Excellence in Polymeric Materials for Medical Practice Devices, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: sarawut.r@chula.ac.th

ABSTRACT

Benzoxazine resin is a thermoset polymer with high thermal stability, high mechanical properties, and no by-products or volatile substances released in the curing process, but its brittleness poses a challenge. This research focuses on improving toughness of polybenzoxazine (PBA-a) using deproteinized natural rubber (DPNR) functionalized with glycidyl methacrylate (GMA). The BA-a was synthesized with bisphenol A, formaldehyde, and aniline. The DPNR grafted with GMA (DPNR-g-GMA) was confirmed by attenuated total reflection Fourier transform infrared spectroscopy and grafting efficiency (%GE) was determined via gravimetric method through Soxhlet extraction. Our preliminary results show that the peak positions at 830 and 909 cm^{-1} were related to the epoxide group, which confirmed the success of GMA grafting onto DPNR, while %GE reached 95% with GMA content at 15 phr. The obtained BA-a blended with DPNR-g-GMA (PBA-a/DPNR-g-GMA) containing different amounts of DPNR-g-GMA of 0-20 wt% were prepared by mechanical mixing at 120°C at 250 rpm for 30 min, followed by curing steps in an oven at 130°C for 3 h, 150°C for 2 h, 180°C for 1 h, and 200°C for 3 h. The effects of rubber contents on glass transition temperature (T_g) and storage modulus (E') of PBA-a/DPNR-g-GMA were studied by dynamic mechanical analyzer. It was found that T_g of the blended PBA-a at 20 wt% rubber content increased 9°C compared to neat PBA-a, but E' decreased systematically with increased rubber content. These results indicated the potential of GMA grafted onto natural rubber to effectively enhance flexibility of PBA-a.

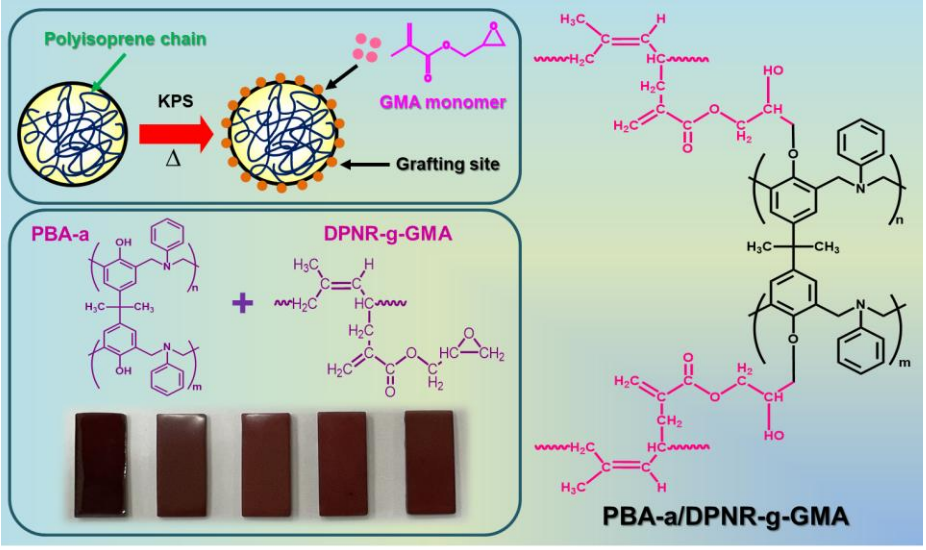


Fig. 1. Toughening mechanism of polybenzoxazine blended with GMA-grafted natural rubber.

Keywords: Deproteinized natural rubber; Glycidyl methacrylate; Grafting efficiency; Polybenzoxazine; Graft-copolymerization

Oral **TIChE-AM-12**

Cellulose nanocrystals from bagasse pulp for oil powder production

Pimpisa Pimpaeng[1], **Khanita Kamwilaisak**[1,2,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Khon Kaen 40002, Thailand
[2] Sustainable Infrastructure Research and Development Center, Khon Kaen University, Khon Kaen 40002, Thailand
[*] Corresponding author: khanita@kku.ac.th

ABSTRACT

Bagasse is a by-product generated in the sugar industry, classified as lignocellulosic biomass primarily composed of cellulose. Consequently, the acid hydrolysis method can be employed to extract cellulose and convert it into cellulose nanocrystals (CNCs), which possess a highly crystalline nanostructure, distinctive surface properties, and the capacity to stabilize Pickering emulsions [1, 2]. This study aims to extract cellulose nanocrystals (CNCs) from bagasse pulp using sulfuric acid hydrolysis, in combination with the Taguchi method and Grey relational analysis, to achieve a high crystallinity index and a low crystallite size. Additionally, the study investigates the potential of a CNC-stabilized emulsion system for oil powder production. The optimal conditions for CNC extraction were determined to be 50%w/w H_2SO_4 with a reaction temperature of 70°C for 60 minutes, resulting in a maximum crystallinity of 79.59% and a crystallite size of 3.65 nm. When applied in the Pickering emulsion, an optimal olive oil-to-water ratio of 30/70 with 3%wt CNCs produced the most stable emulsion. The initial oil droplets exhibited a diameter of 2.91 ± 0.67 μm. After 7 days, their size remained comparable to that of the initial emulsion, with no phase separation observed. Ultimately, the Pickering emulsion was utilized to produce oil powder, which is redispersible, possessing an oil droplet size of 11.80 ± 3.07 μm. This oil powder has potential applications in the food, cosmetic, medicinal, and pharmaceutical industries, particularly in drug delivery systems.

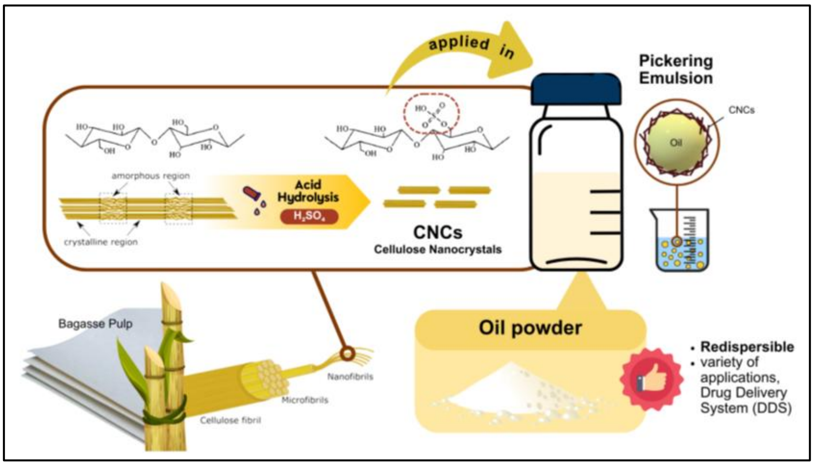


Fig. 1. Concept of this research.

Keywords: Cellulose nanocrystals; Bagasse; Pickering emulsion; Oil powder

References

[1] Pavalaydon K, Ramasawmy H, Surroop D. Comparative evaluation of cellulose nanocrystals from bagasse and coir agro-wastes for reinforcing PVA-based composites. **Environment, Development and Sustainability** 2022; 24(8): 9963-9984.

[2] Martakov IS, Vaseneva IN, Torlopov MA, Legki PV, Paderin NM, Patov SA, et al. Biocompatible nanoparticle heteroaggregates as stabilizers of pickering emulsions for vitamin D3 efficient delivery. **ACS Applied Bio Materials** 2022; 5(9): 4342-4353.

Oral **TIChE-AM-13**

Cellulose nanocrystals produced from bagasse pulp for drug delivery applications

Sirikanya Pimsaran[1], **Khanita Kamwilaisak**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Khon Kaen 40002, Thailand
[*] Corresponding author: khanita@kku.ac.th

ABSTRACT

This research investigates the synthesis of cellulose nanocrystals (CNC) from bagasse pulp, an agricultural byproduct, to enhance its value and apply it to the development of drug-delivery hydrogels. CNC was extracted via sulfuric acid hydrolysis at a concentration of 50% and a temperature of 70°C for 60 minutes, resulting in crystals exhibiting a crystallinity of 72.5%. The optimal loading of CNC in polyvinyl alcohol (PVA) hydrogel was determined to be 0.15 wt%, which achieved a swelling ratio of 268%. The incorporation of CNC into hydrogels significantly improved their mechanical properties, with an increase in strength of 35.59% and an enhancement in flexibility of 10.64%. Drug loading and release experiments utilizing salicylic acid indicated that CNC-containing hydrogels were capable of absorbing larger quantities of the drug, although they demonstrated a slower release profile in comparison to CNC-free hydrogels. This observation suggests that the amount of CNC present was insufficient to facilitate a nano-locking effect necessary for controlled drug release. Overall, the inclusion of CNC enhances the three-dimensional network structure of hydrogels, thereby improving their mechanical durability and positioning them as suitable candidates for biomedical applications, such as drug delivery patches and hydrogel wound dressings.

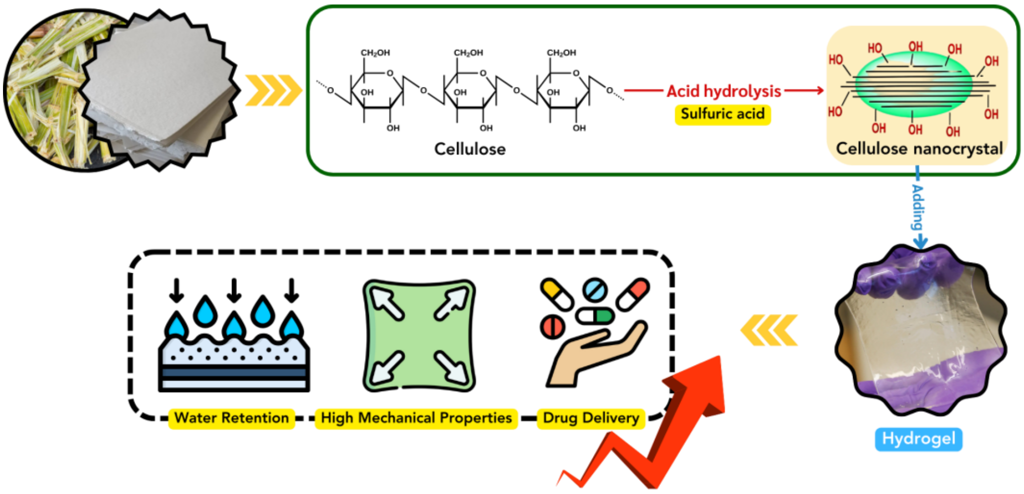


Fig. 1. Concept of this research.

Keywords: Cellulose nanocrystals; Hydrogel; Drug delivery; Biomedical applications

Oral TIChE-AM-14

Molecular insights into cationic surfactant adsorption on Fe(110): A combined MD and DFT study for corrosion inhibition

Sitthikiat Boonchoo[1], Rungroj Chanajaree[2], Bor Jeir Shiau[3], Uthaiporn Suriyaprapadilok[1], Ampira Charoensaeng[1,*]

[1] The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok 10330, Thailand
[2] Metallurgy and Materials Science Research Institute (MMRI), Chulalongkorn University, Bangkok 10330, Thailand
[3] Mewbourne School of Petroleum and Geological Engineering, The University of Oklahoma, Norman, Oklahoma 73019, United States
[*] Corresponding author: ampira.c@chula.ac.th

ABSTRACT

Cationic surfactants act as effective film-forming corrosion inhibitors by adsorbing onto metallic surfaces, creating a protective layer that prevents material degradation. However, their adsorption efficiency depends on molecular structure, interfacial interactions, and environmental conditions. This study employs molecular dynamics (MD) simulations to investigate the adsorption behaviors of four cationic surfactants, dodecyltrimethylammonium chloride (DTAC), dodecyl-3-methylimidazolium chloride (DLIC), dodecylpyridinium chloride (DPC), and benzododecinium chloride (BDAC), on the Fe(110) surface. These surfactants share the same dodecyl (C12) hydrophobic tail but differ in their headgroup structures, enabling a comparative analysis of how headgroup chemistry influences adsorption behavior and inhibition efficiency. The AMBER force field is employed for surfactant molecules and ions, while the SPC/E water model is used to simulate aqueous conditions [1]. To gain deeper insights, density functional theory (DFT) calculations are performed using NWChem with the B3LYP/6-311++G(d,p) basis set to evaluate frontier molecular orbitals and electronic properties [2]. The findings reveal critical aspects of adsorption conformation, headgroup interactions with the Fe surface, hydrophobic tail orientation, and the energy barrier of desorption. The formation of a stable surfactant film effectively blocks the diffusion of corrosive species, such as water and oxygen, reducing electrochemical reactions responsible for corrosion. Adsorption energy results indicate BDAC exhibits the strongest adsorption (-293.22 kJ/mol), followed by DPC (-251.04 kJ/mol), DLIC (-243.97 kJ/mol), and DTAC (-228.97 kJ/mol). BDAC's enhanced adsorption is attributed to π-electron interactions from its benzyl headgroup, while DPC's pyridinium ring stabilizes adsorption through delocalized electron interactions. DLIC forms stable interactions due to its imidazolium headgroup, whereas DTAC, lacking π-electrons, exhibits the weakest adsorption. These differences impact surfactant film compactness and stability, directly influencing corrosion inhibition efficiency.

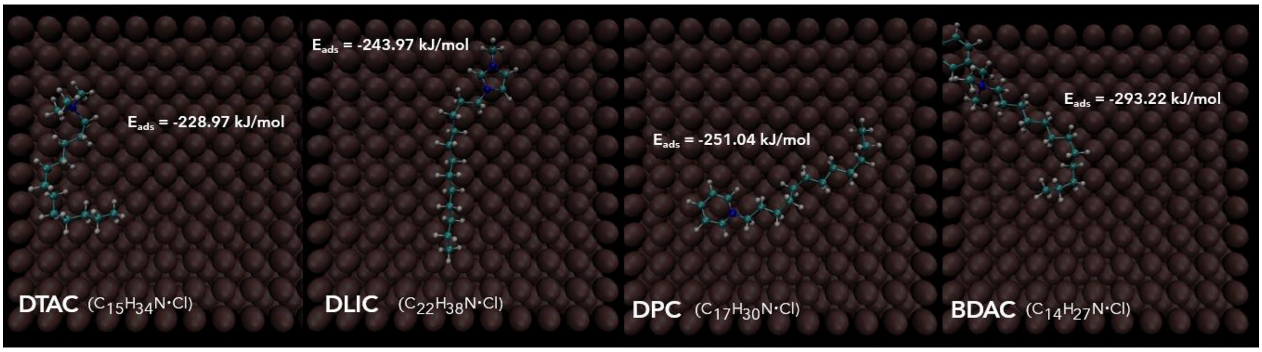


Fig. 1. Adsorption energy and molecular conformation of cationic surfactants on Fe(110) surface.

Keywords: Surfactant; Adsorption; Corrosion inhibitors; Corrosion; Molecular dynamics simulations

References

[1] Zhao H, Yang Y, Shu X, Qiao M, Dong L, Ran Q. Computational simulations of adsorption behavior of anionic surfactants at the portlandite-water interface under sulfate and calcium ions. **Langmuir** 2024; 40(7): 3911-3922.

[2] Quan X, Xiong J, Tong T, Jiao J, Zou J, Wei Y. Molecular dynamics simulation of synergistic behavior at the air-water interface: Mixed cationic-anionic fluorocarbon-hydrocarbon surfactants. **Physical Chemistry Chemical Physics** 2025.

Oral TIChE-AM-15

Influence of CaO on the durability of geopolymer in acidic environments

Cherdphong Seedao[1,*], **Majorie Valix**[2]

[1] Department of Chemical Engineering, Faculty of Engineering, Burapha University, Chon Buri 20131, Thailand
[2] Chemical & Biomolecular Engineering, The University of Sydney, New South Wales 2006, Australia
[*] Corresponding author: cherdphong@eng.buu.ac.th

ABSTRACT

In Australia, the sewer infrastructure includes approximately 122,000 km of concrete sewer pipe networks, known as ‘sewer assets’ [1]. These assets are vital for urban livability and productivity but are prone to deterioration, primarily due to microbial-induced concrete corrosion (MICC) [2-4]. To extend their service life, alkali-activated binders (AAB), such as geopolymers, are used as protective coatings. While CaO in mortar can enhance early compressive strength, it also increases susceptibility to deterioration in acidic environments due to the formation of expansive corrosion products like gypsum and ettringite [5-8]. To assess the influence of CaO on the acid resistance of one-part geopolymer mortar (OGPm), four commercial geopolymer samples with varying CaO content and one calcium aluminate cement mortar (CACm) as a reference were immersed in sulfuric acid (H_2SO_4) at pH 1 and 30°C for 28 days. Samples were periodically removed to measure corrosion depth and correlate with CaO content to understand the relationship between depth of corrosion and CaO. The corrosion depth of OGPm and CACm due to acid permeation is illustrated in Fig 1. The corrosion depth of the four OGPm and CACm samples, plotted in Fig. 2, shows an increase over time. The corrosion behavior occurred in two stages: accelerated corrosion stage (R-1) followed by a slower corrosion stage (R-2). The reduction in corrosion rate during R-2 is attributed to increased diffusion resistance, the build-up of the corrosion layer, and pore blocking by gypsum. Thus, the CaO composition in OGPm must be carefully considered to achieve better corrosion resistance.

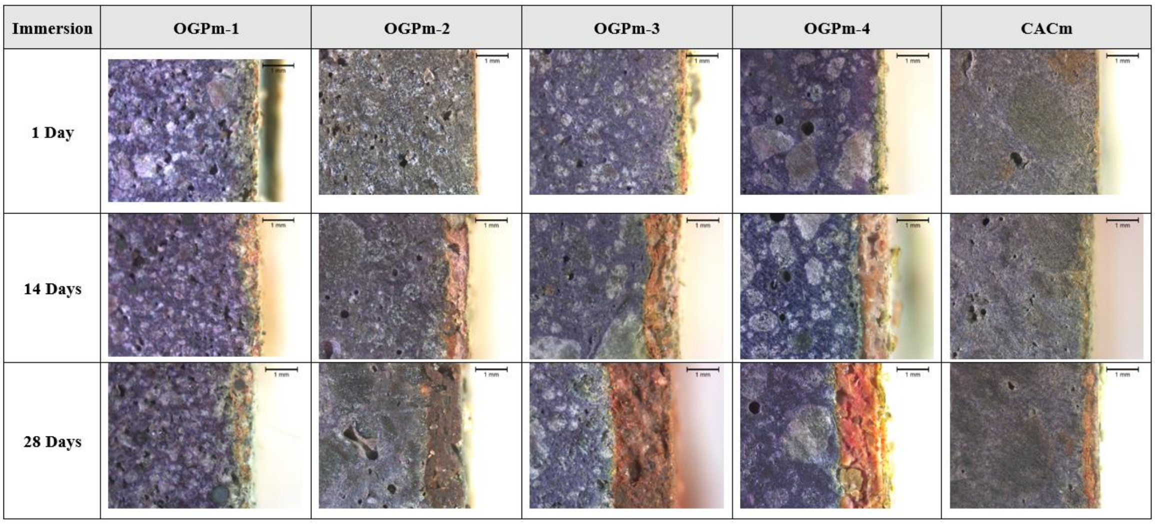


Fig. 1. Progression of corrosion surface for OGPm and CACm after acid immersion up to 28 days.

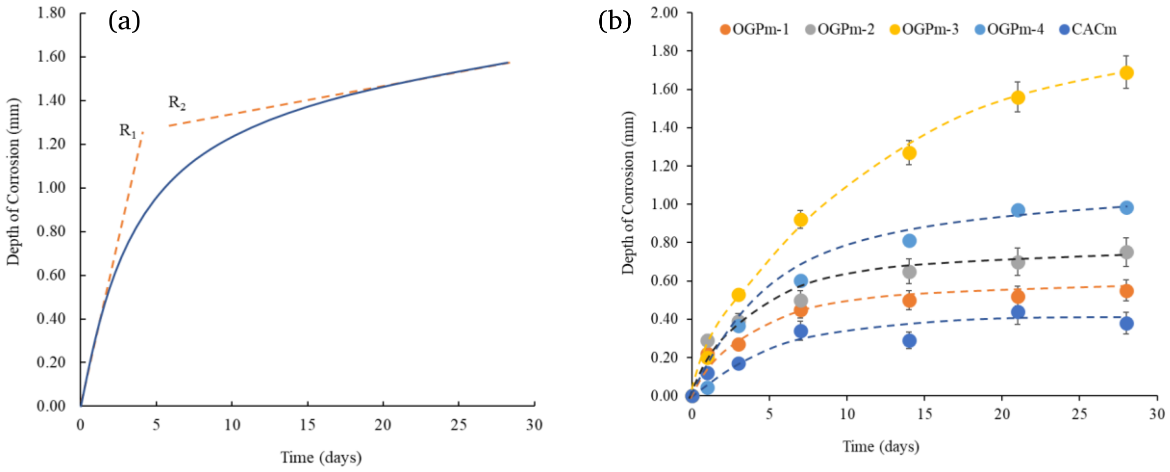


Fig. 2. Fitted rates of corrosion (a) and plot of the depth of corrosion of OGPm and CACm as a function of time of exposure to sulfuric acid (pH 1, 30°C) (b)

Keywords: Alkali-activated binders; Geopolymer; Microbial induced concrete corrosion (MICC)

References

[1] **Manual for selection and application of protective coatings**. Australia: Water Services Association of Australia Limited; 2017.

[2] Grengg C, Mittermayr F, Ukrainczyk N, Koraimann G, Kienesberger S, Dietzel M. Advances in concrete materials for sewer systems affected by microbial induced concrete corrosion: A review. **Water Research** 2018; 134: 341-352.

[3] Auguet O, Pijuan M, Batista J, Borrego CM, Gutierrez O. Changes in microbial biofilm communities during colonization of sewer systems. **Applied and Environmental Microbiology** 2015; 81(20): 7271-7280.

[4] Valix M, Zamri D, Mineyama H, Cheung WH, Shi J, Bustamante H. Microbiologically induced corrosion of concrete and protective coatings in gravity sewers. **Chinese Journal of Chemical Engineering** 2012; 20(3): 433-438.

[5] Wu M, Wang T, Wu K, Kan L. Microbiologically induced corrosion of concrete in sewer structures: A review of the mechanisms and phenomena. **Construction and Building Materials** 2020; 239: 117813.

[6] Aragaw TA. **Concise introduction to cement chemistry and manufacturing**. San Rafael, United States: Morgan & Claypool Publishers; 2018.

[7] Davis JL, Nica D, Shields K, Roberts DJ. Analysis of concrete from corroded sewer pipe. **International Biodeterioration & Biodegradation** 1998; 42(1): 75-84.

[8] Monteny J, Vincke E, Beeldens A, De Belie N, Taerwe L, Van Gemert D, et al. Chemical, microbiological, and in situ test methods for biogenic sulfuric acid corrosion of concrete. **Cement and Concrete Research** 2000; 30(4): 623-634.

Oral **TIChE-AM-16**

Preparation of N, S co-doped activated carbon from rice straw for high performance supercapacitor

Tippapon Tocuweang[1], **Nakorn Worasuwannarak**[1,*], **Darunee Aussawasathien**[2]

[1] The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi,
Bangkok 10140, Thailand
[2] Institute of MTEC, Thailand Science Park, Pathum Thani 12120, Thailand
[*] Corresponding author: nakorn.wor@kmutt.ac.th

ABSTRACT

Supercapacitors are energy storage devices known for their high-power density, long cycle life, and fast charge-discharge capabilities. Activated carbon (AC) from biomass waste, particularly rice straw, is a promising material for supercapacitor electrodes due to its high surface area, electrical conductivity, and cost-effectiveness. In Thailand, where large amounts of biomass waste are produced, utilizing this resource for energy storage devices is crucial. However, biomass has limitations, such as low energy density and high moisture content. To address these challenges, degradative solvent extraction is used to convert biomass into high-quality extracts, called Solubles, at 350°C using petroleum-based solvents. In this study, supercapacitors prepared from activated carbon derived from Solubles obtained from rice straw were investigated. The Solubles were carbonized at 600°C under nitrogen, then chemically activated with KOH at 700°C, resulting in activated carbon (AC700) with specific surface area of 1,911 m^2/g and specific capacitance of 200 F/g. Moreover, this study explored N, S co-doped with thiourea to improve performance of the activated carbon. The effect of thiourea doping at weight ratios of 4:1, 8:1, and 12:1 was studied. The results showed that doping increased nitrogen content from 0.37% to 1.81%, 3.03%, and 3.03%, while the sulfur content increased from none to 3.15%, 4.51%, and 3.49%, at thiourea to activated carbon weight ratios of 4:1, 8:1, and 12:1, respectively. This enhanced the specific capacitance from 200 F/g to 318 F/g at a current density of 1 A/g, with the best performance observed at a thiourea ratio of 8:1.

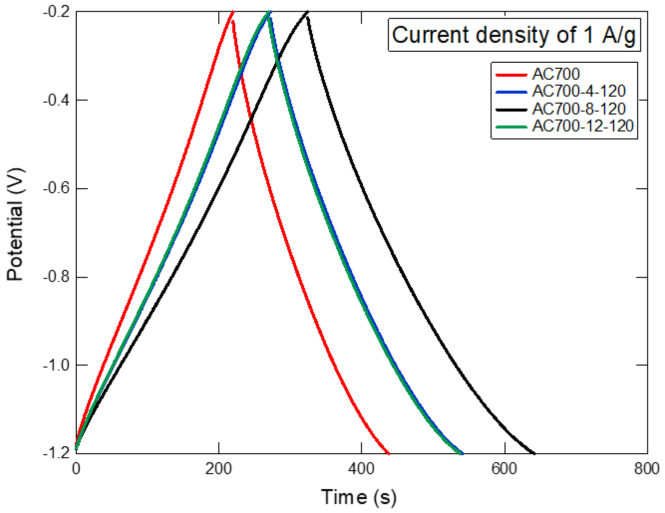


Fig. 1. The galvanostatic charge-discharge curves of activated carbon without thiourea doping (red), compared with activated carbon doped with thiourea at ratios of 4:1 (blue), 8:1 (black), and 12:1 (green).

Keywords: Supercapacitor; Activated carbon; N, S co-doped

Poster **TIChE-AM-17**

Production of graphene from graphite via flash joule heating process

Siranut Sirathanutworakan[1], **Prapan Kuchonthara**[1,2], **Tharapong Vitidsant**[1,2],
Napida Hinchiranan[1,2,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Center of Excellence in Catalysis for Bioenergy and Renewable Chemicals (CBRC), Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: napida.h@chula.ac.th

ABSTRACT

Graphene, a single layer of carbon atoms in a hexagonal lattice, has garnered considerable interest due to its outstanding properties, including high strength, electrical and thermal conductivity. However, conventional production face challenges in scalability, high costs and structural defects, limiting their practical applications. Flash Joule Heating (FJH) is a promising alternative for large-scale with cost-effective graphene production. In this research, graphite is used as a feedstock because of its high carbon purity. By rapidly heating a carbon precursor to high temperatures (>3,000 K) using an electric current, FJH enables precise control of graphene layer thickness and quality, which can be identified from the ratios of peak intensity between the D band and G band (ID/IG) and the 2D band and G band (I2D/IG), as shown in Fig. 1(b). detected by Raman spectroscopy [1]. The important parameters such as resistance of the system and voltage affect graphene's structural and properties [2]. To consider the resistance in the range of 0.3 to 1.5 Ω, it was found that the increase in the resistance decreased the ID/IG ratio and then leveled off when the resistance was higher to 2.0 Ω. Furthermore, the ID/IG ratio decreased with increasing the voltage from 200 to 240 V, whereas the I2D/IG ratio increased. At 240 V, the ID/IG and I2D/IG ratios were 0.53 and 0.01, respectively. The desired I2D/IG ratio should be greater than 0.5, and the ID/IG ratio should be low. These results suggest that the synthesized graphene is few-layer graphene type with minimal defects.

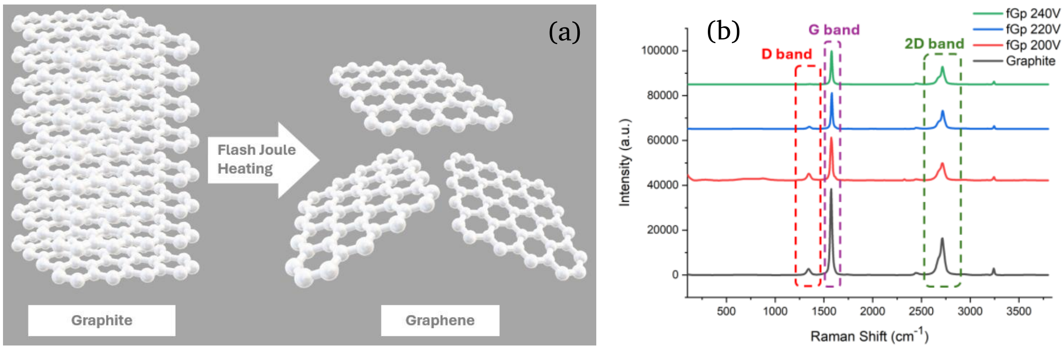


Fig. 1. Flash joule heating of graphite to produce graphene (a), and Raman spectra of graphite and graphene obtained from FJH at various voltage values (b).

Keywords: Graphene production; Flash joule heating (FJH)

References

[1] Liu X, Luo H. Preparation of coal-based graphene by flash joule heating. **ACS Omega** 2024; 9: 2657-2663.

[2] Advincula P, Luong D, Chen W, Raghuraman S, Shahsavari R, Tour J. Flash graphene from rubber waste. **Carbon** 2024; 178: 649-656.

Oral **TIChE-AM-19**

Effects of oxygen, nitrogen, and sulfur doped hard carbons derived from longan seed as anode material for sodium-ion batteries

Sutida Tammanoi[1], **Nikom Klomkliang**[1,*]

[1] School of Chemical Engineering, Suranaree University of Technology, Nakhon Ratchasima 30000, Thailand
[*] Corresponding author: nikom.klo@sut.ac.th

ABSTRACT

Sodium-ion batteries are gaining attention as a cost-effective and sustainable energy storage alternative, but anode performance remains a challenge. Hard carbon, widely studied for its stable charge-discharge properties and sodium-ion storage capability, is a promising solution, especially as it can be synthesized from biomass-derived precursors. In this study, longan seed-derived hard carbon was used as a sodium-ion battery anode. The precursor underwent pyrolysis at 900-1200°C, with samples labeled HCx, where x represents the temperature. Heteroatom doping was applied to modify interlayer spacing, with nitrogen (from urea) and sulfur (from sulfur powder) producing N-HCx and S-HCx, respectively. The BJH method revealed a predominantly mesoporous structure with few micropores, enhancing ion transport. Raman spectroscopy showed a D-band (~1350 cm^{-1}) for disordered carbon and a G-band (~1580 cm^{-1}) for graphitic structure, with the ID/IG ratio increasing at higher carbonization temperatures, indicating more defects. TEM images confirmed a disordered turbostratic structure with expanded interlayer spacing: 3.4-3.9 Å for HC1200, 3.4-4.0 Å for N-HC1200, and 3.9-4.1 Å for S-HC1200. The increased spacing, especially in S-HC1200, enhances sodium-ion intercalation. Electrochemical testing showed that HC1200 achieved the highest capacity (196.5 mAh/g), while N-HC1200 exhibited a slightly lower capacity (173.7 mAh/g) but improved cycling stability. Importantly, this study does not focus on different synthesis methods but rather emphasizes the choice of precursor materials for anode fabrication. By utilizing agricultural and industrial biomass waste, we aim to enhance the value of these residual materials while contributing to sustainable energy storage solutions.

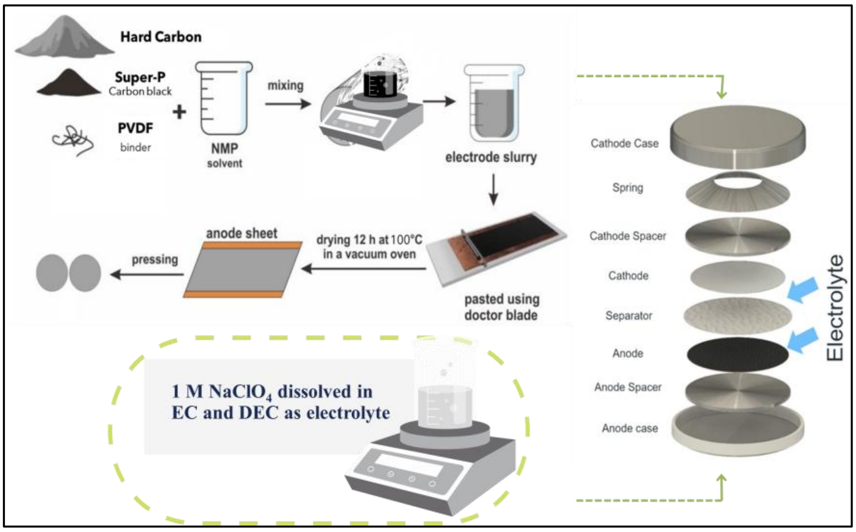


Fig. 1. Preparation and assembly of hard carbon anode for Na-ion half-cell.

Keywords: Hard carbon; Sodium ion; Battery; Energy materials; Anode

Oral **TIChE-AM-20**

Development of shape memory UV curable 3D-print resin based on acrylated epoxidized soybean oil (AESO)

Phuttipong Wongsombun[1], **Nuttinan Boonnao**[1], **Panuwat Luengrojanakul**[1], **Sarawut Rimdusit**[1,*]

[1] Center of Excellence in Polymeric Materials for Medical Practice Devices, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: sarawut.r@chula.ac.th

ABSTRACT

Due to the rapid development of the 3D-priniting and increasing concern on eco-friendly environmental practices, renewable vegetable oil (VO)-based materials present an attractive choice for the development of 3D-printing resin. However, to make VO-based material suitable for this application, incorporation of acrylate groups that can be rapidly solidified upon exposure to UV light into the structure is required. In this present work, we focus on the development of bio-based photoreactive resin from epoxidized soybean oil (ESO) and study its potential use in shape memory applications. Acrylation of epoxidized soybean oil (ESO) with methacrylic acid (MA) was carried out at two different molar ratios, 1:2 and 1:4 (ESO:MA), to produce two types of acrylated epoxidized soybean oil (AESO): A_2ESO (1:2) and A_4ESO (1:4). The curing behavior, mechanical properties, thermal stability, and shape memory properties of cured samples were investigated. FT-IR spectra confirm the successful acrylation of ESO to AESO. The mechanical and dynamic mechanical properties indicate that A_4ESO has higher strength and modulus than A_2ESO, which can be explained by the higher amount of UV induced crosslinking of acrylate groups. In terms of shape memory capabilities, both cured A_2ESO and A_4ESO exhibit shape memory effects with A_4ESO possessing higher shape fixity ratio. This work shows the successful development of bio-based-photoreactive resins from sustainable materials with remarkable shape memory properties.

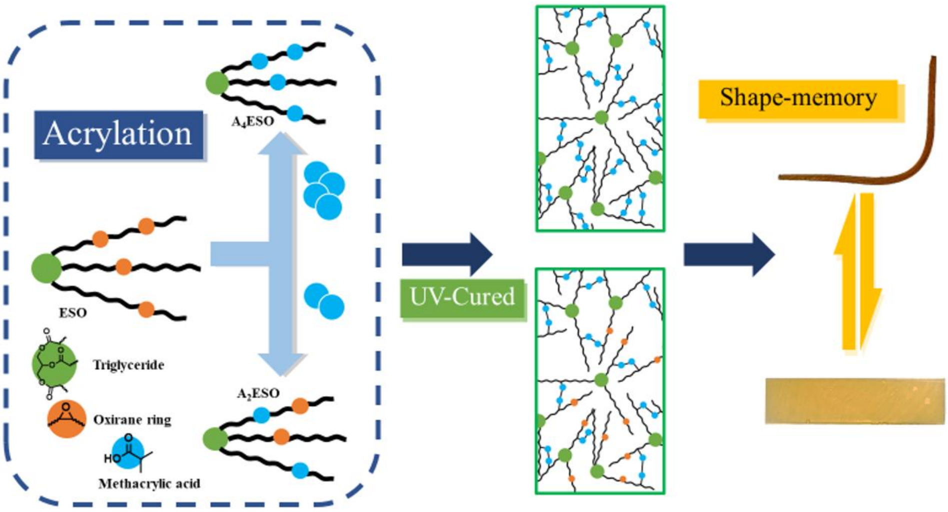


Fig. 1. Preparation of UV-cured shape memory acrylated epoxidized soybean oil.

Keywords: Bio-based photoreactive resin; 4D-printing resin; Acrylated epoxidized soybean oil; Shape memory polymers

Oral TIChE-AM-21

Development of a microencapsulation process of phase change materials from palm oil derivatives in large-scale melamine formaldehyde encapsulation process

Tawatchai Punhapol[1], Rungthiwa Methaapanon[1,2], Apinan Soottitantawat[1,2,*]

[1] Center of Excellence in Particle and Materials Processing Technology, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Bio-Circular-Green-Economy Technology & Engineering Center, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: apinan.s@chula.ac.th

ABSTRACT

Global climate change is significantly driven by greenhouse gas (GHG) emissions, with electricity production from fossil fuels being a major contributor. Phase change material (PCM) microencapsulation presents an environmentally friendly alternative as a renewable energy storage. However, large-scale PCM microencapsulation beyond the laboratory scale (150 mL) has not been extensively studied. This study aims to scale up PCM microcapsule synthesis, focusing on reactor design, equipment selection, and process optimization to achieve comparable or improved encapsulation efficiency on a large scale (2 L) relative to the laboratory scale. PCM microcapsules were synthesized by slowly introducing a melamine-formaldehyde pre-polymer solution at pH 8.5 and room temperature into a pH 3.6 oil-in-water emulsion at 70°C. The feed rate was maintained at 9.4 mL/min. The emulsion was prepared using homogenized methyl palmitate as the PCM, deionized (DI) water, and sodium dodecyl benzene sulfonate (SDBS) as a surfactant. The mixture was then stirred for 3.5 hours, followed by drying the microcapsules via spray drying. The results of the scale-up and feed rate variation experiments indicated that increasing the feed rate led to a reduction in microcapsule size distribution from 11.1 μm to 8.64 μm. However, this decrease in size resulted in a lower encapsulation efficiency, dropping from 74.5% to 54.3%. Additionally, increased agglomeration was observed due to higher collision rates between newly introduced and existing pre-polymer droplets, while the microcapsule morphology remained consistently spherical, as shown in Fig. 1.In conclusion, a lower feed rate should be considered to enhance encapsulation efficiency and minimize microcapsule agglomeration.

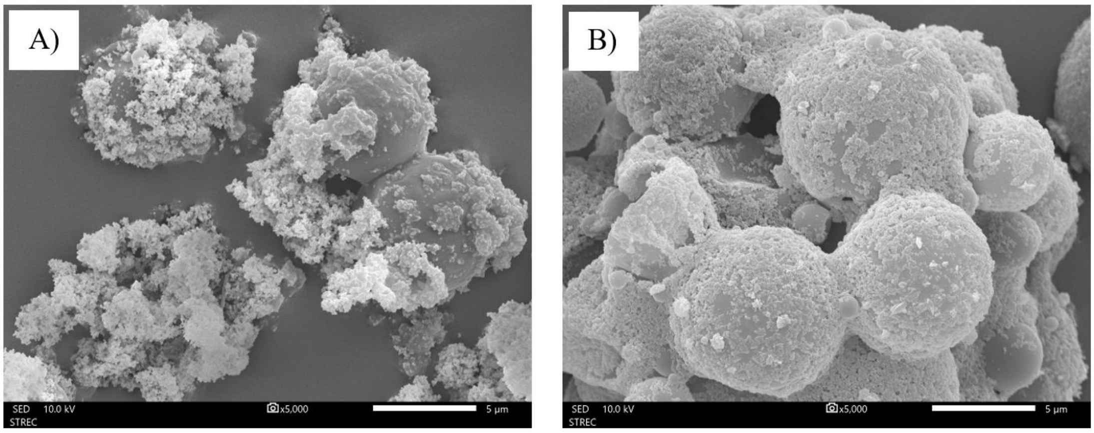


Fig. 1. Microcapsule morphology and agglomeration: (A) Lab scale (B) Pilot scale.

Keywords: Phase change material (PCM); Microencapsulation; Encapsulation efficiency (EE%)

References

[1] Palacio SN, Valentine KF, Wong M, Zhang KM. Reducing power system costs with thermal energy storage. **Applied Energy** 2014; 129: 228-237.

[2] Merline DJ, Vukusic S, Abdala AA. Melamine formaldehyde: Curing studies and reaction mechanism. **Polymer Journal** 2013; 45(4): 413-419.

[3] Fleischer AS. **Thermal energy storage using phase change materials**. 1st edition. Springer Briefs in Applied Sciences and Technology. Springer Cham; 2015.

[4] Maiti TK, Dixit P, Suhag A, Bhushan S, Yadav A, Talapatra N, et al. Advancements in organic and inorganic shell materials for the preparation of microencapsulated phase change materials for thermal energy storage applications. **RSC Sustainability** 2023; 1(4): 665-697.

Oral TIChE-AM-22

Fabrication of polyphenylsulfone (PPSU) electro-spun nanofiltration membrane

Ornpreeya Pongpan[1], **Ratthapol Rangkupan**[2], **Chalida Klaysom**[1,*]

[1] Center of Excellent in Particle and Material Processing Technology, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Metallurgy and Materials Science Research Institute (MMRI), Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: chalida.kl@chula.ac.th

ABSTRACT

In this study, the thin-film composite (TFC) membranes were fabricated based on the support layer of polyphenylsulfone (PPSU) via an electrospinning process. The effect of additive Cetyltrimethylammonium bromide (CTAB) in the morphology and structure of support was also discussed. The results indicated that adding 1wt.% of CTAB in the spinning solution would reduce the average fiber diameter below 200 nm as well as the densely packed branching nanofibers. Therefore, it has a potential in the preparation of high-performance TFC nanofiltration (NF) membranes. Furthermore, the effect of ENF support structure and surface morphology on the formation of polyamide (PA) film as a selective layer was also studied. The schematic of the methodology is shown in Fig. 1. Comparisons in terms of basic properties that were studied include morphology, water permeance, water flux, and salt rejection. It was shown that the use of 1wt.% of CTAB surfactants in the support layer of TFC membranes can increase salt rejection from 13.16% to 78.60% against $CaSO_4$ solution compared to support without CTAB surfactants. Water permeance and water flux also increased by 39% in the presence of CTAB surfactants. However, this work analysis paves the way to increasing the value of membrane fabricating from scrap PPSU in membrane separation for use as a nanofiltration in desalination applications.

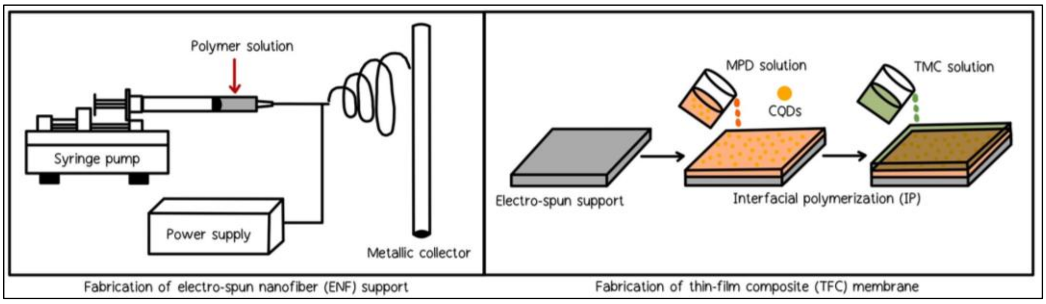


Fig. 1. Schematic of the methodology.

Keywords: Polyphenylsulfone; Electro-spun; TFC membrane; Carbon quantum dots

References

[1] Liu F, Wang L, Li D, Liu Q, Deng B. Preparation and characterization of novel thin film composite nanofiltration membrane with PVDF tree-like nanofiber membrane as composite scaffold. **Materials & Design** 2020; 196: 109101.
[2] Shukla AK, Alam J, Alhoshan M. Recent advancements in polyphenylsulfone membrane modification methods for separation applications. **Membranes** 2022; 12(2): 247.
[3] Sun J, Jia W, Guo J, Khanzada NK, Jin P, Wong PW, et al. Amino-embedded carbon quantum dots incorporated thin-film nanocomposite membrane for desalination by pervaporation. **Desalination** 2022; 533: 115742.

Poster TIChE-AM-23

Plastic waste-derived porous carbon as precursors for supercapacitors

Siriwimon Sophasri[1], **Pattarawan Aomnok**[1], **Onanong Supap**[1], **Punnapat Songsranoi**[1], **Sasitorn Chairanit**[1], **Panarat Rattanaphanee**[1,*]

[1] School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology,
Nakhon Ratchasima 30000, Thailand
[*] Corresponding author: panarat@sut.ac.th

ABSTRACT

This research synthesizes porous carbon from waste polyethylene terephthalate (PET) extracted from used plastic coffee cups with its main objective in producing the precursor materials for supercapacitors. The synthesis starts with autogenic carbonization at 470°C followed by activation at 600°C using KOH as an activating agent at different carbon/KOH mass ratio. The received materials are denoted as PC-1, PC-2 and PC-3 for porous carbon activated using carbon/KOH mass ratio of 1:1, 1:2 and 1:3, respectively. The inactivated porous carbon is denoted as PC-0. Surface morphology, elemental composition as well as microstructure of the materials are characterized using Field Emission Scanning Electron Microscope (FESEM). Porous carbon electrodes are prepared by mixing the active materials of suitable composition using polyvinyl acetate as a polymeric binder. The mixtures are then deposited on the clean copper plates before being oven-dried at controlled temperature. For capacitor assembly, the electrode is rolled and put in a plastic tube, which is then filled with 3M KOH as an electrolyte. Charge-discharge characteristic of the capacitor is tested and recorded. Porosity of the received porous carbon and capacitance of the prepared capacitors are found to increase with the ratio of activating agent used. The specific capacitance of 23.01, 54.4 and 97.98 F/g are obtained for the capacitors prepared with carbon/KOH mass ratio of 1:1, 1:2 and 1:3, respectively. This study, therefore, highlights the potential of converting plastic waste into high-performance carbon materials, contributing to sustainability and the development of eco-friendly energy storage solutions.

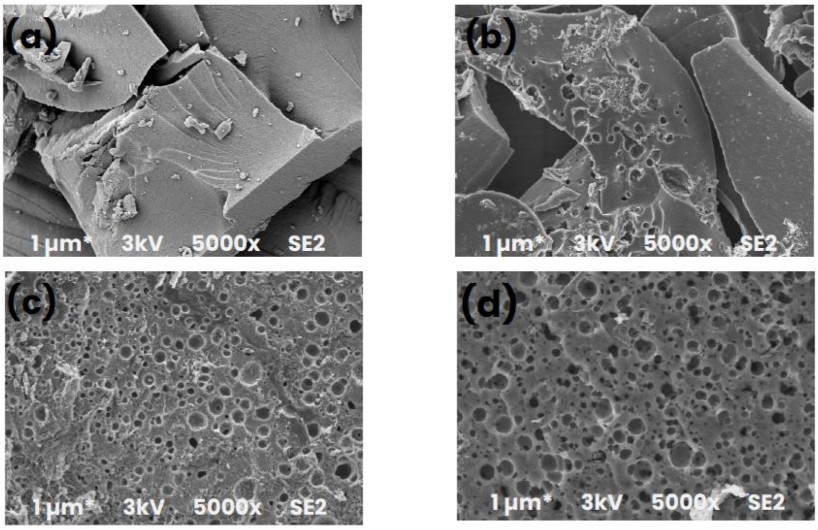


Fig. 1. SEM images of porous carbon derived from waste PET: (a) PC-0, (b) PC-1, (c) PC-2, (d) PC-3.

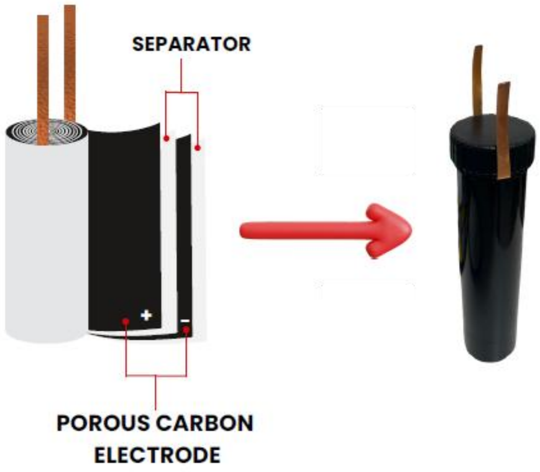


Fig. 2. Porous carbon electrode and capacitor assembly.

Keywords: Plastic waste; Porous carbon; Supercapacitor; Energy storage

References

[1] Olazaba I, Goujon N, Mantione D, Alvarez-Tirado M, Jehanno C, Mecerreyes D, et al. From plastic waste to new materials for energy storage. **Polymer Chemistry** 2022; 13: 4222-4229.

[2] Feng J, Zhu Q, Le Q, Zhu W, Song B, Zhang Z, et al. Source and performance of waste-derived porous carbon material as supercapacitor: Biomass, sludge and plastic waste as precursors. **Renewable and Sustainable Energy Reviews** 2025; 211: 115178.

Oral TIChE-AM-24

Modification of recycled polyethylene terephthalate membrane by using graphene oxide to enhance antifouling properties for protein separation

Thanapol Meeiam[1], **Kiattinatapon Juengchareonpoon**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[*] Corresponding author: kiattinatapon.juen@kmutt.ac.th

ABSTRACT

Egg white powder protein is commonly found in wastewater from the food industry. This study investigates the synthesis of a nanofibrous membrane from recycled polyethylene terephthalate using electrospinning for egg white powder treatment. Additionally, surface modification with graphene oxide was explored to enhance fouling resistance. The membrane was characterized using SEM, FTIR, water contact angle, and mechanical property. Filtration performance was tested using a dead-end stirred cell unit with egg white powder solution to assess protein recovery and membrane fouling. The results showed that the recycled polyethylene terephthalate membrane could recover more than 80 percent of the egg white protein, and the surface modification with graphene oxide could enhance the fouling resistance property.

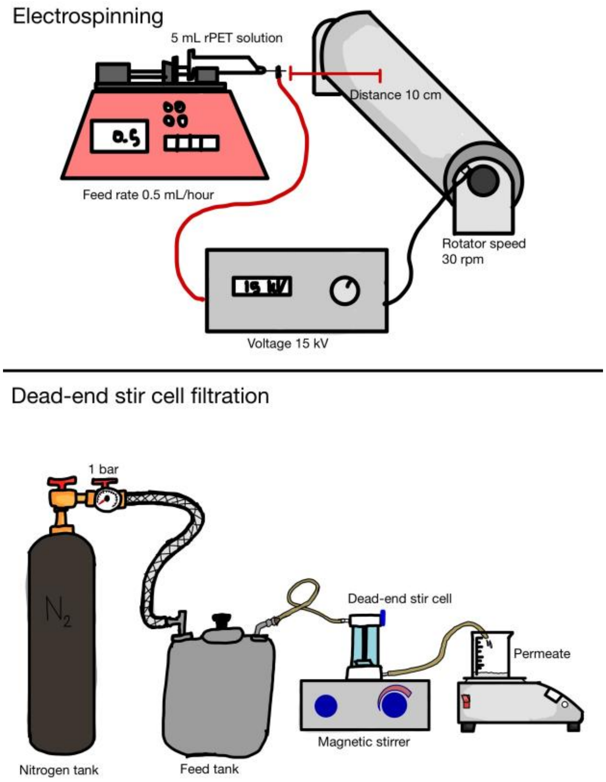


Fig. 1. Electrospinning and filtration methods.

Keywords: Electrospinning; Graphene oxide; Membrane; Polyethylene terephthalate; Wastewater treatment

Oral TIChE-AM-25

Development of PVA-PNVCL-Fe_3O_4 composite nanofibrous for drug delivery in cancer treatment

Sirawit Suknaisilp[1,*], **Saiwan Nawalertpanya**[1], **Waritha Janthaporn**[1]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi
Bangkok 10140, Thailand
[*] Corresponding author: sirawit.suk23@gmail.com

ABSTRACT

Electrospun composite nanofibrous have gained significant attention in biomedical applications due to their high surface area, tunable properties, and multifunctionality. This study focuses on the optimization of polyvinyl alcohol (PVA) as a sacrificial template for electrospinning and the incorporation of poly(N-vinylcaprolactam) (PNVCL) hydrogel with Fe_3O_4 nanoparticles to enhance thermoresponsive and magnetic properties. PNVCL is a temperature-sensitive polymer with a lower critical solution temperature (LCST) near body temperature (~33°C), while Fe_3O_4 nanoparticles introduce magnetic responsiveness, offering potential applications in drug delivery and hyperthermia treatment. Initially, electrospinning parameters for PVA were optimized by adjusting polymer concentration, applied voltage, flow rate, and tip-to-collector distance. The morphology and uniformity of electrospun PVA fibers were analyzed using scanning electron microscopy (SEM) to determine optimal conditions for bead-free fiber formation. The SEM image of optimize PVA fiber was shown in Fig. 1, revealing an average fiber diameter of approximately 114 nm. Once optimized, PNVCL hydrogel and Fe_3O_4 nanoparticles were incorporated into the PVA solution before electrospinning to ensure uniform dispersion. The crystalline structure of Fe_3O_4 was confirmed using X-ray diffraction (XRD), which displayed characteristic peaks matching the inverse spinel structure, as shown in Fig. 1, The resulting composite nanofibrous were characterized using Fourier-transform infrared spectroscopy (FTIR) to confirm polymer interactions and vibrating sample magnetometry (VSM) to assess the magnetic properties of Fe_3O_4 incorporation. The final electrospun composite nanofibrous exhibited excellent structural stability, thermoresponsive behavior, and magnetic responsiveness, making them promising materials for biomedical applications such as targeted drug delivery and magnetic hyperthermia. These findings demonstrate that the PVA optimization process is critical in achieving stable and functional electrospun PVA-PNVCL-Fe_3O_4 composite nanofibrous, highlighting their potential for advanced biomedical research and therapeutic applications.

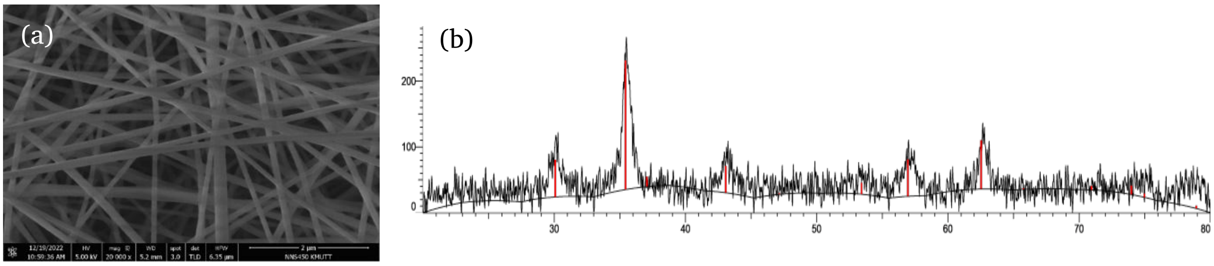


Fig. 1. SEM image of polyvinyl alcohol (PVA) (a) and XRD spectrum of Fe_3O_4 (b).

Keywords: Electrospinning; PVA Template; PNVCL Hydrogel; Fe_3O_4; Composite nanofibrous

Oral TIChE-AM-26

Effect of glycerol on xyloglucan-chitosan film preparation and its properties

Pornpatu Adair[1], **Kanjana Manamoongmongkol**[2], **Pongsert Sriprom**[1,*], **Woatthichai Narkrugsa**[1],
Lamphung Phumjan[1], **Pornsawan Assawasaengrat**[2]

[1] School of Food Industry, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
[2] Department of Chemical Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
[*] Corresponding author: pongsert.sr@kmitl.ac.th

ABSTRACT

This research aims to investigate the influence of glycerol content on the formation of complex compounds between xyloglucan and chitosan in xyloglucan-chitosan films. Xyloglucan was used at 1.00 grams, in combination with 0.25 grams of chitosan, and glycerol was added at concentrations of 25%, 30%, and 35% (w/w of total solids) to act as a plasticizer [1]. The formation of xyloglucan-chitosan complex compounds during the film production process was analyzed using FTIR, which revealed a peak in the wavenumber range of 1635.37 cm-1 to 1636.84 cm-1, suggesting the formation of the xyloglucan-chitosan complex [2]. However, the FTIR spectra indicated that the increased amount of glycerol has no effect on the formation of complex compounds between xyloglucan and chitosan during the production process of the films. SEM images revealed that the surface of the xyloglucan-chitosan films was rough, and increasing glycerol content did not affect the formation of the xyloglucan-chitosan complex. Regarding the properties of the xyloglucan-chitosan films, their thickness was 0.15-0.16 mm. Increasing glycerol content enhanced the elongation of the xyloglucan-chitosan films ($p \leq 0.05$), but did not affect tensile strength ($p > 0.05$), as shown in Table 1. The xyloglucan-chitosan film with 35% glycerol (w/w of total solids) exhibited the highest tensile strength and elongation. Additionally, the addition of glycerol did not significantly affect the water vapor transmission rate ($p > 0.05$).

Table 1 Tensile strength and elongation at break of xyloglucan-chitosan films.

Glycerol (%w/w of total solids)	Tensile strength (MPa)	Elongation at break (%)
25	11.55 ± 0.24^{b}	16.20 ± 0.09^{c}
30	12.18 ± 0.67^{a}	22.95 ± 0.41^{b}
35	12.27 ± 0.23^{a}	28.10 ± 0.16^{a}

Note: Different letters (a-c) within the same vertical column indicate statistically significant differences at a 95% confidence level ($p \leq 0.05$).

Keywords: Glycerol; Xyloglucan; Chitosan; Film

References

[1] Simi CK, Abraham TE. Biodegradable biocompatible xyloglucan films for various applications. **Colloid and Polymer Science** 2010; 288: 297-306.

[2] Adair P, Sriprom P, Narkrugsa W, Phumjan L, Manamoongmongkol K, Permana L, Assawasaengrat P. Preparation, characterization, and antimicrobial activity of xyloglucan-chitosan film from tamarind (*tamarind indica* L.) seed kernel. **Progress in Organic Coatings** 2023; 179: 107486.

Poster **TIChE-AM-27**

The development of an electrochemical sensor for silver ions and silver nanoparticle detection

Phurin Surachotimongkol[1,*], **Kamonwad ngamchuea**[1]

[1] School of Chemistry, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima 30000, Thailand
[*] Corresponding author: phurin53235@gmail.com

ABSTRACT

Silver nanoparticles (AgNPs) are widely utilized in medical, environmental, and industrial applications due to their unique antimicrobial and physicochemical properties. However, the potential release of toxic silver ions (Ag^+) from AgNPs raises significant health and environmental concerns. This study presents the development of a rapid and facile electrochemical sensor capable of detecting and distinguishing between Ag^+ and AgNPs. AgNPs were synthesized and characterized using scanning electron microscopy (SEM), UV-visible spectroscopy, and dynamic light scattering (DLS). SEM analysis revealed predominantly spherical particles with a uniform size distribution, averaging 40.0 ± 2.3 nm in diameter. DLS measurements indicated a hydrodynamic diameter of 54.33 ± 0.23 nm, while zeta potential analysis yielded a value of –69.87 ± 22.13 mV, confirming colloidal stability due to citrate capping. The extinction coefficient of AgNPs was determined to be 0.1616 ± 0.053 ppm^{-1} cm^{-1} using the Beer-Lambert law. Electrochemical measurements using linear sweep voltammetry (LSV) and chronoamperometry showed distinct oxidation peak potentials at 0.025 V for Ag^+ and 0.7 V for AgNPs, enabling effective differentiation, as shown in Fig. 1. The sensor demonstrated detection sensitivities of 0.056 ± 0.0018 µC ppm^{-1} for Ag^+ and 0.26 ± 0.024 µC ppm^{-1} for AgNPs, with corresponding detection limits of 0.11 ppm and 0.30 ppm, respectively. These results highlight the sensor's potential for monitoring of Ag^+ leakage from AgNP-containing products, offering a valuable tool for ensuring safety in AgNPs applications.

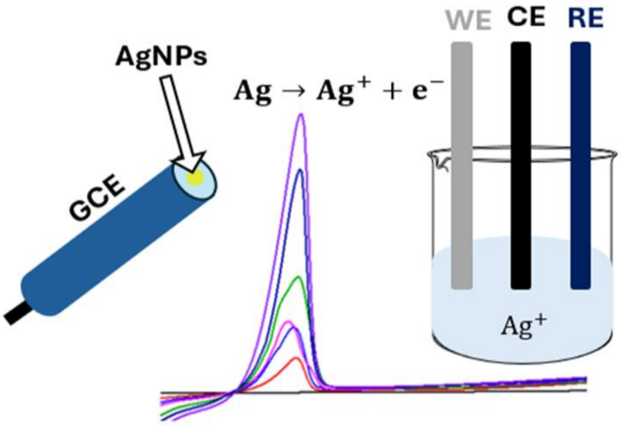


Fig. 1. Schematic illustration of the electrochemical setup for silver ion and silver nanoparticle detection.

Keywords: Silver ion; Silver nanoparticle; Sensor; Electrochemistry

Oral TIChE-AM-28

Surface modification of activated carbon from tamarind shell for tartrazine adsorption

Tinutda Phonlam[1], **Thanakorn Thammasarn**[1], **Pongsert Sriprom**[2,*], **Pornsawan Assawasaengrat**[1]

[1] Department of Chemical Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
[2] School of Food Industry, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
[*] Corresponding author: pongsert.sr@kmitl.ac.th

ABSTRACT

This study proposed the production of activated carbon from tamarind peel for the adsorption of tartrazine food dye. The activated carbon was prepared using a hydrothermal process at 110°C [1] and chemically activated using three different methods: KOH (ATS1), H_2SO_4 (ATS2), and a combination of both (ATS3). The adsorption capacity of the activated carbon was evaluated based on iodine adsorption, where ATS2 exhibited the highest iodine adsorption, indicating a larger surface area [2]. As a result, ATS2 was selected for further investigation in dye adsorption studies. The adsorption process was designed using the Box-Behnken Design and analyzed through Response Surface Methodology (RSM), considering four key factors: activated carbon dosage (g), pH, time (min), and rotation (rpm). The results showed that all factors significantly influenced the tartrazine removal efficiency (R^2 = 93.14). The optimal conditions for tartrazine removal were 2.0 g of activated carbon at pH 2, time of 160 minutes, and rotation of 200 rpm, achieving a removal efficiency of 60.30%. These findings highlight the potential of tamarind peel-derived activated carbon as an effective adsorbent, demonstrating its applicability in reducing water pollution from dye-containing industrial effluents.

Table 1 The iodine adsorption values of activated carbon samples.

Samples	Iodine adsorption value
ATS1	294.48
ATS2	365.56
ATS3	135.39

Keywords: Tartrazine; Activated carbon; Adsorption; Iodine value

References

[1] Huang K, Chai SH, Mayes RT, Tan S, Jones CW, Dai S. Significantly increasing porosity of mesoporous carbon by $NaNH_2$ activation for enhanced CO_2 adsorption. **Microporous and Mesoporous Materials** 2016; 230: 100-108.

[2] Kassem MA, El-Sayed GO. Adsorption of tartrazine on medical activated charcoal tablets under controlled conditions. **Journal of Environmental Analytical Chemistry** 2014; 1: 1000102.

Poster **TIChE-AM-30**

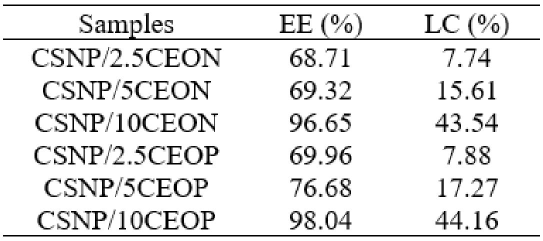
Effect of essential oils in encapsulated chitosan nanoparticles on encapsulation efficiency and antimicrobial activity

Numporn Thungphotrakul[1], **Paweena Prapainainar**[1,2,*]

[1] National Center of Excellence for Petroleum, Petrochemicals and Advance Material, Department of Chemical Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
[2] Center for Advanced Studies in Nanotechnology for Chemical, Food and Agricultural Industries, Kasetsart University, Bangkok 10900, Thailand
[*] Corresponding author: fengpwn@ku.ac.th

ABSTRACT

Chitosan nanoparticles (CSNPs) have gained significant interest as stabilizers or emulsifiers for clove essential oil (CEO) encapsulation due to their biodegradable, biocompatible, and nontoxic properties. CSNPs-based nano-emulsions (CEON) and Pickering emulsions (CEOP) offer new avenues for designing and producing innovative materials suitable for various applications, including food, cosmetics, and medical uses [1, 2]. The stability parameters, including average particle size, zeta potential, polydispersity index, encapsulation efficiency, loading capacity, and antimicrobial activity, were investigated to achieve a nano-emulsion and Pickering emulsion at various concentrations of CEO. The results showed that the CEO-encapsulated CSNP Pickering emulsion had a larger particle size compared to the nano-emulsion method. However, the CEOP exhibited better stability than the CEON. The methods for encapsulating the CEO using nano-emulsion and Pickering emulsion did not affect the percentage of encapsulation efficiency (EE) and loading efficiency (LC), as shown in Fig. 1. An EE of almost 100% with an LC of around 44% was achieved. The CEO encapsulated by Pickering emulsion was selected to test its antimicrobial activity. The results showed that the CEO-encapsulated Pickering emulsion can inhibit both E. Coli and S. Aureus bacteria at concentrations of up to 10% v/v, as seen in Fig. 1. Therefore, Pickering emulsions have promising antibacterial effects for further applications.



Samples	EE (%)	LC (%)
CSNP/2.5CEON	68.71	7.74
CSNP/5CEON	69.32	15.61
CSNP/10CEON	96.65	43.54
CSNP/2.5CEOP	69.96	7.88
CSNP/5CEOP	76.68	17.27
CSNP/10CEOP	98.04	44.16

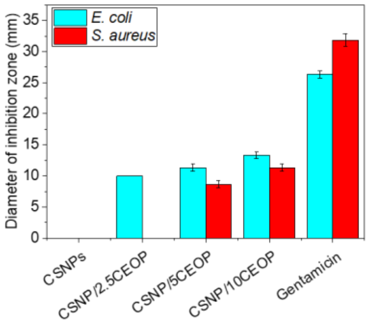


Fig. 1. Encapsulation efficiency (EE) and loading capacity (LC) of CSNP/CEON and CSNP/CEOP (left) and inhibition zones of E. *coli* and S. *aureus* of CEO encapsulated chitosan nanoparticles via Pickering emulsion (right).

Keywords: Antimicrobial activity; Chitosan nanoparticles; Clove essential oil; Nano-emulsion; Pickering emulsion

References

[1] Sharkawy A, Barreiro MF, Rodrigues AE. Chitosan-based Pickering emulsions and their applications: A review. **Carbohydr Polymers** 2020; 250: 116885.
[2] Ahmed R, Wang M, Qi Z, Hira NUA, Jiang J, Zhang H, et al. Pickering emulsions based on the pH-responsive assembly of food-grade chitosan. **ACS Omega** 2021; 6(28): 17915-22.

Poster **TIChE-AM-31**

Development of electrode production for supercapacitors from activated carbon derived from pomelo peels by steam activation

Patthanan Unjiranan[1], **Pimpen Pusanasuwanasri**[1], **Wongsatorn Wareeprasert**[1],
Wanida Koo-amornpattana[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakon Pathom 73170, Thailand
[*] Corresponding author: wanida.koo@mahidol.ac.th

ABSTRACT

This work aims to effectively utilize biomass by pyrolysis and activating pomelo peel into activated carbon to produce supercapacitor electrodes [1, 2]. The activation process is achieved by superheated steam and KOH [3]. It can be found that the suitable conditions for both activation processes of pomelo peel were at 600 degrees Celsius and 120 minutes. Fig. 1(a) and (b) both display a rectangular shape, which is characteristic of an electrical double-layer capacitor (EDCL). A specific surface area of 588.1 m^2/g and 956.8 m^2/g were measured for activated carbon by superheated steam and activated carbon by KOH. CV, GCD, and EIS analyzed the electrochemical properties of electrode materials. The specific capacitance of the electrode from activated carbon by steam activation and KOH was 26.7640 F/g and 25.5869 F/g, respectively. The results also showed that the electrode of activated carbon by superheated steam could be charged and discharged quickly and had less resistance than the electrode of activated carbon by KOH. This electrode also demonstrated good stability after 1000 cycles. Still, the electrode of activated carbon by KOH deteriorated after around 500 cycles, indicating that the electrode of activated carbon by superheated steam has a higher quality than that of activated carbon by KOH.

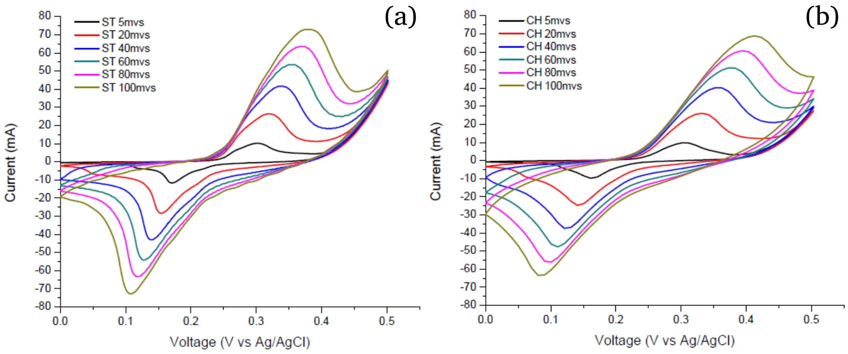


Fig. 1. Results of electrode analysis from activated carbon by (a) steam and (b) KOH activation by CV at various scanning rates.

Keywords: Pyrolysis; Pomelo peels; Activated carbon; Steam activation; Supercapacitor

References

[1] Wang Z, Tan Y, Yang Y, Zhao X, Liu Y, Niu L, et al. Pomelo peels-derived porous activated carbon microsheets dual-doped with nitrogen and phosphorus for high performance electrochemical capacitors. **Journal of Power Sources** 2018; 378: 499-510.
[2] Liang Q, Ye L, Huang ZH, Xu Q, Bai Y, Kang F, et al. A honeycomb-like porous carbon derived from pomelo peel for use in high-performance supercapacitors. **Nanoscale** 2014; 6: 13831-13837.
[3] Li ZY, Akhtar MS, Kwak DH, Yang OB. Improvement in the surface properties of activated carbon via steam pretreatment for high performance supercapacitors. **Applied Surface Science** 2017; 404: 88-93.

Poster **TIChE-AM-32**

Non-toxic quantum dots sensitized solar cells based on TiO_2/$AgInS_2$

Atcharaporn Botalo[1], **Naphaphan Kunthakudee**[1], **Sakhon Ratchahat**[1],
Surachoke Thanapitak[2], **Chularat Sakdaronnarong**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[2] Department of Electrical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[*] Corresponding author: chularat.sak@mahidol.ac.th

ABSTRACT

This study investigates the synthesis of titanium dioxide (TiO_2) nanorods combined with quantum dots (QDs) to enhance sunlight-to-electricity conversion efficiency. $AgInS_2$ quantum dots were synthesized using the successive ion layer adsorption and reaction (SILAR) technique on TiO_2 nanorod films, which were fabricated via a simple hydrothermal method. The study examines the effects of different TiO_2 precursors-Titanium (IV) n-butoxide (TBT) and Titanium tetrachloride ($TiCl_4$)-on nanorod morphology and structure. The nanorods were synthesized under varying time and temperature conditions and subjected to calcination at 450°C for 30 minutes and 550°C for 2 hours. The resulting electrode materials were characterized using Field Emission Scanning Electron Microscopy (FESEM) to analyze surface morphology, X-ray diffraction (XRD) to determine crystal structure, and a solar simulator to evaluate solar cell efficiency. The results revealed that TiO_2 nanorods synthesized from $TiCl_4$ exhibited a tetragonal shape, whereas those from TBT formed a flower-like structure. Both precursors yielded TiO_2 with a rutile-phase crystal structure, but with variations in crystal size, peak intensity, and sharpness, likely influenced by calcination conditions. The synthesized nanorod samples, shown in Fig. 1, will be further explored for electricity generation applications.

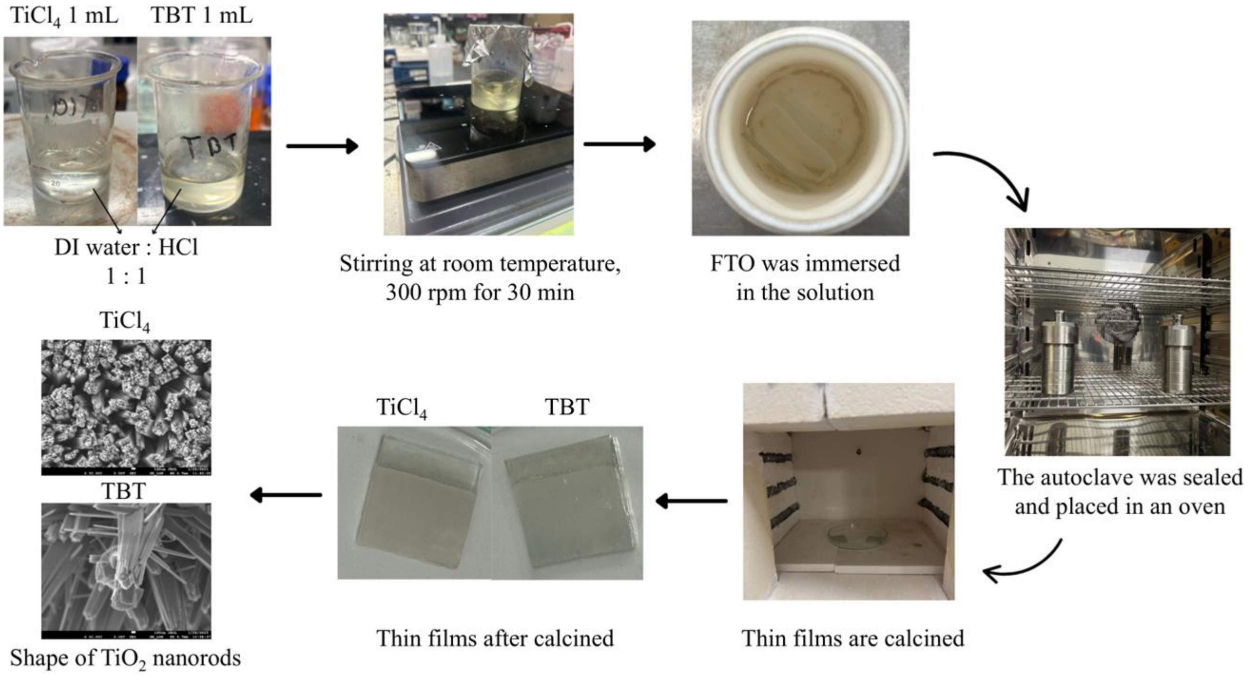


Fig. 1. Synthesis of TiO_2 nanorods.

Keywords: Titanium dioxide (TiO_2); Nanorods; Successive ion layer adsorption and reaction (SILAR); Quantum dots (QDs); $AgInS_2$; Light-to-electricity conversion

Poster **TIChE-AM-33**

Structural transformation of bismuth titanate synthesized via the solvothermal method for wastewater application: Effect of temperature synthesis

Thanawat Phalawong[1], Arriya Jarusan[1], Nattapon Banditsean[1], Papol Pimsri[1], Kitirote Wantala[1], Methus Suwannaruang[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Khon Kaen 40002, Thailand
[*] Corresponding author: totssu@kku.ac.th

ABSTRACT

Bismuth titanate (BTO) photocatalyst was produced using the solvothermal method at different synthesis temperatures and applied to degrade the antibiotic pollutant ciprofloxacin (CIP). The objective was to investigate the effect of synthesis temperature on phase and crystal structure transformations for the degradation of CIP under UV light (400 W). The catalyst was synthesized via the solvothermal method at temperatures ranging from 80 to 200°C. The BTO catalysts were characterized to examine the effect of synthesis temperature on phase structure transition, oxidation state, and band gap energy. The results showed that temperature significantly influenced the phase structure of the catalysts. XRD analysis confirmed that at 80°C, the photocatalyst exhibited a pure $Bi_2Ti_2O_7$ phase. At temperatures above 80°C, a $Bi_2Ti_2O_7/Bi_4Ti_3O_{12}$ phase emerged, while at 170°C, a $Bi_2Ti_2O_7/Bi_4Ti_3O_{12}/Bi_2O_3$ phase was shown, as shown in Fig. 1 [1]. XPS analysis confirmed the oxidation states of Bi and Ti were confirmed as Bi^{3+} and Ti^{4+} [2]. Photocatalytic performance tests revealed that the catalyst synthesized at 80°C, which had a pure $Bi_2Ti_2O_7$ structure, exhibited the highest degradation efficiency, achieving 91% CIP degradation within 90 min. These findings demonstrated that synthesis temperature directly influenced phase structure, with pure $Bi_2Ti_2O_7$ showing the best performance in ciprofloxacin degradation. This study provides valuable insights into the impact of temperature on phase transformations and properties of $Bi_2Ti_2O_7$, offering crucial information for the development of highly efficient photocatalysts for wastewater treatment and pollutant removal in the future.

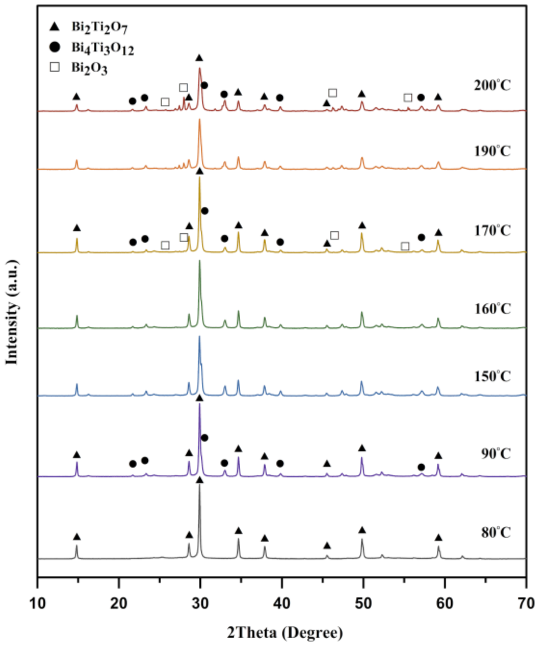


Fig. 1. XRD diffractograms of BTO catalysts with various temperature synthesis.

Keywords: Bismuth titanate; Solvothermal; Phase structure; Photodegradation; Ciprofloxacin

References

[1] Li YF, Zhong Y, Chang JQ, Hu CH. Synthesis and effects on visible light photocatalytic activity of $Bi_2Ti_2O_7$ photocatalyst. **IOP Conference Series: Materials Science and Engineering** 2018; 307: 012041.

[2] Cheng T, Gao H, Wang S, Yi Z, Liu G, Pu Z, et al. Surface doping of $Bi_4Ti_3O_{12}$ with S: Enhanced photocatalytic activity, mechanism and potential photodegradation application. **Materials Research Bulletin** 2022; 149: 111711.

Oral **TIChE-AM-34**

Development of self-adhesive biopolymer hydrogel for strain sensors crosslinked with tannic acid

Noppanan Putdon[1], **Somnuk Theerakulpistut**[2], **Rawit Jittham**[1], **Pornnapa Kasemsiri**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Khon Kaen 4002, Thailand
[2] Energy Management and Conservation Office, Faculty of Engineering, Khon Kaen University, Khon Kaen 40002, Thailand
[*] Corresponding author: pornkas@kku.ac.th

ABSTRACT

Multifunctional hydrogels with exceptional properties, including high mechanical strength, good electrical conductivity, self-adhesion, and antibacterial activity, have garnered significant attention due to their broad applications in biomedical fields, flexible electronics, and other areas [1]. Conductive hydrogels have been widely developed and used as strain sensors to detect external stimuli and convert them into measurable electrical signals, supporting applications in human motion monitoring and personal health diagnostics [2]. Biopolymers are promising eco-friendly materials for fabricating conductive hydrogels due to their low toxicity, abundance, and biodegradability [3]. In this study, a multifunctional strain sensor with antibacterial properties and self-adhesion capability was developed using guar gum (GG), polyvinyl alcohol (PVA), and tannic acid (TA). The effect of TA addition on the strain sensor's performance was investigated. Antibacterial effectiveness against *Escherichia coli* (*E. coli*) and *Staphylococcus aureus* (*S. aureus*) improved with increasing TA content. The adhesive strength ranged from 1.20 ± 0.10 to 5.05 ± 0.23 kPa and tended to increase as TA content increased. Electrical conductivity also increased with TA incorporation up to 1.5%, after which it declined. Consequently, the hydrogel strain sensor with 1.5% TA was selected to evaluate its sensing capability for limb movement. The sample exhibited reproducible and stable signals during repeated movements, highlighting the potential of multifunctional strain sensors for wearable electronic applications.

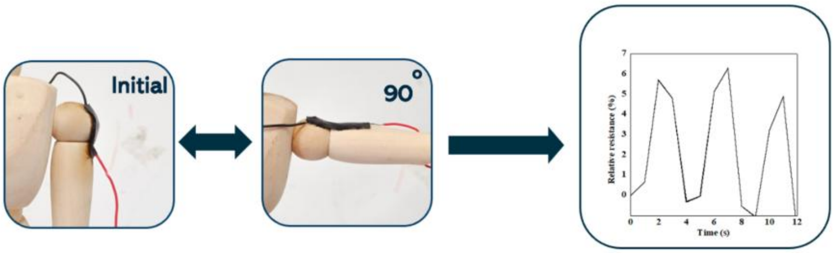


Fig. 1. Hydrogel strain sensor in monitoring limp movement.

Keywords: Strain sensor; Tannic acid; Cross linker

References

[1] Zhang Y, Lu G, Yan C, Luo J, Zhou X, Wang J. Fabrication of flexible accelerated-wound-healing chitosan/dopamine-based bilayer hydrogels for strain sensors. **International Journal of Biological Macromolecules** 2023; 253: 127395.

[2] Li G, Li C, Li G, Yu D, Song Z, Wang H, et al. Development of conductive hydrogels for fabricating flexible strain sensors. **Nano Micro small** 2021; 18(5): 2101518.

[3] Cui C, Fu Q, Meng L, Hao S, Dai R, Yang J. Recent progress in natural biopolymers conductive hydrogels for flexible wearable sensors and energy devices: Materials, structures, and performance. **Applied Bio Material** 2021; 4: 85-121.

Oral **TIChE-AM-36**

Biocompatibility of hydrogel film blended jellyfish gelatin

Nongnapas Luecha[1], **Sukanya Tastub**[2], **Pollawat Charoeythornkhajhornchai**[3], **Santi Phosri**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Burapha University, Chonburi 20131, Thailand
[2] Synchrotron Light Research Institute, Nakhon Ratchasima 30000, Thailand
[3] Department of Advanced Materials Engineering, Faculty of Engineering, Burapha University, Chonburi 20131, Thailand
[*] Corresponding author: santi.ph@eng.buu.ac.th

ABSTRACT

Wounds resulting from trauma, burns, and chronic diseases affect millions of people to experience pain, discomfort, and often disability or death, resulting in significant health, social, and financial consequences worldwide [1]. Bio-functional materials are naturally derived substances with outstanding physical, chemical, and biological characteristics, making them a promising option for the creation of various medical devices especially wound dressing [2]. Carboxymethyl cellulose (CMC) is a widely available, affordable, non-toxic, water-soluble, and biodegradable material [3]. Similarly, gelatin is a natural biopolymer obtained through the hydrolysis of collagen, widely used in the food, pharmaceutical, cosmetic and medical industries [4]. This study aimed to investigate the properties hydrogel films containing jellyfish gelatin by Fourier-transform infrared spectroscopy (FTIR), Differential Scanning Calorimeter (DSC) and contact angle. Additionally, its biocompatibility activity was evaluated on human keratinocyte (HaCaT), African green monkey kidney cell (Vero) and mouse fibroblast (3T3-L1) by MTT assay. FTIR analysis identified amide I and amide II bands, indicating the gelatin functional group. The presence of C–O–C bonds and C–O stretching confirmed the inclusion of carboxymethyl cellulose. Thermal characterization using the DSC technique demonstrated that the scaffolds possess good thermal stability properties. The wettability properties of hydrogel films by observing the water droplets with the surface of a film (hydrophilic) with contact angles below 60°, indicating high hydrophilic properties. Moreover, the biocompatibility of the composite films was determined by cultivation with HaCaT, Vero and 3T3-L1. The films were not toxic to the cells, demonstrating that the hydrogel films can compatible to mammalian cell lines. This finding suggests that the hydrogel film integrating jellyfish gelatin have potential for development as wound dressing materials (Fig 1).

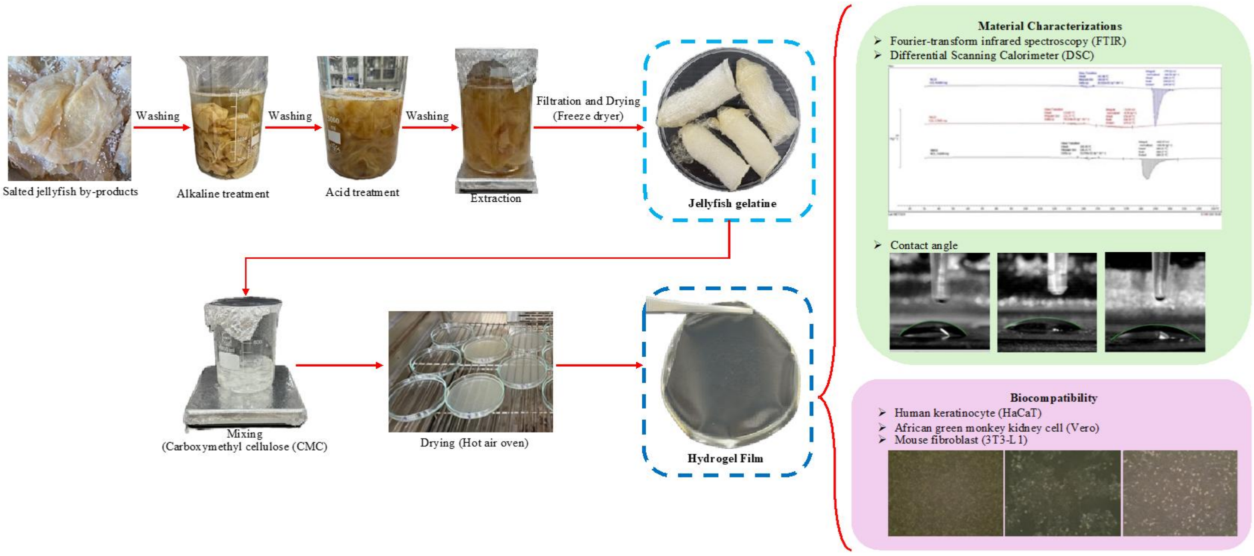


Fig. 1. Graphical abstract of biocompatibility of hydrogel film blended jellyfish gelatin.

Keywords: Natural rubber composites; Sugarcane bagasse; Sustainable materials; Antioxidants

References

[1] Mansur AAP, Rodrigues MA, Capanema NSV, Carvalho SM, Gomes DA, Mansur HS. Functionalized bioadhesion-enhanced carboxymethyl cellulose/polyvinyl alcohol hybrid hydrogels for chronic wound dressing applications. **RSC Advances** 2023; 13(19): 13156-13168.

[2] Osorio Echavarría J, Gómez Vanegas NA, Orozco CPO. Chitosan/carboxymethyl cellulose wound dressings supplemented with biologically synthesized silver nanoparticles from the ligninolytic fungus Anamorphous *Bjerkandera* sp. R1. **Heliyon** 2022; 8(9): e10258.

[3] Giovanni F. de Lima, Alana G. de Souza, Derval dos S. Rosa. Nanocellulose as reinforcement in carboxymethylcellulose superabsorbent nanocomposite hydrogels. **Macromolecul Symphosia** 2020; 394: 2000126.

[4] Charoenchokpanich W, Muangrod P, Roytrakul S, Rungsardthong V, Vatanyoopaisarn S, Wonganu B, et al. Influence of extraction times on physical and functional properties of gelatin from salted jellyfish by-products. **E3S Web of Conferences** 2022; 355: 02014.

Poster **TIChE-AM-37**

Influence of reaction parameters on the exsolution of Ni-Ru bimetallic alloy in GEO-inspired perovskite oxide

Somchate Wasantwisut[1], **Kandis Leslie Gilliard-AbdulAziz**[2,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[2] Department of Civil and Environmental Engineering, Viterbi School of Engineering, University of Southern California, CA 90007, USA
[*] Corresponding author: kabdulaz@usc.edu

ABSTRACT

Results from our previous studies [1, 2] have corroborated our central hypothesis that various parameters (temperature, dwell time, H_2 reducing agent) and rich defect chemistry (cation and oxygen vacancies) of GEO-inspired perovskite oxides (GEOs) can be used to tune the size, shape, and composition of exsolved Ni nanoparticles from Ni-doped $LaFeO_3$ perovskite oxide [3]. In this study, Ru-doped $LaNiO_3$ GEOs were synthesized using the citrate-nitrate sol-gel combustion methods (analogous to the Pechini's method) [4]. The concentration of Ru dopant in $LaNiO_3$ of 5% (mole) was chosen. The samples were calcined between 700-900 °C. The GEO precursors were reduced in 5% H_2/He mix at varying dwell time from 30 minutes to 2 hours. Reduction temperature was varied from 600-800 °C. The GEOs were characterized using XRD, TPR, STEM/EDS, and XAS to determine the crystallinity, reducibility, morphology, and exsolution behavior of the materials. We hypothesize that alloying mechanism of Ni-Ru bimetallic nanoparticles may occur simultaneously (co-exsolution) based on the reduction potential of both metals. However, the results from XANES indicated a sequential exsolution where Ru exsolved first followed by Ni with the two stages reduction of Ru^{3+} to Ru^{2+}, Ni^{3+} to Ni^{2+}, Ru^{2+} to Ru^0 and Ni^{2+} to Ni^0 occurring at 175, 280, 430, and 520 °C. respectively. Calcination temperature influences the number and size of Ni-rich Ni-Ru particles formed on the surface of the GEOs, which lower temperature favoring more exsolution.

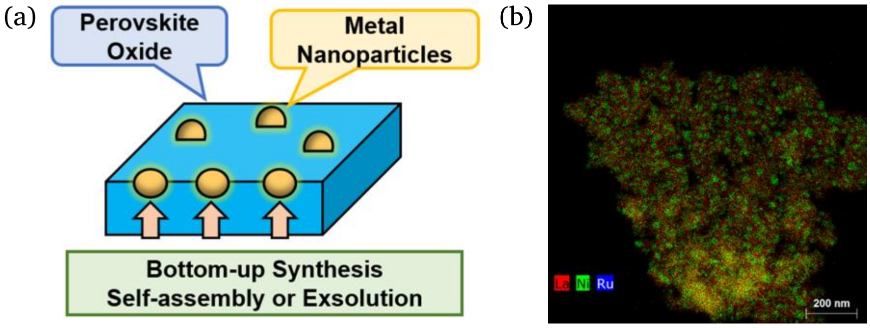


Fig. 1. Illustration showing metallic nanoparticles 'Bottom-up' synthesis from geo-inspired perovskite oxide precursors (GEOs) (a), and STEM/EDS images (b) of $LaNi_{0.95}Ru_{0.05}O_3$ calcined in air at 700 °C for 4 hours and subsequently reduced under 5% H_2/He mixture at 700 °C for 2 hours.

Keywords: Catalysis; Bimetallic metals; Perovskite oxides; Exsolution; Nanomaterials

References

[1] Shah S, Sayono S, Ynzunza J, Pan R, Xu M, Pan X, et al. The effects of stoichiometry on the properties of exsolved Ni-Fe alloy nanoparticles for dry methane reforming. **AIChE Journal** 2020: 66(12): e17078.

[2] Shah S, Xu M, Pan X, Gilliard-Abdulaziz KL. Exsolution of embedded Ni-Fe-Co nanoparticles: Implications for dry reforming of methane. **ACS Applied Nano Materials Journal** 2021; 4: 8626-8636.

[3] Shah S, Hong J, Cruz L, Wasantwisut S, Bare SR, Gilliard-AbdulAziz KL. Dynamic tracking of NiFe smart catalysts using in situ X-ray absorption spectroscopy for the dry methane reforming reaction. **ACS Catalysis** 2023; 13(6): 3990-4002.

[4] Labhasetwar N, Saravanan G, Megarajan SK, Manwar N, Khobragade R, Doggali P, Grasset F. Perovskite-type catalytic materials for environmental applications. **Science and Technology of Advanced Materials** 2015; 16(3): 036002.

Oral **TIChE-AM-38**

Utilization of lignin from agricultural waste for enhancing performance of natural rubber composite

Kanisorn Leelasopin[1,*], Phatcharin Porat[1], Asawin Pratumbud[1], Piyabutr Wanichpongpan[1], Yeampon Nakaramontri[2]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand

[2] Department of Chemistry, Faculty of Science, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand

[*] Corresponding author: kainsorn1235@gmail.com

ABSTRACT

The increasing demand for sustainable materials has driven research into utilizing lignin, a natural polymer derived from agricultural waste, as a reinforcing filler in natural rubber composites. This study focuses on the extraction of lignin from sugarcane bagasse using an alkaline method with varying NaOH concentrations (10%, 20%, 30%, and 40% w/v) to optimize yield and purity. The extracted lignin was characterized using Fourier Transform Infrared Spectroscopy (FTIR), confirming key functional groups—O–H, C = O, and C–H—similar to commercial lignin [1]. Thermogravimetric Analysis (TGA) revealed three main degradation stages: moisture evaporation, structural decomposition, and residual breakdown. Among all samples, lignin extracted with 20% NaOH showed the highest thermal stability, as shown in Fig. 1. The lignin with the best thermal performance was used to prepare lignin-filled natural rubber composites. Their physical properties were tested according to ISO standards for tensile strength (ISO 37), aging resistance (ISO 188), and hardness (ISO 7619) [2]. These results were compared with rubber composites containing conventional antioxidant 6PPD. Findings indicate that lignin extracted from sugarcane bagasse can serve as a sustainable alternative to synthetic antioxidants, offering comparable mechanical performance and durability. This highlights the potential of lignin as an eco-friendly reinforcing filler for high-performance rubber composites [3].

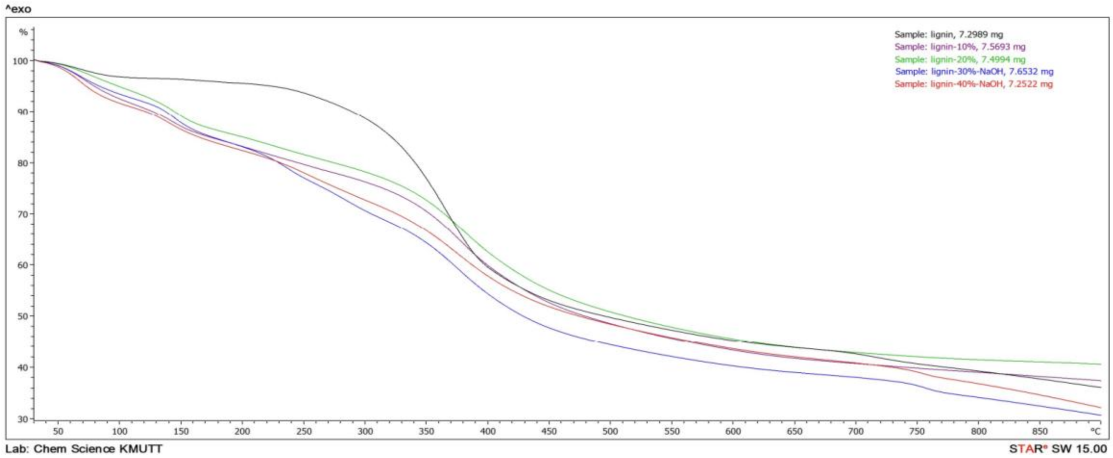


Fig. 1. Thermogravimetric analysis (TGA) curves of lignin extracted with different NaOH concentrations (10%, 20%, 30%, and 40% w/v) compared to commercial lignin.

Keywords: Natural rubber composites; Sugarcane bagasse; Sustainable materials; Antioxidants

References

[1] Demir E, Gerengi H, Savci K, Altundal G, Yüksel C, Çağıl D. Exploration of green alternatives to 6PPD (P-Phenylenediamine) used as antiozonant and antioxidant in the rubber industry. **Materials Sciences and Applications** 2025; 15(2): 87–100.

[2] Zhang X, et al. Structural characterization of lignin extracted from sugarcane bagasse. **Journal of Applied Polymer Science** 2020; 137(15): 48567.

[3] Intapun J, Rungruang T, Suchat S, Cherdchim B, Hiziroglu S. The characteristics of natural rubber composites with Klason lignin as a green reinforcing filler: Thermal stability, mechanical and dynamical properties. **Polymers** 2021; 13: 1109.

Oral **TIChE-BE-01**

Comparative study of methylene blue adsorption using calcium oxide derived from chicken eggshells and calcium oxide standard

Pinchaphat Poka[1], **Woravarun Unkaew**[1], **Weerawat Clowutimon**[1,*], **Pornsawan Assawasangrat**[2]

[1] Samsenwittayalai School, Bangkok 10400, Thailand
[2] Department of Chemical Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
[*] Corresponding author: t.weerawat@samsenwit.ac.th

ABSTRACT

In this study, a comparative analysis of methylene blue adsorption on chicken eggshell-derived calcium oxide (CaO-CE) and standard calcium oxide (CaO standard) was conducted. Calcium oxide was synthesized from chicken eggshells via calcination at 900°C for 3 h and characterized using XRF, XRD, FT-IR, FT-Raman, and BET techniques. The batch adsorption experiment investigated key parameters, including contact time and initial methylene blue concentration. Characterization results indicate that CaO-CE exhibits similar properties to CaO standard based on XRF, XRD, FT-IR, and FT-Raman analyses. However, BET analysis revealed that CaO-CE has a slightly wider average pore diameter, with marginally lower total pore volume and surface area, which may influence its adsorption capacity. Adsorption of methylene blue reached equilibrium within 120 min for both adsorbents. The adsorption isotherms (Fig. 1) were modeled using the Langmuir and Freundlich equations, and the model parameters, including R2 values, are summarized in Table 1. As indicated by the higher R2 values, the Langmuir model provides a better fit, particularly at high equilibrium concentrations, suggesting a homogeneous single-layer adsorption mechanism [1]. In terms of maximum adsorption capacity, CaO-CE exhibits a slightly lower value than CaO standard, approximately 84%. However, CaO-CE presents a significant sustainability advantage, as it is derived from chicken eggshells, a food waste material. Moreover, its preparation does not require the use of chemicals, making it an environmentally friendly and cost-effective alternative.

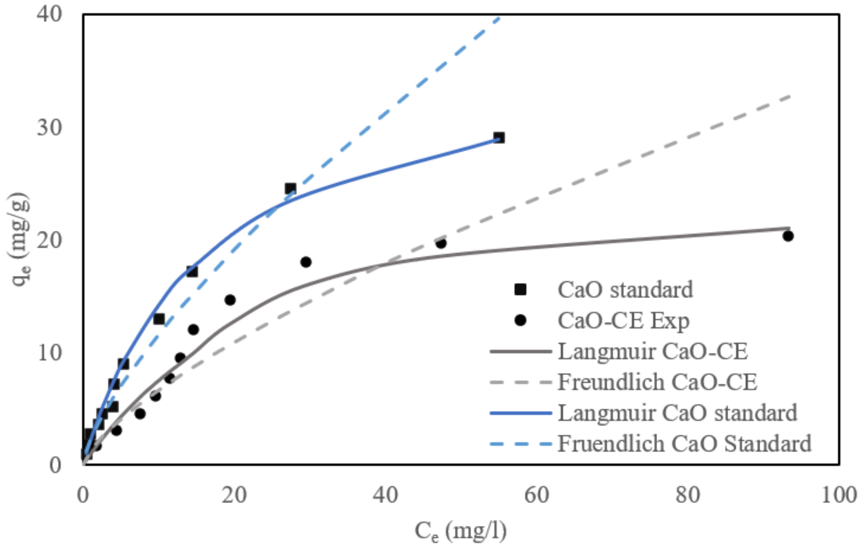


Fig. 1. Adsorption isotherms of methylene blue on CaO-CE and CaO standard.

Table 1 Langmuir and Freundlich isotherm parameters.

Adsorbent	Langmuir isotherm			Freundlich isotherm		
	q_{max} mg/g)	K_L (L/mg)	R^2	K_F (mg/g)	n	R^2
CaO-CE	27.03	0.0323	0.9835	1.28	1.40	0.9105
CaO standard	32.25	0.0680	0.9852	2.17	1.38	0.9729

Keywords: Adsorption; Methylene blue; Calcium oxide; Chicken eggshell; Wastewater

References

[1] Somsri S, Suwankaisorn B, Yomthong K, Srisuwanno W, Klinyod S, Kuhn A, Wattanakit C. Highly enantioselective synthesis of pharmaceuticals at chiral-encoded metal surfaces. **Chemistry–A European Journal** 2023; 29(61): e202302054.

[2] Salinas G, Kuhn A, Arnaboldi S. Self-sustained rotation of Lorentz force-driven Janus systems. **The Journal of Physical Chemistry C** 2023; 127(30): 14704-14710.

Oral **TIChE-BE-02**

Removal of Pb(II) and Hg(II) from water on activated carbon: An insight into multicomponent adsorption

Thanyakorn Sangoondee[1], **Nikom Klomkliang**[1,*]

[1] School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology,
Nakhon Ratchasima 30000, Thailand
[*] Corresponding author: nikom.klo@sut.ac.th

ABSTRACT

This study investigates the simultaneous removal of lead (Pb(II)) and mercury (Hg(II)) from aqueous solutions using activated carbon (AC) and nitrogen/oxygen-doped activated carbon (NOAC) derived from coconut shells. The equilibrium adsorption data were obtained with an adsorbent weight of 0.1 g and 40 ml of multi-metal solution and varying initial concentrations of 30 to 500 mg/L at room temperature. The adsorbents were characterized by using various techniques, including CHN, SEM, and BET analysis. Batch adsorption experiments were conducted to examine the effects of initial concentration and contact time. The adsorption kinetics were found to follow a pseudo-second-order model, indicating chemisorption as the dominant mechanism. The Langmuir isotherm model provided the best fit for both adsorbents, suggesting monolayer adsorption and maximum adsorption capacities on AC of 307.02 $mg{\cdot}g^{-1}$ for Hg(II) and 104.80 $mg{\cdot}g^{-1}$ for Pb(II), A NOAC was found of 266.72 $mg{\cdot}g^{-1}$ for Hg(II) and 111.21 $mg{\cdot}g^{-1}$ for Pb(II). AC showed superior adsorption capacity for Hg(II), while NOAC showed better efficacy for Pb(II). The study provides insights into the adsorption mechanisms and the potential of modified activated carbons for heavy metal removal from water.

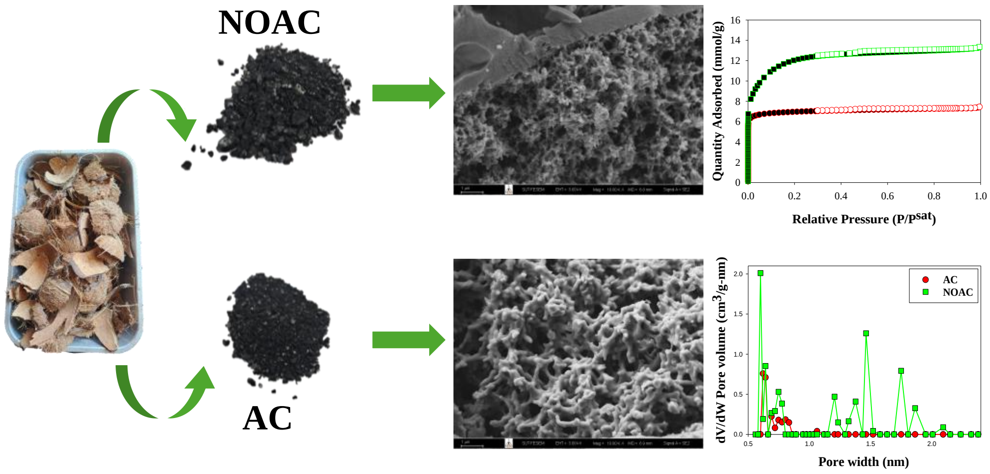


Fig. 1. Production and adsorption properties of activated carbon derived from coconut shell.

Keywords: Heavy metal; Activated carbon; Batch adsorption

Oral **TIChE-BE-03**

Development of composite scaffolds derived from palm kernel shell ash with curcumin encapsulation for tissue engineering applications

Manutchai Eiamniyom[1], **Pornchai Bumroongsri**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[*] Corresponding author: pornchai.bum@mahidol.ac.th

ABSTRACT

In Thailand, palm kernel shell ash is the agricultural waste available in large quantities. This research presents a method to produce composite scaffolds from palm kernel shell ash for tissue engineering applications. In the first step, calcium oxide was obtained from palm kernel shell ash. Calcium oxide was then used to synthesize hydroxyapatite via a chemical synthesis method. In the second step, polylactic acid and hydroxyapatite were mixed and extruded into filaments. The composite scaffold as shown in Fig. 1 was produced from filaments using 3D printing technique. The composite scaffold with the composition of polylactic acid 60%wt and hydroxyapatite 40%wt exhibited the best mechanical properties as shown in Table 1. In the last step, curcumin was encapsulated and coated onto the surface of composite scaffold [1]. The release of curcumin could be prolonged to 5 days as shown in Fig. 2. This research paves the way for producing composite scaffolds from palm kernel shell ash for tissue engineering applications.

Fig. 1. Composite scaffold.

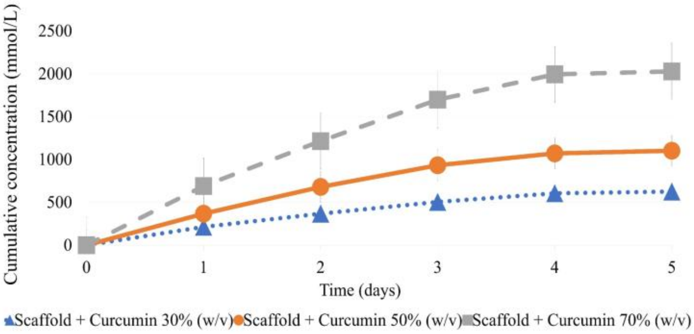


Fig. 2. Release of curcumin from composite scaffold.

Table 1 Mechanical properties of composite scaffold.

Polylactic acid (%wt) : Hydroxyapatite (%wt)	Compressive strength (MPa)	Elastic modulus (MPa)
50 : 50	51	4,397
60 : 40	58	4,416
70 : 30	46	4,321

Keywords: Composite scaffold; Palm kernel shell ash; Curcumin release; Tissue engineering

References

[1] Jiang T, Liao W, Charcosset C. Recent advances in encapsulation of curcumin in nanoemulsions: A review of encapsulation technologies, bioaccessibility and applications. **Food Research International** 2020; 132: 109035.

Oral TIChE-BE-04

Simultaneous saccharification and fermentation (SSF) of corncobs for bioethanol production using *saccharomyces cerevisiae* SC90

Peerawat Suyatar[1], Maythee Saisriyoot[2], Nutchapon Chiarasumran[2], Penjit Srinophakun[2], Anusith Thanapimetha[2,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
[2] Bioprocess Engineering Laboratory, Department of Chemical Engineering, Faculty of Engineering,
Kasetsart University, Bangkok 10900, Thailand
[*] Corresponding author: fengjrc@gmail.com

ABSTRACT

The global challenge of air pollution, exacerbated by the emission of fine particulate matter (PM2.5), remains the most pressing environmental and public health concerns of the modern era. [1] Among the various sources of such pollution, the field burning of agricultural residues, particularly corncob, represents a significant contribution. This practice not only degrades air quality but also possess serious health risks, especially in rural area communities. Converting corncob into a source of energy presents a sustainable and environmentally responsible alternative. As a cost-effective and widely available lignocellulosic material, corncob can be converted into bioethanol through a series of biochemical processes. [2] Initially, corncob was treated with 2% (w/v) H2SO4, after that it was treated with 2% (w/v) NaOH. This pretreatment step significantly increased its cellulose content from 32.28% to 90.21% as illustrated in Table 1. The novel method to discover the optimal temperature for simultaneous saccharification and fermentation (SSF) of pretreated corncob is proposed. Fermentation at this optimal temperature (35.5˚C) resulted in the highest ethanol concentration of 31.946 g/L. These findings highlight the potential of proposed pretreatment and SSF techniques for different kinds of agricultural residues.

Table 1 The composition of corncob before and after pretreatment.

Chemical Composition	Percentages of dry weight (%)		
	Before pretreatment	After pretreatment with H_2SO_4 2% (w/v)	After pretreatment with NaOH 2% (w/v)
Cellulose	32.28 ± 0.45	64.92 ± 0.74	90.21 ± 1.82
Hemicellulose	47.94 ± 0.78	3.21 ± 0.93	1.33 ± 0.49
Lignin	5.26 ± 0.66	16.32 ± 0.03	2.34 ± 0.93
Other	14.51 ± 0.79	15.55 ± 0.57	6.12 ± 0.18

Keywords: Corncob; Simultaneous saccharification and fermentation; SSF; Bioethanol; Saccharomyces cerevisiae

References

[1] Cohen AJ, Brauer M, Burnett R. Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution. An analysis of data from the Global Burden of Disease Study 2015. **The Lancet** 2017; 389(10082): 1907-1918.

[2] Zhao B, Zhang Q. Agricultural biomass burning and its impact on air quality in China. A review. **Environmental Pollution** 2013; 179; 3-9.

Oral TIChE-BE-05

Optimization of bovine serum albumin concentration and diafiltration via tangential flow filtration

Worrawich Boonpan[1], **Natthapoom Thadalimawat**[1], **Pattarathorn Choosakvrrakul**[1], **Asawin Meechai**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[*] Corresponding author: asawin.mee@kmutt.ac.th

ABSTRACT

This study aims to optimize process parameters for the concentration and diafiltration of a 100-L bovine serum albumin (BSA) solution, within 3-hour timeframe. The initial solution contained 1 g/L BSA in phosphate buffered saline (PBS) with 250 mM NaCl, and the final target was 5 g/L BSA in PBS with 137 mM NaCl. Given BSA's molecular weight of 66.5 kDa, Merk Millipore's cassettes with Ultracel® 10 kDa membrane were used. Process optimization was first conducted at a small scale using the Pellicon® XL cassettes (50 cm^2 filtration area), and later validated at a larger scale using the Pellicon® 3 cassettes (88 cm^2) to confirm process scalability. Transmembrane pressure (TMP) excursions were performed on 1 g/L and 5 g/L BSA solutions at three different feed flow rates (3, 5, and 7 LPM/m^2) to determine the optimal TMP and flow rate for protein concentration. The TMP/flux curves (Fig. 1) indicated an optimal TMP of 28 psi and a feed rate of 7 LPM/m^2. Further evaluation revealed that the optimal BSA concentration for diafiltration was 5 g/L. Using these optimal conditions, permeate fluxes obtained from small-scale experiments were used to determine the required volume and filter area for validation and scale-up. At the validated scale with Pellicon® 3, 1.2 L of BSA solution was successfully concentrated and buffer-exchanged within 2 hours and 58 minutes, achieving 81% BSA recovery. Thus, to process 100 L of BSA solution within 3 hours, a minimum area of Ultracel® 10 kDa filter of 0.63 m^2 is recommended.

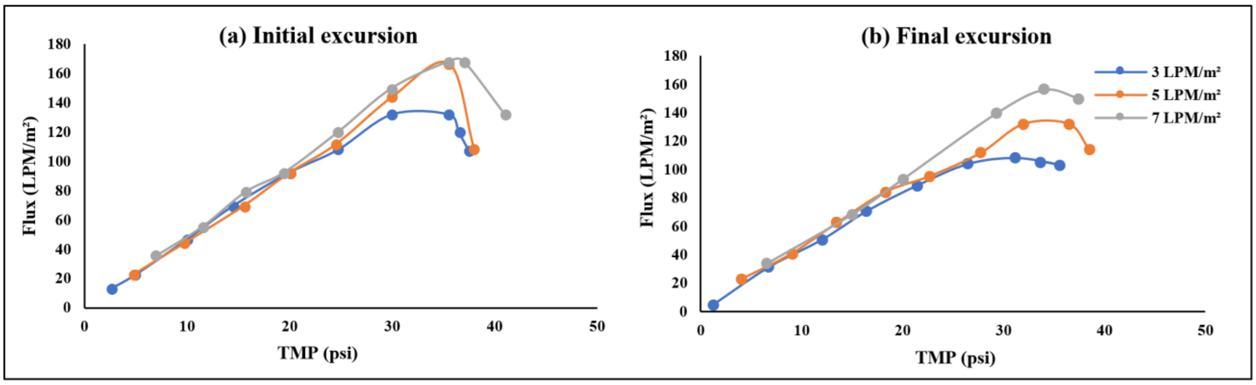


Fig. 1. Flux plotted against TMP using (a) 1 g/L (b) 5 g/L Bovine serum albumin solution.

Keywords: Tangential flow filtration; Bovine serum albumin; Optimization; Pellicon cassettes

Oral TIChE-BE-06

Thermo-responsive PVDF-*grafted*-PVNCL membranes with switchable wettability for efficient oil-water separation

Supakorn Janmunee[1,*], **Waritha Janthaporn**[1], **Saiwan Nawalertpanya**[1]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[*] Corresponding author: supakorn.janm@kmutt.ac.th

ABSTRACT

Industrial activities in the oil and gas, petrochemical, pharmaceutical, and food and beverage sectors are significant contributors to oily wastewater generation. This environmental concern poses serious threats to drinking water quality, groundwater reservoirs, aquatic ecosystems, and human health [1]. To address these challenges, membrane technology has emerged as an efficient and environmentally friendly solution for oil-water separation, offering high efficiency and exceptional capacity. This study focuses on developing thermo-responsive membranes through alkali pretreatment and UV-induced surface modification of commercial polyvinylidene fluoride (PVDF) membranes. Alkali pretreatment using a sodium hydroxide (NaOH) solution introduces hydroxyl groups onto the PVDF membrane surface. Subsequently, surface modification with 3-methacryloxypropyltrimethoxysilane (MPTS) enhances adhesion for the polymerization step. Poly(N-vinyl caprolactam) (PNVCL) is then successfully grafted onto the PVDF surface via a UV-induced surface modification method, using α-ketoglutaric acid (KGA) as a photo-initiator. The modified membranes were thoroughly characterized by FT-IR, SEM and water contact angle measurement. The membrane performance tests have shown that the surface membrane modification by PVNCL enhances hydrophilicity while imparting thermo-responsive properties, thus enabling highly efficient oil-water separation [2].

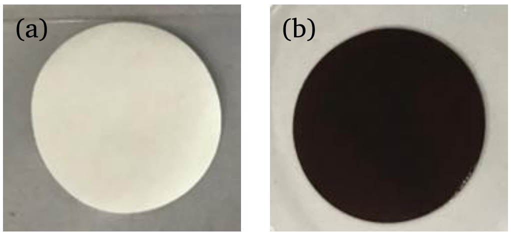


Fig. 1. The appearance of (a) pristine PVDF and (b) modified PVDF membranes.

Keywords: Polyvinylidene fluoride; N-vinylcaprolactam; Thermo-responsive; Surface modification; Oil/water separation

References

[1] Abuhasel K, Kchaou M, Alquraish M, Munusamy Y, Jeng YT. Oily wastewater treatment: Overview of conventional and modern methods, challenges, and future opportunities. **Water** 2021; 13(7): 980-1015.

[2] Cortez-Lemus NA, Licea-Claverie A. Poly(N-vinylcaprolactam), a comprehensive review on a thermoresponsive polymer becoming popular. **Progress in Polymer Science** 2016; 53, 1-51.

Oral **TIChE-BE-07**

Techno-economic analysis of *Ulva spp*. cultivation for capturing CO_2 emissions from natural gas power plants in Thailand

Kantaphan Punnaanan[1,2], **Pichaya In-na**[1,2], **Kasidit Noothong**[1,3], **Christopher Dixon**[4,*]

[1] Research Unit on Sustainable Algal Cultivation and Applications, Chulalongkorn University, Bangkok 10330, Thailand
[2] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[3] Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[4] Chulalongkorn School of Integrated Innovation, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: christopher.d@chula.ac.th

ABSTRACT

The anthropogenic activities are recognized as a primary component contributing to global warming, especially the release of greenhouse gases (GHGs). The emission of carbon dioxide, fossil fuel combustion, is one of the top contributors to GHGs with a continuously increasing energy demand. The natural gas power plant in Thailand currently accounts for up to 38.3% of the energy sector's CO_2 emissions. Carbon capture technologies can contribute to mitigating CO_2 emissions to transition towards a carbon-neutral society. Algal biotechnology is a promising biological carbon capture technology. This study focuses on macroalgae, which have photosynthetic efficiencies up to 16.67% higher than terrestrial tree plantations. *Ulva spp*. is a well-known macroalgae for food production in Thailand, but its cultivation has not been used explicitly for carbon capture. This study conducts a techno-economic analysis of *Ulva spp*. cultivation for CO_2 capture from flue gases emitted from a natural gas power plant based in the city of Rayong, Thailand. SuperPro Designer was applied to simulate the cultivation process with imitation flue gas compositions. The optimal conditions for working volume and biomass yield were determined by varying the residence time of the photosynthesis reaction in the raceway pond. From the simulation, the optimal working volume was 32.16 m^3 and cultivation time was 18 days with the biomass yield was 563.3 ton/year (equivalent to 201.2 tonCO_2/year) and the internal rate of return (IRR) 42.89%. Hence, the cultivation of *Ulva spp*. can potentially be employed as carbon capture technology, contributing to Thailand's carbon sequestration strategy.

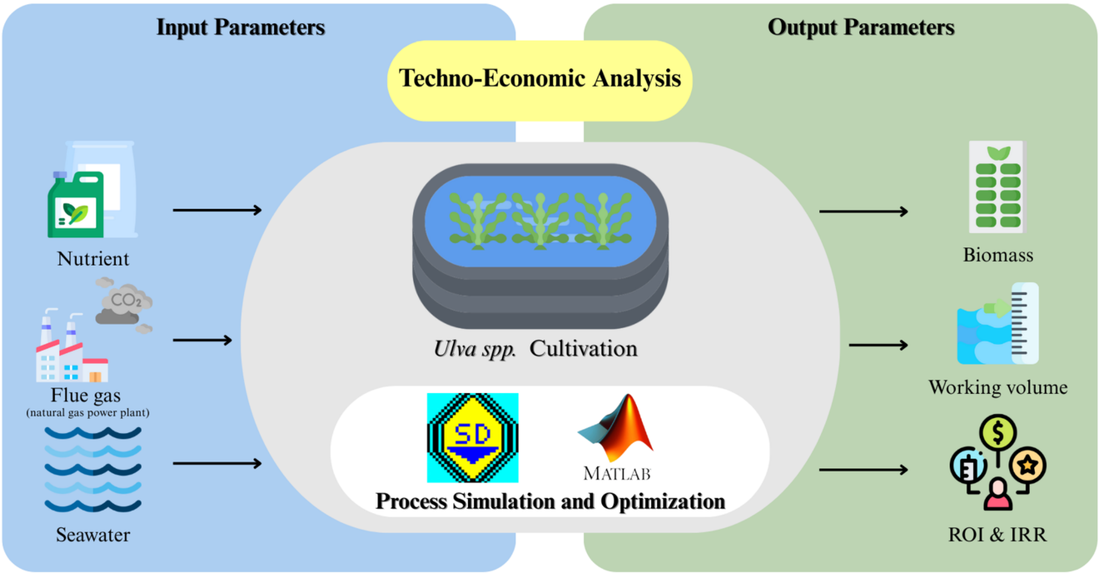


Fig. 1. Concept of this work.

Keywords: *Ulva spp*.; Carbon sequestration; Feasibility analysis; Algal decarbonization

References

[1] Li G, Yao J. A review of algae-based carbon capture, utilization, and storage (algae-based CCUS). **Gases** 2024; 4(4): 468-503.

[2] In-na P, Byrne F, Caldwell GS, Lee JGM. Techno-economic analysis of living biocomposites for carbon capture from breweries. **Algal Research** 2022; 66: 102781.

[3] Chhay L, Limmeechokchai B. CO_2 mitigation in the power sector of Thailand: Analyses of cleaner supply-side options beyond the Paris agreement. **The Open Environmental Research** 2019; 12(1): 15-25.

[4] Yang Y, Tang S, Chen JP. Carbon capture and utilization by algae with high concentration CO_2 or bicarbonate as carbon source. **Science of The Total Environment** 2024; 918: 170325.

[5] Pessarrodona A, et al. Carbon sequestration and climate change mitigation using macroalgae: A state of knowledge review. **Biological Reviews** 2023; 98(6): 1945-1971.

Oral **TIChE-BE-08**

Centella asiatica Active ingredients extraction using ultrasonic-assisted extraction and maceration

Nichapa Areepong[1], **Veronica Winoto**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Thammasat School of Engineering,
Thammasat University, Pathum Thani 12121, Thailand
[*] Corresponding author: wveronic@engr.tu.ac.th

ABSTRACT

Centella asisatica is widely used as an herbal, dietary supplement, and cosmeceutical due to its rich bioactive compounds including total phenolic content [1]. The extraction method is effect in obtaining a high yield of beneficial compounds. In this study, the ultrasonic-assisted extraction (UAE) and maceration methods were evaluated to determine the optimal extraction conditions for maximizing total phenolic content. The three main parameters consisting of the *Centella asisatica* (CAE) concentration, extraction temperature, and extraction time were investigated. The concentration of CAE ranged from 0.5 to 2%w/v, temperature ranged from 40 to 60°C, and time ranged from 1 to 4 h. The antioxidant activity of CAE extracts was analyzed using Total Phenolic Content (TPC) method with Folin-ciocalteu as a reagent and 2 2-diphenyl-1-picrylhydrazyl (DPPH) assay. The absorbance of TPC and DPPH was measured using UV-Vis spectrophotometer at 750 nm and 517 nm, respectively. The results showed that UAE achieved the highest TPC of 33.14 mg GAE/g and DPPH scavenging activity of 91.67% while maceration yielded the highest TPC of 39.56 mg GAE/g and DPPH of 86.34%. Therefore, the optimum condition was 2%w/v of CAE with a temperature of 50°C for 2 h using UAE. These findings suggest that UAE provided higher antioxidant activity than maceration due to its ultrasonic vibration, which disrupts the cell walls and enhances the release of bioactive compounds [2].

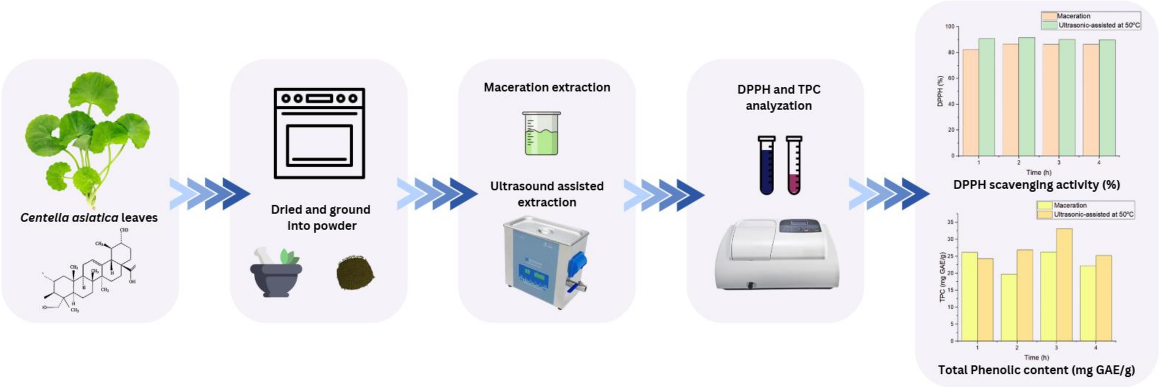


Fig. 1. The methodologies and the results of antioxidant extraction.

Keywords: Antioxidant; *Centella asiatica*; Maceration; Ultrasonic-assisted extraction

References

[1] Azis H, Taher M, Ahmed A, Sulaiman W, Susanti D, Chowdhury S, et al. In vitro and In vivo wound healing studies of methanolic fraction of *Centella asiatica* extract. **South African Journal of Botany** 2017; 108: 163-174.

[2] Huang W, Xue A, Niu H, Jia Z, Wang J. Optimised ultrasonic-assisted extraction of flavonoids from *Folium eucommiae* and evaluation of antioxidant activity in multi-test systems *in vitro*. **Food Chemistry** 2009; 114(3): 1147-1154.

Oral **TIChE-BE-09**

Carthamus tinctorius L. flower antioxidant extracts from subcritical ethanol extraction

Tanapat Wangsomboonsiri[1], Peerapong Srinukul[1], Veronica Winoto[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Thammasat School of Engineering,
Thammasat University, Pathum Thani 12121, Thailand
[*] Corresponding author: wveronic@engr.tu.ac.th

ABSTRACT

Carthamus tinctorius L. flower (Safflower) from the Compositae or Asteraceae family was used widely for medicinal applications. The medicinal activities include antifibrosis, antidiabetic, antitumor, anti-inflammatory, anticoagulants, and antioxidant. The flower is rich in bioactive compounds such as phenolics and flavonoids. A suitable extraction method is essential for acquiring antioxidants. Subcritical ethanol extraction is a green extraction technique with high antioxidant extract performance. Optimal extraction is necessary to maximize efficiency. In this work, the three extraction parameters, the *Carthamus tinctorius L.* flower amount, extraction temperature, and extraction duration, were studied. The results illustrate that temperature is the most important parameter affecting antioxidant activity as analyzed using DPPH scavenging method. Higher temperatures extract a higher DPPH percentage up to 87.01% at 200°C; however, above 200°C, the DPPH percentage slightly decreases.

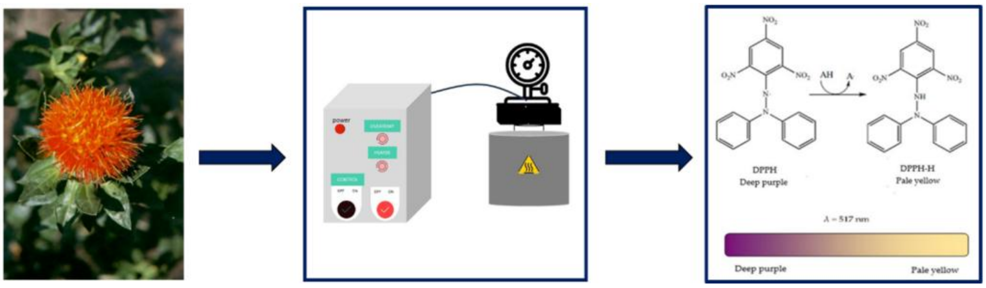


Fig. 1. The methodologies of *Carthamus tinctorius L.* flower antioxidant extraction.

Keywords: Antioxidant; *Carthamus tinctorius L.* flower; Subcritical ethanol extraction; DPPH scavenging activity

References

[1] Aboelsoud NH. Herbal medicine in ancient Egypt. **Journal of Medicinal Plants Research** 2010; 4(2): 082-086.

[2] Yu SY, Lee YJ, Kim JD, Kang SN, Lee SK, Jang JY, et al. Phenolic composition, antioxidant activity and anti-adipogenic effect of hot water extract from safflower (*Carthamus tinctorius L.*) seed. **Nutrients** 2013; 5(12): 4894-4907.

Oral TIChE-BE-10

Lignin extracted from rice straw and coconut coir

Supapohn Pohnanothai[1,*], **Patcharaporn Wutticharoenmongkol**[1]

[1] Department of Chemical Engineering, Faculty of Engineering, Thammasat School of Engineering,
Thammasat University, Pathum Thani 12121, Thailand
[*] Corresponding author: supapohn.poh@dome.tu.ac.th

ABSTRACT

Lignin, a complex biopolymer in plant cell walls, has gained significant interest due to its antioxidant and antimicrobial properties. This study focuses on the extraction and characterization of lignin from rice straw and coconut coir using deep eutectic solvents (DES) as a sustainable and environmentally friendly approach [1]. The extracted lignin was analyzed for its chemical structure, functional groups, and antioxidant activity to evaluate its potential applications as show in Fig. 1. The extracted lignin was characterized using Fourier Transform Infrared Spectroscopy (FTIR) analysis, confirmed the presence of key functional groups, including hydroxyl (-OH), carbonyl (C=O), and aromatic (C=C) bonds, indicating a well-preserved lignin structure. The UV-Vis spectroscopy results showed characteristic lignin absorption peaks, further validating its purity [2]. Antioxidant activity was assessed using the DPPH radical scavenging assay, revealing that coconut coir-derived lignin exhibited higher antioxidant potential (up to 91.12% RSA at 1 mg/mL) compared to rice straw-derived lignin. Additionally, the use of recovered DES did not significantly alter lignin's antioxidant properties, demonstrating its feasibility for reuse in extraction processes. This study highlights the effectiveness of DES in lignin extraction while preserving its bioactive properties. The extracted lignin can be further utilized in biomaterials applications. Future research should focus on optimizing lignin recovery and improving its solubility for broader industrial applications.

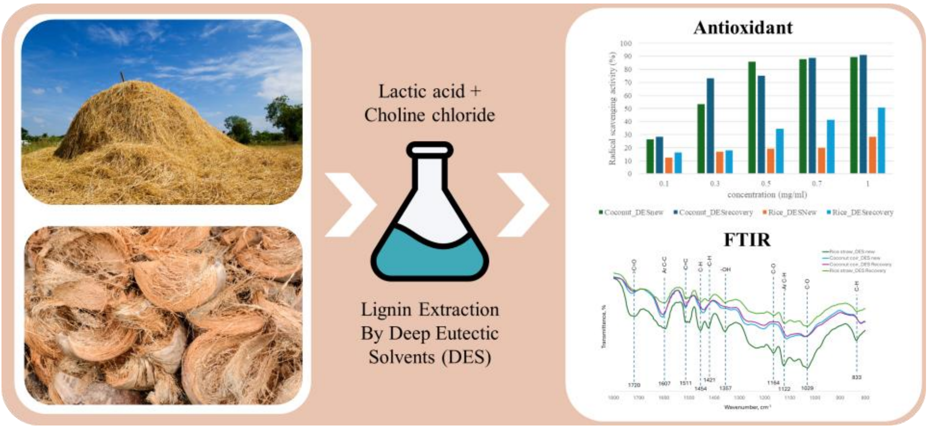


Fig. 1. The methodology and the results of lignin from rice straw and coconut coir.

Keywords: Lignin; Deep eutectic solvents (DES); Rice straw; Coconut coir; Extraction

References

[1] Kumar AK, Parikh BS, Pravakar M. Natural deep eutectic solvent mediated pretreatment of rice straw: Bioanalytical characterization of lignin extract and enzymatic hydrolysis of pretreated biomass residue. **Environmental Science and Pollution Research** 2016; 23: 9265-9275.

[2] Kozmelj TR, Voinov MA, Grilc M, Smirnov AI, Jasiukaitytė-Grojzdek E, Lucia L, et al. Lignin structural characterization and its antioxidant potential: A comparative evaluation by EPR, UV-vis spectroscopy, and DPPH assays. **International Journal of Molecular Sciences** 2024; 25(16): 9044.

Oral TIChE-BE-11

The occurrence of polycyclic aromatic hydrocarbons (PAHs) and halogenated PAHs in Chao Praya River in dissolved phase

Kanyanat Aunachad[1], **Nawatch Surinkul**[1,*], **Shuhei Tanaka**[2]

[1] Department of Environmental and Water Resource Engineering, Faculty of Engineering, Mahidol University,
Nakhon Pathom 73170, Thailand
[2] Department of Environmental Engineering, Graduate School of Engineering, Kyoto University,
Kyoto 615-8540, Japan
[*] Corresponding author: nawatch.sur@mahidol.ac.th

ABSTRACT

PAHs are widely distributed pollutants found in soil, air, and water. There are various research focusing on their presence in sediment and aerosol forms due to their hydrophobic properties. However, a knowledge of dissolved PAHs remains limited. This study aims to investigate the occurrence of dissolved PAHs in the water environment of the Chao Praya River basin which polluted the water quality of raw water to Water Treatment plant. Water samples were collected from four different stations along the canals discharging into the Chao Phraya River. The samples were collected from upstream to downstream in the dry season of 2024. Dissolved samples were done by pretreatment methods. Solid-phase extraction (SPE) was used for extracting and concentrating the target substances. The quantitative analysis was first validated and analyzed by using Gas Chromatography-Mass Spectrometry/Mass Spectrometry (GC-MS/MS). The total concentration of PAHs in the water samples ranged from 1,648 to 10,602 ng/L as shown in Fig. 1, with significantly higher contamination detected in downstream of the canal compared to upstream. Bang-Toei canal emerged as the most contaminated source of PAHs followed by Baan-Prao canal. This study observed that the 2-ring of PAHs were the most prevalent in both upstream and downstream of the Chao Praya River. The 2-rings of PAHs was accounted for 67% of total PAHs in Chiang-Rak canal (upstream) and the 83% in Bang-Toei canal (downstream). This might come from an urban canal (downstream) which tends to be affected by populated areas. PAHs concentrations in canal might be influenced from anthropogenic activities which deposited through runoff and accumulated in canals. Therefore, source identification might help to control PAHs level in canal and Chao Praya River. Application of bio-retention areas such as vegetation purification would also help reduce pollutant loads to canals.

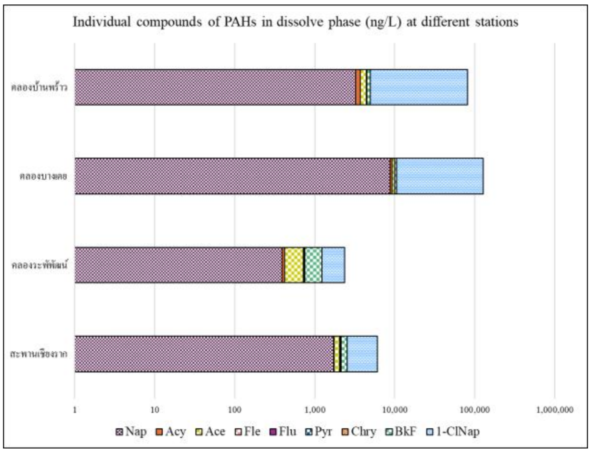


Fig. 1. Individual compounds of PAHs in dissolved phase (ng/L) at different stations.

Keywords: Polycyclic aromatic hydrocarbons (PAHs); Occurrence; Distribution; Chao-Praya River; Dissolved phase

Oral **TIChE-BE-12**

Enhancing absorption under load in alginate-based superabsorbent polymers for sustainable disposable diapers

Nadiya Abdulroman[1], Paeka Klaitong[2], Nuttawan Arpasopana[1], Suwanna Kitpati Boontanon[1], Nawatch Surinkul[1], Weerawut Chaiwat[2,*]

[1] Department of Civil and Environmental Engineering, Faculty of Engineering, Mahidol University,
Nakhon Pathom 73170, Thailand
[2] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[*] Corresponding author: weerawut.cha@mahidol.ac.th

ABSTRACT

Disposable diapers are widely used in infant care due to their convenience. However, the environmental impact of disposable diapers remains a major concern, primarily due to the reliance on synthetic superabsorbent polymers (SAPs), typically derived from petroleum-based sources and not easily biodegradable. This leads to long-lasting waste accumulation in landfills and posing significant environmental risks. As a result, there is a growing demand for sustainable alternatives. This research aims to develop biodegradable superabsorbent polymers (SAPs) using alginate and sugarcane bagasse ash (SCBash) as a reinforcing composite material. Calcium alginate (CaAlg) hydrogel beads crosslinked with Ca^{2+} were synthesized and prepared in a powder form after freeze-drying and grinding prior to be tested for their swelling behaviors in artificial urine, water retention capacities, and absorption under load (AUL). The results revealed that the CaAlg SAPs exhibited a swelling capacity of 39 g/g, which increased to 49 g/g with the addition of 5% SCBash, comparable to 40 g/g of SAPs from commercial diapers (cSAPs). Additionally, the CaAlg SAPs, both with and without SCBash, had significantly higher water retention capacities compared to the cSAPs. However, AUL of the CaAlg SAPs when the pressure was increased by 0.3 - 0.9 psi, the efficiency decreased significantly to 5 g/g compared to cSAPs still remained at 17 g/g. To further improve the AUL of the CaAlg SAPs, efforts are underway to enhance their mechanical strength by exploring alternative cation crosslinker such as Ba^{2+} or dual crosslinkers of Ca^{2+} and Ba^{2+} at various ratios [1] and surface crosslinking techniques using Poly (N, N-dimethyl acrylamide), PDMA [2].

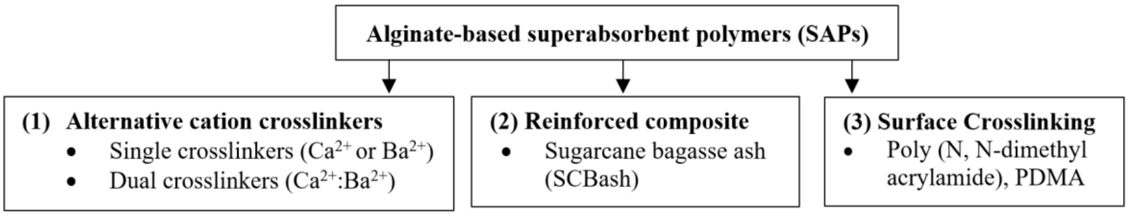


Fig. 1. Alternative methods to enhance adsorption under loading of alginate-based SAPs.

Keywords: Disposable diaper; Superabsorbent polymer; Alginate-based hydrogel; Sugarcane bagasse ash; Absorption under load

References

[1] Yang CH, Wang MX, Haider H, Yang JH, Sun YJ, Chen YM, et al. Strengthening alginate/polyacrylamide hydrogels using various multivalent cations. **ACS Applied Materials & Interfaces** 2013; 5(21): 10418-10422.

[2] Hu Y, Hu S, Zhang S, Dong S, Hu J, Kang L, et al. A double-layer hydrogel based on alginate-carboxymethyl cellulose and synthetic polymer as sustained drug delivery system, **Scientific Reports** 2021; 11: 9142.

Oral **TIChE-BE-13**

Enhancing absorption under load in alginate-based superabsorbent polymers for sustainable disposable diapers

Teradon Loypipan[1], Bor-Yann Chen[2], Chung-Chuan Hsueh[2], Penjit Srinophakun[1],
Anusith Thanapimmetha[1], Maythee Saisriyoot[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
[2] Department of Chemical and Materials Engineering, National I-Lan University, I-Lan 260, Taiwan
[*] Corresponding author: fengmts@ku.ac.th

ABSTRACT

Mangosteen is an important export product of Thailand. The increasing production to meet the high demand has resulted in high waste levels. This study aimed to utilize this agricultural waste for medical purposes as illustrated in Fig. 1. The antioxidant/anti-reductant ratio of mangosteen peel extract (MPE) was improved through the cyclic voltammetry method to increase its electron shuttle property. The magnitude of its electron shuttle property compared with that of dopamine was confirmed by a microbial fuel cell (MFC) system.

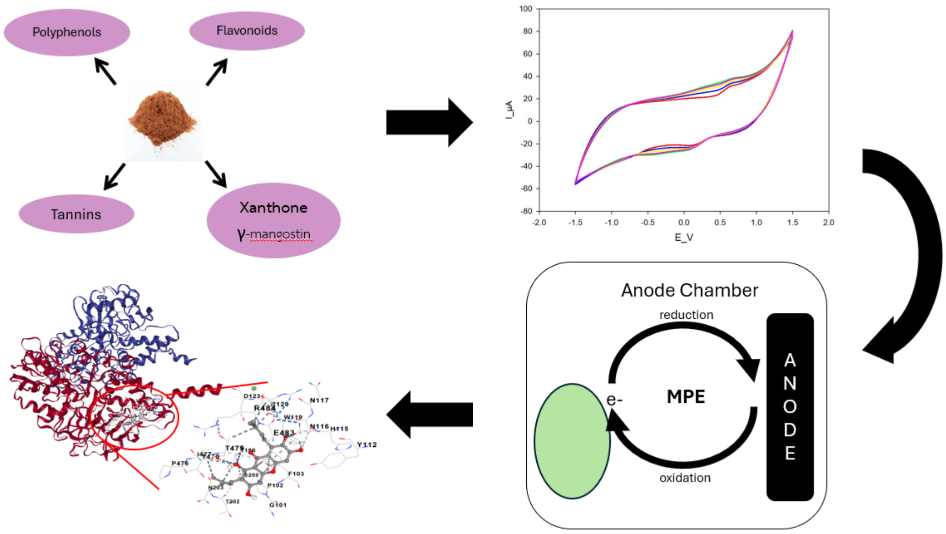


Fig. 1. Method in this research.

The compounds found in MPE samples were Polyphenols (57.3493 ± 1.471 mg/g), Flavonoids (20.1373 ± 0.8750 mg/g), Tannins (65.2344 ± 1.221 mg/g), and Xanthones (356.4530 ± 3.530 mg/g). The MPE showed significant bioenergetic properties after cyclic voltammetry treatment. The power density generated from the MFC was increased 2.27-fold when the treated MPE was employed. This electron shuttle property of the MPE comes from its γ-mangostin, major xanthones in mangosteen peel and ranked second in abundance among xanthone compounds. The molecular docking studies were also conducted to investigate the binding affinity of γ-mangostin to the receptors of proteins involved in Parkinson's disease. Results revealed that its binding affinity was higher than that of current reference drugs.

Keywords: Mangosteen peel extract; Xanthones; γ-mangostin

Oral TIChE-BE-14

Temperature effects on phosphorus transformations in P-enriched biochars

Sreypov Yoem[1], Kaewta Jetsrisuparb[2], Jesper T.N. Knijnenburg[1,*]

[1] International College, Khon Kaen University, Khon Kaen 40002, Thailand
[2] Department of Chemical Engineering, Faculty of Engineering, Khon Kaen 40002, Thailand
[*] Corresponding author: jespth@kku.ac.th

ABSTRACT

The excessive use of chemical fertilizers is responsible for elevated nutrient levels in agricultural fields. Biochar, a charcoal produced by biomass pyrolysis, increases fertilizer effectiveness, which can be further enhanced by incorporation of plant nutrients. The fertilizer value of this nutrient-loaded biochar is largely dictated by the pyrolysis temperature [1, 2]. This study investigated the effect of pyrolysis temperature (350 and 650 ˚C) on the physicochemical properties of cassava waste biochar. To enhance its nutrient content, the cassava waste was premixed with a phosphorus (P) source. The (P-enriched) biochars were characterized for their crystallinity, ash content, composition, and extractability, with special emphasis on understanding the P species (ortho-P or condensed P). Pre-pyrolysis modification increased the biochar ash content to 44-58% and total P contents to 91-112 mg/g (Table 1). The extractability in DI water and especially 0.5 M $NaHCO_3$ was higher than that of the unmodified biochars, suggesting a higher phytoavailability of P. The high extractability of condensed P in 0.5 M $NaHCO_3$ indicated that the P polymerized during pyrolysis, which was confirmed by X-ray diffraction and FTIR spectroscopy. Increasing the pyrolysis temperature from 350 to 650 ˚C decreased the total P extractability in 0.5 M $NaHCO_3$ but not in DI water, suggesting lower P availability to crops of the high temperature biochar. These results will be further discussed based on the P transformations taking place during pyrolysis, with emphasis on the role of the pyrolysis temperature and P additive and implications for applications in agriculture.

Table 1 Ash content, total P, and extractable P (ortho-P and condensed P) in DI water and 0.5 M $NaHCO_3$ from unmodified and P-enriched cassava waste biochars produced at 350 and 650 ˚C.

Biochar	Ash (wt%)	Total P (mg/g)	Extraction in DI water		Extraction in 0.5 M $NaHCO_3$	
			Ortho-P (mg/g)	Condensed P (mg/g)	Ortho-P (mg/g)	Condensed P (mg/g)
BC350	10%	6	0.6	0.1	0.9	0.2
BC650	15%	7	0.6	0.6	0.8	0.8
BC350 + P	44%	91	13.4	4.5	7.7	72.3
BC650 + P	58%	112	4.0	16.2	2.9	50.5

Keywords: Biochar; Phosphorus; Modification; Biomass; Agriculture

References

[1] Knijnenburg JTN, Suwanree S, Macquarrie D, Kasemsiri P, Jetsrisuparb K. Phosphorus recovery from animal manures through pyrolysis: Phosphorus transformations, release mechanisms, and applications of manure biochars in agriculture. **RSC Sustainability** 2025; 3: 1084-1101.

[2] Suwanree S, Knijnenburg JTN, Kasemsiri P, Kraithong W, Chindaprasirt P, Jetsrisuparb K. Engineered biochar from sugarcane leaves with slow phosphorus release kinetics. **Biomass and Bioenergy** 2022; 156: 106304.

Oral TIChE-BE-15

Effects of cultivation temperature on alpha-amylase production from wild-type rice callus suspensions

Worapicha Daungtongcome[1], Kantharakorn Macharoen[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi,
Bangkok 10140, Thailand
[*] Corresponding author: kantharakorn.mac@kmutt.ac.th

ABSTRACT

Alpha-amylase is a key enzyme that hydrolyzes starch into smaller sugars, with applications in food, pharmaceuticals, and biofuels. The objective of this research is to study the effects of cultivation temperature on rice cell growth and the production of α-amylase. Rice callus (Oryza sativa subsp. japonica) suspensions were cultured for 14 days at 140 rpm in 1-L shake flasks under three different temperatures: 27°C, 32°C, and 37°C. Samples were taken and centrifuged to separate spent media (supernatant) and rice callus pellet on days 0, 2, 4, 6, 8, 10, 12, and 14. The α- amylase activity was measured using the DNS (3,5-dinitrosalicylic acid) method. The results indicated that the amount of α-amylase in the spent media was approximately 4-5 times higher than in the cell extract at all three temperatures. The highest specific activity in the spent media was found at 37°C (9.08 U/ml), 32°C (0.90 U/ml), and 27°C (0.86 U/ml). In the cell extract, the activity was highest at 37°C (2.43 U/ml), 32°C (0.61 U/ml), and 27°C (0.07 U/ml), when one unit of enzyme liberates 1.0 mg of maltose from starch in 3 minutes at pH 7.0 and 37°C. Rice callus at 37°C exhibited the highest α-amylase production because this temperature is optimal for the enzyme's structure and function, allowing efficient starch hydrolysis. During the final days of cultivation, α-amylase is produced to break down stored starch into sugars, compensating for the decreased sugar levels and maintaining energy balance [1]. Overall, the analysis of the research is presented in Fig. 1.

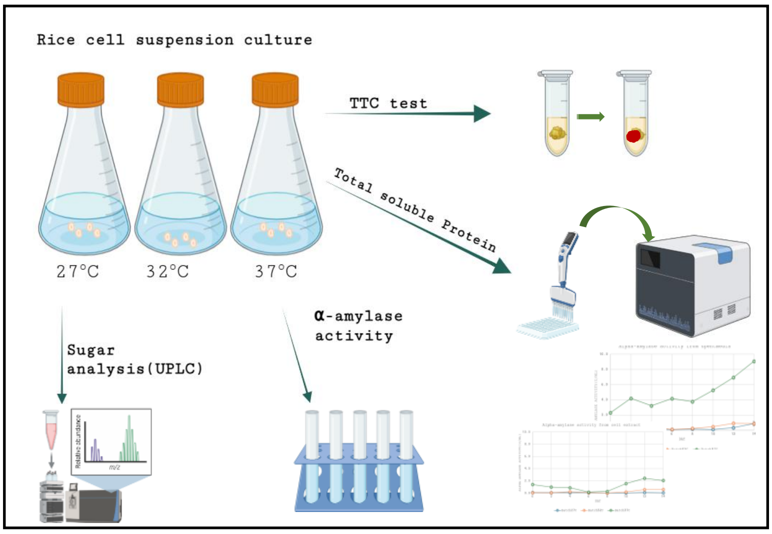


Fig. 1. Workflow of, α-amylase production analysis in rice cell suspension cultures under different temperatures.

Keywords: Rice cell cultures; Plant callus suspension cultures; Amylase enzyme; α-amylase

References

[1] Afrima S, Aswaldi A, Nalwida R. The effect of high temperature on α amylase enzyme activity in the germination of several rice varieties. **Crop Science** 2021; 3: 2655-3023.

Oral TIChE-BE-16

Lysine production from sugarcane molasses using *Corynebacterium glutamicum*

Phatthariya Phromngulueam[1], **Wuttichai Krainok**[1], **Apinya Janphang**[1], **Lek Wantha**[1,*],
Waewdao Dathong[2], **Apichat Boontawan**[3]

[1] School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology,
Nakhon Ratchasima 30000, Thailand
[2] Biology Program, Faculty of Science and Technology, Nakhon Ratchasima Rajabhat University,
Nakhon Ratchasima 30000, Thailand
[3] School of Biotechnology, Institute of Agricultural Technology, Suranaree University of Technology,
Nakhon Ratchasima 30000, Thailand
[*] Corresponding author: lekwa@sut.ac.th

ABSTRACT

One of the essential amino acids for humans and animals is L-lysine. It is helpful to the tissue repairs and the immune system [1]. However, L-lysine can only be obtained through consumption. In general, fermentation is used to produce L-lysine by utilizing glucose as a carbon source. The waste or by-product from agriculture or industry can be used as a carbon source, such as sugarcane molasses, because it contains glucose and sucrose [2]. *Corynebacterium glutamicum* TISTR 461 is selected to produce L-lysine. Firstly, the *C. glutamicum* was cultured on nutrient agar for 2 days. Then, the bacteria were cultured into an inoculum medium, and main medium in an Erlenmeyer flask, respectively. The culture conditions were maintained in a shaker at 200 rpm, a pH of 7.2, a temperature of 30 °C for 72 hr. The study investigated the effects of initial glucose concentration, incubated pH, and seed inoculum in Erlenmeyer flasks with a working volume of 50 ml. For the effect of fermentation time, a parameter was examined in a 5 L fermenter with an agitation speed of 50 rpm, and airflow rate of 1 vvm (volume of air sparged per unit volume of medium per minute). From the results, the optimum initial glucose concentration of 100 g/L, pH of 7.2, and %inoculum seed of 10% produced the highest L-lysine concentration of 37.60 g/L. In a 5 L Bioreactor, the highest L-lysine concentration of 41.86 g/l was achieved at 40 hr.

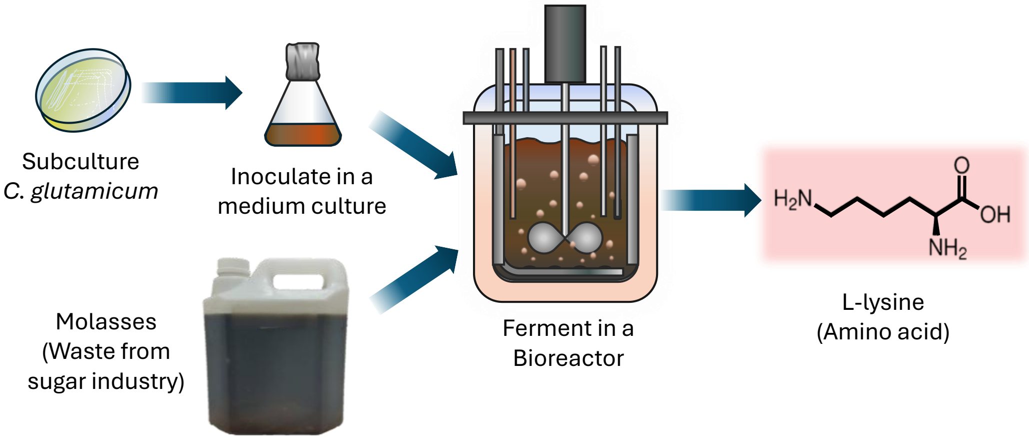


Fig. 1. Lysine production from sugarcane molasses using *C. glutamicum*.

Keywords: Lysine; Sugarcane molasses; *Corynebacterium glutamicum*

References

[1] Hou Y, Wu G. Nutritionally essential amino acids. **Advances in Nutrition** 2018; 9(6): 849-851.
[2] Anastassiadis S. L-lysine fermentation. **Recent Patents on Biotechnology** 2007; 1(1): 11-24.

Poster **TIChE-BE-17**

Enhanced extraction of bioactive compounds from *Aloe vera* leaf skin using natural deep eutectic solvents

Sopita Chanmee[1], **Artiwan Shotipruk**[1,*]

[1] Bio-Circular-Green-economy Technology & Engineering Center, BCGeTEC, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: artiwan.sh@chula.ac.th

ABSTRACT

This study aimed to investigate the extraction efficiency of bioactive compounds, specifically phenolic compounds and anthraquinones, from *Aloe vera* leaf skin (AVLS), a significant by-product of the *Aloe vera* processing industry [1]. Four environmentally friendly natural deep eutectic solvents (NADESs) were evaluated: choline chloride:lactic acid (ChCl:La), choline chloride:glycerol (ChCl:Gly), choline chloride:propylene glycol (ChCl:Pro), and choline chloride:xylose (ChCl:Xy). These were compared with conventional solvents (water and ethanol) using a magnetic stirring extraction method. Results demonstrated that ChCl:Xy extracted significantly higher phenolic content (0.43 mg GAE/g AVLS) compared to other solvents. Conversely, ChCl:La yielded the highest anthraquinone extraction among NADES solvents (1.23 mg Alizarin/g AVLS). Antioxidant activity showed strong correlation with anthraquinone content in the AVLS extracts (Fig. 1.). These findings indicate that specific NADESs offer superior extraction efficiency for phenolic compounds, anthraquinones, and antioxidants compared to conventional solvents. The study suggests the potentials of NADESs for extracting valuable compounds from agricultural waste, offering possible applications in cosmetics, food products, and active food packaging materials.

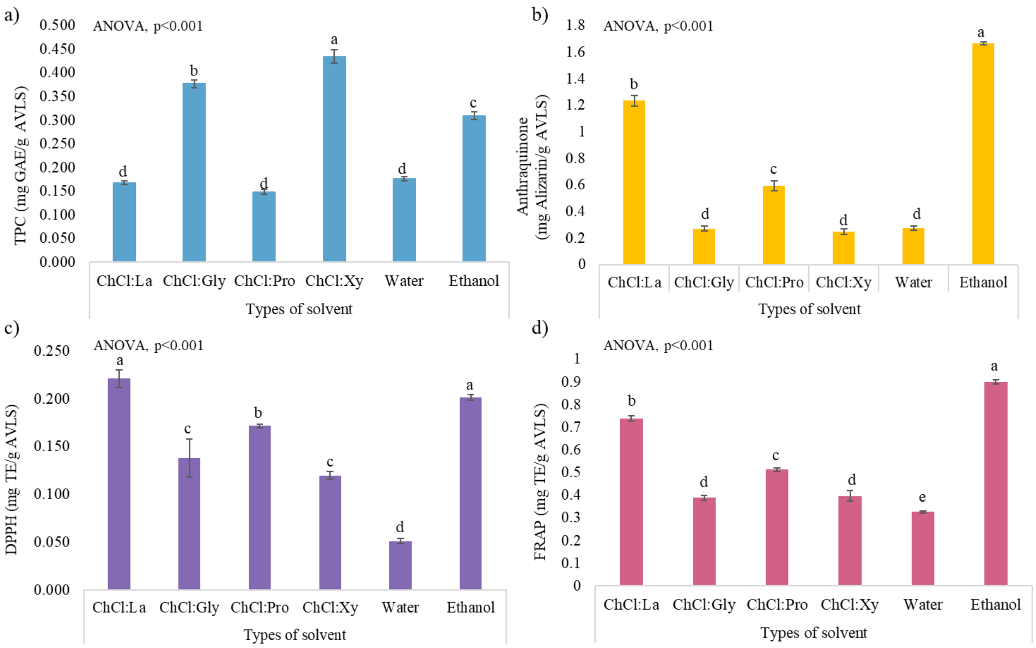


Fig. 1. (a) Total phenolics content, (b) Total anthraquinones content, (c) Total antioxidant content by DPPH assay, and d) Total antioxidant content by FRAP assay. Letters above error bars stand for statistically significant differences between groups.

Keywords: Aloe vera leaf skin; Natural deep eutectic solvents (NADESs); Phenolic compound; Antioxidant; Anthraquinone

References

[1] Hossen MM, Hossain ML, Mitra K, Hossain B, Bithi UH, Uddin MN. Phytochemicals and in-vitro antioxidant activity analysis of *Aloe vera* by-products (skin) in different solvent extract. **Journal of Agriculture and Food Research** 2022; 10; 100460.

Poster **TIChE-BE-18**

Comparative characterization of microplastics from conventional wastewater treatment plants between inland and island of tourism area in Thailand

Charintorn Molee[1], **Suda Ittisupornrat**[1,*], **Suthida Theeparaksapan**[2]

[1] Climate change and Environmental Research Center, Pathum Thani 12120, Thailand
[2] Department of Civil and Environmental Engineering, Faculty of Engineering, Srinakharinwirot University, Nakhon Nayok 26120, Thailand
[*] Corresponding author: suwimolteam@yahoo.com

ABSTRACT

Wastewater treatment plants (WWTPs) are recognized as major sources of microplastic (MP) contamination. Therefore, assessing MPs in wastewater and evaluating treatment performance is important. This study compared the characterization and treatment performance of MPs in conventional WWTPs located inland (activated sludge process: AS) and on an island (aerated tank). The efficiency of these WWTPs in removing MPs from wastewater samples was evaluated using an optical microscope and Fourier Transform Infrared (FTIR) microscopy. The results indicated that the most dominant MPs were polypropylene (PP) and polyethylene (PE), accounting for over 60% of the total MPs identified. These findings suggest that MP contamination is strongly linked to plastic packaging waste. The treatment performance for MP removal exhibited a similar trend, achieving up to 95% removal, with an effluent MP concentration ranging from 22 to 75 MP/m^3.

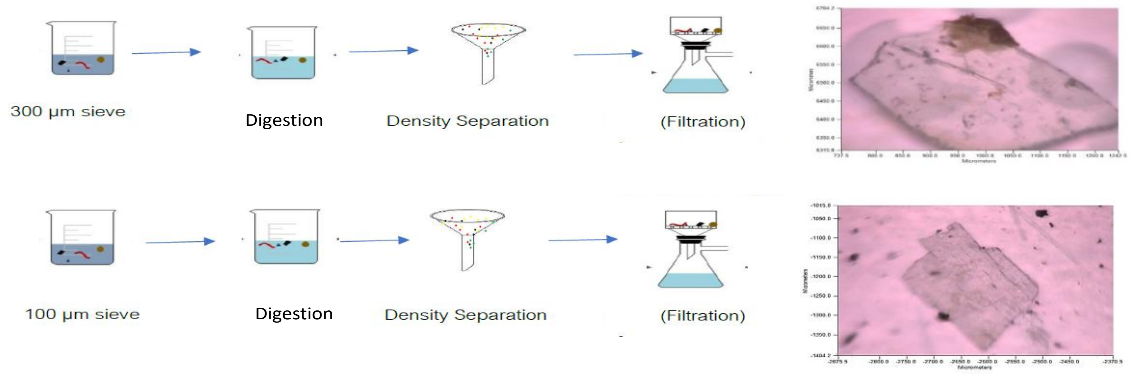


Fig. 1. (a) Step of MP extraction and (b) PP (top) and PE (bottom) by FTIR.

Water samples (influent and effluent) were collected and subjected to digestion using wet peroxide oxidation (WPO) [1]. Subsequently, an optical microscope and Fourier Transform Infrared (FTIR) microscope was used to identify MP characterization. Results: FTIR analysis confirmed that PP and PE were the predominant MP types in influent samples from both conventional wastewater treatment plants. This finding suggests that MPs originate primarily from plastic packaging waste. The estimated discharge of MPs into the water environment ranged between 2.2×10^4 and 2.3×10^5 MPs/m^3-d. Conclusions: This study highlights the predominance of PP and PE contamination in wastewater, mainly attributed to plastic packaging waste. The findings emphasize the urgent need for policymakers to regulate plastic waste disposal and promote biodegradable alternatives. Additionally, further research is required to optimize MP removal efficiency in wastewater treatment processes to mitigate their environmental impact.

Keywords: Microplastics; Wastewater treatment plant; Activated sludge; Aerated tank; Tourism area

References

[1] Masura J, Baker G. Foster C. Arthur. 2015. **Laboratory methods for the analysis of microplastics in the marine environment: Recommendations for quantifying synthetic particles in waters and sediments**. In: NOAA Technical Memorandum NOS-PR&R48, NOAA Marine Debris Program, National Oceanic and Atmospheric Administration. U.S. Department of Commerce, Silver Spring, MD.

Oral TIChE-BE-19

Reduction of acid usage in chitosan production process from white shrimp shell using electro-chemical activation

Pat Thongphet[1], **Kiattinatapon Juengchareonpoon**[1], **Piyabutr Wanichpongpan**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi,
Bangkok 10140, Thailand
[*] Corresponding author: piyabutr.wan@kmutt.ac.th

ABSTRACT

White shrimp is produced more than 250,000 tons per year in Thailand. This generates a significant amount of waste, primarily from shrimp heads and shells, accounting for 40-50% of the total weight. To enhance the value of this waste, chitosan can be extracted through three main processes: deproteination using an alkaline solution (NaOH), demineralization using an acid solution (HCl) and deacetylation using a strong alkaline solution (NaOH). In this study, white shrimp shell powder was prepared and subjected to various processes to determine the optimal conditions for chitosan extraction by varying the concentration, temperature, reaction time and solid-to-liquid ratio. Additionally, before the demineralization process, the shrimp shell powder was soaked in demineralized water and stimulated by electro-chemical activation (ECA) to compare the results between ECA treated and untreated samples. Finally, the obtained chitosan was analyzed for purity and Degree of Deacetylation (DD) using UV Spectrophotometer, Atomic Absorption Spectroscopy (AAS) and Fourier Transform Infrared Spectroscopy (FTIR). The results showed that under the same conditions, chitosan treated with ECA exhibited a lower calcium content and a higher DD compared to untreated chitosan.

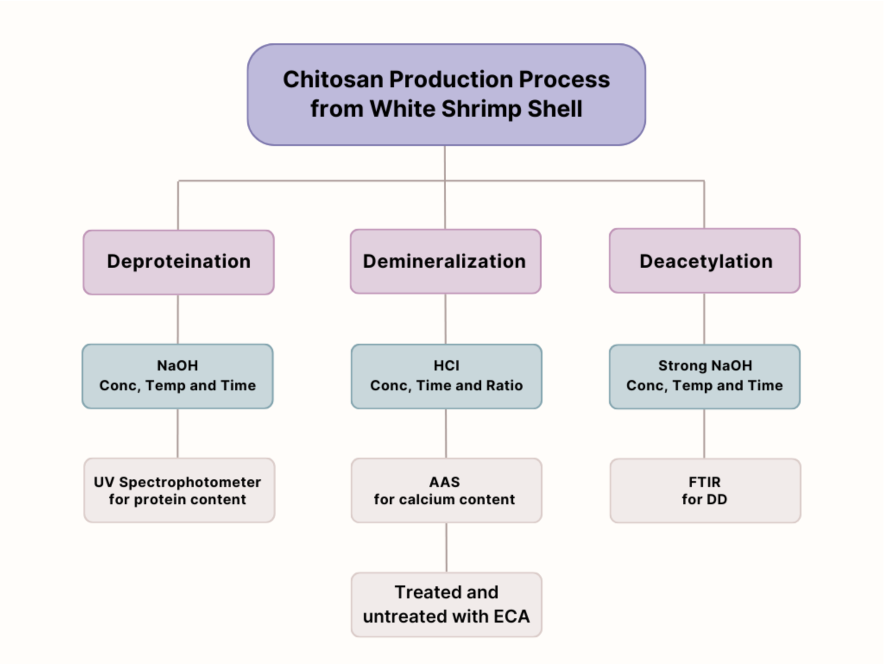


Fig. 1. Overview method of the research.

Keywords: Chitosan; Degree of deacetylation; Electro-chemical activation; White shrimp shell

Oral **TIChE-BE-20**

Enhanced desalination through capacitive deionization: Synthesis and performance evaluation of rubberwood-derived activated carbon

Nannapat Kaewsaenmaung[1], **Wichita Boonprasan**[1], **Pakpoom Athikaphan**[1,2],
Arthit Neramittagapong[1,2], **Sutasinee Neramittagapong**[1,2,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Khon Kaen 40002, Thailand
[2] Research Center for Environmental and Hazardous Substance Management (EHSM), Khon Kaen University, Khon Kaen 40002, Thailand
[*] Corresponding author: sutasineene@kku.ac.th

ABSTRACT

This research focuses on synthesizing activated carbon from rubberwood and evaluating its effectiveness in removing ions from saline water using capacitive deionization (CDI). The CDI electrodes were created from activated carbon derived from rubberwood waste sourced from Loei province. This process involved chemical activation using various agents, including $ZnCl_2$, H_3PO_4, K_2CO_3 H_2SO_4, and KOH, followed by carbonization at 600°C for one hour. The characterization of the synthesized activated carbon indicated that chemical activation led to a higher specific surface area compared to carbonization without chemical activation, as illustrated in Table 1.

Table 1 Specific surface area (m^2/g) and salt adsorption capacity (SAC, mg/g) of rubberwood-derived activated carbon.

Type	Specific Surface Area (m^2/g)	SAC (mg/g)
Commercial AC	1138	10.06
AC-K_2CO_3	378	0
AC-H_2SO_4	425	0
AC-KOH	429	0.31
AC-H_3PO_4	1541	32.59
AC-$ZnCl_2$	2170	38.29

The trends in specific surface area for various activating agents were as follows: $K_2CO_3 < H_2SO_4 < KOH < H_3PO_4 < ZnCl_2$. It was found that the specific surface areas are significantly influenced by the type of chemical activating agent used. Notably, activated carbon treated with $ZnCl_2$ exhibited the highest surface area at 2,170 m^2/g. This high surface area can be attributed to $ZnCl_2$'s ability to break down the wood structure and remove volatile organic compounds. When evaluated for ion removal from synthesized brine solution with NaCl concentration of 250 $mg{\cdot}L^{-1}$ using CDI, the $ZnCl_2$-treated activated carbon demonstrated a salt adsorption capacity (SAC) of 38.29 mg/g, outperforming other chemical activators as well as commercially available activated carbons. This finding highlights the critical role of surface area in ion adsorption efficiency. In summary, activated carbon derived from rubberwood shows considerable promise as electrodes in CDI applications, offering potential advancements in water desalination processes.

Keywords: Activated carbon; Rubberwood; Capacitive deionization; Desalination

Poster TIChE-BE-21

Pressure vessel for ethanol extraction of mitragynine from kratom leaves

Ampai Chanachai[1,*], **Ponpailin Lippanon**[1], **Pansachol Paranundha**[1], **Pimpisa Techamaunwaiwit**[1]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi,
Bangkok 10140, Thailand
[*] Corresponding author: ampai.cha@kmutt.ac.th

ABSTRACT

Kratom leaves are currently popular among workers because they help increase energy, relieve fatigue, and endure long hours of outdoor work. These properties are due to the mitragynine compound in kratom leaves. The purpose of this research is to design and build a pressure vessel for mitragynine extraction and determine the most suitable conditions to achieve the highest percentage of extraction efficiency. Ethanol is used as a solvent for safety of consumption and to create future medical benefits. A pressure vessel that can withstand a maximum pressure of 11.5 bar at a temperature of 70 °C was designed and built, with a total volume of 1,191 ml. Then, the extraction was tested with an ethanol solvent by using Soxhlet method at 78 °C for 1 hour and using a pressure vessel at 1-2 bar pressure, 50, 60 and 70 °C for 20-60 minutes. It was found that using a pressure vessel gave the highest percentage of mitragynine extraction at 0.147% at 70 °C and 2 bars for 60 minutes with an extraction efficiency when compared to Soxhlet extraction of 105.4%. It can be concluded that increasing temperature, pressure and time resulted in more mitragynine extraction. Extraction using ethanol is better than using petroleum ether [1] and methanol [2] and although it does not yield as high as using acetic acid [3], it is better in terms of being safe to use. When compared to extraction using the same solvent ethanol [4], it was found that using a pressure vessel allows for extraction at high temperatures, resulting in extraction time being 72 times less and using 3 times less solvent. However, the amount of mitragynine used in various fields has not been clearly defined, but it should not be used in large quantities. Therefore, the extracted mitragynine can definitely be used.

Table 1 Comparison of the results of mitragynine extraction with other researches.

Method	Solvent	Extraction time (h)	Temperature (°C)	Yield (%w/w)	References
Soxhlet	Petroleum ether	8	60	0.088	Beng et al. [1]
Ultrasonic	Methanol	1	Room Temperature	0.023	Kikura-Hanajiri et al. [2]
Solvent extraction	Acetic acid 50%	0.5	80	2.691	Muandao [3]
Maceration	Ethanol 95%	72	Room Temperature	0.556	Sharma et al. [4]
Solvent extraction	Ethanol 95%	1	70	0.147	This research

Keywords: Kratom leaf; Mitragynine; Pressure vessel; Solvent extraction

References

[1] Beng T, et al. A simple and cost-effective isolation and purification protocol of mitragynine from *Mitragyna speciosa* korth (Ketum) leaves. **The Malaysian Journal of Analytical Sciences** 2011; 15(1): 54-60.

[2] Kikura-Hanajiri R, et al. Simultaneous analysis of mitragynine, 7-hydroxymitragynine, and other alkaloids in the psychotropic plant "kratom" (*Mitragyna speciosa*), LC-ESI-MS. **Forensic Toxicology** 2009; 2(27): 67-74.

[3] Muandao K. Comparison of mitragynine extraction methods for forensic science and antibacterial activity from kratom. **Master of Forensic Science Thesis** 2018; Faculty of Science, Silpakorn University.

[4] Sharma A, et al. Simultaneous quantification of ten key Kratom alkaloids in *Mitragyna speciosa* leaf extracts and commercial products by ultra-performance liquid chromatography-tandem mass spectrometry. **Drug Testing and Analysis** 2019; 11(8): 1162-1171.

Oral **TIChE-BE-23**

Sustainable production of drinking water from saltwater

Shoaib Salman[1], Nawatch Surinkul[1,*], Murad Ali Khan[1], Zu Zu Aung[1], Muhammad Shahab[2]

[1] Department of Civil and Environmental Engineering, Faculty of Engineering, Mahidol University,
Nakhon Pathom 73170, Thailand
[2] Department of Environmental and Sustainability Engineering, Faculty of Engineering, Chulalongkorn University,
Bangkok 10330, Thailand
[*] Corresponding author: nawatch.sur@mahidol.ac.th

ABSTRACT

Access to fresh water has already become a significant issue today [1]. This research addresses the drinking water shortage in saline water areas by developing a solar-powered system for producing potable water from seawater, offering a cost-effective solution with minimal installation and low maintenance requirements. In 2009, the Deputy Secretary-General warned that by 2025, the water shortage problem will affect nearly two-thirds of the world's population (UNO). The model incorporates various ideas and concepts, integrated into the principles of Multi-Effect Distillation (MED), Multi-Stage Flash Distillation (MSF), and Vapor Condensation, to develop a device that continuously produces water using solar radiation. This model is called the "Single Stage Solar Desalination Plant" [2]. The Single Stage Solar Desalination Plant consists of a chamber containing water with high salinity. Solar radiation is concentrated onto the chamber using large reflectors, increasing the temperature of the water. Simultaneously, a vacuum pump is employed to reduce the pressure within the system, which lowers the boiling point of the water. Several factors influencing the evaporation rate were optimized to maximize vapor yield. One factor is the use of large reflectors to concentrate solar radiation onto the glass enclosure, resulting in an increase in temperature by 4-5°C. The enhanced surface area of the glass box further contributes to maximizing the evaporation rate. Additionally, a vacuum pump is employed to lower pressure to 1.066 psi, enabling boiling to occur at 40°C, reducing the boiling point of water. The vacuum pump also facilitates the collection of water vapor in a separate chamber. We achieved a daily production of approximately 178 liters of fresh water from 1000 liters of input, resulting in a recovery rate of roughly 17.8%. Seawater's salinity is around 36295 mg/L, which is one of the major problems and can be harmful if drinking water of this much salinity, reduces the salinity to 125 ppm. Fig. 1 shows the batch plant.

Fig. 1. Single-stage solar desalination plant.

Keywords: Salty water; Potable water; Single-stage solar desalination plant

References

[1] Nabi G, Ali M, Khan S, Kumar S. The crisis of water shortage and pollution in Pakistan: Risk to public health, biodiversity, and ecosystem. **Environmental Science and Pollution Research** 2019; 26: 10443-10445.

[2] Al-Shammiri M, Safar M. Multi-effect distillation plants: State of the art**. Desalination** 1999; 126(1-3): 45–59.

Poster **TIChE-BE-24**

Hydrogel-forming microneedles with epigallocatechin gallate and 4-(hydroxymethyl)-phenylboronic acid for antibacterial wound healing and drug release

Naritsara Suwatsrisakun[1], **Duangkanok Tanangteerapong**[1], **Jindarat Ekprasert**[2,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Khon Kaen 40002, Thailand
[2] Department of Microbiology, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand
[*] Corresponding author: duangkanok@kku.ac.th

ABSTRACT

Chronic wounds in diabetic patients pose a significant medical challenge due to prolonged healing times, increased risk of infection, and the lack of effective wound care methods that combine mechanical strength, ease of use, and therapeutic efficacy [1]. This study aims to synthesize a hydrogel-based microneedle wound dressing incorporating Epigallocatechin Gallate (EGCG) and 4-(Hydroxymethyl)-phenylboronic Acid (HPBA) while investigating the physical, mechanical, and chemical properties of the EGCG-HPBA hydrogel microneedles to ensure their stability, durability, and suitability for wound healing. Additionally, the release behavior of EGCG from the dressing is analyzed to assess its therapeutic efficacy and antibacterial properties. EGCG, a natural polyphenol, exhibits antioxidant, antibacterial, and anti-inflammatory properties, helping to reduce oxidative stress, prevent infection, and promote wound repair [2], while HPBA enables a glucose-responsive drug release mechanism [3], allowing the controlled release of EGCG based on glucose concentrations in the wound. Moreover, boronate ester bonds within the hydrogel enhance stability, tissue adhesion, and the mechanical properties of the material, making the wound dressing more effective and practical for use. The microneedle structure facilitates efficient drug penetration into the wound and ensures sustained therapeutic effects. Experimental results confirm that the EGCG-HPBA hydrogel microneedle wound dressing exhibits excellent drug release and antimicrobial properties. The drug release study shows that pure EGCG had the slowest release, with only 50% of the drug released within 30 hours, while the EGCG-HPBA (1:1) formulation demonstrated the highest release rate, reaching 85% within the same period. The EGCG-HPBA (1:2) formulation released slightly less than the (1:1) ratio, still exceeding 80%. This indicates that the HPBA content influences the release profile, with the 1:1 ratio providing the most efficient and sustained drug delivery as shown in Fig. 1. Additionally, antimicrobial testing revealed that pure EGCG exhibited strong antibacterial activity, with inhibition zones of 17.5 mm for *E. coli* and 14.8 mm for *S. aureus*. The EGCG-HPBA (1:1) formulation showed similar antibacterial efficiency, while the EGCG-HPBA (1:2) and (2:1) formulation demonstrated increased antibacterial activity, with the (2:1) formulation exhibiting the strongest effects, with inhibiting zones of 21.8 mm for *E. coli* and 19.3 mm for *S. aureus* as shown in Fig. 2. These results confirm that the EGCG-HPBA hydrogel dressing not only ensures effective drug release but also provides significant antibacterial properties, making it a promising candidate for chronic wound healing, particularly in diabetic patients.

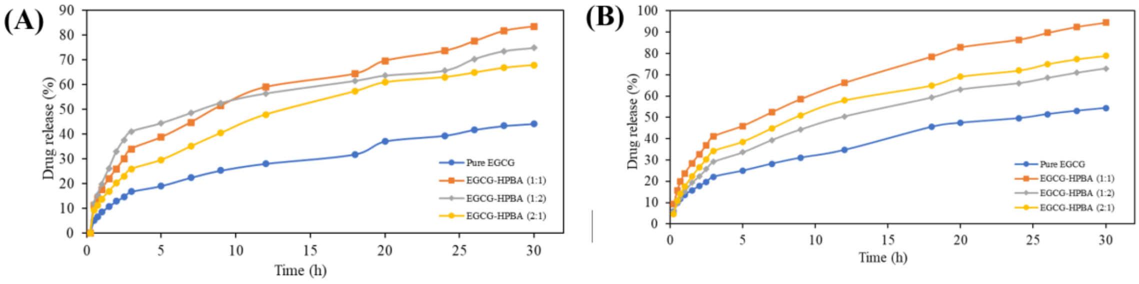


Fig. 1. Drug release (%) results of EGCG, EGCG-HPBA (1:1), EGCG-HPBA (1:2), and EGCG-HPBA (2:1) in pure PBS (A) and in PBS with glucose (200 mg/dL) (B).

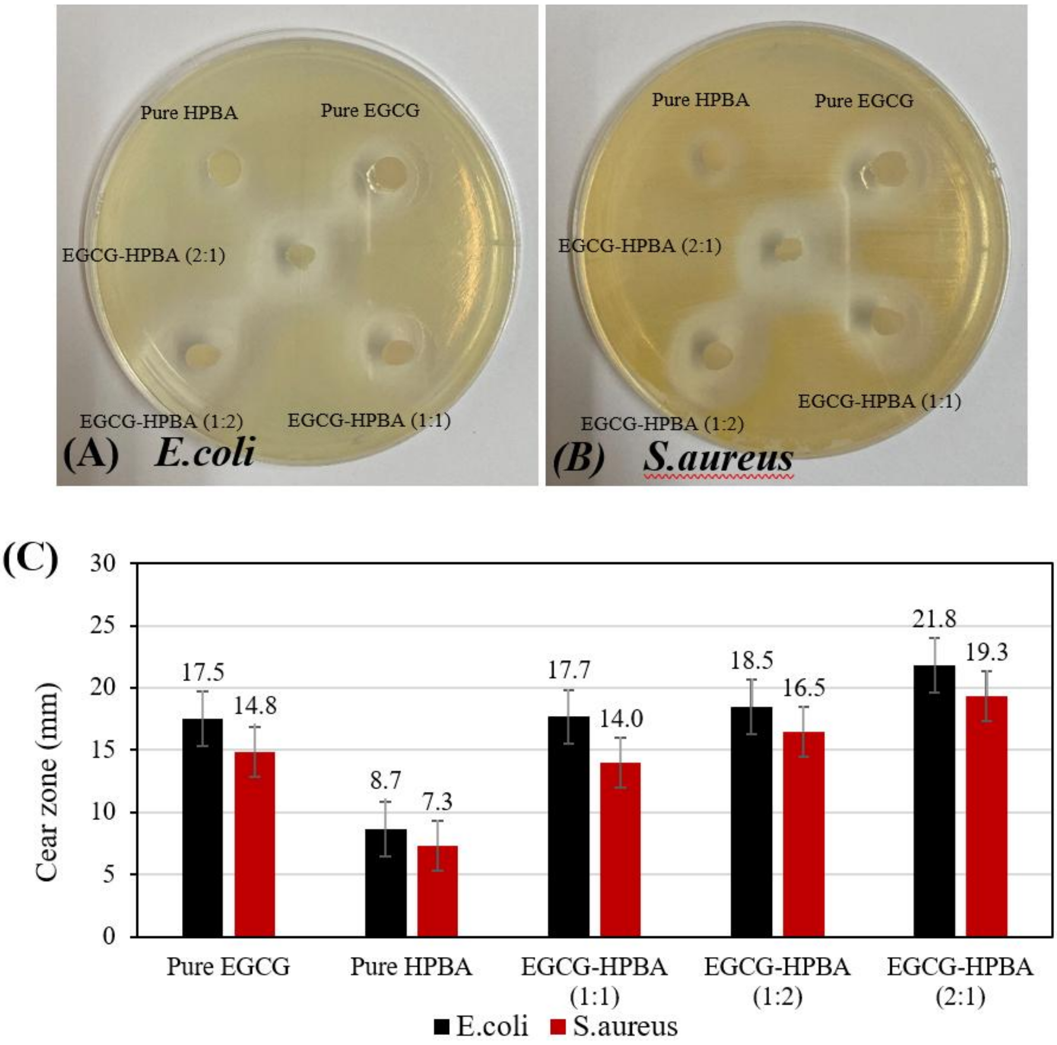


Fig. 2. The antibacterial activity testing of EGCG, EGCG-HPBA (1:1), EGCG-HPBA (1:2), and EGCG-HPBA (2:1) (A) *Escherichia coli* (*E. coli*), (B) *Staphylococcus aureus* (*S. aureus*), (C) The results of clear zone.

Keywords: EGCG; Microneedle; Crosslinking; Drug release

References

[1] Izadi K, Ganchi P. Chronic wounds. **Clinics in Plastic Surgery** 2005; 32(2): 209-222.
[2] Zawani M, Fauzi MB. Epigallocatechin gallate: The emerging wound healing potential of multifunctional biomaterials for future precision medicine treatment strategies. **Polymers** 2021; 13(21): 3656.
[3] Chen W, Zhen X, Wu W, Jiang X. Responsive boron biomaterials and their biomedical applications. **Science China Chemistry** 2020; 63(5): 648-664.

Oral TIChE-BE-25

Role of magnesium in phosphorus transformations during biomass pyrolysis

Jesper T.N. Knijnenburg[1,*], **Wasu Jantapa**[2], **Duncan Macquarrie**[3], **Pornnapa Kasemsiri**[2],
Prinya Chindaprasirt[4], **Kaewta Jetsrisuparb**[2]

[1] International College, Khon Kaen University, Khon Kaen 40002, Thailand
[2] Department of Chemical Engineering, Faculty of Engineering, Khon Kaen 40002, Thailand
[3] Department of Chemistry, University of York, York YO10 5DD, United Kingdom
[4] Department of Chemical Engineering, Faculty of Engineering, Khon Kaen 40002, Thailand
[*] Corresponding author: jespth@kku.ac.th

ABSTRACT

In the past decades, the over-application of water-soluble phosphorus (P) fertilizers to increase crop yields has led to environmental problems worldwide. As a mitigation strategy, biochar-based slow-release fertilizers (prepared by the pyrolysis of agricultural wastes) are an attractive sustainable solution. The P availability to crops and leaching risk strongly depend on the P form (e.g., binding cation, amorphous/crystalline, or orthophosphate/pyrophosphate), and it is thus crucial to understand how the pyrolysis conditions affect the P form and release to optimize the P availability to crops with minimal leaching risk. The presence of magnesium (Mg) facilitates to keep P in a poorly leachable yet phytoavailable form [1, 2], although specific mechanisms and temperature effects are not well understood. Here, biochar-based fertilizers were prepared by pre-pyrolysis modification of the biomass with a P and Mg source. The effect of pyrolysis temperature on the crystallinity, species (i.e., orthophosphate and pyrophosphate), extractability, and release kinetics of P from the biochars was studied. Higher pyrolysis temperatures reduced the kinetic P release in water (Table 1) and extractability, suggesting a lower P availability to crops but also lower leachability. Characterization of the biochars after the kinetic release supported by thermodynamic solubility calculations confirmed the rate limiting phases for P release. Further insights will be given into the P transformations taking place during the pyrolysis process, with special attention to the role of Mg in affecting the crystallinity and species of P.

Table 1 Dissolved P in water over 10 days from biochars produced at different temperatures [1].

Pyrolysis temperature (°C)	Soluble P in DI water (mg P/g biochar)			
	After 1 hour	After 1 day	After 5 days	After 10 days
300	1.8 ± 0.5	8.7 ± 1.1	16.6 ± 2.6	19.1 ± 2.8
500	1.2 ± 0.0	3.2 ± 0.2	5.8 ± 0.2	8.6 ± 0.5
700	0.6 ± 0.0	0.9 ± 0.0	1.1 ± 0.1	1.5 ± 0.1

Keywords: Pyrolysis; Magnesium; Phosphorus; Fertilizer; Agriculture

References

[1] Jantapa W, Jetsrisuparb K, Macquarrie D, Kasemsiri P, Chindaprasirt P, Knijnenburg JTN. Temperature-dependent phosphorus speciation and release from magnesium-rich biochars. **Waste and Biomass Valorization** 2024; 16: 2287-2300.

[2] Jetsrisuparb K, Jeejaila T, Saengthip C, Kasemsiri P, Ngernyen Y, Chindaprasirt P, Knijnenburg JTN. Tailoring the phosphorus release from biocharbased fertilizers: Role of magnesium or calcium addition during co-pyrolysis. **RSC Advances** 2022; 12: 30539.

Oral TIChE-BE-26

Study of biomass productivity of phosphate-solubilizing bacteria using rice bran oil as an alternative media

Pim-orn Thongpanchang[1], **Pichayada Somboon**[2,*], **Nuttapol Lerkkasemsan**[1,*]

[1] Department of Chemical Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang,
Bangkok 10520, Thailand
[2] Program in Fermentation Technology, School of Food Industry, King Mongkut's Institute of Technology Ladkrabang,
Bangkok 10520, Thailand
[*] Corresponding author: pichayada.so@kmitl.ac.th, nuttapol.le@kmitl.ac.th

ABSTRACT

Conventional media are expensive and unsuitable for microorganism cultivation on a large scale [1]. Rice bran oil is abundant in a local of Thailand [2]. Therefore, a challenge for a cost-effective approach to improving bioprocess efficiency is the application of rice bran oil for conventional media. This study aimed to predict kinetic parameters and vary rice bran oil concentration as an alternative media for cultivating a new strain of phosphate-solubilizing bacteria using the Gompertz model. A new strain was isolated from biochar, with a phosphate solubilizing index of 1.116 ± 0.004. The strain was identified as *Bacillus subtilis* (*B. subtilis*) with 98.37% ANIb similarity by the whole genome sequencing method. It was cultivated with varying rice bran oil concentrations (1% v/v, 3% v/v, and 5% v/v). Optical density at 600 nm (OD600) was measured at various time intervals, and the results were analyzed using the Gompertz model as the primary model. The results indicated that 5% v/v rice bran oil is suitable for bacterial cultivation, based on the predicted kinetic parameters, with a maximum specific growth rate (μ_{max}) of 0.1041 per hour, which was higher than μ_{max} of bacterial cultivation in 1% v/v and 3% v/v rice bran oil of 0.0137 and 0.0096 per hour, respectively. In addition, the growth kinetics of bacteria showed a sigmoid shape, consistent with the Gompertz model [3]. Therefore, future investigations could apply the predicted kinetic parameters to upscaling in alternative media or vegetable oils [4].

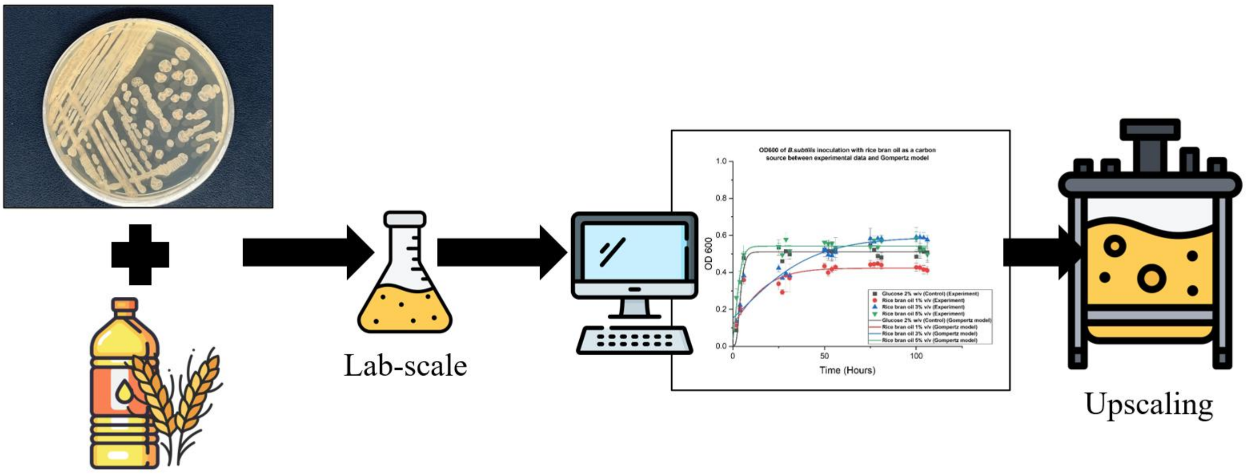


Fig. 1. Concept of the research.

Keywords: Bacterial cultivation; Vegetable oil; Optical density; Gompertz

References

[1] Basu S, et al. Evolution of bacterial and fungal growth media. **Bioinformation** 2015; 11(4): 182-184.

[2] Sapwarobol S, Saphyakhajorn W, Astina J. Biological functions and activities of rice bran as a functional ingredient: A review. **Nutrition and Metabolic Insights** 2021.

[3] Zwietering MH, Jongenburger I, Rombouts FM, Van't Riet K. Modeling of the bacterial growth curve. **Applied and Environmental Microbiology** 1990; 56(6): 1875-1881.

[4] Rezvani F, Ardestani F, Najafpour G. Growth kinetic models of five species of Lactobacilli and lactose consumption in batch submerged culture. **Brazilian Journal of Microbiology** 2017; 48(2): 251-258.

Oral TIChE-BE-27

Removal of styrene and pyrene in a fixed bed adsorption column using rhamnolipid-modified alumina

Davone Keomany[1], **Emma Asnachinda**[1,2,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Burapha University, Chon Buri 20131, Thailand
[2] Biochemical and Environmental Living Lab for Sustainability (BELLS), Faculty of Engineering, Burapha University, Chon Buri 20131, Thailand
[*] Corresponding author: emma@eng.buu.ac.th

ABSTRACT

This study examined the adsolubilization of two organic contaminants, styrene and pyrene, commonly found in soil and groundwater, using a fixed-bed column adsorption process with rhamnolipid-modified alumina. Rhamnolipid biosurfactants produced by Pseudomonas strains were selected to use in this work. In the past research, rhamnolipids were demonstrated to enhance the removal efficiency of oil spills, PAHs, diesel, and heavy metals from contaminated soil and groundwater [1]. The fixed-bed experiment was conducted through a sequential analysis involving tracer studies, surfactant adsorption, and the adsolubilization of organic solutes. Desorption study also evaluated to determine regeneration capability by distilled water. The primary objectives were to assess the effects of varying organic feeding flow rates, as indicated by the retardation factor and adsolubilization capacity. Results indicated that rhamnolipid significantly enhances the adsolubilization capacity of organic solutes in the column, particularly increasing the retardation rate at lower feed flow rates. Additionally, the molecular weight of organic solutes affects their polarity, which in turn influences their behavior during adsolubilization. As a result, styrene and pyrene are solubilized in different regions of the surfactant admicelle. Styrene, with its lower molecular weight and greater water solubility, is located in the palisade region, while pyrene is found in the core area, representing the higher polar region of the admicelle structure [2].

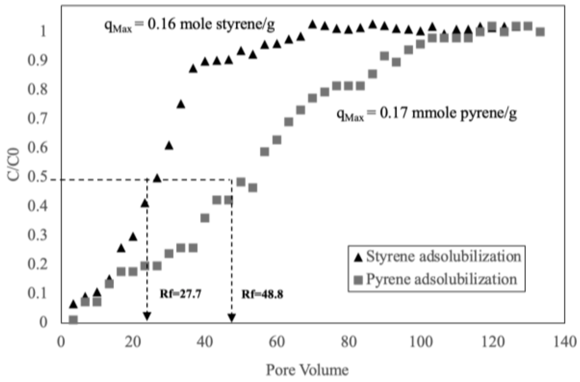


Fig. 1. Adsolubilization of styrene and pyrene by rhamnolipid-modified alumina in the fixed-bed column at flow rate of 0.25 mL/min, initial pH of 8.0-8.5 and temperature of 28 ± 2 °C.

Keywords: Rhamnolipid biosurfactant; Adsolubilization; Fixed-bed column; Styrene, pyrene

References

[1] Wang J, Bao H, Pan G, Zhang H, Li J, Li J, et al. Combined application of rhamnolipid and agricultural wastes enhances PAHs degradation via increasing their bioavailability and changing microbial community in contaminated soil. **Journal of Environmental Management** 2021; 294: 2836-2839.
[2] Asnachinda E, Khaodhiar S, Sabatini DA. Styrene and phenylethanol adsolubilization of a polymerizable Gemini surfactant. **Journal of Surfactants and Detergents** 2010; 13: 143-148.

Oral TIChE-BE-28

Nutrient release from struvite-biochar composites prepared by co-precipitation

Wasu Jantapa[1], Jesper T.N. Knijnenburg[2], Kaewta Jetsrisuparb[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Khon Kaen 40002, Thailand
[2] International College, Khon Kaen University, Khon Kaen 40002, Thailand
[*] Corresponding author: kaewta@kku.ac.th

ABSTRACT

Agriculture plays a crucial role in Thailand's economy. A major issue in agriculture is the overapplication of water-soluble chemical fertilizers, which results in environmental problems such as eutrophication. Because of their high surface area and abundant functional groups, biochars can improve fertilizer efficiency by retaining nutrients and enhancing soil fertility [1]. To improve the fertilizer value of biochar, this study aimed to enrich the biochar with struvite ($MgHPO_4{\cdot}6H_2O$), a poorly water-soluble compound that slowly supplies important plant nutrients (N, P and Mg) to crops throughout the growth season. To prepare the struvite-biochar composite, a biochar prepared from sugarcane filter cake and vinasses [2] was first modified with MgO and H_3PO_4. The Mg/P-modified biochar was then mixed with a NH^{4+} solution to induce struvite formation on the biochar, which was confirmed by X-ray diffraction and SEM analysis. The struvite-biochar composite had 2-4 times higher nutrient contents than the bare biochar (Table 1). Nutrient availability was assessed in DI water and 2% citric acid, which indicated that the nutrients are available to crops with minimal leaching risk. The nutrient release behavior was investigated in DI water; after 10 days, the struvite-biochar released 10-13% of its nutrients, which was higher than that of a commercial struvite (5-8%) and confirmed its slow-release performance. These results highlight the potential of struvite-biochar composite as nutrients source for plants with high nutrient contents and slow-release behavior.

Table 1 Total nutrients content in biochar.

Sample	P content (mg/g)	Mg content (mg/g)	N content (mg/g)
Biochar	18.4 ± 1.3	13.9 ± 0.5	10.4 ± 0.1
Mg/P-modified biochar	80.3 ± 4.8	51.2 ± 2.6	9.9 ± 0.0
Struvite-biochar	64.0 ± 0.4	40.3 ± 1.8	26.7 ± 0.4

Keywords: Biochar; Nitrogen recovery; Slow release; Struvite; Fertilizer

References

[1] Zhao C, Xu J, Bi H, Shang Y, Shao Q. A slow-release fertilizer of urea prepared via biochar-coating with nano-SiO_2-starch-polyvinyl alcohol: Formulation and release simulation. **Environmental Technology & Innovation** 2023; 1(32): 103264.

2. Suwanree S, Knijnenburg JTN, Ölçer EM, Jetsrisuparb K. Nutrient retention and availability of biochars prepared by co-pyrolysis of vinasse with sugarcane filter cake. **Journal of Metals, Materials and Minerals** 2024; 34(4): 2147-2147.

Poster **TIChE-BE-29**

Developing a deep neural network model to predict PM2.5 concentration based on key factors affecting air pollution in Bangkok

Natsuda Klinklan[1], Tanawut Poothong[1], Nuttiwut Areeratphitak[1], Viganda Varabuntoonvit[1,2,*]

[1] Chemical Engineering Department, Kasetsart University, Bangkok 10900, Thailand
[2] The Center of Excellence on Petrochemical and Materials Technology, Chulalongkorn University,
Bangkok 10330, Thailand
[*] Corresponding author: fengvgv@ku.th

ABSTRACT

PM2.5 is a major air pollution issue in Thailand, particularly in urban areas like Bangkok, where the 24-hour average concentration reached 179 μg/m^3 in April 2023. The primary source of PM2.5 in Bangkok is road transportation due to heavy traffic, accounting for 72.5% of PM2.5 emissions, according to a study by the Pollution Control Department. This study develops artificial neural network models to explore the relationship between vehicle count and PM2.5 mass concentration. Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) are used for vehicle detection and counting, while Long Short-Term Memory (LSTM) networks predict PM2.5 levels linked to road transport in urban areas. The dispersion of PM2.5 is also analyzed using the Fixed-Box Model, considering vehicle count, meteorological factors, and PM2.5 concentration. Data was collected from a monitoring station on Vibhavadi Rangsit Road, Din Daeng, Bangkok. The results show that the LSTM model can accurately predict PM2.5 levels, with an R^2 of 0.9453 and an RMSE of 0.4453. Compared to PM2.5 estimates from the Fixed-Box Model, the LSTM model shows about a 20% difference. When compared to actual measurements, the LSTM's predicted values are approximately 49.5% lower, consistent with the 50-70% contribution from land transport. This demonstrates the model's predictive effectiveness. The prediction model can be used to assess the source of PM2.5 from transportation, along with other models, to predict PM2.5 levels in Bangkok and support air quality management.

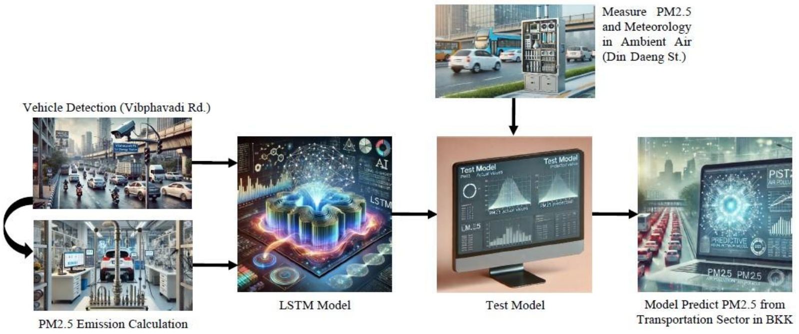


Fig. 1. Schematic diagram of research.

Keywords: Air pollution; PM2.5; Meteorological factors; Land transport; Deep neural network

References

[1] Chang X, Wang S, Zhao B, Xing J, Liu X, Wei L, et al. Contributions of inter-city and regional transport to PM2.5 concentrations in the Beijing-Tianjin-Hebei region and its implications on regional joint air pollution control. **Science of The Total Environment** 2019; 660: 1191-1200.

[2] **Pollution Control Department, Ministry of Natural Resources and Environment**. The project study on the origin sources and management methods of particulate matter not exceeding 2.5 microns in Bangkok Metropolitan Area, 2020.

Oral TIChE-BE-30

Numerical simulation of zinc ion migration in scaled-up electrokinetic remediation using COMSOL Multiphysics

Anis Ayuni Suied[1,*], **Saiful Azhar Ahmad Tajudin**[1,*], **Aziman Madun**[1], **Muhammad Nizam Zakaria**[2],
Muhammad Sazlan Abdul Kadar[3]

[1] Department of Civil Engineering, Faculty of Civil Engineering and Applied Built,
Universiti Tun Hussein Onn Malaysia
[2] Department of Civil Engineering and Architecture, Faculty of Science and Engineering, Saga University, Japan
[3] Faculty of Electrical and Electronics, Universiti Tun Hussein Onn Malaysia
[*] Corresponding author: saifulaz@uthm.edu.my, ayunisuied@gmail.com

ABSTRACT

Electrokinetic Remediation (EKR) is an effective technique for removing heavy metals from contaminated soil, yet its large-scale application remains challenging. This study employs COMSOL Multiphysics to simulate Zn ion migration in a scaled-up EKR system (1:3 ratio), addressing optimizing EKR under three different voltage gradients (0.5 V/cm, 1.0 V/cm, and 1.5 V/cm) as tabulated in Table 1.

Table 1 Experiment set up of EKR using COMSOL Multiphysics.

EKR set up	Voltage (Volts)	Applied current (Amp)
EKR at 0.5 V/cm	30	0.13
EKR at 1.0 V/cm	60	0.22
EKR at 1.5 V/cm	90	0.42

Based on the applied current, a finite element model integrating the Nernst-Planck equation, Ohm's law, and current density vector analysis was developed to predict Zn transport dynamics. To simulate results, reveal that 1.0 V/cm is the optimal voltage gradient, balancing Zn removal efficiency and energy consumption. At 0.5 V/cm, migration is insufficient, leaving Zn residues, while 1.5 V/cm accelerates transport but risks rapid electrolyte depletion and uneven ion distribution. The current density vector analysis confirms that controlled voltage application is critical for optimizing Zn mobility and remediation efficiency. This study demonstrates that numerical modeling is a powerful tool for scaling up EKR application, bridging laboratory findings with field implementation. The results provide a framework for optimizing voltage control strategies in real-world remediation projects. Future work should explore soil heterogeneity effects and alternative electrode configurations to enhance scalability.

Keywords: Electrokinetic remediation; COMSOL Multiphysics; Zinc migration; Numerical modeling; Voltage gradient; Soil remediation

Poster **TIChE-BE-31**

Enhanced air filtration with antibacterial cellulose composites: A sustainable solution for hospital environments

Sopanat Sawatdee[1], **Atcharaporn Botalo**[1], **Pisut Pongchaikul**[2], **Pattaraporn Posoknistakul**[1], **Boonya Charnnok**[3], **Navadol Laosiripojana**[4], **Kevin C.W. Wu**[5], **Chularat Sakdaronnarong**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[2] Chakri Naruebodindra Medical Institute, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Samut Prakan 10540, Thailand
[3] Department of Specialized Engineering, Energy Technology Program, Faculty of Engineering, Prince of Songkla University, Songkhla 90110, Thailand
[4] The Joint Graduate School of Energy and Environment (JGSEE), King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[5] Department of Chemical Engineering, National Taiwan University, Taipei 10617, Taiwan
[*] Corresponding author: chularat.sak@mahidol.ac.th

ABSTRACT

Air pollution and environmental issues have long posed significant challenges, particularly in hospital settings where airborne microorganisms, including bacteria and viruses, contribute to hospital-acquired infections (HAIs). To address this, air purification systems with antibacterial properties are continually being developed and optimized. This study explores the feasibility of utilizing cellulose derived from oil palm waste as an alternative filtration material owing to its abundance and rich cellulose content. In the present study, nanocellulose was produced under optimal conditions, additionally zeolitic imidazolate framework (ZIF-8) and nitrogen/sulfur doped carbon dots (NS/CDs@MSN) were synthesized and incorporated into the nanocellulose matrix as antibacterial additives. Composite cellulose-based filters were fabricated using a freeze-drying technique with tert-butyl alcohol (TBA) as a pore-inducing agent. The air filtering performance of the fabricated filters was evaluated using a six-stage cascade impactor at the Department of Internal Medicine in a hospital in Thailand (Fig. 1) [1]. The results demonstrated that filters incorporating ZIF-8 and NS/CDs@MSN exhibited excellent microbial retention capacity and effectively eliminated airborne microbes, outperforming the control filter. Furthermore, bacterial identification through MALDI-TOF/MS equipped with a pathogenic bacteria database revealed that trapped bacteria remained viable in the control filter, however they were completely eradicated in the antibacterial filter. This research highlights the potential of cellulose-based composite filters enhanced with ZIF-8 and NS/CDs@MSN, offering a sustainable and high-performance antibacterial filtration solution derived from oil palm empty fruit bunches.

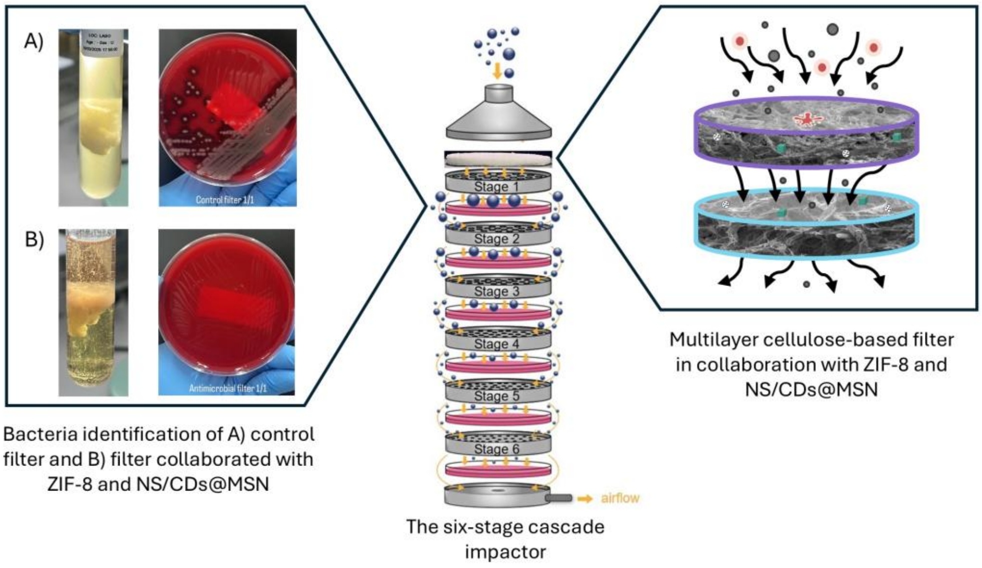


Fig. 1. Schematic illustration of six-stage cascade impactor [1] setup for airborne microbial retention in the hospital.

Keywords: Cellulose-based filter; ZIF-8; Nitrogen/sulfur dopped carbon dots; Mesoporous silica nanoparticles; Antibacterial activity; Hospital's pathogenic bacteria identification; MALDI-TOF/MS

References

[1] Kutter JS, de Meulder D, Bestebroer TM, Mulders A, Fouchier RAM, Herfst S. Comparison of three air samplers for the collection of four nebulized respiratory viruses - Collection of respiratory viruses from air. **Indoor Air** 2021; 31(6): 1874-1885.

Poster **TIChE-BE-32**

Sustainable synthesis of nanocellulose *via* enzymatic and mechanical treatments

Cholaphan Deeleepojananan[1], **Sopanat Sawatdee**[1], **Atcharaporn Botalo**[1],
Pattaraporn Posoknistakul[1], **Pisut Pongchaikul**[2], **Chularat Sakdaronnarong**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[2] Chakri Naruebodindra Medical Institute (CNMI), Faculty of Medicine Ramathibodi Hospital, Mahidol University, Samut Prakan 10540, Thailand
[*] Corresponding author: chularat.sak@mahidol.ac.th

ABSTRACT

Nanocellulose is an environmentally friendly alternative to plastic fibers due to its excellent biodegradability, biocompatibility, and mechanical properties [1]. However, the production of nanocellulose usually involves chemical treatments in order to achieve a substantial yield despite considerable environmental impacts [2]. Therefore, this ongoing study aims to synthesize nanocellulose from the valorization of industrial lignocellulosic waste materials through sustainable enzymatic and mechanical processes. Cellulose-rich industrial residues, including palm empty fruit bunch (EFB) and cassava pulp, are used as starting materials. Enzymatic pretreatments are employed for the removal of lignin and hemicellulose fractions from both EFB and pulp using laccase and xylanase, respectively. The pretreated materials then undergo enzymatic hydrolysis with cellulases, including cellulase from *Trichoderma reesei* and Cellic CTec2, with optimized pH, temperature, and reaction time. High-shear homogenization is subsequently implemented to mechanically defibrillate the cellulose obtained after hydrolysis and produce nanocellulose. The resulting product is expected to be highly biocompatible and suitable for utilization, especially in biomedical applications involving the fabrication of biodegradable hemodialysis membranes that facilitate the filtration of toxins and waste from the blood of patients with kidney failure while maintaining a low environmental impact.

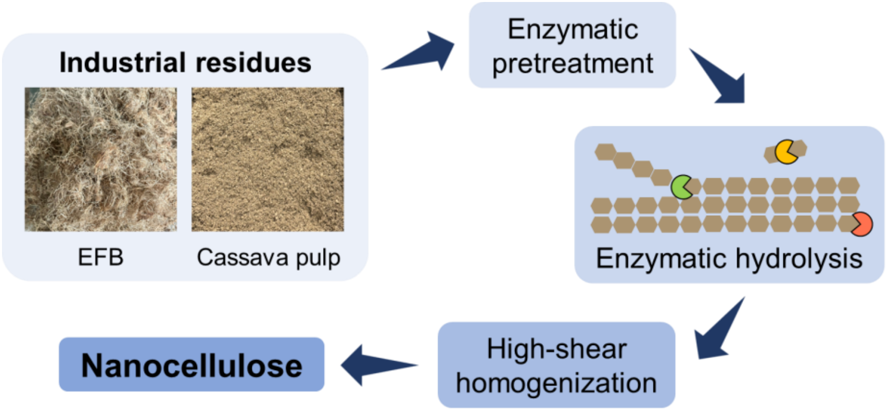


Fig. 1. An overview of sustainable synthesis of nanocellulose in this study.

Keywords: Nanocellulose; Waste valorization; Enzymatic hydrolysis; Mechanical defibrillation

References

[1] Thomas B, Raj MC, Joy J, Moores A, Drisko GL, Sanchez C. Nanocellulose, a versatile green platform: from biosources to materials and their applications. **Chemical Reviews** 2018; 118: 11575-11625.
[2] Mills TY, Sandoval NR, Gill RT. Cellulosic hydrolysate toxicity and tolerance mechanisms in *Escherichia coli*. **Biotechnology for Biofuels** 2009; 2: 26.

Poster **TIChE-BE-35**

Electrochemical sensors for residual organophosphate pesticide detection from pineapple leaf derived cellulose and nickel-containing composite

Supacharee Roddecha[1,2,*], Satawat Thumwong[1], Maythee Saisriyoot[1,2], Anusorn Seubsai[1,2], Paweena Prapainainar[1,2], Chalida Niamnuy[1,2], Manop Charoenchaitrakool[1,2], Kandis Sudsakorn[1,2], Sarawut Cheunkar[3], Supada Khonyoung[4]

[1] Department of Chemical Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
[2] Kasetsart University Research and Development Institute, Kasetsart University, Bangkok 10900, Thailand
[3] Biotechnology Division, School of Bioresources and Technology, King Mongkut's University of Technology Thonburi, Bangkok 10150, Thailand
[4] Department of Chemistry, Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand
[*] Corresponding author: fengsrro@ku.ac.th

ABSTRACT

According to the high toxicity of the widely used organophosphate pesticide for pest control, the inexpensive, high efficiency and users-friendly sensors for detecting this organophosphate pesticide are highly demanded. While Thailand, as the world's largest pineapple producer, discards tons of the waste pineapple leaves that are typically disposed by burning after harvesting each year. Hence, this work, we developed an electrochemical sensor for an ethyl paraoxon (EPO) detection based on the utilization of the wasted pineapple leaves in conjunction with the non-precious NiO electrocatalyst. The uniformly dispersed NiO nanoparticles on the conductive porous carbon substrate derived from the pineapple leaves and the affordable conductive carbon black was modified as the working sensing electrode. In addition, an analysis of the electrokinetic interaction of the EPO on the electrode surface suggested the significant role of the electron conductivity in the initial reduction to convert nitro group into hydroxylamine. This proposed electrochemical sensor could exhibit an acceptable LOD of 1.03 μM, providing available detection for the harmful level of paraoxon pesticide contaminant in the agricultural wastewater. Real samples testing in wastewater from different plantations, and tap water confirmed the sensor's practical utility, with recovery percentages ranging from ~77 to 99.9%.

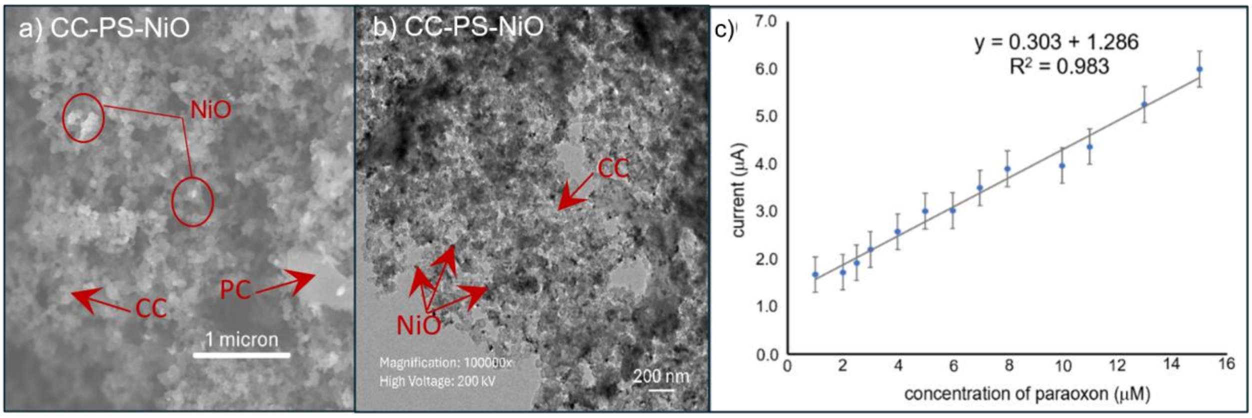


Fig. 1. Physical morphology and sensing performance of the electrochemical sensor modified by CC-PS-NiO composite: a) SEM image of the CC-PS-NiO composite, b) TEM image of the CC-PS-NiO composite and c) the calibration plot of the sensing electrode modified by the CC-PS-NiO electrocatalyst.

Keywords: Organophosphate pesticide; Cellulose based porous carbon; Pineapple leaf fiber; Electrochemical sensor

Refere`nces

[1] Sakdarat P, Chongsuebsirikul J, Thanachayanont C, Prichanont S, Pungetmongkol P. Development of a nonenzymatic electrochemical sensor for organophosphate pesticide detection using copper (II) oxide nanorod electrodes. **Journal of Nanomaterials** 2021; 2021: 1-11.

[2] Mohamed K, Haytham A, Craig B. Non-enzymatic electrochemical platform for parathion pesticide sensing based on nanometer-sized nickel oxide modified screen-printed electrodes. **Food Chemistry** 2018; 255: 104-111.

Oral TIChE-BE-36

Valorization of pineapple leaf fiber industry waste: Optimization of alkali pretreatment for fermentable sugar production

Khemmathin Lueangwattanapong[1], Kanyarat Thaithonglang[2], Jirapha Koonkonyang[2], Chanya Phromchaloem[2], Laksamee Muensritharam[2,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
[2] Faculty of Science and Technology, Muban Chom Bueng Rajabhat University, Ratchaburi 70150, Thailand
[*] Corresponding author: laksamee_biot@hotmail.com

ABSTRACT

Pineapples are one of the major agricultural exports in Southeast Asia, accounting for a significant portion of the global market. Since a pineapple plant only fruits once or twice in its lifetime, farmers need to clear out the remaining stems and leaves through pruning to return nutrients to soil or utilize the leaf fiber. Pineapple leaf fiber (PALF), consisting primarily of cellulose, can be used for handmade products, packaging, and reinforcing material. However, the process of extracting pineapple leaf fiber generates substantial solid waste which has yet to find promising applications beyond being left to dry on fields (producing greenhouse gases) or used as cattle feed. This study investigated the potential of waste from the pineapple leaf fiber industry for reducing sugar production using alkali pretreatment and enzymatic hydrolysis. The PALF waste was soaked in NaOH solutions of varying concentrations (0.1M, 0.15M, and 0.2M) at 121°C for 0.5 hours. The treated PALF waste was then hydrolyzed for sugar production using cellulase enzyme. Simple characterization was performed to determine total solids and volatile solids, while total sugar determination was conducted using the DNS (3,5-dinitrosalicylic acid) method. Results showed that the highest yield of total sugar was 90.27 g/L, obtained from PALF waste treated with 0.15M NaOH. Sugar was also detected during the pretreatment phase. Changes in volatile solids content could be used as an initial indicator of hemicellulose removal during alkali pretreatment. This work provides an alternative solution for PALF waste valorization through sugar production, offering both environmental and economic benefits to the pineapple industry in Southeast Asia.

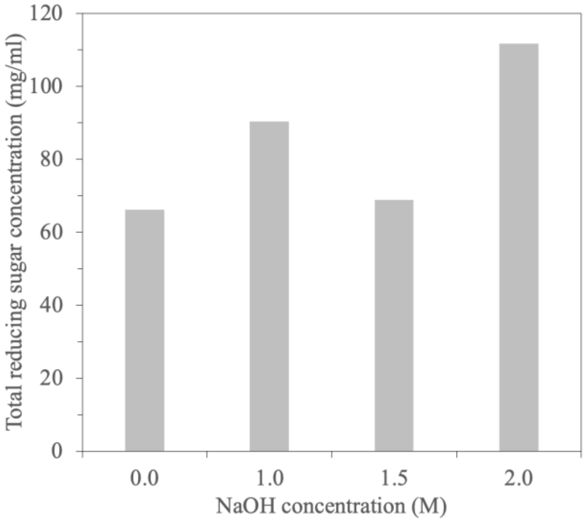


Fig. 1. Total reducing sugar concentration obtained from non-treated and alkali-treated PALF waste after enzymatic hydrolysis.

Keywords: Pineapple leaf fiber; Alkali pretreatment; Reducing sugar; Waste valorization

Oral TIChE-BE-37

Residue extraction on artificial knee surfaces using ultrasonic techniques

Thitima Naovong[1], **Aroonsri Nuchitprasittichai**[1], **Supunnee Junpirom**[1,*]

[1] School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology,
Nakhon Ratchasima 30000, Thailand
[*] Corresponding author: supunnee@sut.ac.th

ABSTRACT

The presence of residual contaminants on artificial knee surfaces poses potential risks to implant performance and patient safety. One technique to assess the level of residue is cleaning validation by extracting contaminants from the surfaces. This study investigates the efficiency of residue extraction using ultrasonic techniques on artificial knee components, including the femoral, tibial, and polyethylene inserts. Ultrasonic extraction was performed using 500 mL of solvent at temperatures ranging from 50°C to 80°C for durations of 10 to 60 minutes, as illustrated in Fig. 1. Residual analysis was conducted using Total Organic Carbon (TOC) measurement. The efficiency of extraction was evaluated using the spike recovery method. The optimal condition at each temperature did not exceed 30 minutes, with the femoral component exhibiting the highest level of residual contaminants compared to the tibial and polyethylene inserts. Spike recovery tests confirmed the method's reliability, with recovery rates exceeding 90%. These findings highlight the effectiveness of ultrasonic extraction as a reliable method for residue extraction, providing a foundation for enhancing cleaning validation processes in orthopedic implant manufacturing.

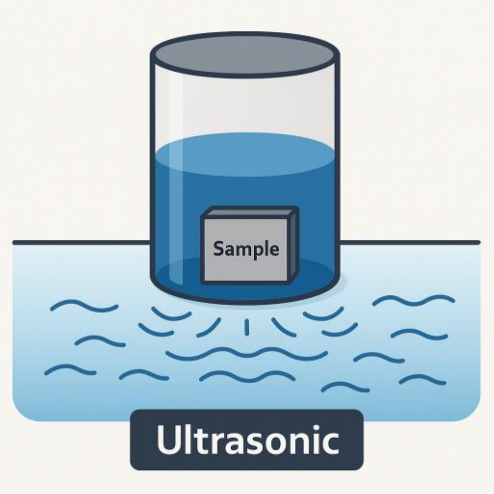


Fig. 1. Ultrasonic extraction setup for residue extraction.

Keywords: Artificial knee; Ultrasonic extraction; Cleaning validation; Residual; Total organic carbon

Oral **TIChE-CR-01**

Autonomous Lorentz force-powered chiral encoded metal rotors for enantioselective synthesis

Wanmai Srisuwanno[1,2], **Gerardo Salinas**[2], **Chularat Wattanakit**[1,*], **Alexander Kuhn**[1,2,*]

[1] School of Energy Science and Engineering, Vidyasirimedhi Institute of Science and Technology,
Rayong 21210, Thailand
[2] University of Bordeaux, CNRS, Bordeaux INP, ISM UMR 5255, 16 Avenue Pey Berland, Pessac 33607, France
[*] Corresponding author: chularat.w@vistec.ac.th, kuhn@enscbp.fr

ABSTRACT

Highly enantioselective synthesis of chiral compounds is enabled by chiral-encoded metals via an electrochemical approach. Breakthroughs in the synthesis of various chiral compounds, particularly pharmaceutical products, illustrate the versatility of such tailor-made materials [1]. Nevertheless, the application of chiral-encoded metals as autonomous redox catalysts is still unexplored and is anticipated to further push the boundaries of this field. Herein, Lorentz force-propelled chiral rotors are designed by combining chiral metal surfaces with reactive zinc to demonstrate the proof-of-concept for the enantioselective synthesis of chiral compounds, as illustrated in Fig. 1. The oxidation of Zn provides electrons and a fraction of the liberated electrons are transferred to a prochiral compound, leading to the asymmetric formation of a chiral compound. The magnetic field imposed perpendicular to the ion flux, generates a Lorentz force perpendicular to both the magnetic field and electron flux, facilitating spontaneous movement in the object [2]. This self-propulsion allows an enhanced production rate of chiral compounds, compared with a static system. This highlights promising perspectives in the general frame of heterogeneous redox catalysis.

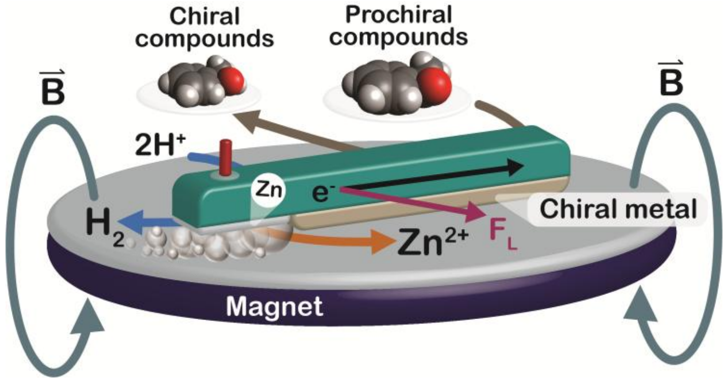


Fig. 1. General scheme of the Lorentz force-powered chiral rotors.

Keywords: Chiral encoded metals; Enantioselective synthesis; Autonomous swimmers; Redox conversion; Lorentz force

References

[1] Somsri S, Suwankaisorn B, Yomthong K, Srisuwanno W, Klinyod S, Kuhn A, Wattanakit C. Highly enantioselective synthesis of pharmaceuticals at chiral-encoded metal surfaces. **Chemistry–A European Journal** 2023; 29(61): e202302054.

[2] Salinas G, Kuhn A, Arnaboldi S. Self-sustained rotation of Lorentz force-driven Janus systems. **The Journal of Physical Chemistry C** 2023; 127(30): 14704-14710.

Oral **TIChE-CR-02**

Development of magnesium aluminate supported nickel catalyst in dry reforming of methane reaction

Pongsaporn Poosri[1], **Waleeporn Donphai**[1,2,*]

[1] KU-Green Catalysts Group, Department of Chemical Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
[2] Center for Advanced Studies in Nanotechnology for Chemical, Food and Agricultural Industries, KU Institute for Advanced Studies, Kasetsart University, Bangkok 10900, Thailand
[*] Corresponding author: fengwod@ku.ac.th

ABSTRACT

The dry reforming of methane (DRM) represents a highly promising technological approach for the efficient utilization of greenhouse gases, utilizing both methane (CH_4) and carbon dioxide (CO_2) as feedstocks. The resultant products of this reaction are commonly referred to as syngas, a composite of hydrogen and carbon monoxide gases [1]. This research focused on developing a magnesium aluminate-supported nickel catalyst to enhance syngas production in the DRM reaction. It specifically examined the effects of various total molar of magnesium (Mg) combined with alumina (Al) on the structure and properties of magnesium aluminate supports, designated as MA-x (where x = 0.02, 0.04, 0.08, and 0.12). The catalyst support was prepared by the co-precipitation method, with a molar ratio of Mg/Al of 0.50. Then, the nickel metal was loaded on the catalyst support by the impregnation method (Ni/MA-x), and the catalyst was tested in DRM at 700 °C. As a result, the Ni/MA-0.04 catalyst exhibited the highest CH_4 and CO_2 conversion compared to the other catalysts, as shown in Fig. 1. It could be explained that the Ni/MA-0.04 catalyst exhibited good nickel dispersion, which contributed to its effective catalytic performance. Furthermore, this catalyst showed the least carbon deposition, indicating excellent resistance to carbon formation.

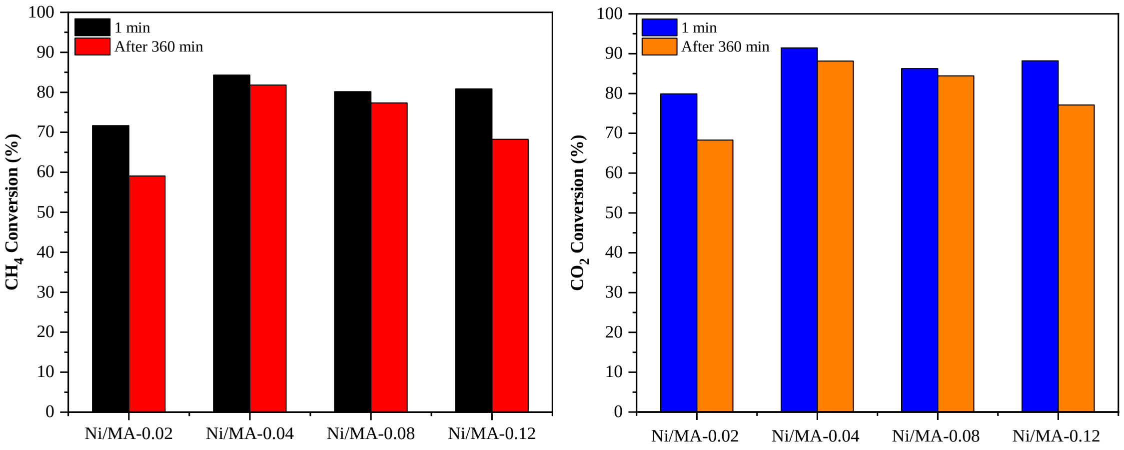


Fig. 1. CH_4 conversion (a) and CO_2 conversion (b) of the catalysts in DRM reaction at 700 °C.

Keywords: Magnesium aluminate; Nickel; Dry reforming of methane; Hydrogen; Coke resistance

References

[1] Pham CQ, Cao ANT, Phuong PTT, Pham LKH, Tran TTV, Trinh TH, Vo DVN, Bui TPT, Nguyen TM. Enhancement of syngas production from dry reforming of methane over Co/Al_2O_3 catalyst: Insight into the promotional effects of europium and neodymium. **Journal of the Energy Institute** 2022; 105: 314-322.

Oral TIChE-CR-03

Effect of graphene nanoplatelets addition during electroless plating of ABS on the properties of copper-nickel-chromium coated ABS

Wantana Chuakamhod[1], **Weerachon Tolek**[1], **Wasu Chaitree**[2], **Joongjai Panpranot**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok, 10330, Thailand
[2] Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University,
Nakorn Pathom 73000, Thailand
[*] Corresponding author: joongjai.p@chula.ac.th

ABSTRACT

Acrylonitrile Butadiene Styrene (ABS) with chromium coating is widely used in applications requiring high strength, durability, and aesthetic appeal, such as automotive parts, electronics, appliances, sanitary fixtures, and decorative consumer goods [1, 2]. Before electroplating, ABS undergoes nickel electroless plating to create a conductive base, traditionally relies on palladium (Pd), a costly material. This research explores reducing Pd usage by incorporating graphene nanoplatelets into the plating bath, enabling a decrease in Pd concentration from the industrial standard of 16-25 ppm to just 6 ppm with the addition of 15 mg/L of graphene nanoplatelets. The Ni-coated ABS achieved an electrical conductivity of 0.775 S/cm, while graphene nanoplatelets enhanced Pd dispersion, reduced agglomeration, and ensured a uniform nickel coating. SEM analysis revealed an optimal etched surface structure with appropriate porosity and grooves, preventing over-etching or insufficient etching, thereby improving Pd adhesion. The findings demonstrate that graphene nanoplatelets increases surface area and Pd uniformity, allowing for significant Pd reduction without compromising plating performance. This study presents a cost-effective and sustainable solution for industrial electroless nickel plating, reducing material costs while maintaining high-quality coatings.

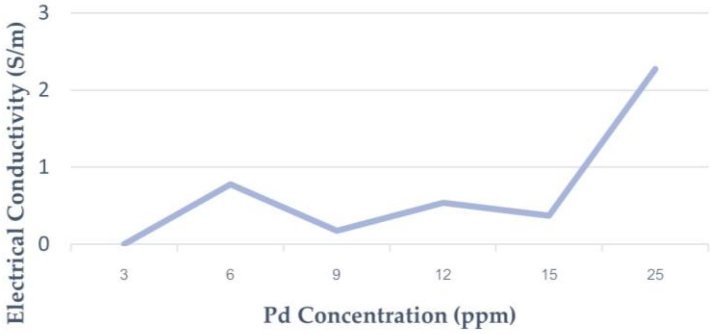


Fig. 1. Electrical conductivity of Ni-coated ABS prepared with different Pd concentrations in Ni electroless plating.

Keywords: ABS plastics; Electrical conductivity; Electroless nickel plating; Graphene oxide

References

[1] Alauddin SM, Ismail I, Zaili FS, Ilias NF, Aripin NFK. Electrical and mechanical properties of acrylonitrile butadiene styrene/graphene platelet nanocomposite. **Materials Today: Proceedings**, 2018; 5: S125-S129.

[2] Yousefi M, Salavati-Niasari M, Gholamian F, Ghanbari D, Aminifazl A. Polymeric nanocomposite materials: Synthesis and thermal degradation of acrylonitrile-butadiene-styrene/tin sulfide (ABS/SnS). **Inorganica Chimica Acta** 2011; 371(1): 1-5.

Oral TIChE-CR-04

Electrooxidation of glycerol on electrolessly deposited carbon-supported CoNiBi electrocatalysts

Wasu Chaitree[1,*], **Boorata Dechpisutthithum**[1], **Winrath Khrutchan**[1], **Muthita Kongroiyou**[1], **Chiwathan Srimangkorn**[1], **Ratthammanoon Sakulsinghdusit**[1], **Joongjai Panpranot**[2]

[1] Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Nakhon Pathom 73000, Thailand
[2] Center of Excellence on Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: chaitree_w@su.ac.th

ABSTRACT

An electrochemical oxidation reaction of glycerol (EOG) plays a crucial role in the sustainable conversion of energy. The reaction can provide valuable chemicals, which is used as starting materials/intermediates for several chemical processes. A high-efficient anode material is considered as a key important item for the reaction. Recently, multi-metallic compositions are used as electrocatalysts due to splendid electrochemical properties. This work aimed to study the reaction performance on CoNiBi electrocatalysts supported on carbon cloth (CC) for the electro-oxidation of glycerol. CoNiBi/CC was prepared via an electroless deposition method. The electrochemical performances of the electrocatalyst were carried out via cyclic voltammetry (CV), linear sweep voltammetry (LSV), and chronoamperometry techniques (CA). X-ray diffraction (XRD), scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDS) were also used to study the surface structure of electrocatalysts. The results showed that CoNiBi/CC prepared from $Bi(NO_3)_3$ at 6 mM provided the highest current density and the lowest onset potential according to LSV (Fig. 1) and CV results. Additionally, tri-metallic compositions (CoNiBi/CC) showed better catalytic performance than CoNi/CC and Ni/CC, respectively. Additionally, CoNiBi/CC was used as an anodic electrocatalyst in a H-cell reactor and the liquid products formed were analyzed by nuclear magnetic resonance spectroscopy (NMR). The result showed that the main liquid product on CoNiBi/CC was formate and the minor product was glycolate at 1.00 V vs Ag/AgCl for 2 h.

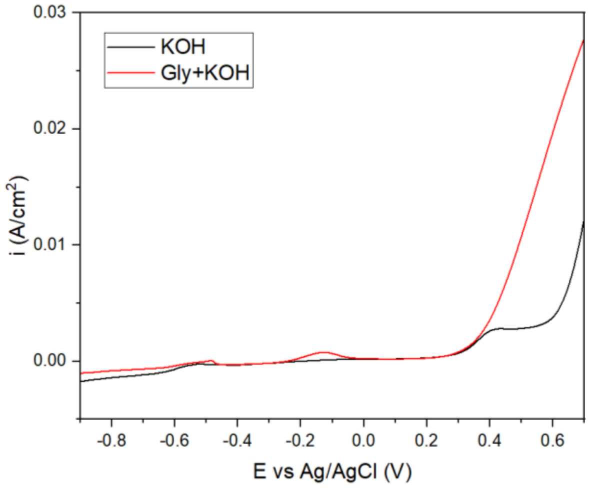


Fig. 1. Linear Sweep Voltammetry on CoNiBi_6mM/CC in 0.5 M KOH solution with the absence (black line) and presence (red lines) of 0.5 M glycerol (a scan rate = 1 mV/s).

Keywords: Electroless deposition; Glycerol electrooxidation; Cobalt; Nickel; Bismuth

Poster **TIChE-CR-05**

Valorization of biodiesel plant-derived glycerol for 1-propanol synthesis over zeolite-supported iridium and rhenium oxides

Chanoknun Kalvibool[1,2], **Supphathee Chaowamalee**[1,2], **Chawalit Ngamcharussrivichai**[1,2,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Center of Excellence in Catalysis for Bioenergy and Renewable Chemicals (CBRC), Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: chawalit.ng@Chula.ac.th

ABSTRACT

Selective hydrogenolysis of bio-based glycerol into 1-propanol (1-PO) as high value-added chemical is a promising solution to surplus glycerol from biodiesel production [1], as shown in Fig. 1. Hydrogenolysis, involving dehydration and hydrogenation [2], necessitates a heterogeneous catalyst with well-dispersed active metals, suitable acidity, and glycerol activation ability. In our group, a series of proton-form ultra-stable Y zeolite-supported iridium and rhenium oxides (Ir-ReO$_x$/HUSY) have been developed for 1-PO synthesis from glycerol. The effects of Ir : Re atomic ratio and HUSY modification on glycerol conversion and 1-PO yield are presented in this communication. Typically, Ir-ReO$_x$/HUSY was prepared via sequential incipient wetness impregnation, while the acidity modification of HUSY support was carried out through dealumination using mild acid solution. The reaction study revealed that the monometallic Re/HUSY catalyst facilitated only dehydration, leading to incomplete hydrogenolysis process, whereas the monometallic Ir/HUSY catalyst promoted both dehydration and hydrogenation, but with insufficient glycerol activation capability, resulting in a low glycerol conversion. The bimetallic Ir-ReO$_x$/HUSY with a 0.5:0.5 Ir: Re atomic ratio exhibited excellent catalytic performance, maximizing a 1-PO yield to 38.4% at 76.8% glycerol conversion. This result was attributed to the synergistic effect of Ir and ReO$_x$, which provided good dispersion of bimetallic sites and balanced acidity in terms of strength and amount, efficiently facilitating glycerol hydrogenolysis. Furthermore, using modified HUSY as support material significantly affected glycerol hydrogenolysis, while the catalyst performance was determined by concentration of acid solution used in dealumination. These findings emphasize the potential of Ir-ReO$_x$/HUSY as a promising catalyst for sustainable glycerol valorization.

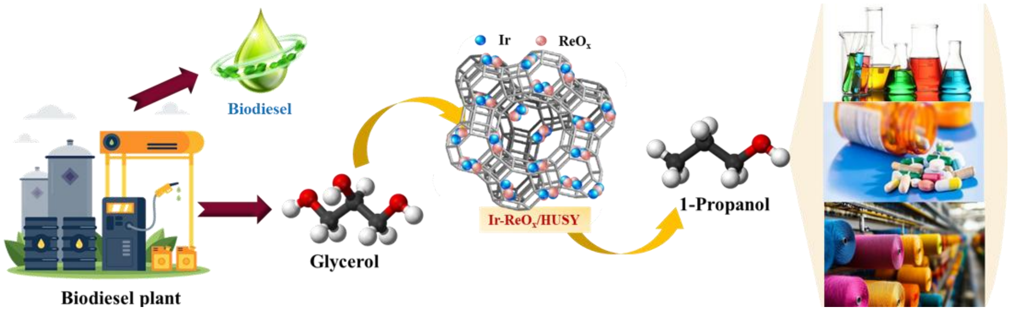


Fig. 1. Schematic of sustainable glycerol valorization to 1-propanol over Ir-ReO$_x$/HUSY catalyst.

Keywords: Glycerol hydrogenolysis; 1-Propanol; Iridium and rhenium catalysts

References

[1] Sun D, Yamada Y, Sato S, Ueda W. Glycerol hydrogenolysis into useful C3 chemicals. **Applied Catalysis B: Environmental** 2016; 193: 75-92.

[2] Nakagawa Y, Tomishige K. Heterogeneous catalysis of the glycerol hydrogenolysis. **Catalysis Science & Technology** 2011; 1(2): 179-190.

Poster TIChE-CR-06

CO_2 methanation using nickel-based catalysts over alumina-ceria support prepared by sol-gel method

Jitsinee Leetrakul[1], **Nuttaya Pongstabodee**[1,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: sangobtip.p@chula.ac.th

ABSTRACT

Since the industrial revolution, global greenhouse gas emissions, primarily CO_2, have increased significantly due to the extensive use of fossil fuels as the main energy source, resulting in substantial environmental impacts. To mitigate these issues, the development of CO_2 conversion technologies has become increasingly urgent. Among these technologies, CO_2 methanation, which converts CO_2 and H_2 into CH_4, is a promising process as it enables the completion of the CO_2 recycling route. Although CO_2 methanation is thermodynamically favored at low temperatures, it is hindered by significant kinetic barriers. Consequently, developing a catalyst with both high catalytic activity and selectivity at low temperatures remains a major challenge. Research indicates that nickel is one of the most promising active metals for this process due to its high catalytic activity and low cost [1]. However, nickel-based catalysts are prone to sintering, which reduces their long-term performance. To address this issue, Al_2O_3 is commonly used as a support to improve nickel dispersion [2], while the addition of ceria (CeO_2) can lower the reaction temperature due to its strong redox properties [3]. This research work then focuses on the development of nickel-based catalysts supported on alumina-ceria, synthesized via the sol-gel method, for CO_2 methanation. Initially, the optimal nickel loading was investigated using the wet impregnation method on synthesized Al_2O_3. Subsequently, the effect of support modification was examined by varying the Al:Ce molar ratio. The catalytic performance of all samples was evaluated in a fixed-bed reactor, with product analysis conducted using online gas chromatography. The results demonstrated that the $50Ni/Al_2O_3$-CeO_2 catalyst achieved a CO_2 conversion of 85% and CH_4 selectivity of 99%. The catalysts were further characterized by XRD, H_2-TPR, N_2 physisorption, and FESEM.

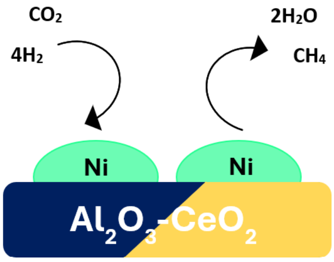


Fig. 1. Nickel based catalysts over alumina-ceria support.

Keywords: CO_2 methanation; Ni catalyst; Sol-gel; Ceria; Alumina

References

[1] Wang H, Wu J, Bao Y, Feng H, Liu J, Wang H. CO_2 methanation over Ni/Al_2O_3-ZrO_2 catalysts: Optimizing metal-oxide interfaces by calcinating-induced phase transformation of support. **Journal of Environmental Chemical Engineering** 2023; 11: 109538.

[2] He L, Ren Y, Yue B, Tsang SCE, He H. Tuning metal-support interactions on Ni/Al_2O_3 catalysts to improve catalytic activity and stability for dry reforming of methane. **Processes** 2021; 9: 706.

[3] Daroughegi R, Meshkani F, Rezaei M. Enhanced low-temperature activity of CO_2 methanation over ceria-promoted Ni-Al_2O_3 nanocatalyst. **Chemical Engineering Science** 2021; 230: 116194.

Poster TIChE-CR-07

Kaolin-based geopolymer as an alternative low-cost adsorbent for biodiesel purification

Aphirak Tharanuvet[1], Kanokwan Ngaosuwan[2,*], Worapon Kiatkittipong[3],
Doonyapong Wongsawaeng[4], Weerinda Appamana[5], Merika Chanthanumataporn[1],
Suttichai Assabumrungrat[1,6]

[1] Center of Excellence in Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Chemical Engineering Division, Engineering Faculty, Rajamangala University of Technology Krungthep, Bangkok 10120, Thailand
[3] Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Nakhon Pathom 73000, Thailand
[4] Research Unit on Plasma Technology for High-Performance Materials Development, Department of Nuclear Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[5] Departments of Chemical and Materials Engineering, Faculty of Engineering, Rajamangala University of Technology Thanyaburi, Pathum Thani 12120, Thailand
[6] Bio-Circular-Green-Economy Technology & Engineering Center, BCGeTEC, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: aphirak.th@gmail.com, kanokwan.n@mail.rmutk.ac.th

ABSTRACT

Kaolin-based geopolymer is a low-cost, environmentally friendly adsorbent for biodiesel purification via the dry washing process. This study explores two methods for transforming kaolin into a geopolymer adsorbent: (1) hydrothermal treatment, where kaolin is mixed with sodium hydroxide (NaOH) at 90°C for 24 hours and then calcined at 500°C for 6 hours, and (2) the fusion method, where kaolin is fused with NaOH at a high temperature for 15 hours, followed by dealkalization through washing with deionized water until neutralized. The synthesized geopolymers were characterized using X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), Brunauer–Emmett–Teller (BET) surface area analysis, and scanning electron microscopy (SEM). Adsorption performance was evaluated by purifying 100 mL of biodiesel at varying FAME concentrations (30%, 50%, and 70%) using 5 wt.% geopolymer. The mixture was stirred at 60°C, centrifuged, and analyzed via gas chromatography (GC) to determine the increase in biodiesel yield due to glycerol and excess methanol adsorption. Characterization results showed the presence of an amorphous phase in both geopolymers, confirmed by XRD, while FTIR spectra (400-4000 cm^{-1}) validated the formation of geopolymer from kaolin. SEM images revealed rough surface morphologies, and BET analysis showed that the specific surface areas of geopolymers synthesized by the hydrothermal and fusion methods were 6.82 m^2/g and 45.9 m^2/g, respectively. The larger surface area of the fusion-based geopolymer suggests a higher adsorption capacity for glycerol. The comparative performance of these methods in biodiesel purification is still under investigation, with final results to be reported upon completion. However, preliminary findings indicate that kaolin-based geopolymer is a promising adsorbent for biodiesel purification.

Keywords: Biodiesel purification; Kaolin; Geopolymer; Adsorbent; Dry washing

Oral TIChE-CR-08

A comparative study of commercial- and hydrothermal-synthesized TiO_2 nanoparticles for photocatalytic silver recovery from jewelry plating effluent

Midori Tanaka[1], **Auttawit Thoumrungroj**[1], **Pimchanok Longchin**[1], **Mali Hunsom**[1,2,3,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[2] Associate Fellow of Royal Society of Thailand (AFRST), Bangkok 10300, Thailand
[3] Advanced Microfabrication and Biomaterial for Organ-on-Chip Research Unit (AMBiO), Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[*] Corresponding author: mali.hun@mahidol.edu

ABSTRACT

Silver is extensively used in industry and usually discharged in processed effluent. Therefore, an effective process to recover silver is required in order to conserve mineral resources. Silver recovery photocatalysts use light to increase the extraction process's efficiency from wastewater. TiO_2 nanoparticles (NPs) are frequently used because of their capacity to produce reactive species when exposed to ultraviolet light. To recover silver ions from jewelry plating effluent using UV light irradiation, TiO_2 NPs were prepared in this work utilizing the hydrothermal process. The morphology and photocatalytic activity were compared with those of commercial TiO_2 NPs. The preliminary results demonstrated that the as-synthesized TiO_2 NPs had a low crystallinity and a small crystallite size in an anatase/brookite mixed phase. In addition, it had superior textural qualities and a lower bandgap value (3.08 eV) than the commercial one (3.21 eV). About 100% of the silver was recovered in 3 h using an as-synthesized TiO_2 NP, which was higher than the photocatalytic activity for silver recovery of the commercial one. Concentrations of hole scavenger and silver ions in effluent importantly affected the photocatalytic performance of an as-synthesized TiO_2 NPs.

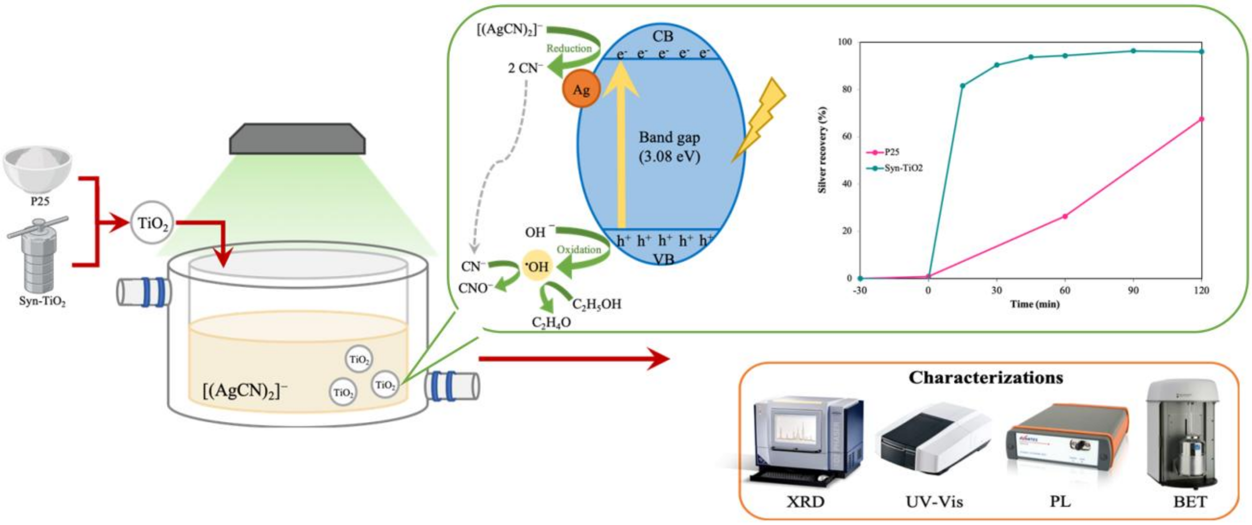


Fig. 1. Concept of this research.

Keywords: Photocatalyst; Titanium dioxide; Hydrothermal method; Silver recovery; Hole scavenger

Oral **TIChE-CR-09**

Photocatalytic silver recovery from cyanide-based plating effluent via TiO_2 nanoparticles synthesized by microwave-assisted method

Auttawit Thoumrungroj[1], **Pimchanok Longchin**[1], **Mali Hunsom**[1,2,3,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[2] Associate Fellow of Royal Society of Thailand (AFRST), Bangkok 10300, Thailand
[3] Advanced Microfabrication and Biomaterial for Organ-on-chip research unit (AMBiO), Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[*] Corresponding author: mali.hun@mahidol.edu

ABSTRACT

Titanium dioxide (TiO_2) is a common catalyst that is widely used in photocatalytic applications due to its high chemical and thermal resistance, low price and non-toxic. This work was conducted to test the feasibility of silver recovery from the cyanide-based plating effluent of jewelry industry by the photocatalytic process using two types of TiO_2; the commercial TiO_2 (CT) and synthesized TiO_2 by microwave-assisted method (MT). The preliminary results demonstrated that the CT sample illustrated the anatase-rutile mixed phase, while the MT sample possessed the anatase-brookite mixed phase. The MT sample exhibited a comparable bandgap value (~3.06 eV), lower crystallinity, higher BET surface area (~4.4 folds) than the CT sample. The MT sample exhibited a higher silver recovery rate than the CT sample in the presence of a hole scavenger at a low concentration (~10 vol.%) and comparable silver recovery rate in the presence of a high concentration of hole scavenger (~25 vol.%). Through the MT sample, the presence of $Na_2S_2O_3$ as an additive positively impacted the photocatalytic activity for silver recovery, while the presence of H_2O_2 had a negative impact. Approximately 94.74% of silver was recovered within 30 min in the presence of 0.05 mM $Na_2S_2O_3$. The application of Ag/MT was tested by hydrogen production and decolorization of distillery wastewater.

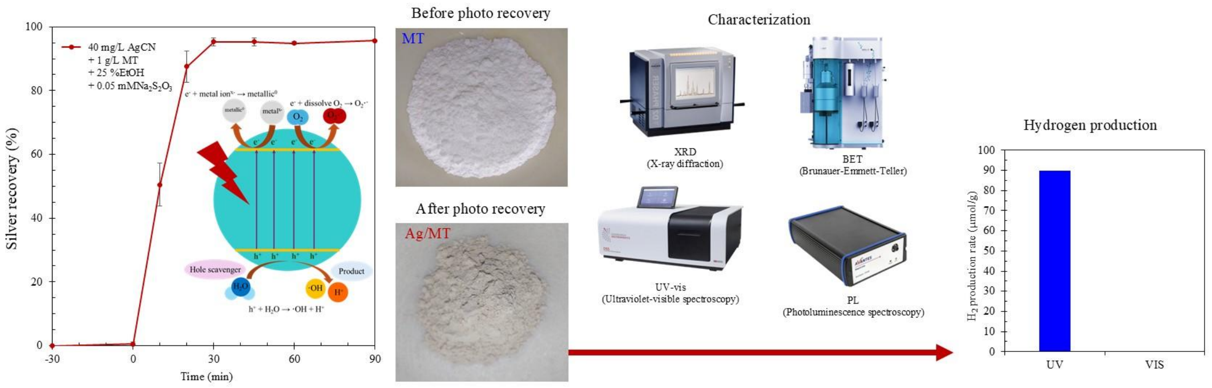


Fig. 1. Concept of this research.

Keywords: Photocatalyst; Titanium dioxide; Microwave synthesis; Metal recovery; Hole scavenger

Poster **TIChE-CR-10**

Effect of activation method on biochar supported nickel catalysts performance in steam reforming of biomass-derived tar

Nutcha Jirundorn[1], **Prapan Kuchontara**[1,2,3,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Center of Excellence on Petrochemical and Materials Technology, Chulalongkorn University,
Bangkok 10330, Thailand
[3] Center of Excellence in Catalysis for Bioenergy and Renewable Chemicals (CBRC), Chulalongkorn University,
Bangkok 10330, Thailand
[*] Corresponding author: prapan.k@chula.ac.th

ABSTRACT

Biochar derived from biomass pyrolysis has potential as a support for metal catalysts in tar reforming. However, the limited specific surface area and pore volume of biochar restrict its use as a catalyst support [1]. Activating biochar, particularly through chemical methods, can improve its surface properties. However, using harmful chemicals in the chemical activation raises sustainability concerns [2]. In contrast, physicochemical activation provides a more sustainable approach by minimizing the reliance on harmful chemicals through the use of oxidizing agents [3]. Therefore, this research focuses on the effect of different activation methods (physical, chemical, and physicochemical) on the catalytic performance of biochar-supported nickel catalysts in steam gasification. Additionally, the effect of processing parameters, including the KOH to char ratio and pyrolysis temperature on gas yield in tar steam reforming. The gasification was carried out in a two-stage fixed bed reactor. The first stage was the pyrolysis process, which varied the temperature (600, 700, or 800 °C), while the temperature of the second stage, the tar reforming zone, was kept at 700 °C. Steam was introduced into the second zone at a flowrate 0.3 mL/min. The mass ratio of biomass feed to catalyst was kept constant at 1:2 (g/g). Activated biochar was characterized using BET, SEM, and FTIR. Ni-loaded biochars were characterized by XRD. Gas products were analyzed by GC. The results indicate that the Ni-loaded physiochemically activated biochar achieved the highest gas yield (20.66 mmol/g of biomass), maximum hydrogen generation (9.63 mmol/g of biomass), and maximum hydrogen selectivity (54.90%) at 700 °C.

Keywords: Activated biochar; Physicochemical activation; Tar reforming; Gasification

References

[1] Zhang M, Liu N, Wu Y, Fan G, Yang M, Li X. Tar removal in pine pyrolysis catalyzed by bio-char supported nickel catalyst. **Journal of Analytical and Applied Pyrolysis** 2023; 169: 105843.

[2] Farooq A, et al. Catalytic steam gasification of food waste using Ni-loaded rice husk derived biochar for hydrogen production. **Chemosphere** 2021; 280: 130671.

[3] Adlak K, Chandra R, Vijay VK, Pant KK. Physicochemical activation and palletisation of *Azadirachta indica* wood carbons for increased biomethane adsorbed energy storage. **Journal of Analytical and Applied Pyrolysis** 2021; 155: 105102.

Oral **TIChE-CR-11**

Double perovskite enhanced with exsolved Ni-Co particles in $Sr_{1.95}TiMo_{1-x}(NiCo)_xO_{6-\delta}$ as anode for direct-fed ammonia solid oxide fuel cell

Solida Oun[1], **Pattaraporn Kim**[1,*]

[1] Center of Excellence on Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Bio-Circular-Green Economy Technology & Engineering Center, BCGeTEC, Faculty of Engineering, Chulalongkorn
University, Bangkok 10330, Thailand
* Corresponding author: pattaraporn.k@chula.ac.th

ABSTRACT

Ammonia has gain attention as a promising fuel for solid oxide fuel cell due to its high energy density, carbon-free hydrogen, and easier storage. Herein, an innovative double perovskite $Sr_{1.95}TiMoO_{6-\delta}$ (STM) is designed by integrating the unique properties of $SrTiO_3$ and $SrMoO_3$, with A-site deficiency introduced using the sol-gel method to enhance anode performance. In this study, NiCo particles are in situ exsolved from the parental STM to improve surface active sites, demonstrating a better catalytic activity for the ammonia cracking reaction and sintering resistance [1, 2]. This is achieved by optimizing the NiCo doping amount in $Sr_{1.95}TiMo_xNiCo_{1-x}O_{6-\delta}$ ($x = 0.1$, 0.2 and 0.3) under 5%H_2-95%N_2 at 800 °C for 5 hours, as confirmed by XRD, SEM-EDX, TEM and XPS analyses. The phase transition and the exsolution of the particles are investigated by X-ray diffraction, Transmission electron microscope. In addition, the performance of direct-fed SOFC cells is evaluated under varying NH_3/N_2 ratio with a total flowrate of 50 ml/min, while ambient air is introduced to the cathode at a flowrate 50 ml/min. This evaluation is conducted at different temperature ranging from 600 °C - 800 °C under an applied voltage (open-circuit voltage - 1.2V). Electrochemical impendence spectroscopy (EIS) is employed to identify the surface electrode exchange and the rate-limiting steps in NH_3-fed SOFC operation. The resistance of these steps can either decrease or increase due to the in situ exsolve NiCo particles from $Sr_{1.95}$ $TiMo_xNiCo_{1-x}O_{6-\delta}$ anode, depending on their distribution and impact on the electrode reaction. Consequently, this also reflects higher catalytic activity or improved stability.

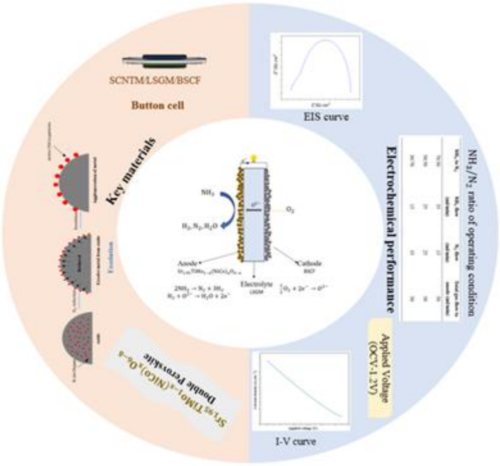


Fig. 1. Concept of this research.

Keywords: $Sr_{1.95}TiMo_xNiCo_{1-x}O_{6-\delta}$ anode; Double perovskite; Exsolution; Solid oxide fuel cell

References

[1] Kim YH, Jeong H, Won BR, Jeon H, Park CH, Park D, et al. Nanoparticle exsolution on perovskite oxides. Insights into mechanism, characteristics and novel strategies. **Nano-Micro Letters** 2023; 16(1): 33.

[2] Shu L, Sunarso J, Hashim SS, Mao J, Zhou W, Liang F. Advanced perovskite anodes for solid oxide fuel cells: A review. **International Journal of Hydrogen Energy** 2019; 44(59): 31275-31304.

Poster **TIChE-CR-14**

Optimization of biodiesel production from waste cooking oil via transesterification using calcium oxide catalyst

Pornsawan Assawasaengrat[1,*], **Natthapol Nakbun**[1], **Wasan Chokelarb**[1], **Pongsert Sriprom**[2]

[1] Department of Chemical Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
[2] Program of Food Process Engineering, School of Food Industry, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
* Corresponding author: pornsawan.as@kmitl.ac.th

ABSTRACT

Biodiesel is primarily derived from vegetable oils, animal fats, and cooking oils. When these materials react with alcohol and use acids, bases, or enzymes as catalysts, biodiesel is produced by two main reactions: esterification and transesterification [1]. Among these, acid- or base-catalyzed transesterification is the most used technique because it is cost-effective and easy to implement [2]. This research aims to study the optimization of biodiesel synthesis from waste cooking oil via transesterification using calcium oxide catalyst. The experiment was created by a Box-Behnken design. The variables affecting the transesterification reaction included temperature (60 - 70 ˚C), methanol percentage (30 - 50% v/v), calcium oxide catalyst (0.856 - 1.712% wt./v), and reaction time (120 -240 min). After that, the chemical and physical properties were analyzed. The optimum reaction condition was a temperature of 70 ˚C, a reaction time of 240 min, methanol of 50% v/v, and calcium oxide catalyst of 1.712 %wt./v. In this condition, the highest yield of biodiesel was 99.20%. The functional groups of the biodiesel structure were analyzed by FTIR. The results showed that the C=O (Stretching) of the ester in triglyceride was found at a peak of 1743 cm-1. The presence of the C-H (Bending) bond of the methylene group (CH_2) and the methyl group (CH_3) were found at peak 1466 cm^{-1} and peak 1438 cm^{-1}, respectively, indicating that the product was actual biodiesel. The physical properties of biodiesel were analyzed and found that the viscosity at 40 ˚C was 5.78 cSt, the acidity was 0.22 mg KOH/g, the water content was 0.0745% wt., the density at 15 ˚C was 0.891 g/cm^3, and the flashpoint was at 170 ˚C.

Keywords: Biodiesel; Transesterification; Waste cooking oil; Calcium oxide

References

[1] Pavlović SM, et al. A CaO/zeolite-based catalyst obtained from waste chicken eggshell and coal fly ash for biodiesel production. **Fuel** 2020; 267(1): 117-171.
[2] Marinković DM, et al. Calcium oxide as a promising heterogeneous catalyst for bio-diesel production: Current state and perspectives. **Renewable and Sustainable Energy** 2016; 56: 1387-1408.

Poster **TIChE-CR-15**

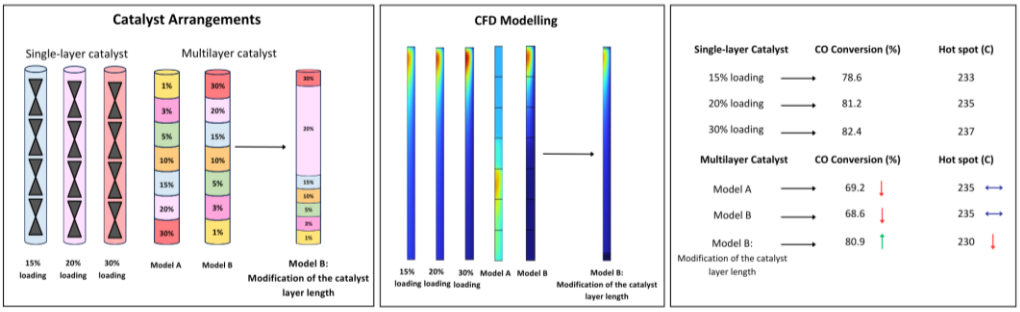
Effect of catalyst bed configuration on temperature profile and reactor performance for Fischer-Tropsch synthesis: A computational fluid dynamic simulation

Natthasit Khawyen[1], **Lida Simasatitkul**[2,*], **Suwimol Wongsakulphasatch**[3], **Sakhon Ratchahat**[4], **Suttichai Assabumrungrat**[1,5]

[1] Center of Excellence in Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Department of Industrial Chemistry, Faculty of Applied Science, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand
[3] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok 10800, Thailand
[4] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[5] Bio-Circular-Green-economy Technology & Engineering Center (BCGeTEC), Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
* Corresponding author: lida.s@sci.kmutnb.ac.th

ABSTRACT

Reactor performance and catalyst stability are significantly impacted by the extremely exothermic reaction of Fischer-Tropsch synthesis (FTS) that results in hot spot formation. In this regard, the arrangement of catalyst could change a temperature profile within the reactor and reduce hot spot effect. This study investigates the performance analysis of a single-layer (i.e., 15%, 20%, and 30% loading) and multilayers (varying at 1% to 30% loading) of the catalytic fixed-bed reactor for the Fischer-Tropsch synthesis (FTS) by using a spiral-structured Co/SiO_2 catalyst. A simulation model of a fixed-bed reactor with a 1 cm of diameter and a 25 cm of catalyst zone is developed using COMSOL Multiphysics. The inlet temperature and pressure are operated at 220 ˚C and 20 bar respectively. The results showed that the spiral-structured Co/SiO_2 catalyst was employed, offering advantages in heat distribution and removal. The single-layer catalytic beds with 15%, 20%, and 30% catalyst loadings show hot spot temperatures of 240 ˚C to 233 ˚C, 235 ˚C, and 237 ˚C, respectively. The arrangement of multilayered catalytic bed reactor is proposed (Model A, increasing catalyst loading from 1% to 30%, and Model B decreasing from 30% to 1%). The results showed that multilayered catalytic bed arrangement in Model B can significantly enhance FT reactor performance by reducing the hotspot to 230 ˚C and improving a CO conversion efficiency to 80.9% ,as shown in Figure 1.



Single-layer Catalyst	CO Conversion (%)	Hot spot (C)
15% loading	78.6	233
20% loading	81.2	235
30% loading	82.4	237
Multilayer Catalyst	**CO Conversion (%)**	**Hot spot (C)**
Model A	69.2 ↓	235 ↔
Model B	68.6 ↓	235 ↔
Model B: Modification of the catalyst layer length	80.9 ↑	230 ↓

Fig. 1. Overview of the research.

Keywords: Fischer-Tropsch synthesis (FTS); CFD simulation; Cobalt structured catalyst; Hot spot; Multilayer catalytic bed

References

[1] Aurud P, Srifa A, Koo-Amornpattana W, Assabumrungrat S, Wongsakulphasatch S, et al. The improvement of heat transfer using Co/SiO_2 spiral structured catalyst for green diesel production by Fischer-Tropsch synthesis. **Scientific Reports** 2024; 14(1), 19782.

Oral TIChE-CR-16

Simulation of dry and steam reforming of methane over a nickel-based catalyst in a fixed-bed tube reactor using COMSOL

Krissadang Khamma[1], **Asawin Meechai**[1], **Suwimol Wongsakulphasatch**[2], **Paritta Prayoonyong**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi,
Bangkok 10140, Thailand
[2] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology
North Bangkok, Bangkok 10800, Thailand
* Corresponding author: paritta.boom@gmail.com

ABSTRACT

At present, most of the world's synthesis gas (syngas), composed of carbon monoxide (CO) and hydrogen (H_2), originates from methane reforming. Syngas is a crucial feedstock in the chemical industry for producing various chemicals. This study presents a mathematical model of methane steam reforming and methane dry reforming in a 25 cm nickel-based catalytic fixed-bed tubular reactor, which is equipped with a counterflow air heat exchanger house in a small tube within the reactor. The simulation, conducted using COMSOL Multiphysics, analyzes the effects of operating conditions on product yield, composition, temperature and concentration profiles, and the optimization of process parameters. The inlet temperature is set between 700-1000 K, with pressures ranging from 1-50 bar. The results indicate that steam reforming primarily produces hydrogen, whereas dry reforming predominantly yields carbon monoxide. Both reactions exhibit high efficiency at high temperatures and low pressures due to their endothermic nature and gas expansion characteristics. The 3D velocity profile analysis reveals that the flow velocity increases along the reactor length. Regarding concentration profiles, the reactant concentration is lowest at the reactor center and increases toward the near-wall region (Fig. 1.), while the opposite trend is observed for product concentration due to enhanced reaction efficiency at high temperatures in the middle of the reactor. The optimal conditions for steam reforming were found to be 900 K at 1 atm, achieving a conversion of 95.5%, while for dry reforming, the optimal conditions were 1000 K at 1 atm, with a conversion of 89%.

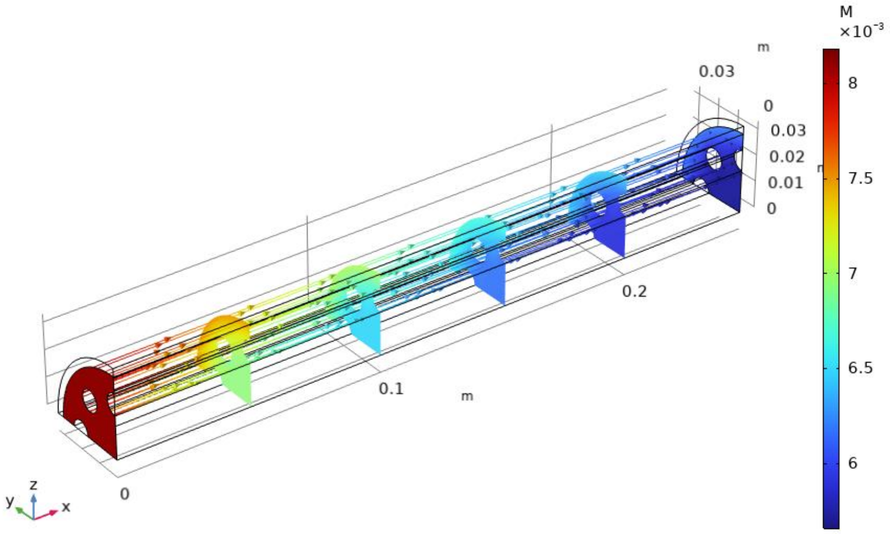


Fig. 1. Molar concentration profile of CH_4 of dry reforming along the fixed bed tube reactor at 1bar and 700 K.

Keywords: Methane reforming; COMSOL; Nikel-based catalyst

Oral TIChE-CR-17

Promotional effect of Fe in the Cu/TiO_2 catalyst on the liquid-phase selective hydrogenation of furfural to furfuryl alcohol

Jenjeera Sathukan[1], Luksiga Noomsalee[1], Chadaporn Jirawantanasakun[1], Menisa Choochuen[1], Choowong Chaisuk[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Nakhon Pathom 73000, Thailand
* Corresponding author: chaisuk_c@su.ac.th

ABSTRACT

Copper chromite is a commercially used catalyst for producing furfuryl alcohol (FOL) through the selective hydrogenation of furfural (FAL), but it is highly toxic to the environment. The development of Cu-based catalysts without Cr has been investigated. Fe was an interesting promoter due to the synergistic effect between Fe sites with a strong oxophilic nature and Cu sites with a high ability for hydrogen activation [1]. In this work, Fe with varying contents was impregnated onto a 10 wt% Cu/TiO_2 catalyst, and the Cu content was subsequently varied to 5 - 20 wt%, while maintaining a suitable ratio of Fe to Cu. The catalysts were characterized using the X-ray diffraction, N_2 physisorption, temperature-programmed reduction and N_2O decomposition. The furfural hydrogenation was conducted under 20 bar of hydrogen at 160 °C for 2 h in isopropanol solvent. The BET surface area was decreased by about 30% when Fe was added at high loadings (1, 2, and 5 wt%). The presence of Fe had little effect on the pore characteristics of the catalysts and the crystalline sizes of the CuO particles. The reduction temperature of the catalysts shifted to higher temperatures with increasing the Fe loadings. The 2 wt% Fe content was optimal for achieving a high yield of furfuryl alcohol, as shown in Fig. 1., which is consistent with the high Cu active sites measured by N_2O decomposition. By fixing the Fe to Cu ratio at 1:5 and varying the Cu content, the 10 wt% Cu - 2 wt% Fe/TiO_2 catalyst was promising.

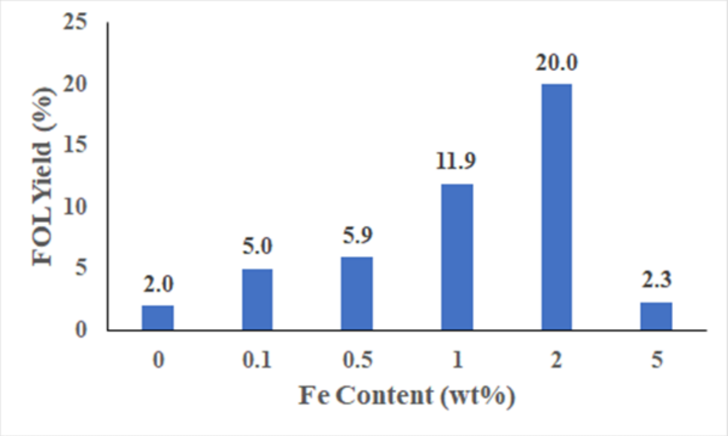


Fig. 1. Effect of Fe content in 10 wt% Cu/TiO_2 catalyst on the yield of furfuryl alcohol during the selective hydrogenation of furfural.

Keywords: Furfural hydrogenation; Furfuryl alcohol; Cu/TiO_2 catalyst; Fe promoter

References

[1] Manikandan M, Venugopal AK, Nagpure AS, Chilukuri S, Raja T. Promotional effect of Fe on performance of supported Cu catalyst for ambient pressure hydrogenation of furfural. **RCS Advances** 2016; 5: 3888-3898.

Poster TIChE-CR-18

Study on epoxidation of vegetable oil using different acidic ion-exchange resins

Patiphan Palachote[1], **Ornsiripim Siriphat**[1], **Naseerat Khunmathurot**[1], **Anusorn Seubsai**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
Corresponding author: fengasn@ku.ac.th

ABSTRACT

The increasing demand for plastics has raised concerns about the depletion of limited resources. Vegetable oils are interesting as an alternative resource, as their unsaturated fatty acids, such as oleic acid, linoleic acid, and linolenic acid, contain double bonds that can be oxidized to epoxy groups. This work explores the epoxidation reaction through the Prilezhaev epoxidation, which is the most widely used in industrial applications, as shown in Fig. 1. [1]. The epoxidation process used canola oil as a representative of the vegetable oil. Various acidic ion-exchange resins with different ion-exchange capacities, including Amberlite IRC120, Amberlyst 15, and NKC-9, were used as catalysts in the epoxidation process. The highest epoxy value achieved was 6 h using Amberlyst-15 0.35 mol/100 g of canola oil as determined by titration. The kinetic study showed that the reaction follows a pseudo-first-order model. Thermodynamic values, including enthalpy, entropy, and Gibbs free energy, will be presented. This study shows an alternative approach to preparing monomers for preparing epoxy resin, one of the essential components in many applications.

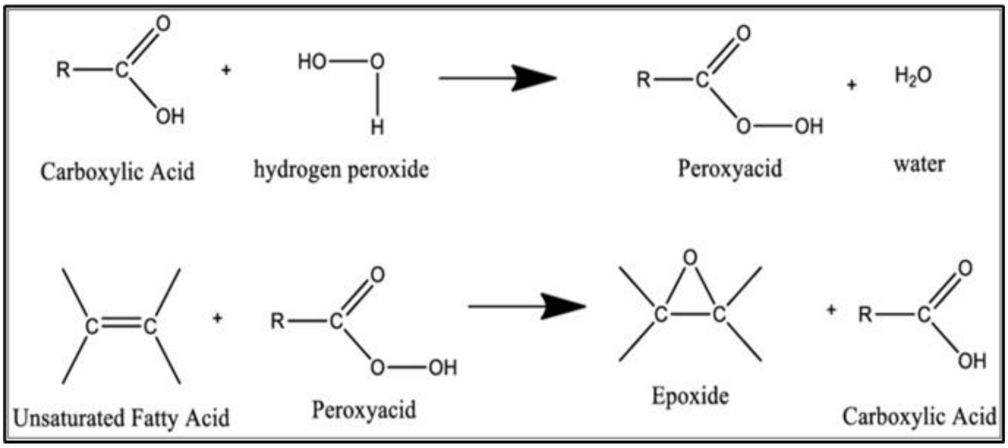


Fig. 1. Prilezhaev reaction for epoxidation of unsaturated fatty acid.

Keywords: Vegetable oils; Ion-exchange resin; Epoxidation; Epoxy value

References

[1] Raofuddin DNA, Azmi IS, Jalil MJ. Catalytic epoxidation of oleic acid derived from waste cooking oil by in situ peracids. **Journal of Polymers and the Environment** 2024; 32: 803-814.

Poster **TIChE-CR-19**

Photocatalytic activity of N, S-CQDs/TiO_2 composites for the degradation of methylene blue (MB) under visible-light irradiation

Thanyapak Akkharaamnuay[1], **Okorn Mekasuwandumrong**[2], **Joongjai Panpranot**[1,*]

[1] Center of Excellence on Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University,
Nakorn Pathom 73000, Thailand
* Corresponding author: joongjai.p@chula.ac.th

ABSTRACT

Water pollution occurs when harmful substances contaminate water environments. Among the prominent contributors to this issue are dyes, originating predominantly from industrial sectors such as textiles, using complex compounds like methylene blue (MB) [1]. In this work, N and S co-doped carbon quantum dots (N, S-CQDs)/titanium dioxide (TiO_2) were used to eliminate MB from water via photodegradation reaction under visible light. N, S-CQDs were synthesized via hydrothermal reaction using glycine as a precursor and ammonium sulfate as N and S source. TiO_2 was synthesized via a sol-gel method using titanium tetra-isopropoxide (TTIP). The SEM-EDX analysis confirmed the presence of C, O, S, N, and Ti as the primary elements in the composites. Moreover, TEM shows the lattice space of both N, S-CQDs and TiO_2 at 0.21 nm and 0.33 nm, corresponding to (1120) plane of graphene and (110) plane of TiO_2, respectively. Incorporating N, S-CQDs into TiO_2 boosts the photodegradation efficiency under visible-light for 150 min from 41% to 70% as shown in Fig. 1. The optimum amount of N, S-CQDs was determined to be around 1 wt%.

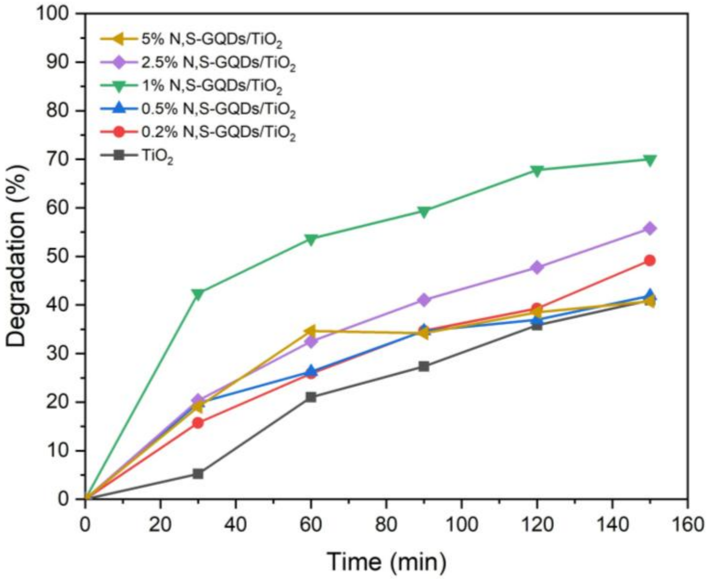


Fig. 1. Photodegradation activity of methylene blue using N, S-CQDs/TiO_2 composites.

Keywords: Methylene blue; Titanium dioxide; Photodegradation

References

[1] Periyasamy AP. Recent advances in the remediation of textile-dye-containing wastewater: prioritizing human health and sustainable wastewater treatment. **Sustainability** 2024; 16(2): 495.

Oral **TIChE-CR-20**

Development of core-shell $LaNi_{0.8}Fe_{0.2}O_3$ catalysts with $CeZrO_2$ shells for carbon-resistant dry reforming of methane

Suchayamon Kaewprasert[1], **Merika Chanthanumataporn**[1,2,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Center of Excellence in Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
* Corresponding author: merika.c@chula.ac.th

ABSTRACT

The primary challenge in the dry reforming of methane (DRM) is the deactivation of Ni-based catalysts due to carbon deposition, primarily induced by metal sintering. Ni-Fe bimetallic perovskites have gained attention for hydrogen production, with $LaNi_{0.8}Fe_{0.2}O_3$ exhibiting a higher H_2/CO ratio than $LaNiO_3$. This enhancement results from Fe doping, which increases the amount of lattice oxygen, facilitating its participation in the reaction to promote hydrogen formation while also preventing coke deposition through continuous oxygen release. Additionally, zirconia-doped ceria enhances oxygen storage capacity, oxygen mobility, and thermal resistance. Moreover, core-shell structured catalysts have emerged as promising coke-resistant materials with improved sintering resistance by encapsulating active metal sites. This study aims to investigate the catalytic performance of core-shell $LaNi_{0.8}Fe_{0.2}O_3@CeO_2$ and $LaNi_{0.8}Fe_{0.2}O_3@Ce_{0.95}Zr_{0.05}O_2$ catalysts for DRM in terms of activity and carbon resistance. $LaNi_{0.8}Fe_{0.2}O_3$ will be synthesized via the sol-gel method as the core, while CeO_2 and $Ce_{0.95}Zr_{0.05}O_2$ shells will be prepared via precipitation. Prior to testing, both catalysts will be reduced in situ under 50% H_2-N_2 (60 mL/min) at 700 °C for 1 hour to generate active particles. Catalytic activity will be evaluated at 600 °C using CH_4/CO_2 (3:2) with a WHSV of 7.5 $L{\cdot}h^{-1}{\cdot}gcat^{-1}$. XRD will be used to analyze phase composition, while TEM-EDX will be conducted to examine morphology and elemental distribution. N_2 adsorption-desorption will be employed to determine surface area and porosity. Finally, carbon deposition on the spent catalysts will be assessed using TGA.

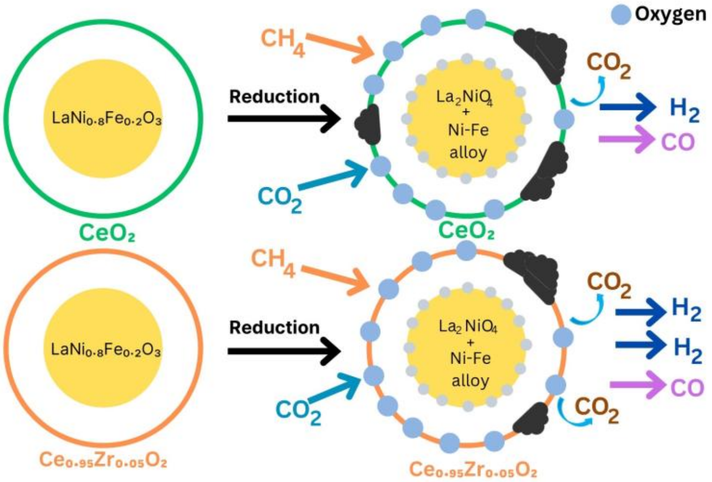


Fig. 1. Schematic illustration of core-shell $LaNi_{0.8}Fe_{0.2}O_3$ catalysts for carbon-resistant dry reforming of methane.

Keywords: Core-shell catalyst; Perovskite; Dry reforming of methane; Oxygen mobility; Carbon deposition inhibition

References

[1] Das S, Jangam A, Jayaprakash S, Xi S, Hidajat K, Tomishige K, Kawi S. Role of lattice oxygen in methane activation on Ni-phyllosilicate@$Ce_{1-x}Zr_xO_2$ core-shell catalyst for methane dry reforming: Zr doping effect, mechanism, and kinetic study. **Applied Catalysis B: Environmental** 2021; 282: 119998.

[2] Liu C, Li S, Chen D, Xiao Y, Li T, Wang W. Hydrogen-rich syngas production by chemical looping steam reforming of acetic acid as bio-oil model compound over Fe-doped $LaNiO_3$ oxygen carriers. **International Journal of Hydrogen Energy** 2019; 44(37): 17732-17744.

Oral **TIChE-CR-21**

Integrated absorption-mineralization

Wannida Lilathanakiad[1], **Palang Bumroongsakulsawat**[2], **Chalida Klaysom**[1,*]

[1] Center of Excellence in Particle and Material Processing Technology, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Center of Excellence on Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
* Corresponding author: chalida.kl@chula.ac.th

ABSTRACT

This work is a new and exciting technology that aims to capture and convert CO2 into stable minerals that can be easily stored or become valuable minerals used in other industries. It also has the ability to return the adsorbent to the system, thereby reducing the amount of chemical addition and providing a new alternative for adsorbent recovery that doesn't require the use of heat energy. This study used an electrodialysis system for carbon dioxide capture and carbonate mineral crystallization. A membrane process was used to separate calcium ions from the salt chamber. The calcium ions then moved to the alkaline chamber, reacted with CO_0^+, and formed $CaCO_0$ in the alkaline chamber. Still, no precipitation could occur in the salt chamber [1]. The schematic diagram of the electrodialysis system is shown in Fig. 1. It is considered a potential option due to its slightly alkaline, higher Ca^{2+} and Mg^{2+} content as well as lower cost than distilled water and chemical solvents [2]. The study is mainly about the steps that were taken in this research project, which aims to recover amine-based absorbents that are usually used to capture CO_2 in factories by combining the process of turning CO_2 into stable minerals.

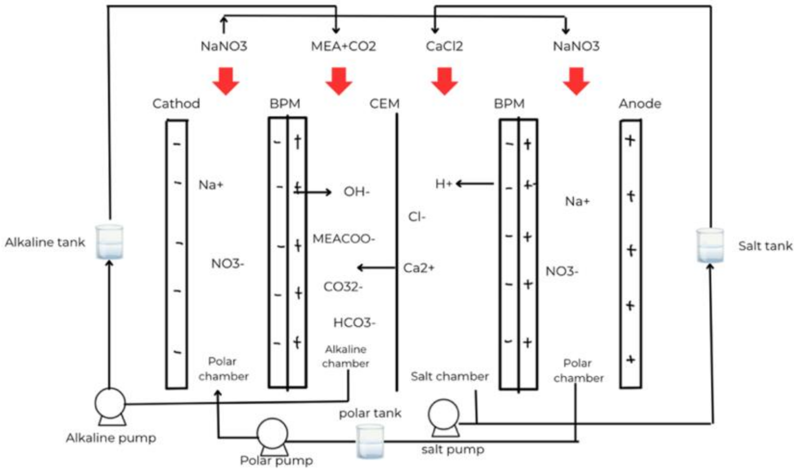


Fig. 1. The schematic diagram of electrodialysis system.

Keywords: CO_2 capture; Electrodialysis system; Amine regenerate

References

[1] Zhao Y, et al. A novel technology of carbon dioxide adsorption and mineralization via seawater decalcification by bipolar membrane electrodialysis system with a crystallizer. **Chemical Engineering Journal** 2020; 381: 122542.

[2] Ho HJ, Iizuka A. Mineral carbonation using seawater for CO_2 sequestration and utilization: A review. **Separation and Purification Technology** 2023; 307: 122855.

Oral **TIChE-CR-22**

Titania incorporated into magnetite mesoporous silica for removal of ciprofloxacin under UV radiation

Dwita Widyawati[1], Numpon Insin[2,*]

[1] Department of Chemistry, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Photocatalysts for Clean Environment and Energy Research Unit, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
* Corresponding author: numpon.i@chula.ac.th

ABSTRACT

Ciprofloxacin (CIP) is a widely used antibiotic, but its poor absorption leads to its release into the environment. CIP accumulation in surface waters raises concerns about antibiotic resistance. Photodegradation can break down pollutants in the environment through the action of light. This study presents a magnetite-silica-titania photocatalyst that can be magnetically extracted after degrading organic compounds in water. Magnetite was successfully coated with MCM-48 mesoporous silica, creating a large surface area for the attachment of TiO_2. The catalyst was characterized using XRD, SEM-EDX, FTIR and BET. Magnetite MCM-48 mesoporous silica (MSI) possesses a surface area of 1,115.24 m^2/g. The incorporation of titania alters the surface area while maintaining the mesoporous structure. As a result, titania-modified magnetite MCM-48 mesoporous silica (T-MSI) exhibited a reduced surface area of 489.44 m^2/g. T-MSI achieved 95.99% photocatalytic degradation of 20 ppm CIP under UV radiation within 2 hours. This experimental result demonstrates the efficiency of T-MSI in degrading high concentrations of CIP within a short time, reinforcing its potential for environmental remediation applications.

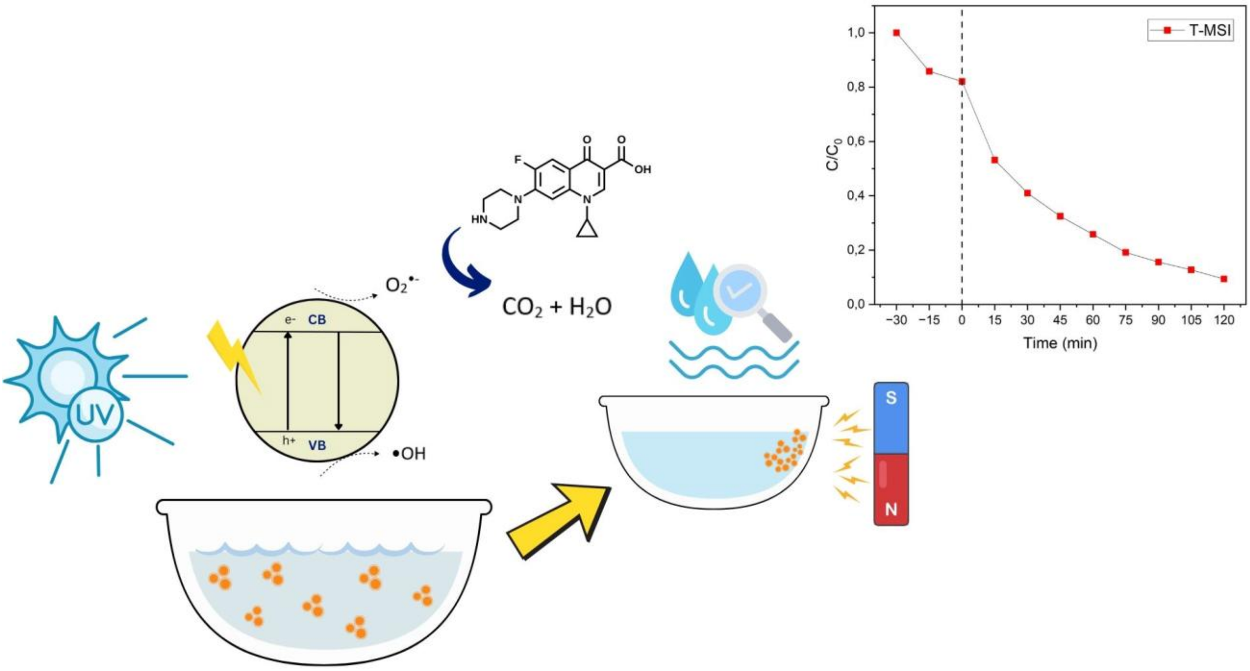


Fig. 1. Concept of this research.

Keywords: Magnetite; Mesoporous silica; Titania; Ciprofloxacin

Oral **TIChE-CR-23**

Electrochemical reduction and regeneration of carbamate

Nattiya Jumpadib[1], **Parivat Phiphatbunyabhorn**[1], **Varong Pavarajarn**[1,*]

[1] Center of Excellence in Particle and Materials Processing Technology, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok10330, Thailand
* Corresponding author: varong.p@chula.ac.th

ABSTRACT

A reliable method for removing carbon dioxide (CO_2) gas from industrial emissions involves CO_2 absorption into monoethanolamine (MEA) solution to achieve carbon neutrality. However, the regeneration of MEA is costly and still requires heat to release the CO_2 that was captured. In our research, integrating CO_2 capture with electrochemical CO_2 conversion is demonstrated to lower energy consumption. The electrochemical reduction and regeneration of MEA-CO_2 adduct were investigated simultaneously by using copper pulse-electrodeposited on different metal sheets as a cathode in a H-cell reactor. The gas products were analyzed by gas chromatography, and several C_1 products, e.g., CO and CH_4, were revealed. While the liquid was examined through ^{13}C nuclear magnetic resonance spectroscopy, revealing the conversion of MEA-CO_2 adduct back to MEA after the reaction. The result indicated that the electrochemical reduction of CO_2 captured in the MEA solution reaction competes with the hydrogen evolution reaction (HER). A high negative potential tends to favor HER over electrochemical reduction of MEA-CO_2 adduct. The result also showed that different metal substrates produce different gas products. Additionally, CO_2 was released from MEA solution through the electrochemical reduction at the same time as the MEA-CO_2 adduct was electrochemically converted into gas products. The effects of copper electrodeposition duration and the presence of the supporting electrolyte are also discussed. In conclusion, the electrochemical reduction of MEA-CO_2 adduct presents an alternative approach for producing value-added products while regenerating MEA with low energy consumption.

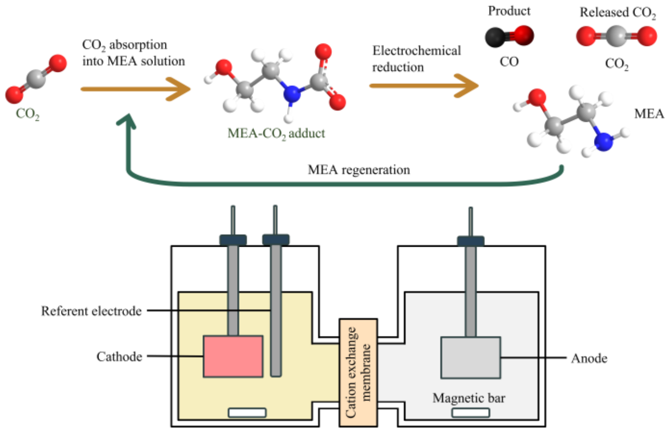


Fig. 1. Overview of electrochemical reduction and regeneration of carbamate.

Keywords: Electrochemical reduction of MEA-CO_2; Monoethanolamine (MEA); Amine regeneration for carbon capture

References

[1] Chen L, et al. Electrochemical reduction of carbon dioxide in a monoethanolamine capture medium. **ChemSusChem** 2017; 10(20): 4109-4118.

[2] Lee G, et al. Electrochemical upgrade of CO_2 from amine capture solution. **Nature Energy** 2021; 6(1): 46-53.

Poster TIChE-CR-24

Loading iron/manganese/zinc/copper oxide onto TiO_2 for vanillin production from photoconversion of lignin

Mutsee Termtanun[1,*], **Saranya Ngaopitakkul**[1], **Chatkun Puakpong**[1], **Artittaya Suksri**[1],
Pornpimol Kritasumpun[1], **Paksanan Rattanachunnoppohn**[1], **Varaporn Paradamit**[2],
Paul Egwuonwu Dim[3]

[1] Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Nakhon Pathom 73000, Thailand
[2] Department of Chemistry, Faculty of Science, Silpakorn University, Nakhon Pathom 73000, Thailand
[3] Department of Chemical Engineering, School of Infrastructure, Process Engineering and Technology, Minna, Nigeria
* Corresponding author: termtanun_m@su.ac.th

ABSTRACT

In general, large amount of lignin is eliminated from the pulp and paper manufacturing process. Considerable efforts have been made to convert lignin into value-added chemicals using photocatalysis [1]. Titanium dioxide is one of the most potential and widely investigated photocatalysts due to its high efficiency in decomposition of many organic pollutants under UV light, but with the 3.2 eV bandgap energy seems to be a drawback. Therefore, TiO_2 has been developed for many years to extend the absorption spectrum into visible light region by loading TiO_2 with various transition and precious metals [2, 3]. To improve the potential of titanium dioxide, this research added the transition metals on to the titanium dioxide and applied to photocatalytic conversion of lignin under visible light. 1%, 2%, 3%, and 5% by weight of Fe, Cu, Mn, Zn oxide on P-25 TiO_2 were prepared by incipient wetness impregnation. The prepared catalysts were analyzed using N_2 physisorption, X-ray diffraction, UV-Visible Spectroscopy and Photoluminescence Spectrometer. Four hours photocatalytic conversion of Kraft based lignin using prepared TiO_2 was performed at ambient temperature and ambient pressure in lithium hydroxide aqueous under visible light. Vanillin was confirmed as a main product and its yield was evaluated using UV-Visible Spectroscopy. Among all promotors, 5% copper oxide on titanium dioxide provides the highest vanillin production rate at 0.117 $ppm{\cdot}min^{-1}$ compared with other catalysts.

Table 1 Concept of this research.

Catalyst	Vanillin Production Rate ($ppm{\cdot}min^{-1}$)
P-25 TiO_2	0.0127
5 wt% Fe-TiO_2	0.0836
5 wt% Zn-TiO_2	0.0911
5 wt% Mn-TiO_2	0.1132
5 wt% Cu-TiO_2	0.1167

Keywords: Photocatalyst; Lignin conversion; Vanillin production

References

[1] De S, Dutta S, Saha B. Critical design of heterogeneous catalysts for biomass valorization: current thrust and emerging prospects. **Catalysis Science Technology** 2016; 6: 7364.

[2] Yakob Y, Naknun K, Hirunmas P, Dim Egwuonwu P, Termtanun M. Mo and Mn co-doping for isoproturon degradation under visible light. **Engineering journal** 2021; 25(2): 277-283.

[3] Yodsomnuk P, Junjeam K, Termtanun M. Photoactivity of Fe and Zn-doped TiO_2 in phenol degradation under visible light. **MATEC Web of Conferences** 2018; 192(1-2): 03047.

Poster **TIChE-CR-25**

Utilization of biomass from palm oil industry for monoglycerides production

Sutthiphong Rangauthok[1], **Kanokwan Ngaosuwan**[2,*], **Suttichai Assabumrungrat**[1,3]

[1] Center of Excellence on Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Chemical Engineering Division, Faculty of Engineering, Rajamangala University of Technology Krungthep, Bangkok 10120, Thailand
[3] Bio-Circular-Green-economy Technology & Engineering Center (BCGeTEC), Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
* Corresponding author: kanokwan.n@mail.rmutk.ac.th

ABSTRACT

As the third-largest global palm oil producer, Thailand has abundance of waste materials such palm kernel shell (PKS) and palm fatty acid distillate (PFAD). This research aims to utilize biomass as feedstock and catalyst to produce high-value chemicals of monoglycerides (MGs) and diglycerides (DGs). They are useful as an emulsifier and stabilizer in the food and pharmaceutical industries, supporting the concept of bio-circular-green economy. Biochar derived from PKS was pyrolyzed under N_2 gas at 600 °C for 2 h. Then, 30 wt.% of tungstophosphoric acid (TPA) was further modified on the biochar to produce TPA/PKS catalyst. NH_3-TPD revealed that high acid site density of 2.402 mmol/gcat was observed from TPA/PKS, comparable to TPA/MAS (mesoporous aluminosilicate) [1]. The TPA/PKS catalyst was further used to catalyze glycerolysis of PFAD to produce MG and DG using a glycerol to PFAD molar ratio of 3:1, a catalyst loading of 3 wt.%, and a reaction temperature of 130 °C for 240 min. The PFAD conversion was increased along the reaction time as illustrated in Fig. 1. The maximum PFAD conversion of 48.% and MG selectivity of 67.0% were found at 210 min. High catalytic activity of TPA/PKS catalyst was due to its high acid site density [2]. However, the optimum condition for TPA/PKS catalyzed glycerolysis of PFAD should be further investigated to achieve high conversion and high MG and DG selectivity by varying the reaction temperature, glycerol to PFAD molar ratio and catalyst loading.

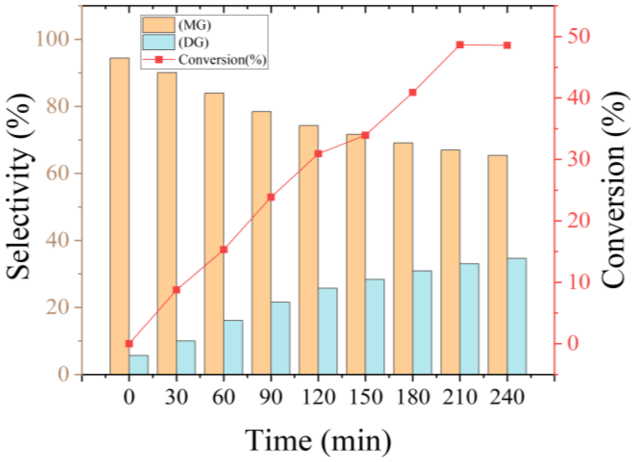


Fig. 1. Conversion and selectivity for glycerolysis of PFAD.

Keywords: Palm kernel shell (PSK); Palm fatty acid distillate (PFAD); Tungstophosphoric acid (TPA); Monolgyceride (MGs); Glycerolysis; Biochar

References

[1] Esmi F, Masoumi S, Dalai AK. Comparative catalytic performance study of 12-tungstophosphoric heteropoly acid supported on mesoporous supports for biodiesel production from unrefined green seed canola oil. **Catalysts** 2022; 12(6): 658.

[2] Zheng XC, et al. Preparation and catalytic performance of tungstophosphoric acid anchored to SiO_2@graphene aerogel 3D porous catalysts for the synthesis of ethyl levulinate biofuel. **Journal of Porous Materials** 2019; 26(3): 723-732.

Oral **TIChE-CR-26**

Synthesis of biolubricant from waste cooking oil methyl ester by transesterification reaction via ethylene glycol

Atipong Paikamnam[1], Thanakorn Whangchang[2], Worawut Thongpradit[2], Anuphan Submee[2], Wasan Chokelarb[1], Pongsert Sriprom[2], Pornsawan Assawasaengrat[1,*]

[1] Department of Chemical Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
[2] School of Food Industry, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
* Corresponding author: pornsawan.as@kmitl.ac.th

ABSTRACT

This research aimed to present the Box-Behnken experimental design for the determination of optimal conditions for biolubricant production from waste cooking oil by double transesterification via ethylene glycol with three factors such as FAME:EG ratio (1:1 to 3:1), temperature (from 110 to 130 °C) and reaction time (from 120 to 240 min) [1, 2]. This study found that the optimal condition for biolubricant synthesis from methyl esters of waste cooking oil by transesterification with ethylene glycol was FAMEs: EG molar ratio of 2:1, the reaction temperature 110 °C, and reaction time 135 min, using 1%w/w K_2CO_3 as a catalyst, under these conditions, an 80% biolubricant yield was achieved. For this reason, a molar ratio of 2:1 ensured an adequate supply of ethylene glycol while maintaining an excess of FAME, which assisted shift the equilibrium toward biolubricant formation. A temperature of 110 °C was optimal for promoting transesterification while avoiding the negative effects of excessive heat and prolonged reaction time on conversion. Regarding reaction time, the yield of biolubricant production tends to decrease due to methanol which can promote the reverse reaction, converting biolubricant back into FAME. The chemical structure of the biolubricant was analyzed by FTIR and the physical properties were investigated. The kinematic viscosity at 40 °C and 100 °C was measured at 12.22 cSt and 3.32 cSt, respectively, with a viscosity index of 151.11. It can be that the synthesis of biolubricant by transesterification of methyl esters derived from waste cooking oil in the presence of ethylene glycol can enhance the physicochemical properties of biolubricant.

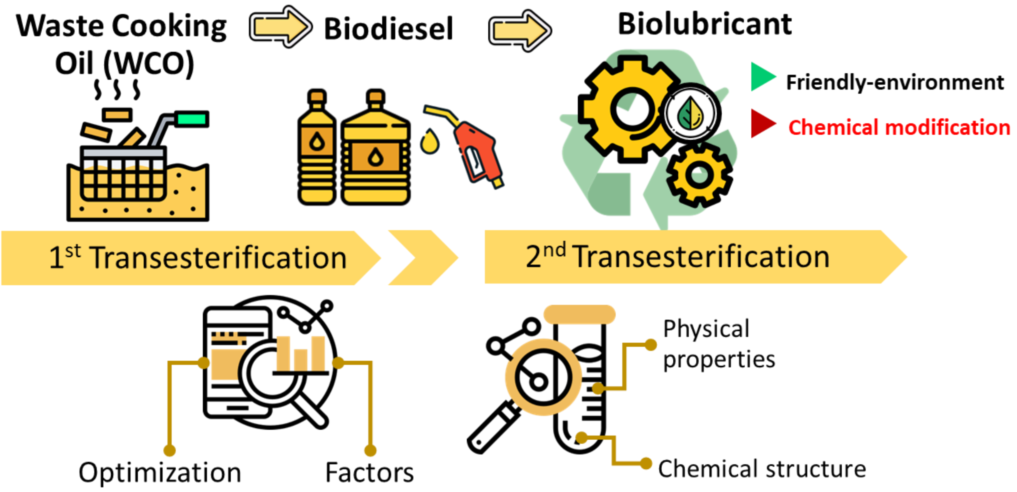


Fig. 1. Schematic representation of biolubricant production from waste cooking oil via double transesterification.

Keywords: Biolubricant; Transesterification; Biodiesel; Waste cooking oil; Ethylene glycol

References

[1] Encinar J, Nogales-Delgado S, Pinilla A, Biolubricant production through double transesterification: Reactor design for the implementation of a biorefinery based on rapeseed. **Processes** 2021; 9, 1224.

[2] Hussein RZK, Attia N, Fouad M, ElSheltawy S, Experimental investigation and process simulation of biolubricant production from waste cooking oil. **Biomass and Bioenergy** 2021; 105850.

Poster **TIChE-CR-27**

Low-temperature methanol synthesis via ethanol-assisted approach over $Cu/ZnO/Al_2O_3$ in fixed-bed reactor

Panisara Kampaeng[1], **Pattaraporn Kim**[1,*]

[1] Department of Chemical Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Center of Excellence on Catalysis and Catalytic Reaction Engineering (CECC), Chulalongkorn University,
Bangkok 10330, Thailand
* Corresponding author: pattaraporn.k@chula.ac.th

ABSTRACT

Our world is facing many crises. One of the biggest problems that needs to be addressed is global warming, which is caused by human activities such as wildfire, fossil fuel, and industry. These activities emit greenhouse gases, especially carbon dioxide (CO_2), a major factor in global warming. Many research projects have focused on the CO_2 utilization by converting it into high-value substances. One approach is the synthesis of methanol from CO_2 via an ethanol-assisted. The conventional methanol production process is high energy due to the increased reaction temperature. However, the ethanol-assisted method presented in this research can change the reaction pathway to reduce energy consumption effectively. This research chose the $Cu/ZnO/Al_2O_3$ catalyst because ZnO helps disperse the reduced Cu, resulting in more active sites. In addition, Cu^+ is also stable on the ZnO surface, and ZnO helps Cu^{2+} to be reduced easily. It supports CO_2 hydrogenation, while Al_2O_3 helps in enhancing the stability of the catalyst and reducing the sintering. This research studied the effect of temperature on the reaction. The results found that the reaction temperature increased from 130 - 170 °C. The CO_2 conversion and methanol yield increased. However, the selectivity of methanol is decreased, which shows that the ethanol-assisted approach can convert CO_2 into high-value products such as methanol, and it can also reduce the energy consumption in the reactor section by up to 7 times compared to the conventional method.

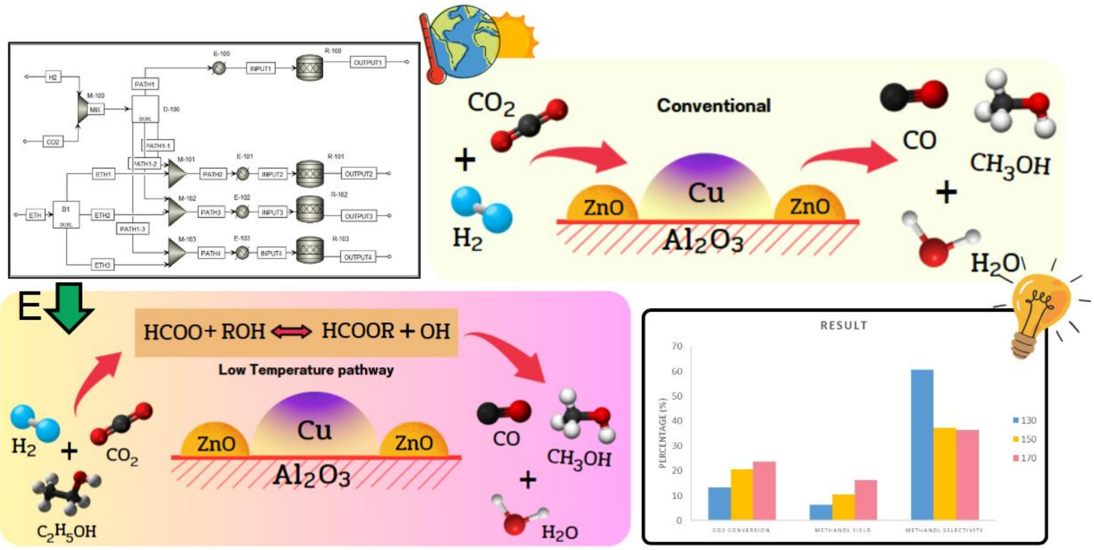


Fig. 1. Concept of this work.

Keywords: CO_2 utilization; Ethanol-assisted methanol synthesis; Catalyst; Temperature

References

[1] Slaa JC, Van O, Ross J. The synthesis of higher alcohols using modified Cu/ZnO/Al_2O_3 catalysts. **Catalysis today** 1992; 15(1): 129-148.

[2] Azhari NJ, Erika D, Mardiana S, et al. Methanol synthesis from CO_2: A mechanistic overview. **Results in Engineering** 2022; 16: 100711.

[3] Boonamnuay T, Laosiripojana N, Assabumrungrat S, Kim-Lohsoontorn P. Effect 3A and 5A molecular sieve on alcohol-assisted methanol synthesis from CO_2 and H_2 over Cu/ZnO catalyst. **International Journal of Hydrogen Energy** 2021; 46(60): 30948-30958.

[4] Li D, Xu F, Tang X, Dai S, Pu T, Liu X, Zhu M. Induced activation of the commercial Cu/ZnO/Al_2O_3 catalyst for the steam reforming of methanol. **Nature Catalysis** 2022; 5(2): 99-108.

Oral TIChE-CR-28

Hydroconversion of biodiesel over Ni/beta zeolite catalysts prepared by glycine-assisted impregnation for sustainable aviation fuel production

Witchakorn Jankool[1], **Napida Hinchiranan**[1,2,3,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Center of Excellence on Petrochemical and Materials Technology (PETROMAT), Chulalongkorn University, Bangkok 10330, Thailand
[3] Center of Excellence in Catalysis for Bioenergy and Renewable Chemicals (CBRC), Chulalongkorn University, Bangkok 10330, Thailand
* Corresponding author: napida.h@chula.ac.th

ABSTRACT

According to a measure to reduce carbon dioxide emissions from aviation sector announced by International Civil Aviation Organization (ICAO), hydroprocessed esters and fatty acids (HEFA) is a promising process to commercially produce sustainable aviation fuel (SAF). Nickel (Ni) is attractive for using as a metal site for bi-functional catalysts in hydroconversion due to its high activity and cost effectiveness. However, Ni-based catalysts are suffered from metal agglomeration resulting in the poor metal dispersion and weak metal-support interaction, which could affect catalyst activity and stability. Recently, glycine has been used as a chelating agent to prepare Ni-based catalysts by impregnation method for solving these problems [1, 2]. Hence, the objective of this research was to emphasize the improvement of Ni-based catalysts using glycine-assisted impregnation method for hydroconversion of biodiesel derived from palm oil. The hydroconversion was conducted in a fixed-bed reactor operated under 30 bar H2 pressure at 380 ˚C and WHSV of 1.6 h^{-1}. Product selectivity was analyzed by gas chromatography-mass spectrometer (GC-MS). It was found that liquid yield decreased from 66.6 wt% to 63.2 wt% when the system was operated by Ni0.2Gly/beta catalyst (10 wt% Ni loading, glycine:Ni molar ratio = 0.2) compared to Ni/beta catalyst. However, bio-jet (C_9-C_{14}) yield increased from 10 wt% to 13.6 wt%. Moreover, glycine-assisted impregnation could promote hydrodeoxygenation of biodiesel to decrease the selectivity of oxygenated compounds from 21.2% to 5.3%.

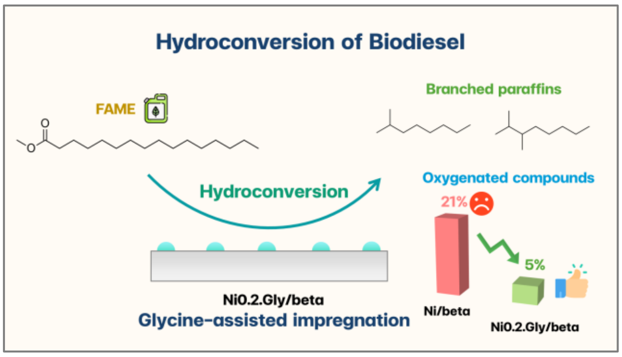


Fig. 1. Hydroconversion of FAME over Ni0.2Gly/beta catalyst.

Keywords: Hydroconversion; Bio-jet; Nickel; Glycine

References

[1] Yang J, et al. Glycine-assisted preparation of highly dispersed Ni/SiO_2 catalyst for low-temperature dry reforming of methane. **International Journal of Hydrogen Energy** 2022; 47: 32071-32080.
[2] Yang Y, et al. Ligand assistance via solid-state coordination for promoting nickel dispersion over the Ni/Beta hydroisomerization catalyst. **Fuel** 2022; 318: 123568.

Oral TIChE-CR-29

Optimization of biodiesel synthesis from waste cooking oil by transesterification reaction

Sarun Phonpho[1], Sutthirat Wilaisai[1], Sanchai Pomunruan[1], Chariyaporn Thanyathippipat[2], Wasan Chokelarb[2], Pongsert Sriprom[1,*], Pornsawan Assawasaengrat[2]

[1] School of Food Industry, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
[2] Department of Chemical Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
* Corresponding author: pongsert.sr@kmitl.ac.th

ABSTRACT

The optimum conditions for biodiesel production from waste cooking oil by transesterification reaction [1, 2] was investigated the four-factor determination by using the Box-Behnken experimental design were: Reaction temperature (60 to 65℃), Reaction time (60 to 120 min), Volume of methanol (15 to 45% by volume), and the amount of catalyst (1.0 to 1.5% by weight). The waste cooking oil used in this study had oleic acid as the major fatty acid and a free fatty acid (FFA) content of 2.81%. The optimum reaction condition was a temperature at 65℃, a reaction time of 120 min, the methanol of 33% by volume, and amount of catalyst of 1.0% by weight. The highest yield of 94.64% was obtained under the optimal condition. The biodiesel structure was characterized by Fourier Transform Infra-Red (FT-IR), and the biodiesel properties were measured viscosity at 40˚C is 4.52 cSt, total acid number is 0.25 mg KOH/g, water content is 0.06% by weight, density at 15˚C is 0.877 g/cm^3, and flash point is 180˚C. The obtained properties were comparable to those of biodiesel standards an announcement from the Department of Energy Business. Therefore, it can be concluded that the conditions used for biodiesel synthesis from waste cooking oil in this study were optimal.

Table 1 Comparing the chemical and physical properties of biodiesel with the biodiesel standard according to the announcement from the Department of Energy Business.

Product	Density at 15 ℃ (g/cm^3)	Viscosity @40℃, cSt	Water content (%wt)	Total acid number, mg KOH/g	Flash Point (℃)
Product-Biodiesel	0.877	4.52	0.06	0.25	180
Standard-Biodiesel	0.86-0.90	3.50-5.00	< 0.05	<0.5	>120

Keywords: Biodiesel; Transesterification reaction; Waste cooking oil

References

[1] Encinar JM, Nogales S, González JF. Biodiesel and biolubricant production from different vegetable oils through transesterification. **Engineering Reports** 2020; 2(12): e12190.

[2] Freedman BEHP, Pryde EH, Mounts TL. Variables affecting the yields of fatty esters from transesterified vegetable oils. **Journal of the American Oil Chemists Society** 1984; 61(10): 1638-1643.

Oral **TIChE-CR-30**

Synthesis of Al-doped MCM-41 for molecular sieve and catalysis application

Nathatchapong Burong[1,2], Babasaheb M. Matsagar[1], Varong Pavarajarn[2,*], Kevin C.W. Wu[1,*]

[1] Department of Chemical Engineering, National Taiwan University, Taipei 10617, Taiwan
[2] Center of Excellence in Particle and Materials Processing Technology, Department of Chemical Engineering, Chulalongkorn University, Bangkok 10330, Thailand
* Corresponding author: varong.p@chula.ac.th, kevinwu@ntu.edu.tw

ABSTRACT

MCM-41 (Mobil Composition of Matter No. 41) is a promising mesoporous silica material widely used as a molecular sieve and catalyst support due to its high surface area, uniform pore size distribution, and thermal stability. Incorporating aluminum into the MCM-41 framework enhances its catalytic performance by generating additional Brønsted acid sites [1]. Meanwhile, 5-hydroxymethylfurfural (5-HMF) is a key bio-based platform chemical used in fine chemical synthesis and renewable fuel production. It can be synthesized from inulin, a polysaccharide derived from biomass, via solid acid catalysis through depolymerization and dehydration reactions.This study aims to investigate the catalytic performance of aluminum-doped MCM-41 (Al-MCM-41) for inulin conversion to 5-HMF. Al-MCM-41 was synthesized using a liquid-crystal templating method involving CTAB, NaOH, TEOS, and aluminum sulfate. The resulting gel was calcined at 550 °C for 6 hours to remove the template and yield a mesoporous solid catalyst. The structure and properties of the catalyst were confirmed using X-ray diffraction (XRD), nitrogen sorption (BET), infrared spectroscopy (FTIR), ammonia temperature-programmed desorption (NH_3-TPD). These results verified the successful incorporation of aluminum, high surface area, and enhanced acidity. To further improve its catalytic activity, Al-MCM-41 was functionalized with sulfonic acid groups, forming a sulfonated solid acid catalyst [2]. This modified catalyst was then applied to the conversion of inulin to 5-HMF. The study evaluates the catalyst's efficiency, selectivity, and potential for biomass valorization under mild reaction conditions.

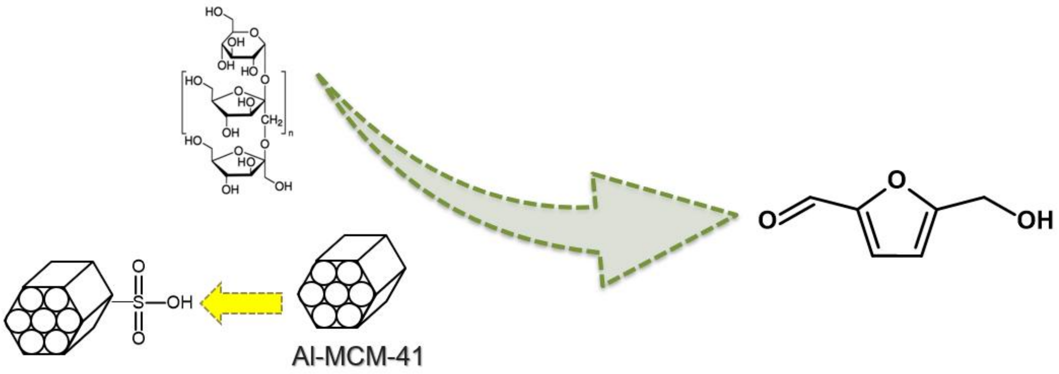


Fig. 1. Concept of this work.

Keywords: MCM-41; Mesoporous silica; Sulfonation; Inulin conversion; 5-HMF production

References

[1] Prasomsri T, Jiao W, Weng SZ, Martinez JG. Mesostructured zeolites: Bridging the gap between zeolites and MCM-41. **Chemical Communications** 2015; 51: 8900-8911.

[2] Vekariya RH, Prajapati NP, Patel HD. MCM-41-anchored sulfonic acid (MCM-41-SO_3H): An efficient heterogeneous catalyst for green organic synthesis. **Synthetic Communications** 2016, 46(21): 1713-1734.

Oral **TIChE-CR-31**

Methane dry reforming of calcium carbonate from carbamate mineralization

Nattanan Watcharasawat[1], **Varong Pavarajarn**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
* Corresponding author: varong.p@chula.ac.th

ABSTRACT

The urgent need to mitigate carbon dioxide (CO_2) emissions has led to the development of Carbon Capture, Utilization, and Storage (CCUS) technologies. This study proposed the looping of calcium carbonate ($CaCO_3$) between the Integrated Absorption–Mineralization (IAM) process and Dry Reforming of Methane (DRM) using a Nickel-calcium carbonate (Ni-$CaCO_3$) catalyst. $CaCO_3$ generated from IAM using ethanolamine (MEA) as absorbent and calcium chloride ($CaCl_2$) as calcium source was utilized as a Ni-$CaCO_3$ catalyst in DRM via impregnation of a precursor solution, where it was converted into calcium oxide (CaO) and syngas (H_2 and CO). The regenerated CaO was then reused as a calcium source for IAM, forming a closed-loop system. The features of the IAM and DRM process were characterized through Chittick apparatus, XRD, TEM, and ND-IR. A temperature-programmed scanning test was conducted to evaluate catalytic performance, and it was found that DRM initiated at around 670 °C, shown in Fig. 1, though there was CO_2 released due to a weak interface between Ni and $CaCO_3$. The catalyst was then characterized by XRD, peaks indicated that $CaCO_3$ had fully converted as $Ca(OH)_2$ was detected due to hydration of CaO upon being exposed to moisture. The mineralization of the catalyst after DRM reaction showed that it could be used as calcium source, as the loading of CO_2 decreased and the XRD result showed peak of $CaCO_3$. This showed the feasibility of combining the two processes, however, further study on improving the Ni-$CaCO_3$ as DRM catalyst and calcium source for mineralization should be investigated.

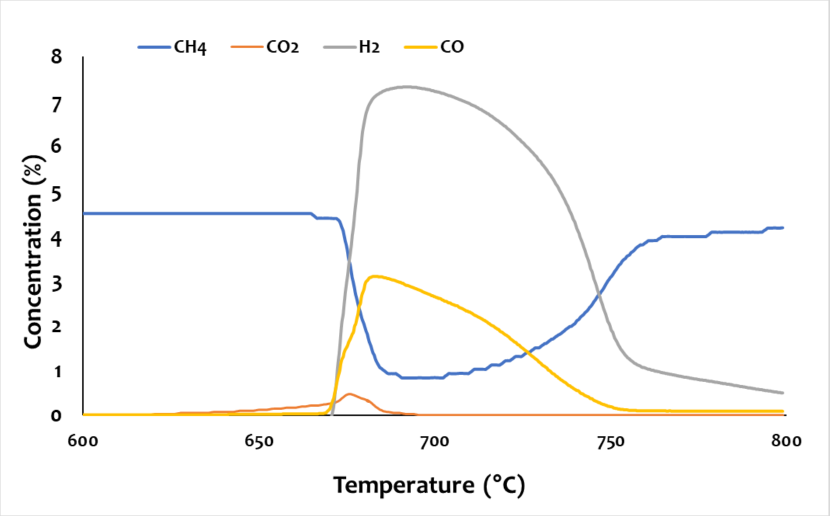


Fig. 1. Gaseous concentration profiles during temperature-programmed catalytic performance test.

Keywords: Integrated absorption-mineralization (IAM); Dry reforming of methane (DRM); Nickel-calcium carbonate (Ni-$CaCO_3$) catalyst; Looping of calcium carbonate

Oral TIChE-CR-32

Fabrication of Fe-TiO_2 loaded on mesoporous activated carbon and improved by Fe_3O_4 for reusing on photocatalytic degradation of reactive red 120 under visible light irradiation

Jakkapat Saehkow[1], **Kitirote Wantala**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Khon Kaen University, Khon Kaen 40002, Thailand
* Corresponding author: kitirote@kku.ac.th

ABSTRACT

The purpose of this study was to synthesize and characterize iron-doped titanium dioxide (Fe-TiO_2) supported on mesoporous activated carbon (AC) and improve the photocatalyst to be reusable by adding magnetic (Fe-TiO_2-AC/Fe_3O_4) and evaluate its efficiency in photodegradation of reactive red 120 (RR-120) under visible light. The Fe-TiO_2-AC composite was synthesized via a hydrothermal method, utilizing varying weight ratios of AC. AC was derived from coffee grounds through hydrothermal carbonization, followed by activation with H_3PO_4 and carbonization at 600°C. The Fe-TiO_2-AC/Fe_3O_4 was prepared by co-precipitation method and varying the ratio of weight of the magnetic. Characterization of the catalyst composite was performed using a variety of analytical techniques, including X-ray diffraction (XRD), scanning electron microscopy (SEM), nitrogen adsorption-desorption isotherms, UV-Vis diffuse reflectance (UV-DR) analysis, X-ray photoelectron spectroscopy (XPS), and X-Ray absorption spectroscopy (XAS). The results revealed that the catalyst possessed a structure comprising a mixture of anatase and rutile phases upon the incorporation of iron, with particle sizes within the nanoparticle range. Moreover, the integration of activated carbon led to an increase in the Brunauer-Emmett-Teller (BET) surface area and a concomitant reduction in the energy band gap from 2.88 eV to 2.50 eV. Additionally, activated carbon significantly improved the efficiency of RR-120 degradation, particularly by enhancing the initial absorption of RR-120 prior to light exposure. The most effective catalyst was Fe-TiO2 containing 40% AC by weight, degradation rate of 77.36% for RR-120. Lastly, the improved catalyst by adding magnetic permitted easy for separation to reuse the catalyst after the reaction.

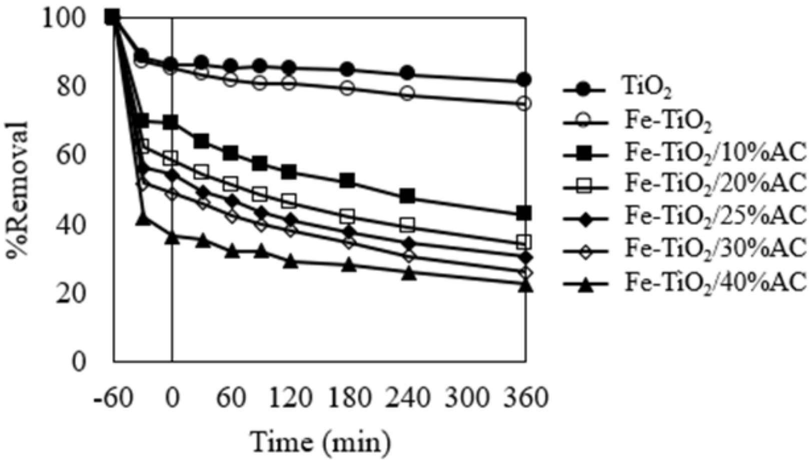


Fig. 1. Performance of photocatalyst on degradation of 50 ppm reactive red 120 for 360 min.

Keywords: Visible light; Persistent organic pollutants; Photocatalysis; Mesoporous activated carbon; Contaminants of emerging concern

Oral TIChE-CR-33

Catalytic activity in dry reforming of methane over Ce modified Ni/Silica fiber catalyst

Jirawan Janlon[1,2], **Nitcha Chatsuwan**[1,2], **Suwadee Kongparakul**[1,2], **Prasert Reubroycharoen**[3],
Yeong Yin Fong[4], **Chanatip Samart**[1,2,*]

[1] Department of Chemistry, Faculty of Science and Technology, Thammasat University,
Pathum Thani 12120, Thailand
[2] Thammasat University Research Unit in Bioenergy and Catalysis, Thammasat University,
Pathum Thani 12120, Thailand
[3] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[4] Department of Chemical Engineering, Faculty of Engineering, Universiti Teknologi Petornas, Perak, Malaysia
* Corresponding author: chanatip@tu.ac.th

ABSTRACT

Mass transport resistant is an important effect to decrease the reaction rate which can be observed in heterogeneous catalyst especially porous catalyst. Dry reforming of methane (DRM) is also carried out with heterogeneous catalyst. The Ni based over SiO_2 catalyst is mostly used for catalysis DRM however, the mass transfer limitation and coke deposition were caused in decreasing their activity. CeO_2 was added in the Ni catalyst to improve the catalytic activity and stability due to promoting carbon oxidation to CO. In this research, the nickel-based modified with cerium for the dry reforming of methane (DRM) was investigated which would focus on enhancing catalytic activity and stability. Three different catalysts were synthesized using the wetness impregnation method over silica fiber (SF), cerium-silica composite fiber (CeSF), and silica powder (SP). The physicochemical properties of catalysts were revealed using various techniques, including Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), X-ray diffraction (XRD), Nitrogen adsorption-desorption (BET), and Temperature-programmed reduction with H_2 (H_2-TPR). Catalytic performance in DRM was evaluated at 800°C with two different feed gas ratios including 0.15 CH_4 : 0.85 CO_2 and 0.5 CH_4 : 0.5 CO_2. The 10% Ni/CeSF catalyst exhibited the highest H_2 and CO yield, along with the highest CH_4 and CO_2 conversion rates, compared to other catalysts. Furthermore, the SP-supported catalyst presented lower conversion rate to compare with the fiber-supported catalysts which is a highlighting the impact of 1D-structure of catalyst support on reaction rate. Notably, the 10% Ni/CeSF catalyst maintained stable performance for over 52 hours, demonstrating its potential for long-term DRM applications.

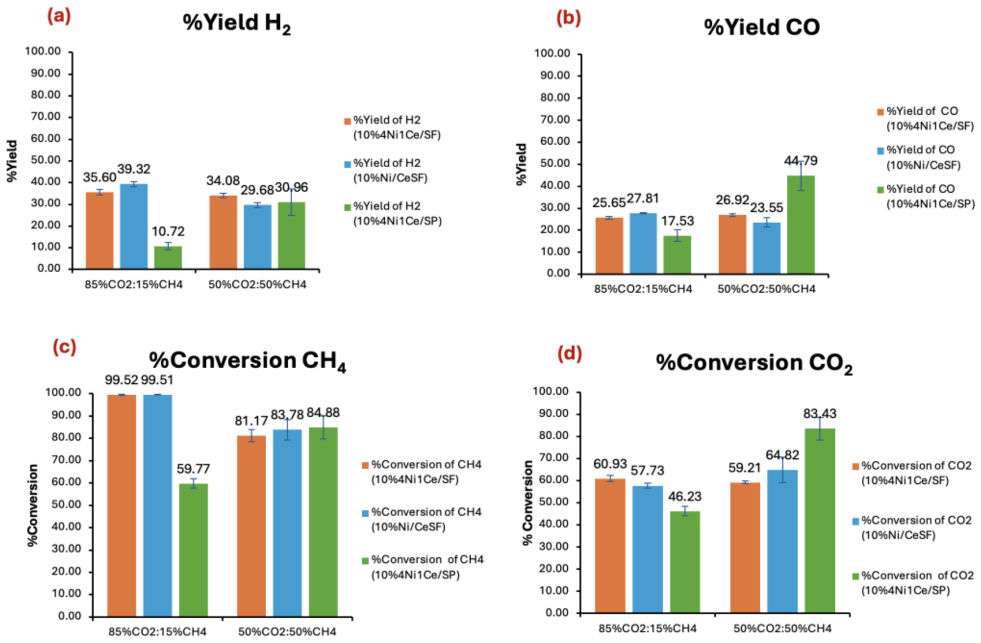


Fig. 1. The %Yield of (a) H_2, (b) CO and % Conversion of (c) CH_4, (d) CO_2 rates of 10% NiCe/SF, 10% Ni/CeSF and 10%NiCe/SP catalysts.

Keywords: Nickel-cerium bimetallic catalyst; Dry reforming of methane; Carbon dioxide; Methane

References

[1] Zhao X, et al. Design and synthesis of NiCe@m-SiO_2 yolk-shell framework catalysts with improved coke- and sintering-resistance in dry reforming of methane. **International Journal of Hydrogen Energy** 2016; 41(4): 2447-2456.

[2.] Ma X, et al. Structural evolution of Ni-Ce bimetallic alloy on Al_2O_3 support in methane dry reforming: Achieving sustainability and high-efficiency reaction through cerium modulation strategy. **Fuel** 2025; 384: 134084.

[3.] Jin H, et al. Three-dimensional mesoporous Ni-CeO_2 catalyst for dry reforming of methane. **Catalysts** 2024; 14(5): 291.

[4.] le Saché E, et al. Biogas upgrading via dry reforming over a Ni-Sn/CeO_2-Al_2O_3 catalyst: Influence of the biogas source. **Energies** 2019; 12(6): 1007.

Poster **TIChE-CR-34**

Thermal oxidative reaction of HMF to Bio-based monomer: 2,5 Furandicarboxylic acid (FDCA)

Settakorn Upasen[1], **Dang Saebea**[1], **Piyasan Praserthdam**[2], **Joongjai Panpranot**[2],
Piyachat Wattanachai[1], **Partipan Boonruam**[1], **Pailin Ngaotrakanwiwat**[1], **Karaked Tedsri**[3],
Soipatta Soisuwan[1,*]

[1] Research Unit of Developing Technology and Innovation of Alternative Energy for Industries, Department of Chemical Engineering, Faculty of Engineering, Burapha University, Chonburi 20131, Thailand
[2] Center of Excellence in Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[3] Department of Inorganic Chemistry, Faculty of Science, Burapha University, Chonburi 20131, Thailand
* Corresponding author: soipatta@eng.buu.ac.th

ABSTRACT

Our experiment aims to use titanium dioxide alternatively under thermal excitation for an application of an oxidative catalyst. A behavior of HMF oxidation over three different titanium oxide-based catalysts, i.e., commercial titanium dioxide, black titanium dioxide and black titanium dioxide modified with copper oxide, were investigated in a range of temperature (70 to 180 °C). According to the observation, the Power Law Model of HMF oxidation to FDCA was proposed and the activation energy for all catalysts was reported at 72.3, 28.4 and 12.3 kJ/mole. The black titanium dioxide modified with copper oxide catalyst was the most active at 70 °C and it possessed the lowest activation energy and was selective to FFCA (>90%) which was approached to desirable FDCA product. The HMF oxidation was investigated in cleaner production using an aqueous solution and hydrogen peroxide and oxygen as oxidizing agents and it was found an over oxidation of HMF under thermal oxidation only at 70 °C. The hydrogen peroxide with black titanium dioxide modified with copper oxide catalyst can increase the selectivity of FDCA up to 70%.

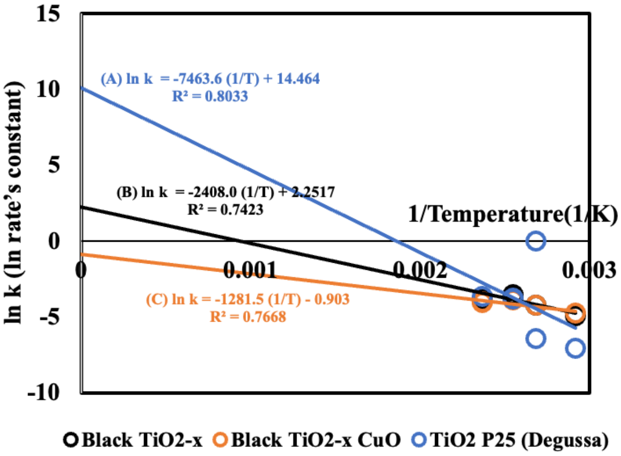


Fig. 1. The temperature behaviors and the rate constant of (A) TiO_2, (B) Black TiO_{2-x} and (C) Black TiO_{2-x} CuO.

Keywords: Titanium dioxide; Black titanium dioxide; Copper oxide doped titanium dioxide; HMF and FDCA

References

[1] Yu J, Hai Y, Jaroniec M. Photocatalytic hydrogen production over CuO-modified titania. **Journal of Colloid and Interface Science** 2011; 357(1): 223-228.

Oral **TIChE-EF-01**

Unlocking the potential of semi-clathrates for gas storage: Synergistic enhancement of TBAF with amino acids

Chakorn Viriyakul[1], Santi Kulprathipanja[1], Praveen Linga[2,*], Pramoch Rangsunvigit[1,*]

[1] The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok 10330, Thailand
[2] Department of Chemical and Biomolecular Engineering, National University of Singapore,
Singapore 117585, Singapore
[*] Corresponding author: pramoch.r@chula.ac.th, praveen.linga@nus.edu.sg

ABSTRACT

The global imperative to develop efficient gas storage technologies has led to an increased interest in advanced materials that can operate under moderate conditions. Semi-clathrate hydrate (SCH) represents a distinct class of hydrate structures that offer significant advantages across various applications, particularly due to their unique molecular arrangement. While gas storage is one promising application of these structures, its relatively low gas storage capacity presents a limitation. This study aims to address this limitation by investigating the enhancement of gas storage capacity through the incorporation of kinetic promoters while maintaining the inherent advantages of the structure. Tetrabutylammonium fluoride (TBAF), recognized as an effective promoter for SCH formation, is combined with three distinct amino acids under different conditions. The investigation encompassed comprehensive analyses of hydrate formation kinetics, thermodynamics, and morphological characteristics. The results provide valuable insights into optimizing SCH performance for enhanced gas storage applications. 5.0 wt% TBAF presents an optimal concentration in terms of gas storage compared to 2.5 wt% and 10.0 wt% TBAF. Interestingly, adding amino acids improves storage capacity by about 50% compared to the system with only TBAF. Furthermore, at high TBAF concentrations, SCH can form even without gas, demonstrating their potential not only for gas storage but also for cold storage applications. Therefore, this research contributes to promising pathways for developing more efficient gas storage solutions, while also highlighting the potential of SCH for cold storage applications.

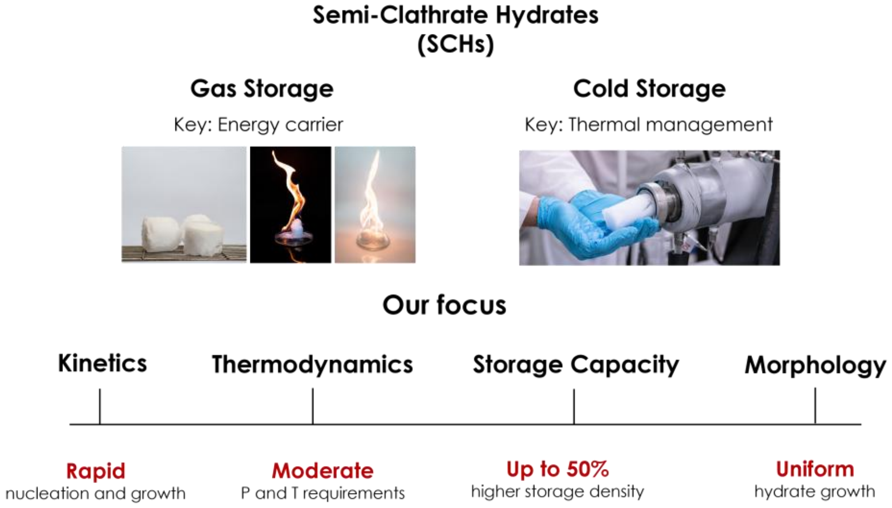


Fig. 1. Dual-functionality of semi-clathrate hydrates: Gas storage and cold storage applications.

Keywords: Gas storage; Cold storage; Semi-clathrate hydrate; Amino acids; Tetrabutylammonium fluoride (TBAF)

Oral **TIChE-EF-02**

Effect of diverse cation-anion salt combinations on methane hydrate formation

Teerapat Pongpuak[1], **Santi Kulprathipanja**[1], **Praveen Linga**[2,*], **Pramoch Rangsunvigit**[1,*]

[1] The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok 10330, Thailand
[2] Department of Chemical and Biomolecular Engineering, National University of Singapore,
Singapore 117585, Singapore
[*] Corresponding author: pramoch.r@chula.ac.th, praveen.linga@nus.edu.sg

ABSTRACT

Global natural gas consumption is projected to rise steadily, highlighting the need for efficient storage and transport solutions. Solidified natural gas (SNG), stored as gas hydrates, has emerged as a promising method due to its high energy density and stability under moderate conditions. However, using deionized water in hydrate formation presents significant cost challenges, especially for large-scale applications. Seawater offers a viable alternative, making it crucial to understand the influence of different salt ions on hydrate formation. This study investigates the effects of various cation-anion salt combinations on methane hydrate formation under controlled conditions of 8.0 MPa and 4 °C. Eight salts, representing diverse cations and anions, were examined to assess their impact on methane uptake, formation kinetics, thermodynamics, and morphology. Additionally, 1 wt.% methionine, a hydrophobic amino acid, was introduced to accelerate hydrate formation in saline environments. The results indicate that divalent cations such as Ca^{2+} and Mg^{2+} exhibit strong inhibitory effects. At 0.6 and 0.4 mol% concentrations, hydrates failed to form, with no observable methane consumption over a 12-hour. The hydrate formation rate and methane uptake generally decreased with increasing salt concentration, demonstrating the concentration-dependent inhibitory effect of salts. In terms of anions, OH^- showed an extreme inhibitory effect, preventing methane uptake even at a low concentration of 0.2 mol%. These findings suggest that specific salt compositions can significantly hinder or enhance hydrate formation, providing valuable insights for optimizing SNG storage in seawater-based systems.

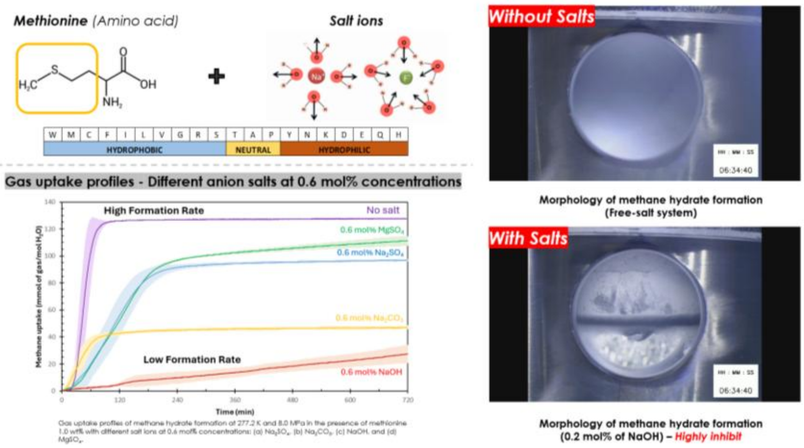


Fig. 1. Methane hydrate formation at 277.2 K and 8.0 MPa in the presence of methionine 1.0 wt% with different salt ions.

Keywords: Methane hydrate; Salt inhibition; Hydrate formation kinetics; Seawater-based storage

Oral **TIChE-EF-03**

Feasibility of hydrogen production from crude glycerol via photocatalysis using TiO_2-based photocatalysts

Thanapol Sutthiphong[1], **Auttawit Thoumrungroj**[1], **Pimchanok Longchin**[1], **Mali Hunsom**[1,2,3,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[2] Associate Fellow of Royal Society of Thailand (AFRST), Bangkok 10300, Thailand
[3] Advanced Microfabrication and Biomaterial for Organ-on-Chip Research Unit (AMBiO),
Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[*] Corresponding author: mali.hun@mahidol.edu

ABSTRACT

In this work, the feasibility of hydrogen (H_2) production from commercial- and crude glycerol was conducted by the photocatalytic process with TiO_2 and gold-doped TiO_2 (Au/TiO_2) photocatalysts. The preliminary results demonstrated that both photocatalysts possessed similar crystallinity and textural properties. However, the Au/TiO_2 displayed a higher visible light absorption, a longer lifetime of electron-hole pairs as well as a higher photocatalytic H_2 production. Besides, it was found that the glycerol purity and content significantly affected the H_2 production rate. Via the commercial glycerol, approximately 301 μmol/g of H_2 was produced with Au/TiO_2, which is about 26.6 times higher than the yield with the TiO_2 sample. By the Au/TiO_2 photocatalysts, approximately 71.2 μmol/g of H_2 was generated in the presence of 5 %vol crude glycerol, which was lower than that of commercial glycerol of around 4.23 times. Additionally, the operating cost of H_2 production from crude glycerol solution was 4.17 times higher than that of commercial glycerol. The improvement of H_2 production from crude glycerol will be explored. It is expected that the results obtained from this work may widen the horizon on the conversion of the by-product of the biodiesel process to a versatile energy carrier.

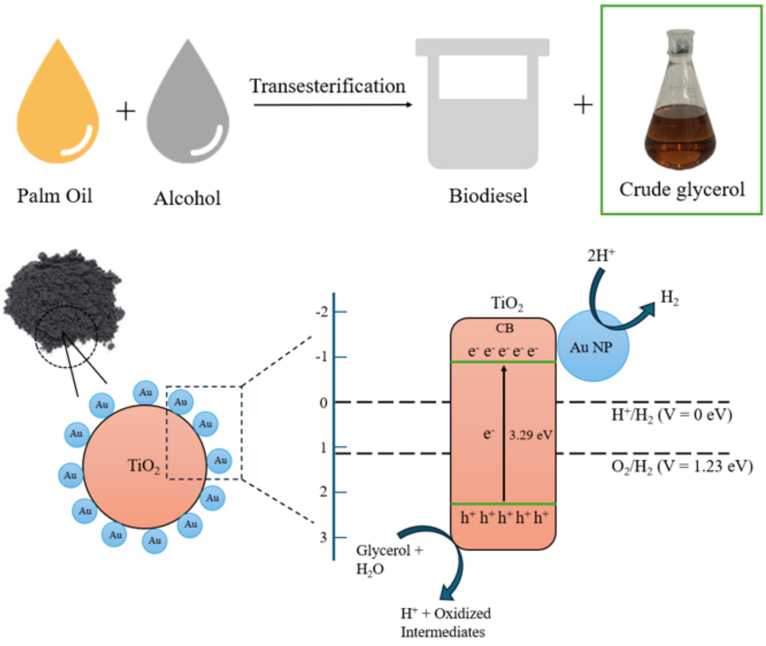


Fig. 1. Adsorption isotherms of methylene blue on CaO-CE and CaO standard.

Keywords: Crude glycerol; Photocatalysis; Hydrogen production; Au/TiO_2; Water splitting

Oral TIChE-EF-04

Effect of cation type and carrageenan structure on the formation and electrochemical properties of bio-gel electrolytes

Dedy Firmansyah[1], **Peerasak Paoprasert**[2], **Phongphot Sakulaue**[3], **Khanin Nueangnoraj**[1,*]

[1] School of Bio-Chemical Engineering and Technology, Sirindhorn International Institute of Technology, Thammasat University, Pathum Thani 12120, Thailand
[2] Department of Chemistry, Faculty of Science and Technology, Thammasat University, Pathum Thani 12120, Thailand
[3] Division of Chemical Engineering, Faculty of Engineering, Rajamangala University of Technology Krungthep, Bangkok 10120, Thailand
[*] Corresponding author: khanin@siit.tu.ac.th

ABSTRACT

Bio-gel electrolytes have gained significant attention due to their potential applications in energy storage devices [1]. This study investigates the effect of cation type (Li^+, Na^+, K^+) from their respective chloride salts (LiCl, NaCl, KCl) and carrageenan variant (kappa, iota, lambda) on the maximum salt concentration for gel formation, electrochemical window, and ionic conductivity. Dissolving different chloride salts in carrageenan-based matrices produced gel electrolytes, followed by an analysis of their electrochemical properties. Cyclic voltammetry determined the potential window, while electrochemical impedance spectroscopy analyzed ionic conductivity and charge transfer resistance. The results indicate that lithium chloride can form stable gels up to 5 M in all three carrageenan types, while sodium chloride and potassium chloride exhibit lower solubility limits. Cyclic voltammetry measurements show that at 5 M concentration, kappa-carrageenan achieves the most expansive potential window of 2.0 V, compared to iota and lambda, which both reach 1.8 V. Electrochemical impedance spectroscopy analysis reveals that ionic conductivity increases with salt concentration, with lithium chloride-based gels demonstrating the lowest resistance. These findings highlight the importance of selecting optimal cation-carrageenan combinations for enhanced electrochemical performance in bio-gel electrolytes, paving the way for their potential application in sustainable energy storage systems.

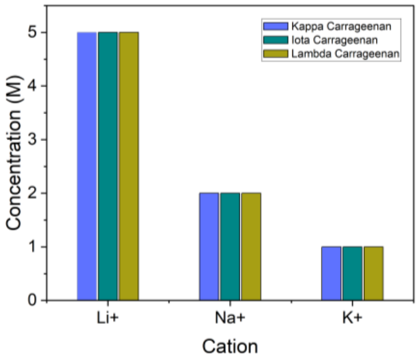


Fig. 1. Maximum salt concentration for gel electrolytes with different cations and carrageenan types.

Keywords: Gel electrolyte; Carrageenan; Electrochemical stability Window; Energy storage

References

[1] Ahmad F, Shahzad A, Sarwar S, Inam H, Waqas U, Pakulski D, et al. Gel polymer electrolyte composites in sodium-ion batteries: Synthesis methods, electrolyte formulations, and performance analysis. **Journal of Power Sources** 2024; 619: 235221.

Oral TIChE-EF-05

Regeneration by electrodialysis of secondary spent monoethanolamine solution obtained after mineralization of captured carbon dioxide with calcium sulfate

Ketwarang Nimnualrat[1], Nathaporn Kenbubpha[1], Kittiporn Laitha[1], Palang Bumroongsakulsawat[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: palang.b@chula.ac.th

ABSTRACT

The greenhouse effect has been impacting our planet further than we realized. In recent years, the earth's atmosphere has rapidly changed at a faster pace than ever. The main villain, mostly released from industry, is carbon dioxide (CO_2), which contributes about 79.7 percent of total greenhouse gases [1]. Consequently, Carbon Capture, Utilization and Storage (CCUS) has now become an important role to mitigate this problem. A widely used industrial medium for capturing CO_2 is aqueous solution of monoethanolamine (MEA), which is capable of capturing CO_2 from fossil fuel-fired processes. However, current MEA regeneration by stripping has high energy requirements for boiling the solution. In this study, mineralization followed by electrodialysis was examined as an alternative method to recover MEA. $CaSO_4$ was added to CO_2-rich MEA solution to precipitate CO_2 out as $CaCO_3$. This mineralization process produced protonated MEA ($MEAH^+$) and left sulfate in the solution. Electrodialysis was performed to deprotonate $MEAH^+$ and remove sulfate. The main energy requirement of this coupled process laid in the electrical energy for electrodialysis and did not involve the energy-intensive boiling of solution. Fig. 1 shows the schematic of Electrodialysis model for this experiment.

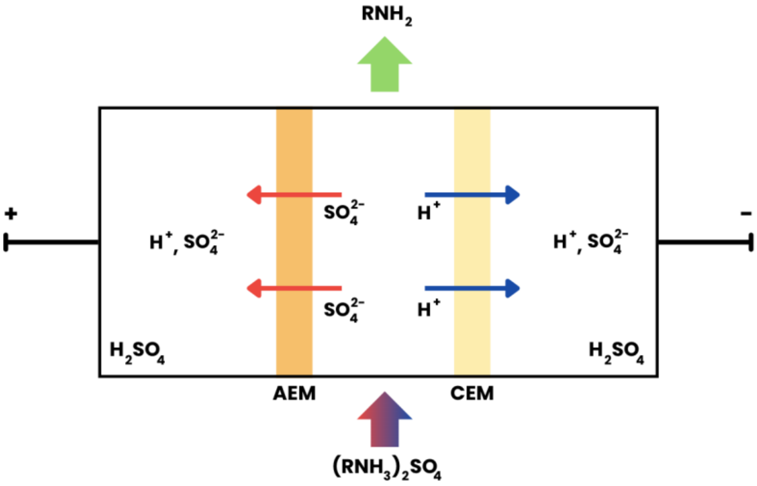


Fig. 1. Schematic of electrodialysis model for this experiment.

Keywords: Carbon dioxide; CCUS; MEA; Electrodialysis; Regeneration

References

[1] **U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022**. (n.d.). Retrieved Mar 04, 2025, https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

Oral TIChE-EF-06

One-dimensional simulation of an alkaline-acid direct glycerol fuel cell

Papitchaya Chaloeypanit[1], Supaporn Therdthianwong[1], Apichai Therdthianwong[2,*]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[2] Fuel Cells and Hydrogen Research and Engineering Center, Pilot Plant Development and Training Institute, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[*] Corresponding author: apichai.the@kmutt.ac.th

ABSTRACT

A one-dimensional numerical model of an alkaline-acid direct glycerol fuel cell (AA-DGFC) was developed to investigate the influences of the operating parameters such as glycerol to sodium hydroxide ratio ($C_3H_8O_3$:NaOH) and glycerol concentration on the AA-DGFC performance. A model of AA-DGFC was created by using computational software. In setting up the model, mass transport and charge transport, and ionic charge transport equations were coupled under steady state assumptions. Fick's law was used to describe species diffusion, while Butler-Volmer kinetic governed electro-chemical charge transfer at electrode-electrolyte interfaces. Concentration-dependent diffusivity formulation of Sodium ion (Na^+) transport in membrane was used. The simulation results show good agreement with experimental data under steady-state conditions, yielding a MAE of 0.03 V, and RMSE of 0.0330 V as shown in Table 1. The model not only captures both electrochemical and transport phenomena but also can be extended to analyze various operating conditions and support design optimization for AA-DGFC systems.

Table 1 MAE and RMSE simulation between experimental polarization curves after excluding transient regions.

Case (GLY:NaOH)	MAE (V)	RMSE (V)
0.5MGLY:2.5MNaOH	0.06	0.0660
1.0MGLY:3.0MNaOH	0.05	0.0619
1.0MGLY:5.0MNaOH	0.03	0.0330
1.0MGLY:8.0MNaOH	0.02	0.0250
1.0MGLY:10.0MNaOH	0.01	0.0110
1.5MGLY:7.5MNaOH	0.03	0.0376

Keywords: Alkaline-acid direct glycerol fuel cell (AA-DGFC); Mass transport; Charge transport; Steady-state conditions; Butler-Volmer kinetic

Poster **TIChE-EF-07**

Impact of trihexyl phosphate and dimethyl sulfoxide on $LiPF_6$-based electrolytes: A molecular dynamics study

Nudchakorn Supakamnerd[1], **Manaswee Suttipong**[1,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: manaswee.s@chula.ac.th

ABSTRACT

Lithium-ion batteries (LIBs) are essential for portable electronics and electric vehicles, yet conventional electrolytes suffer from flammability and safety risks, limiting their long-term viability [1]. Standard electrolytes, typically based on lithium hexafluorophosphate (LiPF6) in ethylene carbonate (EC) and propylene carbonate (PC), offer high ionic conductivity but pose significant safety challenges. To address this, we introduce trihexyl phosphate (THP) and dimethyl sulfoxide (DMSO) as unconventional co-solvents to systematically tune electrolyte properties, focusing on ion transport, viscosity, and solvation dynamics [2]. Using molecular dynamics (MD) simulations, we explore the impact of varying THP and DMSO concentrations on electrolyte structure and transport behavior. THP is shown to increase Li^+–PF_6^- electrostatic interactions, leading to greater contact-ion pair (CIP) formation, which reduces ionic mobility due to higher viscosity. DMSO weakens Li^+ solvation, disrupts ion-pair interactions, and promotes solvent-separated ion pairs (SSIPs), enhancing ion transport and conductivity. However, increasing DMSO concentrations, while beneficial for conductivity, may alter electrolyte stability. This study presents a novel molecular-level understanding of how phosphates and sulfoxides influence $LiPF_6$-based electrolytes, providing a new strategy for designing safer, high-performance electrolyte formulations for next-generation LIBs.

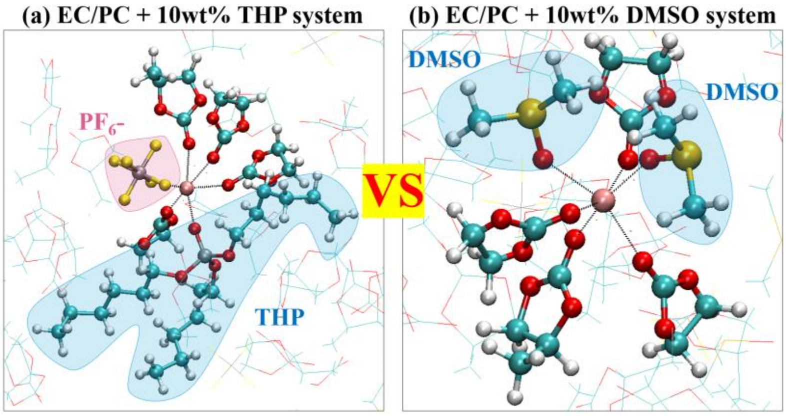


Fig. 1. Structural comparison of Li^+ solvation in EC/PC with (a) 10 wt.% THP and (b) 10 wt.% DMSO as co-solvents.

Keywords: Electrolyte optimization; Co-solvents; Solvation; Ionic conductivity; Molecular dynamics

References

[1] Gond R, van Ekeren W, Mogensen R, Naylor AJ, Younesi R. Non-flammable liquid electrolytes for safe batteries. **Materials Horizons** 2021; 8(11): 2913-2928.
[2] Alamdar S, Zarif M. Exploring lithium salt solution in sulfone and ethyl acetate-based electrolytes for Li-ion battery applications: A molecular dynamics simulation study. **Journal of Materials Chemistry A** 2024; 12(28): 17471-17482.

Poster **TIChE-EF-08**

Co-solvent engineering of deep eutectic electrolytes: A molecular dynamics study

Pongpon Pipattanachaiyanan[1], **Manaswee Suttipong**[1,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: manaswee.s@chula.ac.th

ABSTRACT

Zinc flow batteries (ZFBs) offer cost-effective and scalable energy storage but are hindered by the hydrogen evolution reaction (HER), reducing efficiency and lifespan [1]. Conventional aqueous electrolytes struggle to suppress HER while maintaining high ionic conductivity, necessitating alternative solutions. This study introduces deep eutectic electrolytes (DEEs) as a novel non-aqueous platform to enhance ZFB performance [2]. A 1:4 choline chloride (ChCl)-ethylene glycol (EG) DEE improves electrochemical stability but suffers from high viscosity, limiting ion transport [3]. To address this, we incorporate co-solvents: acrylonitrile (ACN), dimethyl sulfoxide (DMSO), and water (H_2O), to optimize viscosity and conductivity. Using molecular dynamics (MD) simulations, we analyze how co-solvents influence solvation dynamics and Zn^{2+}/Cl^- mobility. ACN-based systems favor contact ion pairs (CIP), while DMSO and H_2O promote solvent-separated ion pairs (SSIP), affecting ion diffusivity. The 1:4:4 ChCl:EG:H_2O composition achieves the highest ionic conductivity (108.98 mS/cm). This work advances high-performance, low-HER electrolytes, bridging electrochemical stability and ion transport. The findings enhance ZFB efficiency, safety, and scalability, accelerating next-generation zinc-based energy storage development.

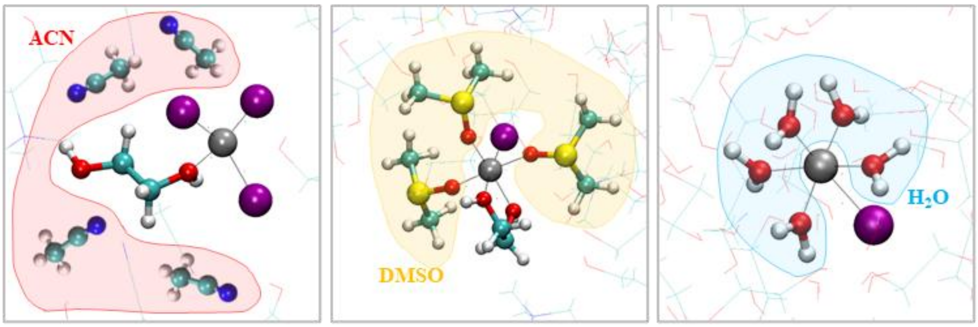


Fig. 1. Zn^{2+} solvation structure in deep eutectic solvent with different co-solvents: acetonitrile (ACN), dimethyl sulfoxide (DMSO), and water (H_2O).

Keywords: Zinc flow batteries; Deep eutectic electrolyte; Hydrogen evolution reaction; Molecular dynamics simulation

References

[1] Han M, Huang J, Xie X, Li TC, Huang J, Liang S, et al. Hydrated eutectic electrolyte with ligand-oriented solvation shell to boost the stability of zinc battery. **Advanced Functional Materials** 2022; 32(25): 2110957.
[2] Zhang C, Zhang L, Yu G. Eutectic electrolytes as a promising platform for next-generation electrochemical energy storage. **Accounts of Chemical Research** 2020; 53(8): 1648-1659.
[3] Dean W, Muñoz M, Noh J, Liang Y, Wang W, Gurkan B. Tuning and high throughput experimental screening of eutectic electrolytes with co-solvents for redox flow batteries. **Electrochimica Acta** 2024; 474: 143517.

Oral **TIChE-EF-09**

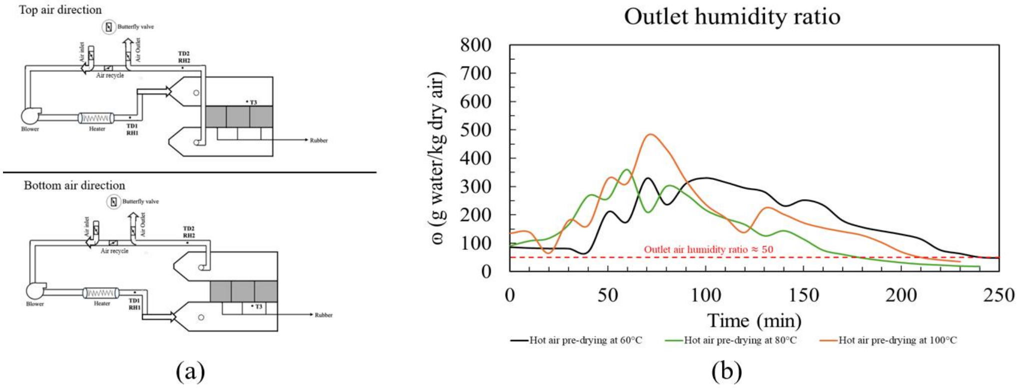
Enhancing drying efficiency of STR20 block rubber production using hot air pre-drying treatment

Jirapat Kongsong[1,2,5], Racha Dejchanchaiwong[1,2,5,*], Perapong Tekasakul[1,3], Arkom Palamanit[1,4,5]

[1] Air Pollution and Health Effect Research Center, Prince of Songkla University, Songkhla 90112, Thailand
[2] Department of Chemical Engineering, Faculty of Engineering, Prince of Songkla University, Songkhla 90112, Thailand
[3] Department of Mechanical and Mechatronics Engineering, Faculty of Engineering, Prince of Songkla University, Songkhla 90112, Thailand
[4] Energy Technology Program, Department of Specialized Engineering, Faculty of Engineering, Prince of Songkhla University, Songkhla 90110, Thailand
[5] Biomass Energy and Sustainable Technologies Research Unit, Faculty of Engineering, Prince of Songkhla University, Songkhla 90110, Thailand
[*] Corresponding author: racha.d@psu.ac.th

ABSTRACT

The present study evaluated the pre-drying of block rubber using waste-heat-derived hot air to enhance production efficiency and reduce the operation time. The objective focused on replacing conventional natural convection pre-treatment (40 minutes at room temperature) with active pre-drying at 60˚C, 80˚C, and 100˚C with airflow of 0.22 m^3/s. The present study was investigated using a prototype single-chamber dryer (1.80 × 1.55 × 1.50 m) featuring alternating airflow direction. Methods involved pre-drying followed by conventional drying (airflow of 0.22 m^3/s at temperature range of 100-125 ˚C and drying time of 220 minutes) with moisture content (MC), drying time, energy consumption, and STR20 standard compliance analyzed. The results show that pre-drying at 80˚C for 20 mins can reduce the moisture content (MC) of block rubber up to 63.61% as compared to conventional natural convection pre-treatment. The pre-treated block rubbers were then dried under the conventional drying condition. Total operation time, including pre-heat and drying time, decreased by 80 minutes (from 260 to 180 minutes), while specific energy consumption dropped by 24% as compared to conventional. The resulting rubber blocks met STR20 standards (MC = 0.3% db, Dirt = 0.02%, Ash = 0.45%, Nitrogen = 0.16%, Volatile = 0.28%, Initial Plasticity = 30%, Plasticity Retention Index = 71%). Conclusions highlight that 80˚C pre-drying optimizes waste heat utilization, reduces energy demand, and shortens drying time without compromising quality. This method offers a sustainable, cost-effective solution for industrial rubber production.



(a) (b)

Fig. 1. (a) Schematic diagram of block rubber drying process and (b) Results of humidity ratio at outlet for pre-drying at temperature of 60˚C, 80˚C, and 100˚C.

Keywords: Block rubber; Pre-drying; Hot air drying; STR20

Oral TIChE-EF-10

Reduction and capture of chlorine in Napier grass using microwave torrefaction

Prodpran Siritheerasas[1,*], **Roong Sirinuntavitaya**[1], **Phakjira Sangcharoenwathana**[1]

[1] Department of Chemical Engineering, Thammasat School of Engineering, Thammasat University,
Pathum Thani 12120, Thailand
[*] Corresponding author: sprod@tu.ac.th

ABSTRACT

The purpose of this study was to remove and capture chlorine (Cl) from Napier grass using microwave torrefaction with the microwave powers of 300 and 600 W for 5 min. Microwave absorbers, comprising silicon carbide (SiC) and activated carbon (AC), with the amounts of 10 and 20 wt.%, were added to Napier grass to simultaneously absorb microwave and capture Cl during torrefaction. It was found that microwave torrefaction could reduce Cl by ~48-82 wt.% and that SiC was more effective in removing Cl than AC. Increases in both microwave power and amount of microwave absorber led to an increase in Cl removal. When considering the abilities to capture Cl of the microwave absorbers, it was discovered that SiC could not capture Cl, whereas AC was able to capture Cl in the amount of ~2-27 wt.% of the amount of Cl released during torrefaction, as depicted in Fig. 1. Increases in both microwave power and amount of microwave absorber resulted in an increase in Cl capture ability.

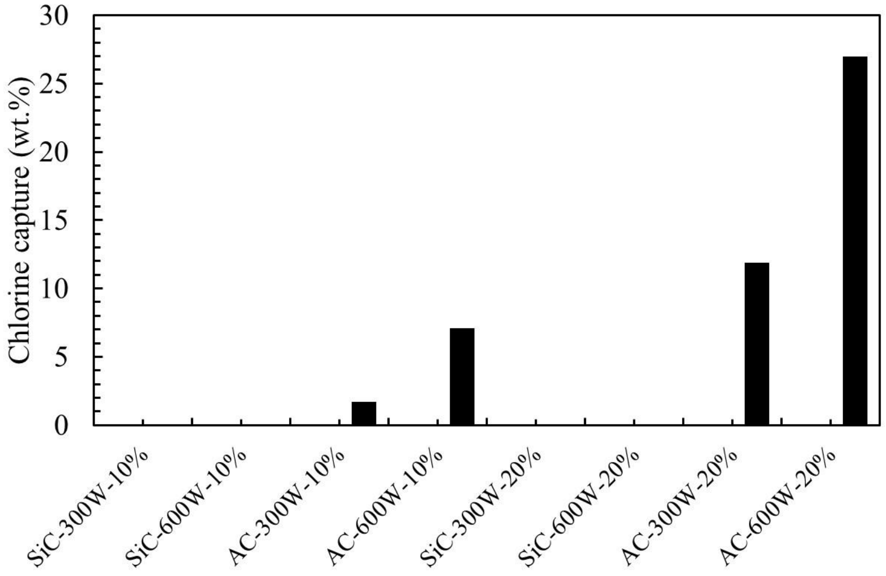


Fig. 1. Percentage of chlorine capture using silicon carbide (SiC) and activated carbon (AC) in the amounts of 10 and 20 wt.% with the microwave powers of 300 and 600 W for 5 min.

Keywords: Chlorine capture; Chlorine removal; Microwave absorber; Napier grass, Torrefaction

References

[1] Ren X, Rokni E, Zhang L, Wang Z, Liu Y, Levendis YA. Use of alkali carbonate sorbents for capturing chloring-bearing gases from corn straw torrefaction. **Energy & Fuels** 2018; 32: 11843-11851.

[2] Ramao EL, de Silva JM, dos Santos Luz NV, Conte RA. Torrefaction as a chlorine reduction process of Brazilian *Eucalyptus* sp. for use as biofuel. **BioEnergy Research** 2023; 16: 448-456.

Poster TIChE-EF-11

Regeneration by electrodialysis enhanced with ion-exchange resin of spent MEA solution after CO_2 capture and mineralization by $CaSO_4$ addition

Nathaporn Kenbubpha[1], Ketwarang Nimnualrat[1], Palang Bumroongsakulsawat[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: palang.b@chula.ac.th

ABSTRACT

Global warming is primarily driven by the increase in greenhouse gases, particularly CO2 emissions. The combustion of fossil fuels, a primary energy source for human activities, has significantly elevated atmospheric CO_2 levels, rising from a preindustrial concentration of 280 ppm to 420 ppm in 2023 [1]. As a result, Carbon Capture, Utilization, and Storage (CCUS) has become a critical approach to mitigate this issue. Monoethanolamine (MEA) solution is widely used in various industries to capture CO_2; however, the regeneration of MEA remains a challenge due to the high energy demands associated with the conventional stripping method, which requires boiling the solution. This research proposes a novel method for MEA recovery through a mineralization process, wherein $CaSO_4$ is added to an MEA solution with high CO_2 concentration to precipitate CO_2 as $CaCO_3$. The solution is then subjected to electrodialysis ion exchange resin added to enhance solution conductivity, especially when MEA is regenerated to its original, non-ionic form. This process utilizes electrical energy for electrodialysis, thereby having a possibility of reducing the need for high energy consumption required for boiling the solution in traditional methods.

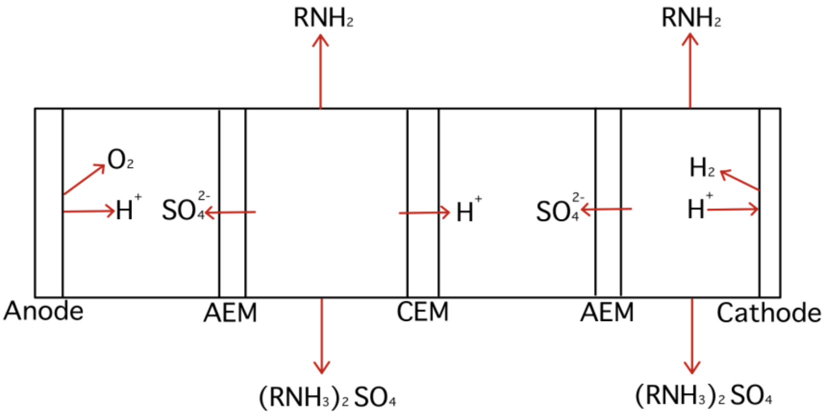


Fig. 1. Electrodialysis systems and ion exchange membranes.

Keywords: Carbon dioxide; CCUS; MEA; Electrodialysis; Regeneration

References

[1] Seo H, Hatton TAJN. Electrochemical direct air capture of CO_2 using neutral red as reversible redox-active material. **Nature Communications** 2023; 14: 313.

Poster TIChE-EF-12

The effect of methanol and ethanol-based solvent on enhancing CO_2 absorption efficiency and reducing energy consumption in the desorption process

Sasiphan Deenan[1], Weerawat Patthaveekongka[1,*], Kuntima Krekkeitsakul[2], Parinya Thongyindee[2], Penpan Pedsawang[2], Sunisa Luadlai[2], Rujira Jitrwung[3]

[1] Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Nakhon Pathom 73000, Thailand
[2] Expert Center of Innovative Clean Energy and Environment Thailand Institute of Scientific and Technological Research (TISTR), Pathum Thani 12120, Thailand
[3] Research and Development Group for Sustainable Development, Thailand Institute of Scientific and Technological Research (TISTR), Pathum Thani 12120, Thailand
[*] Corresponding author: patthaveekongka_w@silpakorn.edu

ABSTRACT

This research focuses on investigating the effects of using methanol and ethanol as solvents in amine solutions, specifically MEA (monoethanolamine) and DEA (diethanolamine), for CO_2 absorption. The study investigates six different solutions: MEA + H_2O, MEA + MeOH, MEA + EtOH, DEA + H_2O, DEA + MeOH, and DEA + EtOH, in the CO_2 absorption process and their impact on CO_2 capture efficiency from flue gas, which consists of 12% CO_2, 5% O_2, and 83% N_2 and the energy consumption of the process, in comparison to conventional water-based amine absorption. Various process parameters were examined, including the amine solution flow rate (0.6-1.2 L/min), gas mixture flow rate (15-25 L/min), and reboiler temperature (85-100°C). Previous research indicates that incorporating alcohols into amine solutions can enhance CO_2 absorption performance, [1] demonstrated that alcohol-amine mixtures reduce regeneration energy by 10-15%. [2] reported a 5-8% increase in absorption efficiency when ethanol was introduced into MEA solutions.

Table 1 Summary of CO_2 absorption-desorption efficiencies and energy consumption for various amine-solvent systems.

Amine Type	Solvent Type	Temperature(°C)	Absorption Efficiency(%)	Desorption Efficiency(%)	Energy Consumption (MJ/kg CO_2)
MEA30	Water70	93.50	100.00	97.30	55.86
MEA30	Methanol70	95.00	100.00	32.08	53.38
MEA30	Ethanol70	92.00	97.51	93.66	24.83
DEA30	Water70	99.50	100.00	97.60	49.66
DEA30	Methanol70	88.00	98.26	93.87	24.08
DEA30	Ethanol70	87.75	99.18	97.62	20.98

The findings of this study reveal that DEA-ethanol solutions exhibit superior CO_2 absorption (95.04%) and desorption efficiency (94.52%) compared to conventional MEA-H_2O systems (85-90%) [3]. Furthermore, ethanol-based DEA solutions outperformed methanol-based counterparts by 6-10% [4]. The optimal DEA-ethanol system, operating at a solution flow rate of 1 L/min, achieved an energy consumption of 24.46 MJ/kg CO_2, representing a reduction of over 50% relative to traditional water-based absorption (48-50 MJ/kg CO_2) [1]. These findings suggest that the use of alcohol as a solvent in amine-based CO_2 absorption could be a promising approach to improving process efficiency and reducing energy costs, which are critical factors in the sustainable development of CO_2 capture technology.

Keywords: Alcohol-based solvents; Amine absorption; CO_2 capture; Desorption process; Energy consumption

References

[1] Fu D, Xie J, Wang F, Wang S. Investigation of surface tension and viscosity for aqueous solutions of MEA-MeOH and DEA-MeOH. **The Journal of Chemical Thermodynamics** 2018; 116: 197-205.

[2] Hanna K, Rennemo R, Arlinda F. New solvent blends for post-combustion CO_2 capture. **Green Energy & Environment** 2019; 4(4): 439-452.

[3] von Harbou I, Hoch S, Mangalapally H, Notz R, Sieder G, Garcia G, et al. Removal of carbon dioxide from flue gases with aqueous MEA solution containing ethanol. **Chemical Engineering and Processing: Process Intensification** 2014; 75: 81-89.

[4] Lai Q, Kong L, Gong W, Russell A, Fan M. Low-energy-consumption and environmentally friendly CO_2 capture via blending alcohols into amine solution. **Applied Energy** 2019; 254: 113696.

Oral TIChE-EF-13

Four-zone modelling of modified downdraft gasifier for performance prediction: Case study of semi-batch operation

Kantapat Palawat[1,*], Phavanee Narataruksa[1,2], Piyapong Hunpinyo[1,2], Nuwong Chollacoop[3], Apichart Meechai[4]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand
[2] Research Center for Chemical Engineering Unit Operation and Catalyst Design (RCC), King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand
[3] National Energy Technology Center (ENTEC), Pathum Thani 12120, Thailand
[4] Phra Nakhon Energy Co., Ltd, Rayong 21000, Thailand
[*] Corresponding author: kantapat.pt@gmail.com

ABSTRACT

Bio-syngas from biomass gasification is an alternative fuel for bioenergy production. This study aims to develop a user-friendly operational guideline for a modified downdraft gasifier prototype, designed for semi-batch operation, with dimensions of 150 (H) × 50 (D) cm. The methodology involved two main steps: (1) refining a theoretical model using Aspen Plus® simulation, based on a four-zone existing chamber concept, which consists of condensing, drying, gasifying, and reducing zones, as shown in Fig. 1. [1]. In this model, part of the internal hot-gas stream generated in the gasifying zone was redirected as thermal feedback to the pyrolysis section within the drying zone, representing internal heat loss. Meanwhile, syngas produced in the reduction zone was drawn upward into the gas collection box by suction pressure applied at the top of the box. This pressure gradient, where $P_{reduction} > P_{top}$, box led the syngas to move upward from the bottom of the reduction zone to the top of the box. The collected gas subsequently passed through a cyclone filter and entered the buffer tank to stabilize the syngas for future uses, such as blowdown and electricity generation; (2) A gasifier performance database was developed by integrating simulation outputs with a machine learning approach, specifically, linear regression, to evaluate syngas flow behavior under varying semi-batch feed durations of 15, 30, and 60 minutes.

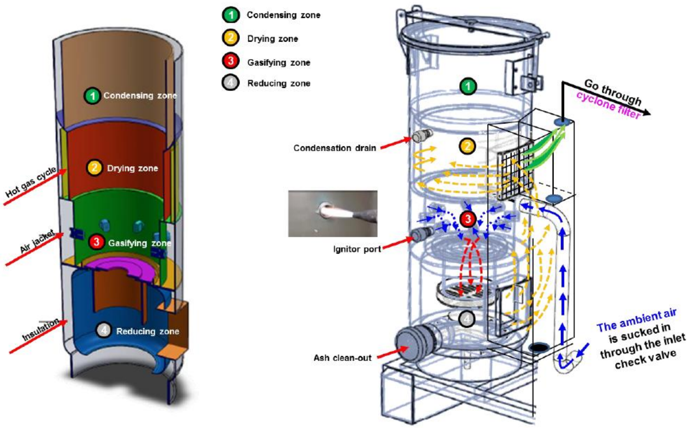


Fig. 1. Prototype downdraft gasifier with characteristic flow inside and outside the system.

Keywords: Bio-syngas; Downdraft gasifier; Biomass gasification; Linear regression

References

[1] Meechai A. **Laboratory-scale demonstration units for biomass-to-liquid (BTL) systems**. Internal documentation, Biomass Energy Lab, Thailand, 2023.

Oral TIChE-EF-14

Improvement of electrocatalytic activities of Ag-based catalysts in oxygen reduction and oxygen evolution reactions

Phatcharanan Pipatnawakit[1], **Jatupon Chaiwasu**[1], **Apichai Therdthianwong**[2],
Montree Ob-choey[1,*], **Sarayut Yongprapat**[2,*], **Supaporn Therdthianwong**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[2] Fuel Cell and Hydrogen Research and Engineering Center, Pilot Plant Development and Training Institute, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[*] Corresponding author: sarayut.yon@kmutt.ac.th, supaporn.the@kmutt.ac.th

ABSTRACT

The electrocatalytic performances in oxygen reduction and oxygen evolution reactions (ORR/OER) of catalysts are crucial for the development of regenerative fuel cells (RFCs). This study explored the effects of cobalt (Co) and cerium (Ce) in Ag nanowires (AgNWs) on the ORR and OER. The catalysts were synthesized by incorporating cerium-doped cobalt oxide (Ce-Co_3O_4) through the precipitation method. The X-ray diffraction (XRD) results confirmed that Ce exists predominantly as CeO_2, while Co is present in the form of Co_3O_4. The catalytic activity of the catalyst tested as the oxygen electrode was evaluated using cyclic voltammetry and linear sweep-voltammetry techniques. The experimental results showed that the presence of Ce in Ce-Co_3O_4 facilitated the formation of AgO or the OER reaction at a lower potential and enhanced the ORR at higher potentials compared to the catalysts containing only CeO_2 or Ce_3O_4, as shown in Fig. 1. This highlights the role of Co-Ce interactions in improving their catalytic activity in ORR/OER. In the O_2-saturated electrolyte, the Ag-Ce-Co_3O_4 catalysts also improved the limiting current density and E1/2 potential. These findings suggested that the AgNWs/CeO_2-Co_3O_4 is a promising bifunctional electrocatalyst for energy conversion applications.

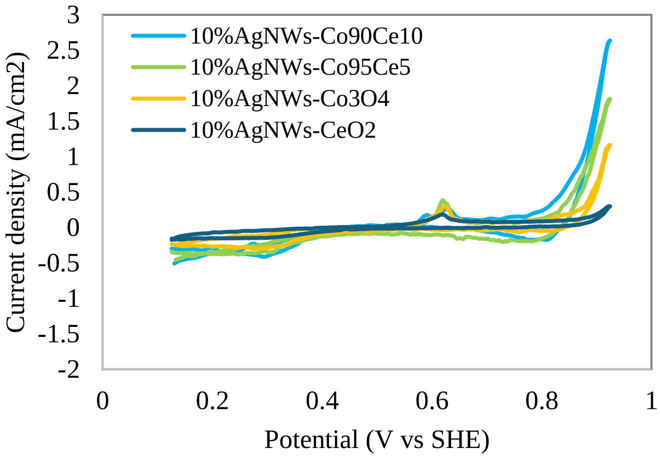


Fig. 1. Cyclic voltammograms of Ce-Co_3O_4 in different ratios with 10% AgNWs in Ar-purged 0.1 M NaOH solution.

Keywords: Oxygen reduction reaction; Oxygen evolution reaction; Ag-based catalysts, Regenerative fuel cell; CeO_2-Co_3O_4

Oral TIChE-EF-15

Photocatalytic green hydrogen production by gold-decorated TiO_{2-x} photocatalyst

Naphaphan Kunthakudee[1], **Tarawipa Puangpetch**[2], **Prakorn Ramakul**[2], **Mali Hunsom**[1,3,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[2] Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University, Nakhon Pathom 73000, Thailand
[3] Associate Fellow of Royal Society of Thailand (AFRST), Bangkok 10300, Thailand
[*] Corresponding author: mali.hun@mahidol.edu

ABSTRACT

Green hydrogen (H_2) is the H_2 that is produced from renewable energy sources through a process that not emit CO_2 or other greenhouse gases such as electrolysis or photocatalysis. This work was conducted to synthesize a gold-decorated defective TiO_2 (Au/TiO_{2-x}) photocatalyst for green H_2 production. Effect of the solution pH used to decorate gold (Au) on TiO_2 by photodeposition was first explored. The impact of the defective structure on the properties and activity for H_2 production of Au/TiO_{2-x} nanoparticles was also investigated. The preliminary results demonstrated that the change in gold solution pH from 3.2 to 10.0 did not affect the phase or crystallite size of the Au/TiO_2, but it did alter the quantity of deposited Au, surface area, band gap energy, LSPR intensity, and the particle size of Au nanoparticles. The Au/TiO_2 synthesized from the gold solution with pH 10 possessed the highest photocatalytic H_2 production due to the presence of the smallest size of Au nanoparticles. The presence of defects induced the color change of TiO_2 from white to brown color with the improved light absorption capacity and charge separation efficiency. The presence of an optimal concentration of defects enhanced the photocatalytic performance, while excessively high or low defect content reduced the performance. The photocatalytic activity of H_2 production dropped approximately 8.2% after the 5th use (Fig. 1).

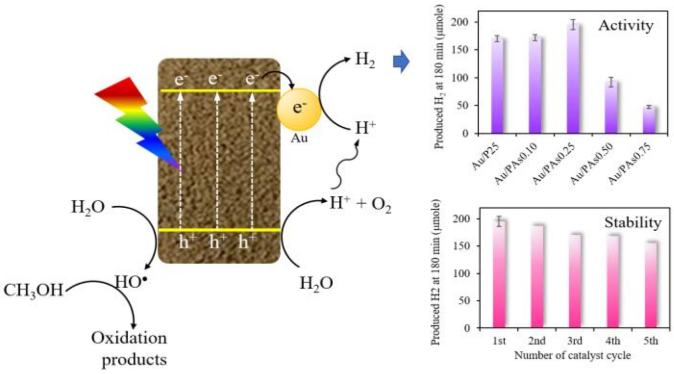


Fig. 1. Activity and stability of Au/TiO_{2-x}.

Keywords: Hydrogen; Photocatalyst; Defective TiO_2

References

[1] Kunthakudee C, Puangpetch T, Ramakul P, Serivalsatit K, Hunsom M. Light-assisted synthesis of Au/TiO_2 nanoparticles for H_2 production by photocatalytic water splitting. **International Journal of Hydrogen Energy** 2022; 47(56): 23570-23582.

[2] Kunthakudee C, Puangpetch T, Ramakul P, Serivalsatit K, Ponchio C, Hunsom M. Ultra-fast green synthesis of defective TiO_2 photocatalyst towards hydrogen production application. **RSC Advance** 2024; 14: 24213.

Poster **TIChE-EF-16**

Cultivation of green microalga *Scenedesmus* Sp. under semi-continuous condition

P. Chitsing[1], **N. Manang**[1], **Chatchai Kunyawut**[1], **Idtisak Paopo**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Ubon Ratchathani University,
Ubon Ratchathani 34190, Thailand
[*] Corresponding author: idtisak.p@ubu.ac.th

ABSTRACT

Green microalgae can be cultivated under semi-continuous conditions to achieve high dry cell weight and oil content. This cultivation method prolongs exponential growth phase of the microalgae [1]. This study aimed to evaluate the effect of semi-continuous cultivations on a specific growth rate, and oil content of *Scenedesmus* Sp. The microalgae were cultured in 5 L Erlenmeyer flasks and a 10 L bubble column photobioreactor (BCPBR) as described in [2]. They were grown in BG-11 culture medium at 28-34oC under LED lighting with an intensity of 3,500 lux. The specific growth rates (μ) were 0.145, 0.146, and 0.185 day-1 for batch culture in Erlenmeyer flasks, batch BCPBR and semi-continuous BCPBR, respectively. The BCPBR system also extended the exponential growth, enhancing overall growth and productivity. As shown in Fig. 1, further optimization of culture medium replacement may be necessary to maximize productivity.

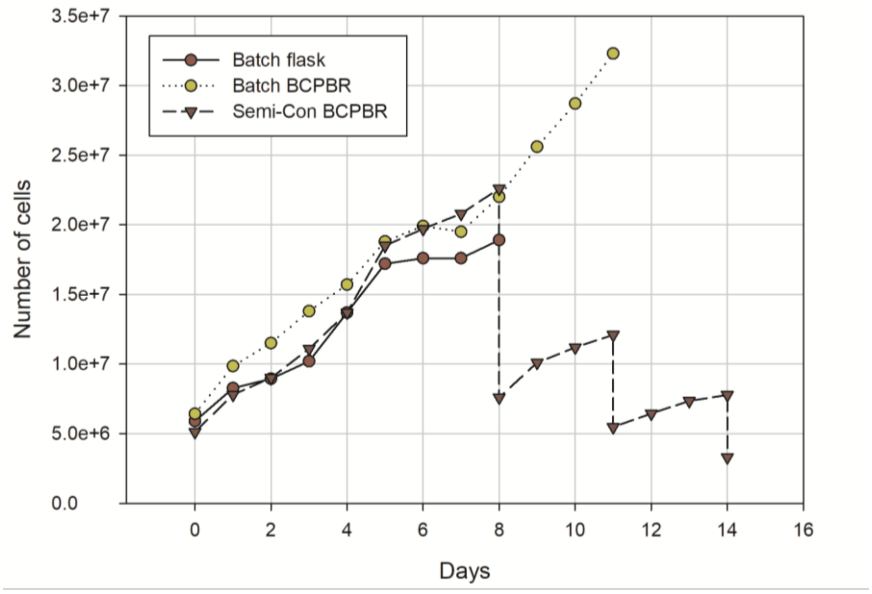


Fig. 1. Growth characteristic of *Scenedesmus* Sp. under different conditions.

Keywords: Microalgae; Bubble column; Photobioreactor; Biofuels

References

[1] Sánchez-Bayo A, Morales V, Rodríguez R, Vicente G, Bautista LF. Cultivation of microalgae and cyanobacteria: Effect of operating conditions on growth and biomass composition. **Molecules** 2020; 25(12), 2834.

[2] Kunyawut C, Paopo I, Krommuang A. Development of a bubble column photobioreactor for microalgal culture. **Burapha Science Journal** 2019; 24(2), 471-488.

Oral TIChE-EF-17

Development of low-cost Ag-based ORR electrodes via electrodeposition on carbon cloth for AEM fuel cells

Mongkon Thongom[1], **Natthaphon Sirireak**[1], **Parinrat Chitsaart**[1], **Jatupon Chaiwasu**[1,*],
Sarayut Yongprapat[2], **Supaporn Therdthianwong**[1], **Apichai Therdthianwong**[2]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[2] Fuel Cell and Hydrogen Research and Engineering Center, Pilot Plant Development and Training Center, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[*] Corresponding author: jatupon.chai@kmutt.ac.th

ABSTRACT

This study investigates the electrodeposition of Ag onto carbon cloth using an aqueous solution of 20 mM $AgNO_3$ and 0.1 M $NaNO_3$, with the goal of developing a low-cost oxygen reduction reaction (ORR) electrode for use in Anion Exchange Membrane Fuel Cells, (AEMFC). The aim is to explore a straightforward method for depositing silver onto inexpensive porous transport layers such as carbon cloth. Cyclic voltammetry (CV) was used as a preliminary technique to identify the appropriate plating potential window for Ag deposition. Cathodic peaks from CV indicate the reduction of Ag^+ and help guide the plating condition. SEM analysis showed that Ag particles were successfully deposited on the carbon fiber surface, with visible particle formation across the entire woven cloth structure. The distribution of Ag is non-uniform, with denser clusters forming in some regions while other areas remain sparsely covered, indicating surface-dependent nucleation behavior. EDX analysis confirmed the elemental presence of silver with minimal contamination, verifying successful deposition.

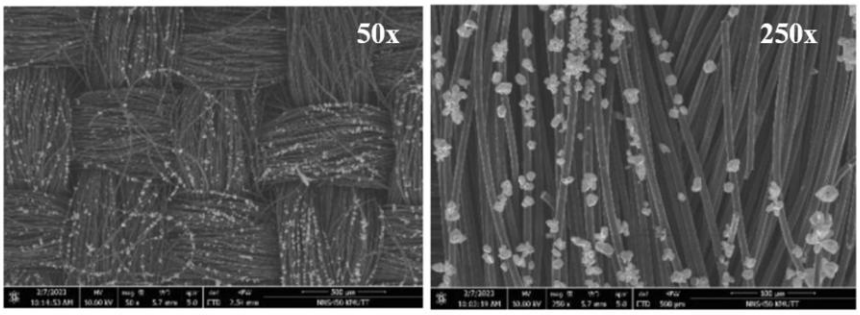


Fig. 1. SEM images of Ag electrodeposited onto carbon cloth.

The Ag-deposited carbon cloth was assembled into a lab-scale AEM fuel cell for initial performance testing. Preliminary results showed oxygen reduction and measurable current under voltage, confirming basic ORR activity. These findings support further development of electrodeposited Ag and potentially other low-cost metal catalysts for AEM fuel cells.

Keywords: Electrodeposition; Anion exchange membrane fuel cells; Oxygen reduction reaction

Oral TIChE-IA-01

Prediction of latent heat of vaporization of binary mixture using COSMO-SAC model

Natamorn Kamlue[1], **Surat Areerat**[1,*]

[1] Department of Chemical Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
[*] Corresponding author: surat.ar@kmitl.ac.th

ABSTRACT

This study aims to predict the latent heat of vaporization of mixtures rather than evaluating VLE predictions using the UNIFAC model due to our project's interest in predicting the efficiency of mixed refrigerants, it is essential to determine the latent heat of vaporization to assess the efficiency of a refrigerant in a cooling system. Moreover, several studies have already compared VLE predictions obtained from the COSMO-SAC model with other models. For instance, the study by Santos et al. in 2015 [1] compared VLE predictions for alcohol and hydrocarbon mixtures using the COSMO-SAC, NRTL, and UNIQUAC models. Their results indicated that NRTL and UNIQUAC perform better than COSMO-SAC due to the advantage of using regressed parameters. However, the average absolute relative deviation (AARD) of COSMO-SAC predictions ranged from 5.0% to 13.8%, which is still considered acceptable for a model that relies solely on quantum calculations for the sigma profile. Additionally, another study by da Silveira et al. in 2018 [2] compared activity coefficient models for VLE predictions between correlative models, such as Wilson, NRTL, and UNIQUAC, and predictive models, including UNIFAC (estimated parameters), COSMO-SAC, and F-SAC. Their findings showed that the correlative models, particularly UNIQUAC and NRTL, exhibited the best performance compared to predictive models due to their reliability with optimized parameters. Among the predictive models, COSMO-SAC provided better results for almost every binary system. However, the infinite-dilution activity coefficients (IDAC) predicted by the F-SAC model outperformed those of both COSMO-SAC and UNIFAC. Thus, in summary, to predict the performance of refrigerant mixtures in cooling systems, this study focuses on predicting the latent heat of vaporization using the COSMO-SAC and UNIFAC models. Particular attention is given to the COSMO-SAC model since it does not require experimental parameters but instead relies on quantum calculations to estimate the latent heat of vaporization based on properties of the substances.

Table 1 Comparison of mean absolute deviation (MAD) between of predicted ΔH_{vap} between UNIFAC and COSMO-SAC models.

Binary Mixtures	%MAD$_{\text{UNIFAC}}$	%MAD$_{\text{COSMO-SAC}}$
Ethyl acetate(1)/Benzene(2)	13.46%	1.73%
Ethyl acetate(1)/Toluene(2)	16.37%	9.86%
Ethanol(1)/Iso-octane(2)	8.79%	13.90%
R152A(1)/DME(2)	3.32%	6.47%

Keywords: COSMO-SAC; UNIFAC; Latent heat of vaporization; Sigma-profile; Activity coefficients

References

[1] Santos D, Segtovich I, Teixeira F, Alvarez VH, Mattedi S. Vapor-liquid equilibrium calculations for alcohol and hydrocarbon mixtures using COSMO-SAC, NRTL, and UNIQUAC models. **Brazilian Journal of Petroleum and Gas** 2015; 8(4): 127-137.

[2] da Silveira CL, Salau NPG. From Wilson to F-SAC: A comparative analysis of correlative and predictive activity coefficient models to determine VLE and IDAC of binary systems. **Fluid Phase Equilibria** 2018; 464: 1-11.

Poster **TIChE-IA-02**

Sustainable manufacturing of polycaprolactone films: Effects of processing conditions on film quality

Kitthanya Ritthichai[1], **Sirilux Poompradub**[2,3,4*]

[1] Petrochemistry and Polymer Science Program, Faculty of Science, Chulalongkorn University,
Bangkok 10330, Thailand
[2] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[3] Center of Excellence on Petrochemical and Materials Technology Chulalongkorn University,
Bangkok 10330, Thailand
[4] Center of Excellence in Green Materials for Industrial Application, Chulalongkorn University,
Bangkok 10330, Thailand
[*] Corresponding author: sirilux.p@chula.ac.th

ABSTRACT

Polycaprolactone (PCL) [1] is a biodegradable polymer with a low melting point and excellent biocompatibility, making it widely used in medical applications such as tissue engineering, drug delivery, and sutures. It is synthesized from ε-caprolactone through ring-opening polymerization and can be dissolved in organic solvents such as chloroform, dichloromethane, and acetone. However, conventional solvent-based processing raises environmental concerns and presents challenges in process control. To develop a more sustainable and continuous manufacturing process, cast film extrusion is a promising alternative as shown in Fig. 1 [2]. Despite its advantages, PCL film extrusion presents challenges related to gel formation, which negatively impacts film quality and mechanical properties. The gel formation is influenced by multiple factors, including temperature, shear rate, and residence time within the extruder. This study aims to investigate the effect of extrusion processing conditions on the mechanical properties of PCL films, focusing on temperature variations and their impact on film properties.

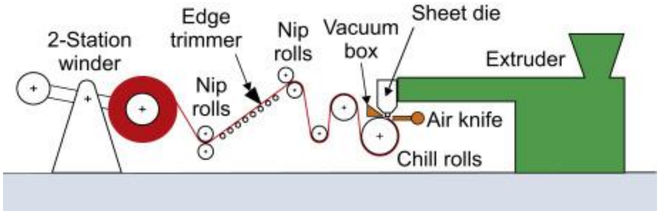


Fig. 1. Cast film extrusion for PCL material [2].

The results demonstrate that higher extrusion temperatures significantly promote gel formation on the film surface, leading to defects such as uneven thickness and reduced mechanical performance. In contrast, optimized processing conditions help minimize gel formation and improve film uniformity. Understanding these relationships is critical for enhancing the quality of PCL films and expanding their potential applications in biomedical and industrial fields. This study provides insights into the optimization of PCL film extrusion, offering a pathway to more efficient and environmentally friendly processing methods.

Keywords: Polycaprolactone; Extrusion; Film quality; Processing optimization; Gel formation

References

[1] Lyu JS, Lee JS, Han J. Development of a biodegradable polycaprolactone film incorporated with an antimicrobial agent via an extrusion process. **Scientific Reports** 2019; 9: 20236.
[2] Crawford RJ, Martin PJ. **Processing of plastics**. In: Plastics Engineering (Fourth Edition). Butterworth-Heinemann; 2020: 279-409.

Oral TIChE-IA-03

Feedforward control of pulsed bed adsorption column for colorant removal in sugar syrup at different flow rates

Chanya Plangklang[1], **Terasut Sookkumnerd**[1,*]

[1] School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology,
Nakhon Ratchasima 30000, Thailand
[*] Corresponding author: terasut@sut.ac.th

ABSTRACT

To minimize the environmental impact of colorant removal in sugar syrup, pulsed bed adsorption columns present a promising alternative to conventional ion exchange resin processes. Despite their environmental advantages, these columns pose new challenges in operation due to their cyclic steady-state nature. In this study, the numerical method of lines was applied to investigate the dynamic behavior of pulsed bed adsorption columns under various conditions. Specifically, the effectiveness of feedforward control when the inlet colorant concentration in syrup fluctuates periodically at flow rates between 4 and 8 ml/min was investigated. From the study, it was confirmed that feedforward control successfully regulated the outlet colorant concentration, as illustrated in Fig. 1. These findings support the adoption of feedforward control to improve the practicality and efficiency of pulsed bed adsorption columns in sugar refining processes.

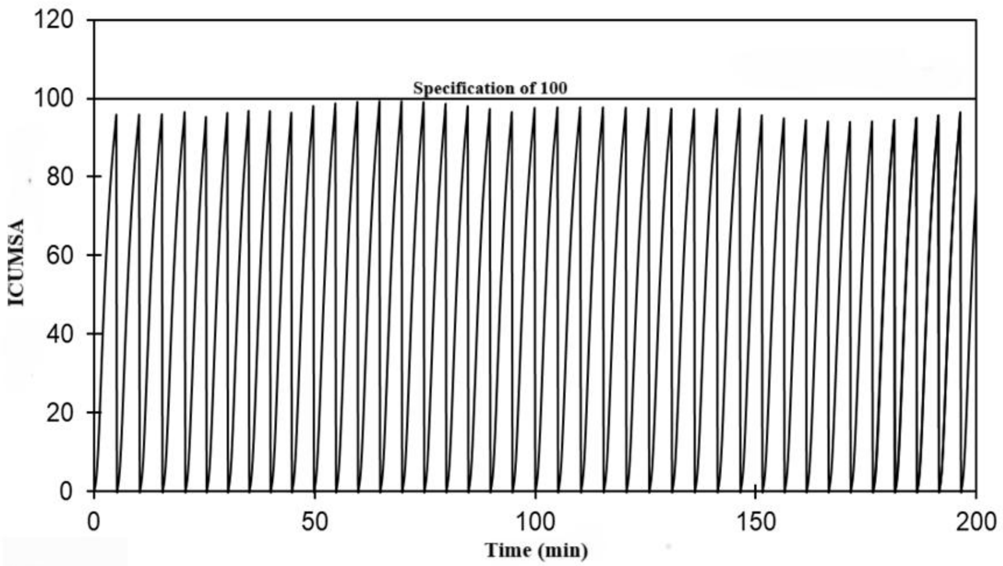


Fig. 1. Feedforward control of a pulsed bed adsorption column for colorant removal in sugar syrup at 8 ml/min with periodic inlet concentration changes.

Keywords: Pulsed bed; Feedforward control; Sugar refining; Colorant removal

References

[1] Svedberg UG, Numerical solution of multicolumn adsorption processes under periodic countercurrent operation. **Chemical Engineering Science** 1976; 31(5): 345-353.
[2] Plangklang C, Sookkumnerd T. Modeling and feedforward control of pulsed bed adsorption column for colorant removal in sugar syrup. **Engineering Journal** 2023; 27(1): 29-38.

Oral TIChE-IA-04

The impact of learner characteristics on learning outcomes and time to degree completion

N. Punsuwan[1], Idtisak Paopo[1,*], P. Sangthean[1], T. Sangthean[1]

[1] Department of Chemical Engineering, Faculty of Engineering, Ubon Ratchathani University,
Ubon Ratchathani 34190, Thailand
[*] Corresponding author: idtisak.p@ubu.ac.th

ABSTRACT

Learners play a crucial role in enhancing their academic performance and time to degree completion [1]. This study examined the characteristics of learners that influence academic success, focusing on second-year and higher students in the Chemical Engineering Department, Ubon Ratchathani University. Sixty-eight students who studied basic design in chemical engineering were assessed through tests designed to analyze the correlation between learners' characteristics and their performance. The study revealed that learners with a background in mathematics and science can effectively solve basic problems and design fundamental chemical engineering tasks. Conversely, learners without a background in mathematics and science struggle to solve basic problems and design chemical engineering tasks. Learners with a good to excellent level of knowledge can solve complicated problems and design intricate chemical engineering tasks. Hence, backgrounds in mathematics and science significantly influence chemical engineering students' problem-solving abilities, design skills, attention to detail, and time to degree completion.

Table 1 Effects of learner characteristics on their academic performance.

Learner performance	%Pass					
	Basic knowledge		Basic design	Complex design	Awareness of engineering	Attention to detail
	Math	Science				
Excellent	100	100	100	75	56	100
Very good	100	100	100	100	50	67
Good	100	100	100	100	58	100
Satisfactory	100	100	100	0	55	18
Poor	100	100	100	0	35	0
Fail	68	48	0	0	45	4

Keywords: Academic performance; Learner characteristics; Learning outcomes; Engineering

References

[1] Joyce B, Main G, Amanda G. **The impact of math and science remedial education on engineering major choice, degree attainment, and time to degree**. ASEE 2022 Annual Conference: Excellence Through Diversity, Minneapolis, Minnesota, June 26th - 29th, 2022, 1-26.

Oral TIChE-PE-01

Development of computational fluid dynamics modeling of packed bed membrane reactor for dimethyl ether production from carbon dioxide

Kannika Lhongbangplee[1], **Pornchai Bumroongsri**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University,
Nakhon Pathom 73170, Thailand
[*] Corresponding author: pornchai.bum@mahidol.ac.th

ABSTRACT

Dimethyl ether (DME) is a valuable chemical synthesized from syngas (CO_2 and H_2). This research investigates DME production in a catalytic membrane reactor using a CuO-ZnO-Al_2O_3/HZSM-5 catalyst and a water-selective membrane [1, 2]. Computational fluid dynamics modeling was applied to study key parameters including the temperature, pressure, and ratio between sweep gas and feed gas. The results indicate that the optimal condition for maximizing CO_2 conversion and DME yield is at the temperature 200 °C, the pressure 20 bar and the ratio between sweep gas and feed gas 20. The selective removal of water significantly enhances the equilibrium shift toward DME formation. The study confirms that an efficient catalytic membrane reactor design can provide a scalable and sustainable solution for DME production.

Keywords: Dimethyl ether; Water vapor removal; Computational fluid dynamics; Carbon dioxide

References

[1] Han Y, Zhang H, Ying W, Fang D. Modeling and simulation of production process on dimethyl ether synthesized from coal-based syngas by one-step method. **Chinese Journal of Chemical Engineering** 2009; 17(1): 108-112.

[2] Poto S, Llosa Tanco M, Tanaka D, Neira D'Angelo M, Gallucci F. Experimental investigation of a packed bed membrane reactor for the direct conversion of CO_2 to dimethyl ether. **Journal of CO_2 Utilization** 2023; 72: 102513.

Poster **TIChE-PE-02**

Analysis of carbon dioxide trapping efficiency in saline aquifer by machine learning

Jakkai Jitkoolsamphan[1], **Suparit Tangparitkul**[2], **Teerawat Sema**[1,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Department of Mining and Petroleum Engineering, Faculty of Engineering, Chiang Mai University,
Chiang Mai 50200, Thailand
[*] Corresponding author: teerawat.se@chula.ac.th

ABSTRACT

With growing climate change concerns, carbon capture and storage (CCS) plays a key role in reducing carbon dioxide (CO_2) emissions. Saline aquifers are a promising option for long-term CO_2 storage [1], where Residual Trapping Index (RTI) and Solubility Trapping Index (STI) indicate storage efficiency [2]. Accurate estimation of RTI and STI is crucial for CCS projects, yet conventional numerical simulations are computationally expensive. This work proposes an Extreme Gradient Boosting (XGBoost) model to predict RTI and STI due to its efficiency and predictive power. The model was trained and validated on a simulation-generated dataset (5,790 data collected from 35 articles) incorporating geological attributes and reservoir characteristics from various saline aquifers. Inputs include physical properties, i.e., permeability, thickness, porosity, depth, and salinity, along with operational conditions like time elapsed and injection rate. Hyperparameter tuning was performed for key parameters, including the number of estimators, regularization terms, maximum tree depth, learning rate, subsample ratio, and minimum child weight. The optimized XGBoost model achieved high predictive accuracy, with R^2 of 0.9961 and RMSE of 0.0077 on the test set. As shown in Fig. 1, SHapley Additive exPlanations (SHAP) analysis reveals that injection rate, porosity, and thickness are the most influential factors on storage efficiency. RTI is primarily affected by injection rate, porosity, and depth, while STI is influenced by time elapsed and thickness. This method provides a reliable tool for assessing CCS feasibility, supporting carbon reduction efforts, and paving the way for more efficient, data-driven climate solutions.

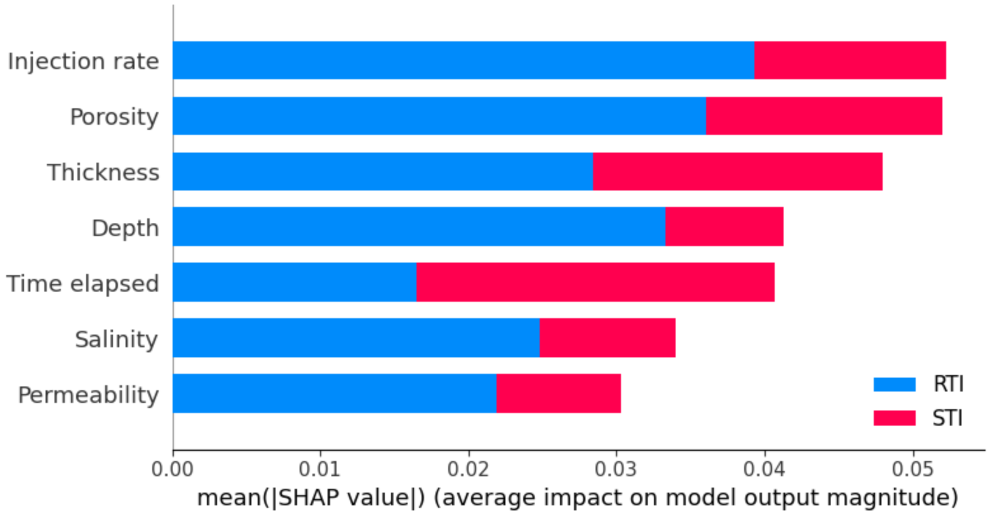


Fig. 1. SHAP analysis of key parameters influencing RTI and STI within saline aquifers.

Keywords: CO_2 storage; Saline aquifer; Machine Learning; Extreme gradient boosting

References

[1] Luo A, Li Y, Chen X, Zhu Z, Peng Y. Review of CO_2 sequestration mechanism in saline aquifers. **Natural Gas Industry B** 2022; 9(4): 383-393.

[2] Song Y, Sung W, Jang Y, Jung W. Application of an artificial neural network in predicting the effectiveness of trapping mechanisms on CO_2 sequestration in saline aquifers. **International Journal of Greenhouse Gas Control** 2020; 98: 103042.

Oral TIChE-PE-03

Graph neural network for descriptor-free CO_2 solubility prediction in aqueous amines

Apri Wahyudi[1], Natthapong Sueviriyapan[1,*], Uthaiporn Suriyapraphadilok[1,2]

[1] The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok 10330, Thailand
[2] Centre of Excellence on Petrochemical and Materials Technology, Bangkok 10330, Thailand
[*] Corresponding author: natthapong.su@chula.ac.th

ABSTRACT

The development of effective carbon capture via chemical absorption depends on the knowledge of CO_2 solubility in amine solutions. Conventional modeling methods lack flexibility in solvent representation by relying on predetermined molecular descriptors such as the COSMO σ-profile, which requires computationally expensive quantum chemistry calculations [1]. This study presents a graph neural network (GNN) for learning molecular representations directly from SMILES notations, thereby removing the reliance on predefined descriptors [2]. Our approach offers flexible and reliable solubility prediction for 61 species of single amine systems, over wide ranges of concentrations, temperatures, and CO_2 partial pressures, achieving equivalent accuracy for the training and validation sets compared to descriptor-based approaches ($R^2 > 0.97$, RMSE < 0.07 mol CO_2/mol amine), as shown in Fig. 1. Under industrially relevant conditions, the model effectively predicted the CO_2 solubility for different amines, including well-known amines such as Monoethanolamine (MEA) and Piperazine (PZ).

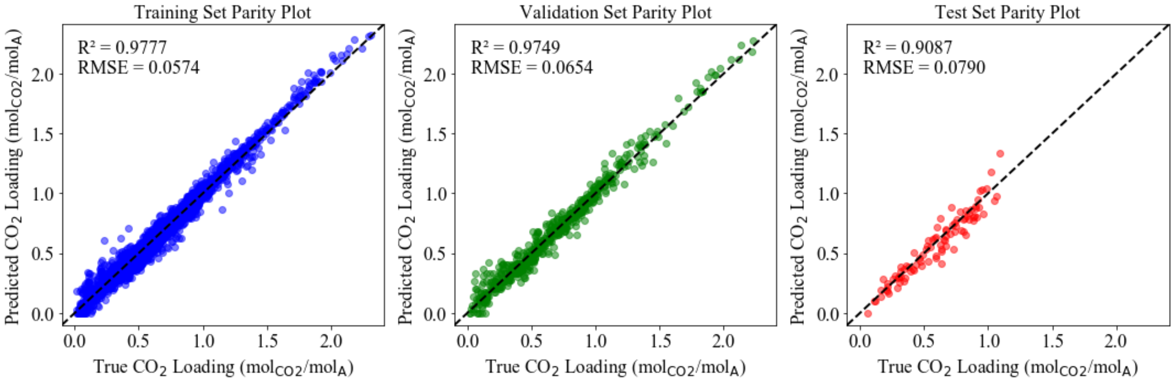


Fig. 1. Parity plot of training, validation, and test results.

Our proposed method allows for the rapid screening of new amine structures without relying on feature engineering. This enables inverse molecular design, that is, identifying ideal amine structures for certain operating conditions, potentially accelerating the development of better solvents. This study demonstrates how graph-based machine learning can overcome the constraints of conventional descriptor-based models, thereby offering a more flexible path to rational solvent design for carbon-capture applications.

Keywords: Amine; Carbon capture; Graph neural network; Machine learning; Solubility

References

[1] Wahyudi A, Suriyapraphadilok U. Predicting CO_2 equilibrium solubility in various amine-CO_2 systems using an artificial neural network model. **Energy and AI** 2024; 18(1): 100426.

[2] Morales GN, Medina EIS, Jiménez-Gutiérrez A, Zavala VM. Graph neural networks for CO_2 solubility predictions in Deep Eutectic Solvents. **Computers & Chemical Engineering** 2024; 187(1): 108750.

Poster **TIChE-PE-04**

Techno-economic analysis of sequential process to valorization of rambutan seed waste by supercritical CO_2-ethanol and subcritical water extraction

Kassama Utthachat[1], **Ruengwit Sawangkeaw**[2], **Somkiat Ngamprasertsith**[1,3,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Institute of Biotechnology and Genetic Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[3] Center of Excellence on Petrochemical and Materials Technology, Chulalongkorn University,
Bangkok 10330, Thailand
[*] Corresponding author: somkiat.n@chula.ac.th

ABSTRACT

Rambutan is an agricultural fruit extensively cultivated in Thailand, producing approximately 270,000 tons annually. In rambutan processing factory, a large amount of rambutan seeds is discarded as waste. To address this concern, this study focuses on the techno-economic analysis (TEA) of a sequential process for adding value to rambutan seeds using supercritical CO_2 extraction with ethanol as a co-solvent and subcritical water extraction. Polysaccharides extracted from these seeds have diverse biological properties, making them valuable in the food and pharmaceutical industries. Subcritical water extraction is an effective method for obtaining these polysaccharides. However, rambutan seeds contained a high fat content (33.40% to 39.13%) [1], necessitating fat removal prior to polysaccharide extraction. Supercritical CO_2 extraction is chosen because it is non-toxic chemical process. To enhance the overall efficiency, screw pressing extraction was applied, achieving yields of 6.29 and 8.84 g/100 g of feed with screw pressing and supercritical CO_2 combined with ethanol [2], respectively. The overall process is illustrated in the Fig. 1.

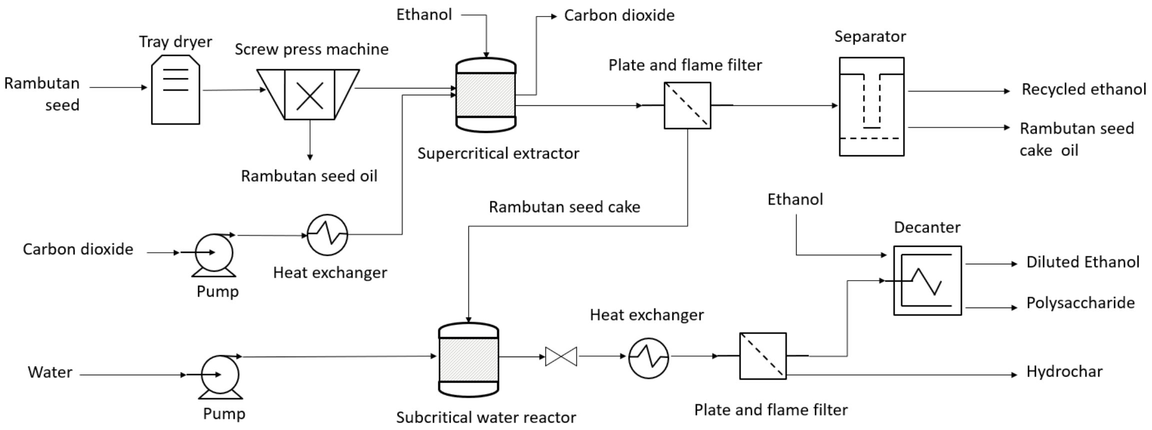


Fig. 1. P&ID diagram of the rambutan seed extraction process.

The process was simulated in Aspen Plus to determine mass and energy balance, as well as to estimate electricity consumption. Additionally, an experiment was conducted to evaluate a comparative scenario using supercritical CO_2 extraction without ethanol, yielding 7.32% wt oil. A TEA assessed the feasibility of each process, considering key variables such as product price, raw material cost, and operating costs for industrial-scale implementation.

Keywords: Supercritical; Subcritical water; Polysaccharide; Techno-economic analysis

References

[1] Torgbo S, Rugthaworn P, Sukatta P. Biological characterization and quantification of rambutan (*Nephelium lappaceum L.*) peel extract as a potential source of valuable minerals and ellagitannins for industrial applications. **ACS Omega** 2022; 7: 34647-34656.

[2] Nilmat K, Ngamprasertsith S, Sakdasri W, Karnchanatat A, Sawangkeaw R. Sequential process to valorisation of rambutan seed waste by supercritical CO_2-ethanol and subcritical water extractions. **Chemical Engineering Transactions** 2024; 109: 313-318.

Poster **TIChE-PE-05**

Techno-economic analysis of crude peptides production from defective coffee beans

Chatchaphong Nakphadungsuk[1], **Ruengwit Sawangkeaw**[2], **Somkiat Ngamprasertsith**[1,3,*]

[1] Department of Chemical Engineering, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Institute of Biotechnology and Genetic Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[3] Center of Excellence on Petrochemical and Materials Technology, Chulalongkorn University,
Bangkok 10330, Thailand
[*] Corresponding author: somkiat.n@chula.ac.th

ABSTRACT

Coffee is one of the world's most significant economic crops. Thailand produces approximately 9,510 tons of Arabica beans annually. Coffee grading generates 15-20% defective green coffee beans (GCB), amounting to roughly 1,900 tons per year. To enhance the value of these GCB, this study explores crude peptide production from GCB by using process simulation through a techno-economic analysis (TEA), evaluating total capital investment, total operating cost, revenues and profitability analysis, and sensitivity analysis. The process begins with drying and crushing GCB, followed by supercritical CO_2 extraction using ethanol as a co-solvent to extract coffee oil. The defatted beans undergo enzymatic hydrolysis with papain to obtain crude peptides, which are then encapsulated via spray drying, as shown in Fig. 1 [1].

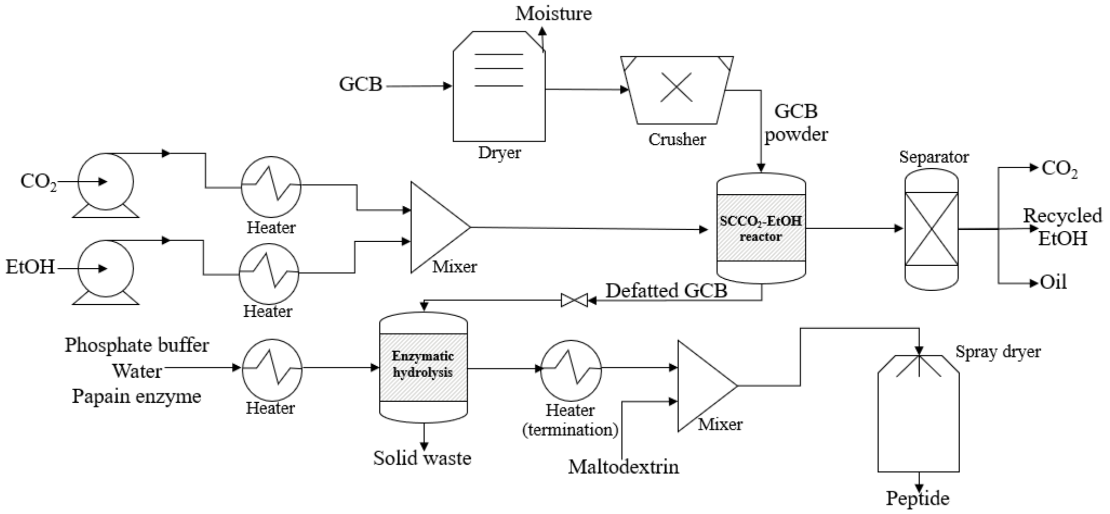


Fig. 1. P&ID diagram of crude peptide production.

Three experiments were conducted to extract oil: soxhlet, solvent, and supercritical CO_2 extractions. The obtained yields were 23.36% wt, 6.86% wt, and 7.80% wt, respectively. The overall process was simulated in Aspen Plus to analyze mass and energy balance and to estimate electricity consumption. The TEA is conducted under two scenarios: (1) encapsulation via spray drying with maltodextrin as a carrier material to enhance peptide stability, and (2) spray drying without maltodextrin. Sensitivity analysis is performed on key economic factors, including product price and labor costs, to evaluate their impact on profitability [2].

Keywords: Green coffee beans; Supercritical CO_2 extraction; Techno-economic analysis

References

[1] Hunsub P, Ngamprasertsith S, Prichapan N, Sakdasri W, Karnchanatat A, Sawangkeaw R. Life cycle assessment of spray-drying encapsulation of crude peptides produced from defective green coffee beans. **Clean Technologies and Environmental Polic** 2024.

[2] Thoppil Y, Zein SH. Techno-economic analysis and feasibility of industrial-scale biodiesel production from spent coffee grounds. **Journal of Cleaner Production** 2021; 307(127113): 127113.

Oral **TIChE-PE-06**

Comparative analysis of machine learning models for predicting operating condition in a pentane-hexane distillation column with limited data

Jirapat Romkaew[1], **Kritchart Wongwailikhit**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: kritchart.w@chula.ac.th

ABSTRACT

Distillation is an energy consumption intensive process which is widely used in the chemical industry. Optimizing steady state operating condition of distillation column is a convenient method to reduce the operating cost without any modification of column [1]. Many researchers have studied predicting operating condition of column using variation of machine learning algorithms with limited data [2]. Therefore, this study aims to identify the best algorithm for distillation column with limited data.

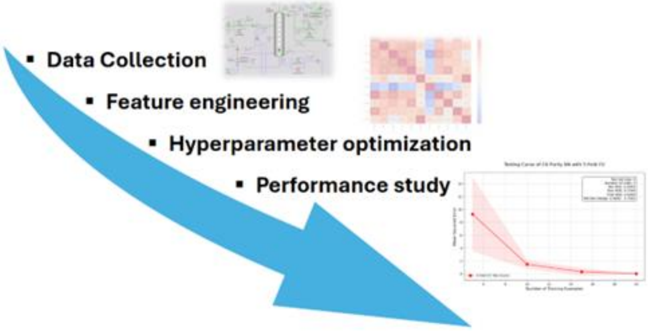


Fig. 1. Overall framework methodology of the study.

The methodology was done in following procedure, as in Fig.1: Data was collected from a dynamic simulation of a distillation column then feature selection and engineering were done before preparing train and test dataset. Algorithms optimization was performed and performance at different sizes of train data samples was studied. Feedforward neural network (FNN) multi-input with single-output (MISO) was considered to be the best algorithm with every subset of data. It was observed that as the number of train data samples increased, the errors decreased. The errors at 20 train data samples were averaged across all output with the root mean squared error of 0.0083 and mean absolute percentage error of 0.10%. The reason behind this result is due to the ability to adapt and learn complex non-linear relationships of FNN compared to other algorithms (Kernel ridge, k-Nearest neighbors, Decision tree). The result contradicts with conventional knowledge that FNN generally performs badly with limited data, however, FNN can perform better by properly optimizing hyperparameters to conform with pattern of data.

Keywords: Binary distillation column; Machine learning; Optimization; Prediction model

References

[1] Kwon H, Oh KC, Choi Y, Chung YG, Kim J. Development and application of machine learning-based prediction model for distillation column. **International Journal of Intelligent Systems** 2021; 36(5): 1970-1997.

[2] Sison AE, Etchieson SA, Güleç F, Epelle EI, Okolie JA. Process modelling integrated with interpretable machine learning for predicting hydrogen and char yield during chemical looping gasification. **Journal of Cleaner Production** 2023; 414: 137579.

Oral **TIChE-PE-07**

Techno-economic analysis of hydrogen production pathways for carbon dioxide to methanol conversion process

Gantaphon Manimon[1], **Kritchart Wongwailikhit**[1,*]

[1] Center of Excellence in Particle and Material Processing Technology Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: kritchart.w@chula.ac.th

ABSTRACT

The petrochemical industry significantly contributor to global carbon dioxide (CO_2) emissions. Specifically, from the steam naphtha crackers process [1]. Carbon capture and utilization (CCU) has been introduced as an effective approach to reducing CO_2 emissions. One promising pathway involves the hydrogenation of CO_2 for methanol synthesis [2]. Given the crucial role of hydrogen as a raw material in CCU, this study evaluates three primary hydrogen production methods: grey, blue, and green hydrogen. Grey hydrogen production was studied using Steam Methane Reforming (SMR), Autothermal Reforming (ATR), and a combined SMR-ATR process. Blue hydrogen follows the same processes as grey hydrogen with the CO_2 capture process, while for green hydrogen, Alkaline Electrolysis (AEL) was analyzed. Process simulations were conducted in Aspen Plus, with economic feasibility is assessed by the levelized cost of hydrogen (LCOH), considering capital expenditures (CAPEX) and operating expenses (OPEX) including raw material, utility, operating labor, maintenance and other related costs. Environmental impact is assessed via CO_2 emissions. The results indicate that the most economical H_2 production pathway is grey hydrogen from SMR-ATR process achieves the lowest LCOH at 1.66 USD/kg but results in the highest CO_2 emissions at 20.13 kg CO_2 per kg H_2. Blue hydrogen has an LCOH of 3.32 USD/kg with significantly lower emissions of 0.06 kg CO_2 per kg H_2. Green hydrogen, which has the lowest CO_2 emissions, achieves the highest LCOH of 9.09 USD/kg as shown in Fig. 1. These findings provide insights into H_2 production strategies for methanol synthesis and MTO process.

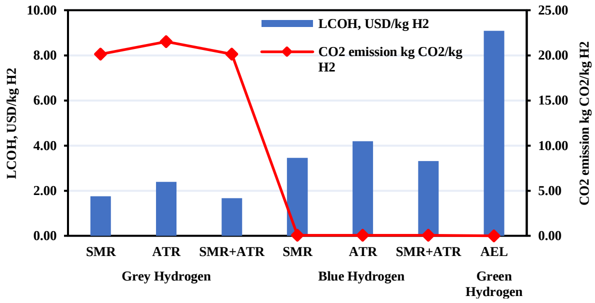


Fig. 1. Comparative of the LCOH and CO_2 emissions for different hydrogen production pathways.

Keywords: Hydrogen production; Carbon capture and utilization; Techno-economic analysis

References

[1] Zanon-Zotin M, et al. Industrial sector pathways to a well-below 2 °C world: A global integrated assessment perspective. **Applied Energy** 2025; 381: 125173.

[2] Khojasteh-Salkuyeh Y, et al. CO_2 utilization for methanol production; Part I: Process design and life cycle GHG assessment of different pathways. **Journal of CO_2 Utilization** 2021; 50: 101608.

Oral **TIChE-PE-08**

Performance of combination ESN and LSTM in prediction of temperature in magnetic heating reactor

Rasiq Dipta Alkindi[1,*], **Paisan Kittisupakorn**[1]

[1] Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: rasiqdipta@gmail.com

ABSTRACT

Hydrogen is critical to numerous industrial applications, yet its efficient production remains challenging due to the complex and often unpredictable dynamics of reactor systems. In this study, we address this challenge by employing a neural network (NN) approach to emulate a reactor model in cases where traditional mathematical modeling struggles with unknown factors. We propose a hybrid neural network model that integrates an Echo State Network (ESN) with a Long Short-Term Memory (LSTM) network in series. The ESN processes complex systems and high-dimensional input data by transforming them into a simplified state while preserving essential nonlinear dynamics. The LSTM then captures both rapid fluctuations and long-term trends through its gating mechanisms. These experiments rely on input and output datasets derived from a simulated reactor model. By combining these two methods, our approach enhances prediction accuracy and reliability in modeling dynamic, complex systems. The experiments revealed that increasing the number of reservoir nodes from 10 to 20 reduced the ESN's training mean absolute error (MAE) by over 90%, and the optimal configuration with 30 reservoir nodes, a spectral radius of 0.5, 0.9 connectivity, a batch size of 4, 50 LSTM units, and 60 epochs, achieved training MAE values ranging from 9.15 to 6.33, testing MAE of 8.74 to 8.06, and validation MAE of 14.88 to 14.96, with R^2 consistently exceeding 0.998 across 7N, 9N, and 17N winding coils. Simulation experiments demonstrate that the ESN-LSTM model achieves better prediction accuracy and overall model fitness.

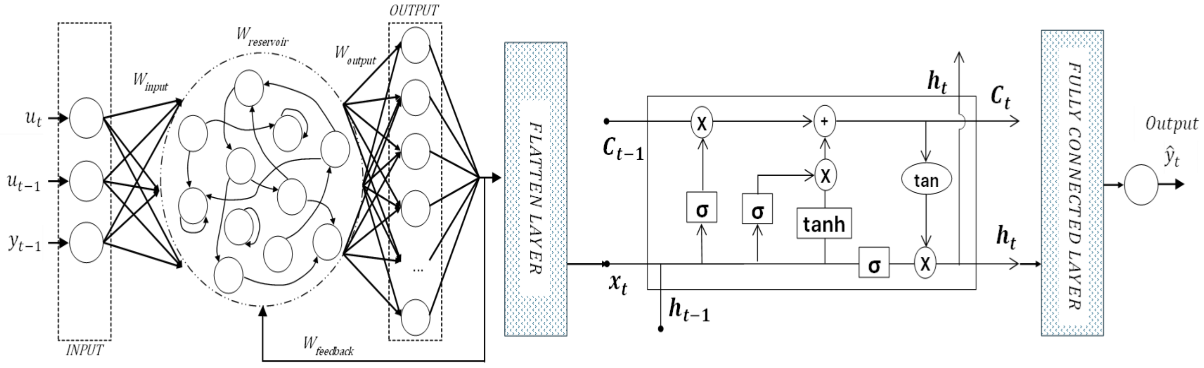


Fig. 1. Echo state network with long-short memory term in series combination.

Keywords: Artificial neural network; Echo state network; Long-short term memory; Series ESN-LSTM.

Oral **TIChE-PE-09**

Techno-economic insights and limitation analysis of CO_2 capture via monoethanolamine (MEA) absorption

Manisa Mahahing[1], **Kritchart Wongwailikhit**[1,*]

[1] Center of Excellence in Particle and Materials Processing Technology, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: kritchart.w@chula.ac.th

ABSTRACT

Carbon dioxide (CO_2) capture is crucial for reducing greenhouse gas emissions, which not only drive climate change but also negatively impact the environment and human health. This study focuses on a techno-economic analysis and limitation study of CO_2 absorption using monoethanolamine (MEA). Although chemical absorption offers high capture efficiency, it faces challenges with solvent regeneration and degradation. Therefore, this study analyzes key parameters affecting the performance of this technology, including factors influencing carbon capture costs and CO_2 emissions. The simulation results show that at the same recovery, as the CO_2 concentration increases, the levelized cost of carbon capture decreases. Moreover, as the percentage of CO_2 recovery increases within a CO_2 concentration range of 5-16%, the levelized cost of carbon capture rises because higher capital and operating costs are required. In contrast, beyond a CO_2 concentration of 17%, the levelized cost of carbon capture decreases due to enhanced mass transfer at higher concentrations. The findings provide valuable insights for selecting suitable technologies for different industries and offer guidance for developing future innovations to improve the efficiency and sustainability of carbon capture processes. An overview of the research, which results from the economic assessment, is shown in Fig. 1.

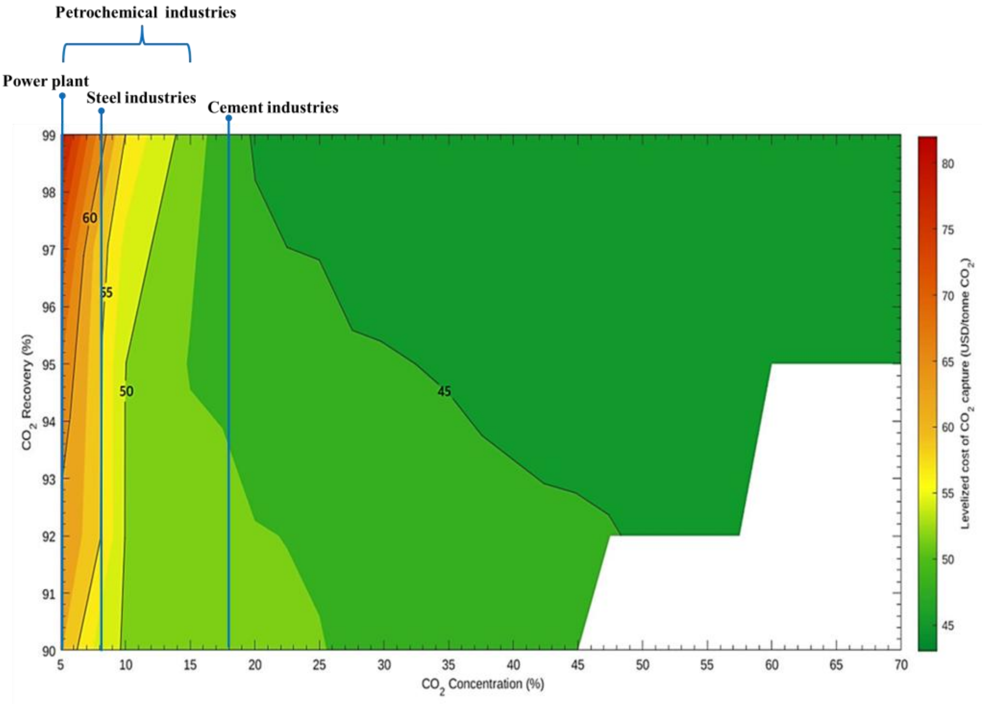


Fig. 1. Levelized cost of MEA carbon capture at MEA-to-CO_2 ratio equal to 2.

Keywords: CO_2 capture; Chemical absorption; Monoethanolamine; Process simulation

Oral **TIChE-PE-10**

Computational fluid dynamics (CFD) analysis of cooling water temperature profiles in high temperature operation heat exchangers

Suwapat Thiaranatron[1], Kritchart Wongwailikhit[1,*]

[1] Center of Excellence in Particle and Material Processing Technology, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: kritchart.w@chula.ac.th

ABSTRACT

Cooling water plays a crucial role in various industrial processes, particularly in petrochemical plants and power plants, where it serves to dissipate excess heat from machinery and heat exchangers. One common heat exchanger type is the double-pipe heat exchanger, where heat is transferred between hot and cold fluids through conduction and convection mechanisms. This study investigates the temperature profile of cooling water in a double-pipe heat exchanger operating under high-temperature of hot fluid in order to avoid boiling in the pipe. Computational Fluid Dynamics (CFD) is employed to analyze the effect of cooling water Reynolds number on its temperature profile inside the pipe. The research focuses on the relationship between the Reynolds number and the thermal boundary layer thickness on the inner surface of the pipe, as well as temperature variations. For the simulation scope, two pipe sizes: 30 mm and 25 mm, are used. The flow velocity is set between 0.5 to 3.0 m/s, and the hot fluid temperature ranges from 100°C to 250°C. From the simulation results, it can be observed that the larger tube (30 mm) exhibits a thicker thermal boundary layer and a significantly higher wall temperature (Twall) than the smaller tube (25 mm). Additionally, as the Reynolds number increases, both the wall-to-bulk temperature ratio (Twall/Tbulk) and the thermal boundary layer thickness decrease, indicating enhanced convective heat transfer due to boundary layer thinning. Therefore, tube size is a crucial factor influencing heat transfer performance, with smaller tubes promoting more efficient convective heat transfer.

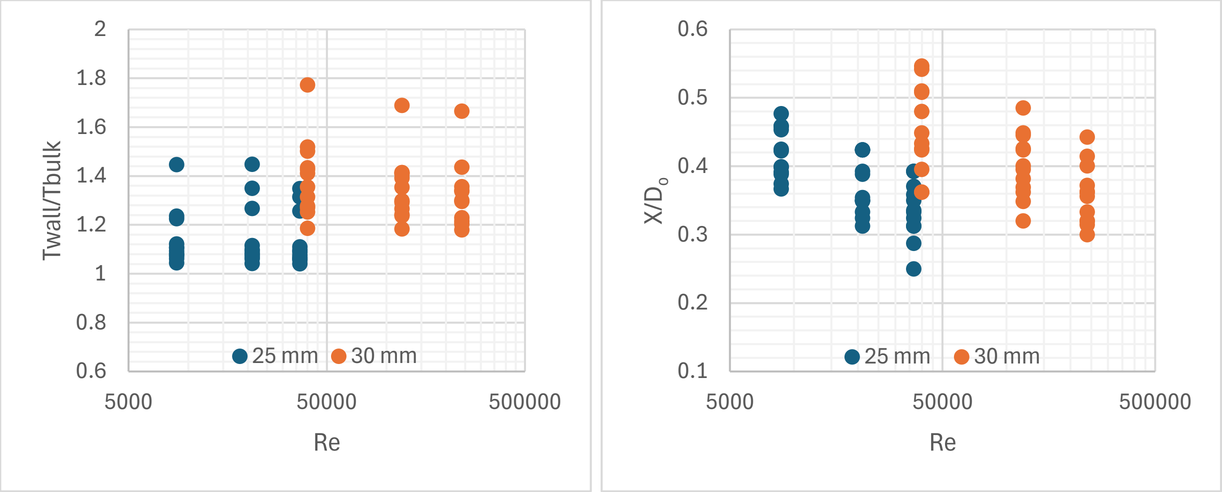


Fig. 1. Effect of Reynolds number on wall-to-bulk temperature ratio (Twall/Tbulk) and boundary layer thickness in different pipe sizes.

Keywords: Cooling water; Double pipe heat exchanger; Computational fluid dynamics (CFD); Boundary layer

Oral TIChE-PE-11

Simulation of desulfurization in natural gas by using ferrous oxide

Satok Chaikunchuensakun[1,*], **Kanokwan Kammongkhun**[1], **Pronpranate Jenhud**[1]

[1] Department of Chemical Engineering, Faculty of Engineering, Thammasat University, Phathum Thani 12120, Thailand

[*] Corresponding author: csatok@engr.tu.ac.th

ABSTRACT

This study investigated the process of desulfurization in natural gas by examining the reaction between hydrogen sulfide (H_2S) and ferrous oxide (FeO) using the Gibbs free energy minimization. The desulfurized simulation was performed using the RGibb block in Aspen Plus V11, as shown in Fig. 1. This simulation aimed to examine the effects of varying temperatures, pressures and the amount of ferrous oxide in the reactor. The inlet gas mainly contained methane with a concentration of 4.685 kmol/hr (3000 ppm) hydrogen sulfide at 40 °C and 35.5 bar. The solid feed contained ferrous oxide at 5.3928 kmol/hr. The outlet gas contains a trace amount of hydrogen sulfide at 2.5×10^{-14} kmol/hr (equivalent to 4.65×10^{-12} ppm). The simulation results of the desulfurization align with those of a previous study by J. B. Mutabazi and J. Chidamoio [1].

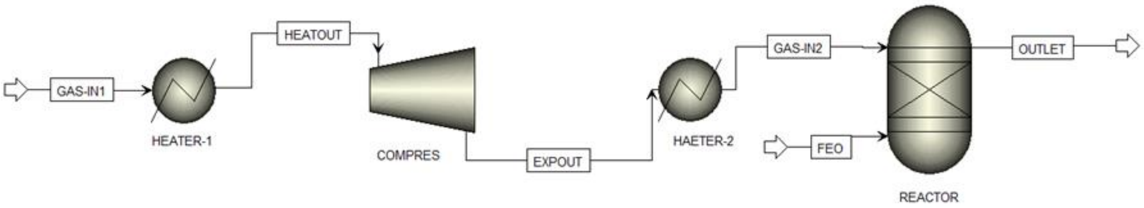


Fig. 1. Desulfurization in natural gas using ferrous oxide.

The concentration of hydrogen sulfide in the outlet gas remained constant with a pressure variation between 0.1 and 100 bar. However, when the variation of temperatures was between 25 °C and 500 °C, the concentration of hydrogen sulfide in the outlet increased from 6.5×10^{-33} to 4.3×10^{-9} kmol/hr (equivalent to 1.21×10^{-30} to 8.01×10^{-7} ppm). Sensitivity analysis revealed that a minimum of 4.7 kmol/hr of ferrous oxide was required for effective desulfurization, with a hydrogen sulfide flow rate below 1×10^{-12} kmol/hr (equivalent to 1.86×10^{-10} ppm).

Keywords: Desulfurization; Ferrous oxide; Simulation

References

[1] Mutabazi JB, Chidamoio J. Simulation on performance of metal oxide for H2S removal in natural gas under influence of CO_2. **Global Scientific Journal** 2022; 10(6): 1392-1407.

Oral **TIChE-PE-12**

Modification of the syngas production process using fluidized-bed twin reactor system and chemical looping gasifier

Sutanon Krataipo[1], **Monsicha Sitta**[1], **Ratchaphon Chaloemkamonsit**[1], **Bunyaphat Yimsanguan**[1], **Choowong Chaisuk**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University,
Nakhon Pathom 73000, Thailand
[*] Corresponding author: chaisuk_c@su.ac.th

ABSTRACT

Currently, biomass is widely used as a replacement for fossil fuels to produce syngas. One of the processes for producing syngas is downdraft technology, which consists of four main stages: pyrolysis, combustion, gasification and CO_2 separation. The major problems are the formation of coke in downdraft gasifiers, as well as the dilution of the syngas product by other gases. It is interesting to address these issues using fluidized-bed gasifiers, such as twin reactors and chemical looping. In this work, the economic indicators and energy usage of two modified processes were evaluated using Aspen Plus program, version 14. The prototype process was referenced from the work of Adnan and Hossain [1]. The twin reactors replaced the reaction zone, while the chemical looping, containing calcium oxides to remove CO_2 from the syngas, replaced both reaction and separation zones. Both flowsheets are shown in Fig. 1.

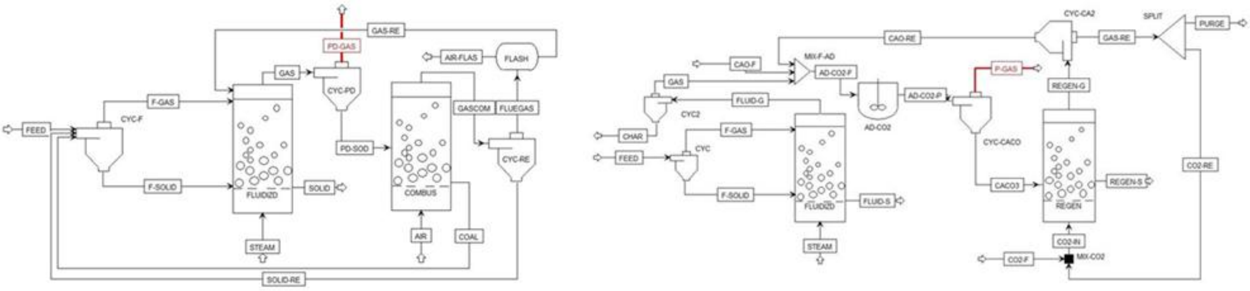


Fig. 1. Process flowsheets of the fluidized-bed twin reactors (left-hand side) and the fluidized-bed chemical looping gasifier (right-hand side).

From the simulation results, both modified processes showed high purity of the syngas product on a dry basis: 88.2 mol% for twin reactors and 94.6 mol% for chemical looping, compared to 78.6% for the prototype process. The CO_2 in the syngas was effectively removed through chemical looping. Its composition was 1.8 mol%, compared to 7.1 mol% in the prototype process. The economic indicators, including CAPEX, OPEX, NPV, IRR, and DPP, showed positive results after modification. The energy cost for chemical looping was decreased by 31.6% but that for twin reactors was increased by 14.7%. Hence, the chemical looping proved to be a promising process for producing the syngas.

Keywords: Syngas production; Fluidized-bed; Twin reactors; Chemical looping; Aspen plus

References

[1] Adnan MA, Hossain MM. Gasification performance of various microalgae biomass – A thermodynamic study by considering tar formation using Aspen plus. **Energy Conversion and Management** 2018; 165: 783-793.

Oral **TIChE-PE-13**

Reinforcement learning control for optimal ethanol production from microbial fermentation

Kanisorn Thanutwuttikorn[1], **Suttirak Pairoj**[2], **Pornpimon Kavansu**[3], **Bundit Boonkhao**[4,*],
Rujapa Nanthapodej[4]

[1] Division of Mechanical Engineering, Faculty of Engineering, Nakhon Phanom University,
Nakhon Phanom 48000, Thailand
[2] Division of Applied Foundation, Faculty of Industrial Technology, Nakhon Phanom University,
Nakhon Phanom 48000, Thailand
[3] Research and Development Institute, Nakhon Phanom University, Nakhon Phanom 48000, Thailand
[4] Division of Industrial Engineering, Faculty of Engineering, Nakhon Phanom University,
Nakhon Phanom 48000, Thailand
[*] Corresponding author: bundit@npu.ac.th

ABSTRACT

Ethanol serves as a renewable alternative energy source that can be synthesised through microbial fermentation. However, the efficiency of this production process is inherently challenged by the variability in microbial growth, which is influenced by key process parameters such as temperature, pH, and substrate concentration, among others. Consequently, the effectiveness of model-based control strategies may be compromised due to the inherent uncertainties associated with these dynamic biological factors. Reinforcement Learning (RL) has recently been introduced as a control strategy, leveraging its capability for optimal control to determine the most effective control trajectory under process variability. In this context, the Deep Deterministic Policy Gradient (DDPG) algorithm has been implemented as a control strategy for ethanol fermentation, specifically regulating temperature and pH to enhance process performance. By including temperature and pH as biological model, then applying DDPG algorithm to find the optimal path of fermentation and to maximise the alcohol yield. The result found that DDPG can maintain the process to optimal alcohol yield with random noise. This control strategy may further be applied for real process.

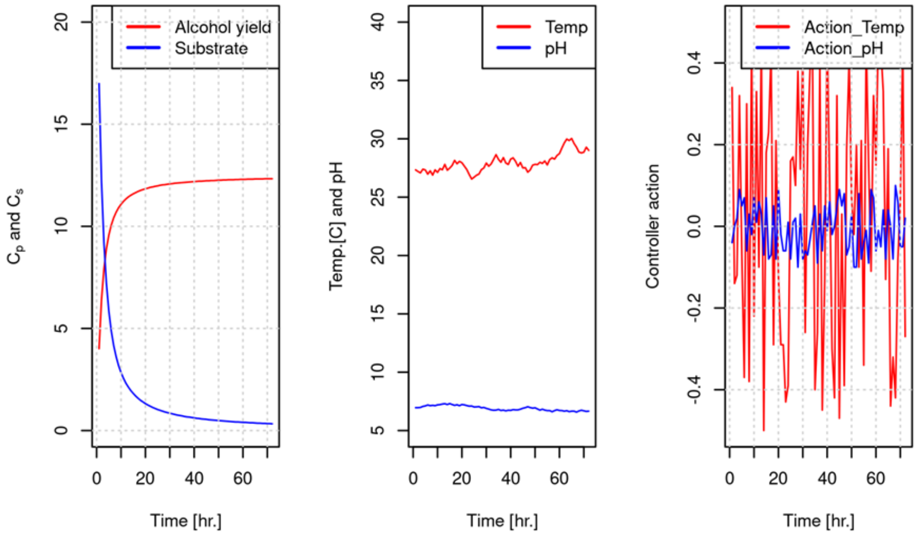


Fig. 1. Maximising alcohol with controller actions.

Keywords: Reinforcement learning; Deep deterministic policy gradient; Fermentation; Ethanol production

Poster **TIChE-PE-14**

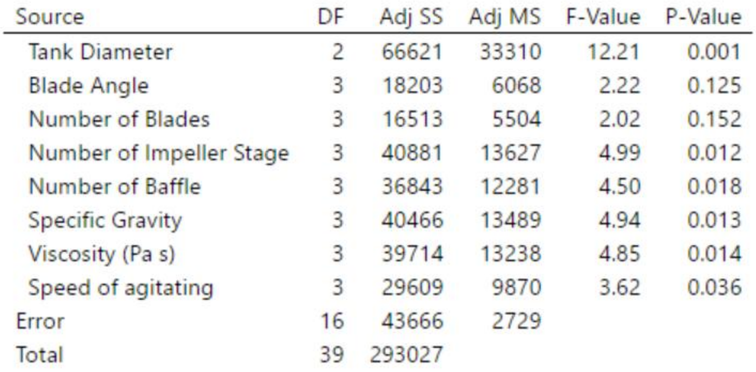
Application of computational fluid dynamics for industrial liquid-liquid mixing tank design

Patiphon Klongyut[1], **Ratchanon Piemjaiswang**[2], **Benjapon Chalermsinsuwan**[3,*]

[1] Program in Science for Industry, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Sustainable Environment Research Institute, Chulalongkorn University, Bangkok 10330, Thailand
[3] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: benjapon.c@chula.ac.th

ABSTRACT

Industrial mixing tank is a common process used in various industries. Agitator tanks are widely used as fundamental operations in multiphase flow mixing. The applications of agitators encounter long blending times due to dead zones within the tank while increasing agitation turbulence is insufficient without proper dimensional design considerations. This research focuses on liquid-to-liquid batch mixing using a commercial blade (Viscoprop) with comparative simulation data augmentation. The objective is to determine the effects of important factors, including mechanical design and liquid material properties that affect mixing time. Computational fluid dynamics simulations are numerical methods used to investigate mixing performance by studying the effect of agitator tank design parameters on 95% homogeneity of liquid in a period [1]. A turbulent model with the large eddy simulation (LES) is successfully validated by analyzing velocity data from literature research study to ensure the correctness of flow phenomena [2]. Here, eight parameters are investigated by selecting the optimal levels depending on real case application. As can be seen in Fig.1, the analysis of variance (ANOVA) summarizes tank diameter ($p = 0.001$), number of impeller stage ($p = 0.012$) and specific gravity ($p = 0.013$) as the most three significant factors. However, the results also show other factors with p-value < 0.05 such as viscosity ($p = 0.014$), number of baffle ($p = 0.018$) and speed of agitating ($p = 0.036$). These results suggested the importance of proper agitator tank design for improving mixing homogeneity.



Source	DF	Adj SS	Adj MS	F-Value	P-Value
Tank Diameter	2	66621	33310	12.21	0.001
Blade Angle	3	18203	6068	2.22	0.125
Number of Blades	3	16513	5504	2.02	0.152
Number of Impeller Stage	3	40881	13627	4.99	0.012
Number of Baffle	3	36843	12281	4.50	0.018
Specific Gravity	3	40466	13489	4.94	0.013
Viscosity (Pa s)	3	39714	13238	4.85	0.014
Speed of agitating	3	29609	9870	3.62	0.036
Error	16	43666	2729		
Total	39	293027			

Fig. 1. Analysis of variance (ANOVA).

Keywords: Industrial mixing tank; Agitator; Liquid to liquid mixing; Computational fluid dynamics

References

[1] Jones PN, Ozcan-Taskin GN. Effects of physical property differences on blending. **Chemical Engineering & Technology** 2005; 28(8): 847-951.
[2] Li Z, Bao Y, Gao Z. PIV experiments and large eddy simulations of single-loop flow fields in Rushton turbine stirred tanks. **Chemical Engineering Science** 2011; 66(6): 1219-1231.

Oral TIChE-PE-15

Performance evaluation of combined torrefaction and gasification process of lignocellulosic biomass

Aphiwat Lakkhanasombat[1], **Supachai Jadsadajerm**[1], **Jindarat Pimsamarn**[2], **Lida Simasatitkul**[1,*]

[1] Department of Industrial Chemistry, Faculty of Applied Science King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand
[2] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand.
[*] Corresponding author: lida.s@sci.kmutnb.ac.th

ABSTRACT

Durian peels, often regarded as agricultural waste, pose significant disposal challenges and costs. This study investigates their use in a torrefaction process, utilizing machine learning to predict the resulting fuel properties. Key predictive factors include time, temperature, oxygen concentration, and elemental composition. The outputs of these machine learning models are then used as inputs in Aspen Plus to simulate the torrefaction and gasification process for hydrogen production. In the simulation, the torrefaction temperature of 260 °C and various operating parameters are examined, including steam-to-durian peel ratio, air-to-durian peel ratio, a combined steam–air-to-durian peel ratio (ranging from 1 to 1.5), and temperature (700 °C to 900 °C). The results indicate that the optimal conditions for hydrogen production are a temperature of 750 °C and a steam-to-durian peel ratio of 1.2, yielding 46.67% hydrogen. A palladium membrane in the separation process further increases hydrogen purity to 99%. Overall, the findings highlight the potential of converting agricultural waste into green hydrogen or clean energy, thereby enhancing sustainability and reducing environmental impact. The overall simulation model is shown in Fig. 1.

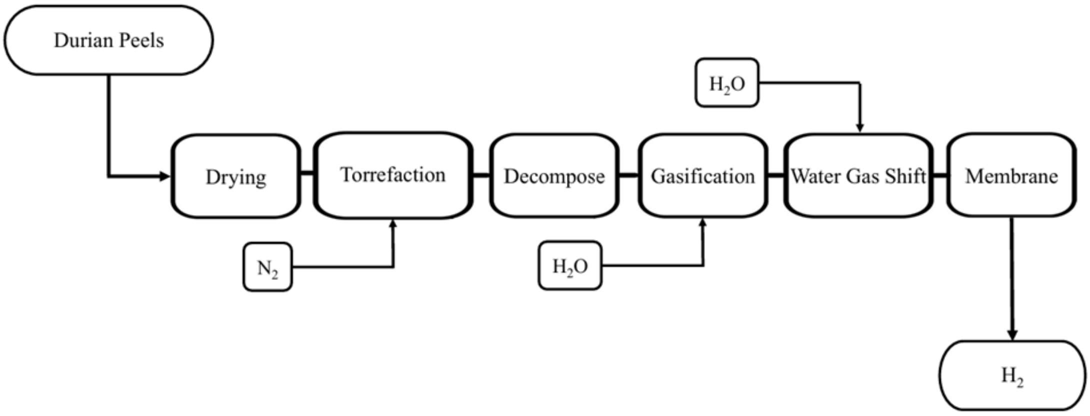


Fig. 1. Simulation model of torrefaction and gasification process.

Keywords: Durian peels; Gasification; Hydrogen; Torrefaction; Simulation

Oral TIChE-PE-16

Process simulation of synthetic fuel production from palm oil mill waste

Worawit Morin[1], **Suksun Amornraksa**[2], **Lida Simasatitkul**[1,*]

[1] Department of Industrial Chemistry, Faculty of Applied Science King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand
[2] Chemical Engineering and Management Program, The Sirindhorn International Thai German Graduate School of Engineering, King Mongkut's University of Technology North Bangkok, Bangkok 10800, Thailand
[*] Corresponding author: lida.s@sci.kmutnb.ac.th

ABSTRACT

This research focuses on the simulation of biofuel production from oil palm wastes using the Fischer-Tropsch (FT) process. The waste, consisting of empty fruit bunches (EFB) 12.15 tons/hr. and palm kernel shells (PKS) 5.4 tons/hr., are fed into a gasification process followed by the FT process. This study employs process simulation using Aspen Plus software to investigate the optimal operating conditions for maximizing biofuel yield. The suitable operating conditions are temperature of 900 °C and pressure of 2 bars, with a steam to carbon ratio of 0.8, to produce synthesis gas (syngas). The produced syngas, primarily composed of hydrogen (H_2), carbon monoxide (CO), and carbon dioxide (CO_2), is then introduced into the Fischer-Tropsch (FT) process, which is conducted at 230 °C and 25 bar, to produce synthetic fuels. The resulting distillate yields include 819.28 kg/hr. of gasoline, 469 kg/hr. of kerosene, 1,091.42 kg/hr. of diesel, and 1,131.74 kg/hr. of wax. The overall simulation model is shown in Fig. 1.

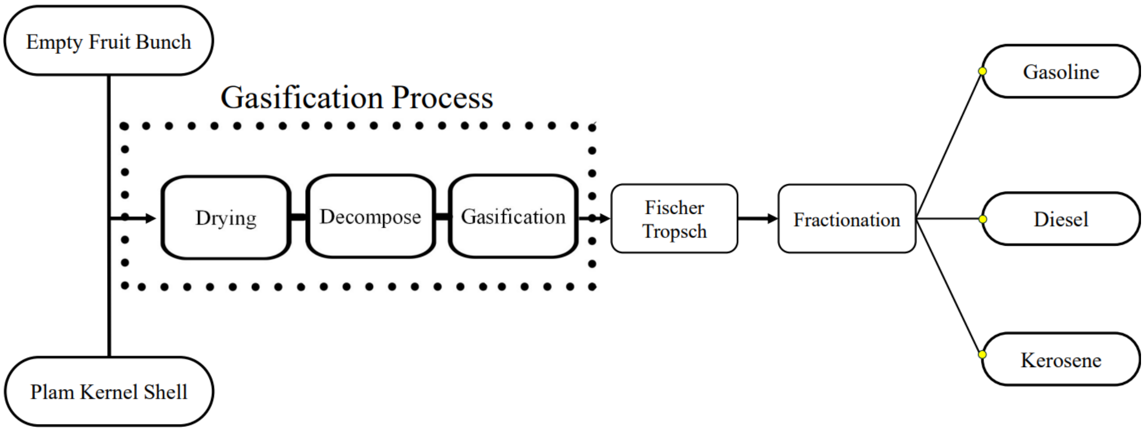


Fig. 1. Simulation model of Gasification and Fischer-Tropsch.

Keywords: Empty fruit bunches; Palm kernel shells; Gasification; Fischer-Tropsch; Process simulation; Synthetic fuels

Oral **TIChE-PE-17**

Optimal input variables for an artificial neural network to predict evaporation efficiency in detergent production process

Baramee Imsin[1], **Pailin Ngaotrakanwiwat**[1,3], **Chalermpan Fongsamut**[2,3,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Burapha University, Chonburi 20131, Thailand
[2] Department of Electrical Engineering, Faculty of Engineering, Burapha University, Chonburi 20131, Thailand
[3] Interdisciplinary Center for Decarbonisation and Green Energy, Faculty of Engineering, Burapha University, Chonburi 20131, Thailand
[*] Corresponding author: chalerm@eng.buu.ac.th

ABSTRACT

The spray drying process is the most energy-intensive unit in detergent production; therefore, the operation parameters must be controlled to achieve lower energy consumption per unit of dried detergent powder production, which is defined as evaporation efficiency. Unfortunately, evaporation efficiency cannot be measured directly by sensors; however, it must be calculated using the multiple data monitored in the process, using mass and energy balance. [1] Therefore, this research focuses on developing a soft sensor using data obtained from the actual production process, starting from the beginning of production, reaching a steady state, and ending the production, with an artificial neural network (ANN) model to predict evaporation efficiency by optimizing various configurations, i.e., hidden layers, activation functions, and neurons per layer. In particular, the effect of the number of input variables on the predicted evaporation efficiency was investigated to achieve an optimal model with a simple structure and high prediction accuracy. The results showed that the ANN (4-34-1) model with four input variables, i.e., rate of natural gas consumption, inlet hot air temperature, Feed rate of slurry detergent and moisture content in dried detergent powder achieved a root mean squared error (RMSE) of 0.0403 and a coefficient of determination (R^2) of 0.9969. This high level of accuracy in predicting evaporation efficiency can be directly applied to optimize detergent production processes, reducing energy consumption and improving product quality.

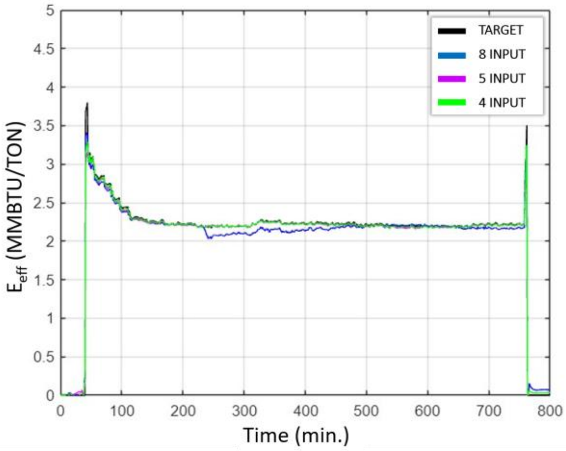


Fig. 1. Prediction of evaporation efficiency using an ANN model with different input structures.

Keywords: Soft sensor; Evaporation efficiency; Spray drying process; Detergent production

References

[1] Bardeeniz S, Panjapornpon C, Fongsamut C, Ngaotrakanwiwat P, Hussain MA. Digital twin-aided transfer learning for energy efficiency optimization of thermal spray dryers: Leveraging shared drying characteristics across chemicals with limited data. **Applied Thermal Engineering** 2024; 242: 122431.

Oral **TIChE-PE-18**

Effect of ethanol on the crystallization of dl-methionine polymorphs

Lamphoun Inthavideth[1], Lek Wantha[1,*]

[1] School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology,
Nakhon Ratchasima 30000, Thailand
[*] Corresponding author: lekwa@g.sut.ac.th

ABSTRACT

DL-methionine plays a crucial role in maintaining health and is used in various fields, such as pharmaceuticals, dietary supplements, animal feed, and chemical synthesis. When crystallized, DL-methionine can exist in three forms: α-, β- and γ-form. In this study, an antisolvent crystallization process was conducted to induce nucleation, with a focus on obtaining the pure α-form of the crystal in order to estimate its nucleation rate. Raman spectroscopy and microscopy were employed to identify the crystal polymorph. Fig. 1 shows the polymorph in the nucleation stage and its nucleation rate with various ethanol volume fraction (x). It is reported that the α-form obtained is in agreement to literature [1] when the ethanol fraction is higher than 0.10, the pure α-form is obtained. However, at an ethanol fraction of 0.23 (Fig. 1a)), it likely presented concomitant of α- and β-form, where it might be a critical concern in future study. Additionally, the nucleation rate of α-form was assessed using Focus Beam Reflectance Measurement (FBRM), where the number count of crystals detected by FBRM can be converted to the total number of crystals in the solution, based on the correlation equation defined in [2]. Nucleation rate (J) of α-form was increasing with increasing ethanol content as shown in Fig. 1b). Furthermore, the transformation of polymorph α- into β-form in the solution was carried out by an offline-Raman spectroscopy. Therefore, this work illustrated the nucleation and transformation stage of DL-methionine polymorph in the antisolvent crystallization, and the nucleation rate of pure α-form was included.

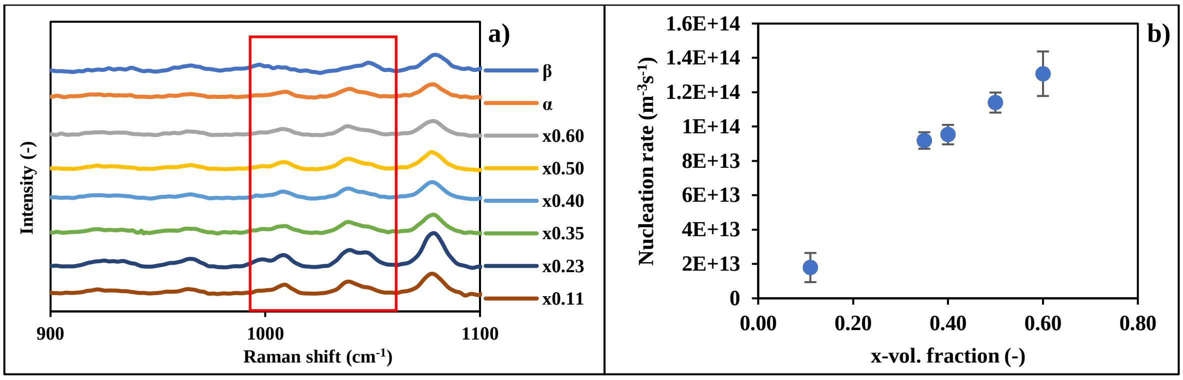


Fig. 1. (a) Raman spectra of the nucleation of DL-Methionine polymorph and (b) the nucleation rate of α-form in a various ethanol volume fraction (x).

Keywords: Nucleation; Transformation; Antisolvent; Polymorph

References

[1] Suresh M, Srinivasan K. Concomitant polymorphism and nucleation control of DL-methionine through antisolvent crystallization. **Chemical Engineering & Technology** 2021; 44(4): 614-621.

[2] Kongsamai P, Wantha L, Flood AE, Tangsathitkulchai C. In-situ measurement of the primary nucleation rate of the metastable polymorph B of L-histidine in antisolvent crystallization. **Journal of Crystal Growth** 2019; 525: 125209.

Oral TIChE-PE-19

Process simulation of lactic acid esterification in reactive distillation column: Effects of reboiler duty and alcohol

S. Imsomboon[1], **P. Tatiyaboworнchai**[1], **A. Silamas**[1], **J. Chaiwasu**[1], **Anawat Sungpet**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi,
Bangkok 10140, Thailand
[*] Corresponding author: anawat.sun@kmutt.ac.th

ABSTRACT

The reactive distillation column is widely utilized in the esterification process, particularly for converting lactic acid into esters such as methyl lactate, ethyl lactate, and isopropyl lactate using methanol, ethanol, and isopropanol [1]. This study investigated the effects of reboiler duty and alcohol type on the efficiency of lactic acid esterification, particularly in terms of conversion rate (based on unreacted lactic acid) and conversion to product (lactic acid transformed into lactic acid). ASPEN Plus V.12 was used to simulate the process, evaluating reboiler duty values ranging from 330 kW to 350 kW for methanol, 425 kW to 445 kW for ethanol, and 970 kW to 990 kW for propanol. Simulation results indicated that higher reboiler duty enhanced the esterification process by increasing both conversion rate and conversion to product. These findings suggested that methanol provided superior performance in esterification, achieving higher conversion efficiency, better product yield, and enhanced purity.

Table 1 Effect of reboiler duty on conversion rate, product conversion, and purity for different alcohols.

Alcohol	Reboiler duty (kW)	Conversion rate (%)	Conversion to product (%)	Product purity (%)
Methanol	330	99.989	61.818	20.805
	350	99.978	95.028	28.198
Ethanol	425	98.723	62.037	20.541
	445	98.097	96.567	28.608
Isopropanol	970	99.971	99.005	88.531
	990	99.971	99.106	88.577

Keywords: Lactic acid; Reactive distillation; Esterification; Reboiler duty

References

[1] Su CY, et al. Plant-wide economic comparison of lactic acid recovery processes by reactive distillation with different alcohols. **Industrial & Engineering Chemistry Research** 2013; 52(32): 11070-11083.

Oral **TIChE-PE-20**

Design and simulation of the coffee drying unit using solar thermal energy and ambient air circulation

Rittichai Preungchana[1], Passapong Sangthong[1], Pongsapak Rattanachai[1], Wipada Sonsiri[1],
Kiattinatapon Juengchareonpoon[1], Wimolsiri Pridasawas[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi,
Bangkok 10140, Thailand
[*] Corresponding author: wimolsiri.pri@kmutt.ac.th

ABSTRACT

Sun drying is one of the most crucial and widely used techniques in coffee processing due to its effectiveness in inhibiting microbial spoilage, slowing enzymatic activity, and preventing chemical degradation. However, several drawbacks exist, such as the prolonged too high surface temperature, and strong dependence on weather conditions. Despite these limitations, sun drying is preferred over mechanical drying because of its low cost and availability. High temperature drying can degrade the structure of green bean coffee and its overall quality. This study focuses on the design and simulation of a coffee drying greenhouse using a 3D model developed in COMSOL Multiphysics as shown in Fig. 1(a) and an experimental solar drying unit. The research aims to analyze airflow characteristics and temperature distribution within the greenhouse. Simulations examine airflow through inlets of varying areas (0.010, 0.025, and 0.050 m^2) and different exhaust fan sizes (6-, 8-, and 10-inch), each with different volumetric flow rates (270, 540, and 900 m^3/h), with sunlight transmitted only through the greenhouse roof.

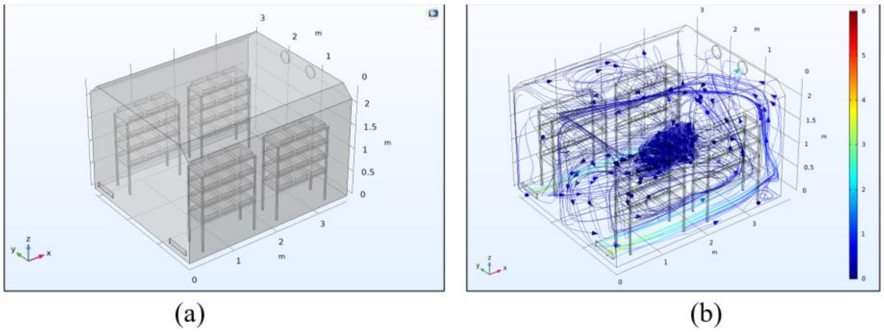

(a) (b)

Fig. 1. 3D model developed in COMSOL Multiphysics (a) 3D model of coffee drying unit, (b) Simulated airflow streamlines inside the solar dryer with a 0.050 m^2 inlet area and a 10-inch ventilation fan.

Results indicate that narrower inlet openings, together with larger ventilation fans, resulted in higher inlet air velocity. For larger fans, airflow recirculation became more noticeable due to the increased flow rate, leading to the formation of larger vortex zones, especially at the center of the drying house as shown in Fig. 1(b). Additionally, narrower inlet openings consistently resulted in higher internal temperatures for the same fan size. Simulation results show that with a 0.050 m^2 inlet area, the drying house maintained internal temperatures of 38.7–41.0 °C. Reducing the inlet area to 0.025 m^2 and 0.010 m^2 raised these temperatures to 39.9–43.2 °C and 42.4–45.3 °C, respectively. The smaller inlet area limited airflow and thus reduced convective heat transfer, causing more heat to be retained within the drying house. Consequently, the overall interior temperature increased. Moreover, different coffee processing stages require different temperature ranges, suggesting that operators should adjust the inlet area accordingly to maintain optimal conditions throughout the drying process.

Keywords: Coffee drying unit; Solar drying

Poster **TIChE-PE-21**

Production of wood-plastic composite from non-metallic powders recovered from printed circuit board (PCB) waste

Ampai Chanachai[1,*], Preechaya Sanguansai[1], Watcharapon Wimonratpanya[1], Mewika Norachai[1], Waraporn Kidkarn[1]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[*] Corresponding author: ampai.cha@kmutt.ac.th

ABSTRACT

This research studied the recovery of nonmetallic powders (NMPs) from waste printed circuit board (PCB) to produce a wood plastic composite. The NMPs was blended with polymers including : recycled high density polyethylene (rHDPE), wood flour, polyethylene vinyl acetate (EVA) and linear low-density of polyethylene grafted with maleic anhydride (LLDPE-g-MAH) as compatibilizer. NMPs was prepared by grinding PCB to 0.106 mm size. Copper in PCB powders was extracted by ammoniacal alkaline solution in the ratio of PCB powder to solvent is 1 g : 10 ml. Then, all compositions were blended in various ratios through twin-screw extruder to produce the polymer composite and molded by hot compressor. The mechanical properties such as tensile strength, %elongation at break and flexural strength of polymer composites were tested. Morphological characteristics were studied by scanning electron microscope. All polymer composites, which contained wood flour, had mechanical properties pass Thai industry standard of composite wood (TIS.178 – 2549) i.e., Flexural strength > 34 Pa and Elastic Modulus > 4,500 Pa. Thus, all composites could be produced as composite wood. It was found from the SEM results that the composite that had the ratio of rHDPE : NMPs : Wood flour equal to 50 : 30 : 20 were well dispersed of NMPs. It also had the highest tensile strength, which was 20.34 MPa and Flexural strength and Elastic Modulus were 16.68 MPa and 2.54 MPa, respectively (Table 1). This research enables the utilization of NMPs from electronic waste (PCB), which helps create sustainability and protect the environment.

Table 1 Properties of wood-plastic composites in various compositions.

No.	rHDPE (%)	EVA (%)	NMPs (%)	Wood flour (%)	HDPE (%)	Tensile strength (MPa)	% Elongation at break (%)	Flexural strength (MPa)
1	50	10	20	20	0	11.99	10.20	8.68
2	50	20	20	10	0	11.75	16.23	5.67
3	50	0	30	20	0	20.34	10.48	16.68
4	50	0	40	10	0	12.88	6.96	14.18
5	50	10	40	0	0	14.52	14.25	10.01
6	50	20	30	0	0	11.24	26.57	7.37
7	50	30	20	0	0	10.71	71.08	4.74
8	0	0	50	0	50	17.40	10.85	14.45

Keywords: Nonmetallic powders; Polymer composite; Printed circuit board; TIS.178-2549

References

[1] Kanchanapiya P, Jareemit S, Kwonpongsagoon S, Pinyo W. Recycling of non-metallic powder from printed circuit board waste as a filler material in a fiber reinforced polymer. **Environment Protection Engineering** 2015; 41(4): 151-166.

[2] **Thai Industrial Standards Institute**, Ministry of Industry, TIS.178-2549: Industrial Product Standards for Plywood, the Government Gazette, Announcement and General Affairs Edition 2007; 124 (Special Section 28D): 10.

Poster **TIChE-PE-22**

PID controller tuning using genetic algorithms incorporated with dynamic simulation

Parattakorn Noonin[1], **Tanawat Jongpipatwanit**[1], **Veerayut Lersbamrungsuk**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University,
Nakhon Pathom 73000, Thailand
[*] Corresponding author: lersbamrungsuk_v@su.ac.th

ABSTRACT

PID controllers are conventional control techniques widely used in industries. However, to obtain satisfied control performance, optimal tuning of PID parameters is required. This work proposed to solve PID controller tuning using an optimization method. The tuning problem was formulated as optimization with minimizing performance criteria while satisfying control constraints. As the resulting optimization was difficult to solve, genetic algorithm was used for the solution. For a given set of PID parameters, closed-loop dynamic simulations were performed. The control results were used to calculate objective function, that is, control performance, and satisfaction of control constraints (such as overshoot). These results were submitted to genetic algorithms for finding the new set of PID parameters as shown in Fig 1. The proposed method was implemented with 1st-order, 1st-order plus time delay, and temperature control system. Simulation results showed that the use of the proposed method could provide better closed-loop performance compared to other standard tuning techniques [1, 2].

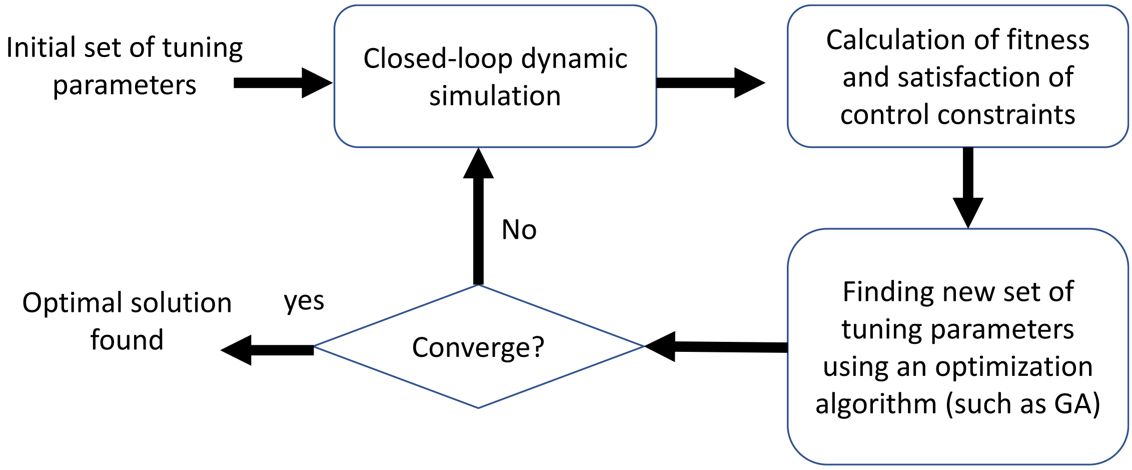


Fig. 1. PID controller tuning using an optimization method incorporated with dynamic simulation.

Keywords: PID controller; Controller tuning; Genetic algorithms

References

[1] Ziegler JG, Nichols NB. Optimum settings for automatic controllers. **Transactions of the ASME** 1942; 64: 759-768.

[2] Rivera DE, Morari M, Skogestad S. Internal model control 4.PID controller design. **Industrial Engineering and Chemistry Process Design and Development** 1988; 25: 252-265.

Oral TIChE-PE-23

Machine learning-assisted multi-objective optimization of furfural production from lignocellulosic biomass hydrolysate

Patcharapuek Pattaramanon[1,*], **Choowong Chaisuk**[1], **Nutchapon Chotigkrai**[1]

[1] Department of Chemical Engineering, Faculty of Engineering and Industrial Technology, Silpakorn University,
Nakhon Pathom 73000, Thailand
[*] Corresponding author: pattaramanon_p@su.ac.th

ABSTRACT

The conventional process for furfural production from lignocellulosic biomass has disadvantages due to low furfural yield and high operating costs. Therefore, the reactive distillation (RD) process can mitigate these drawbacks by continuously separating furfural from the reaction medium, preventing its degradation. In this study, the process of furfural production via RD from three biomass hydrolysates was simulated using Aspen Plus V14. and optimized using machine learning (ML). The dataset (1,406 datapoints) consisting of 9 input features and 4 output variables was generated using Latin hypercube sampling by integrating Python code with Aspen Plus. Multi-layer perceptron (MLP) models were developed to predict each output separately, including furfural revenue, CO_2 emissions, furfural purity, and total annual cost (TAC). For multi-objective optimization (MOO), NSGA-II and TOPSIS were employed for maximizing profit while minimizing CO_2 emissions. The MLP models demonstrated high predictive performance, with R^2 scores exceeding 0.9 for all outputs. The MOO results showed that optimizing for 2-objectives reduced CO_2 emissions by 68.63% and increased gross profit by 7.18% compared to the 1-objective optimization for maximum profit. SHapley Additive exPlanations revealed that hydrolysate feed rate and RD reboiler duty significantly influenced TAC, CO_2 emissions, and revenue. Additionally, acetic acid concentration had a substantial impact on TAC due to acetic acid cost, while biomass type influenced revenue based on xylose content. To improve economic feasibility, biomass hydrolysates should have high xylose content with optimal acetic acid levels and feed rate optimization is essential for efficiency.

Keywords: Furfural production; Reactive distillation; Machine learning; Multi-objective optimization

Poster **TIChE-PE-24**

Optimization of solketal reaction conditions for maximum yield using response surface methodology (RSM) in MATLAB®

Sittinut Damnoensawat[1], **Paisan Kittisupakorn**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: paisan.k@chula.ac.th

ABSTRACT

A glycerol derivative called solketal has attracted considerable interest from various businesses because of its many uses and the global trend toward sustainable practices. Solketal (2,2-dimethyl-1,3-dioxolane-4-methanol) is an acetal glycerol derivative formed by acetone and glycerol.[1] Solketal is widely used in medications, solvents, and biofuels due to its desirable physicochemical properties. Therefore, solketal's demand is increasing. The solketal reaction is shown in Fig. 1 [2].

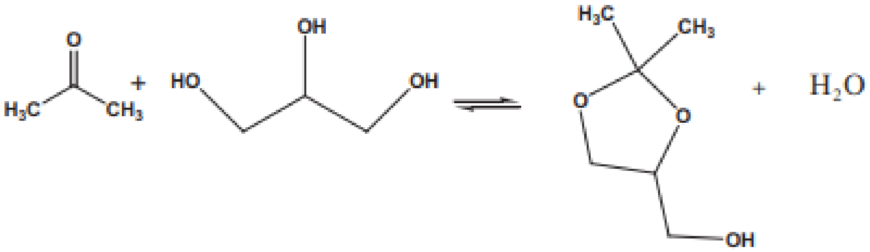


Fig. 1. Solketal reaction with acetone and glycerol as reactants.

Because of its demand, the reaction condition parameters needed to predict and optimize solketal synthesis, MATLAB® R2022b is used [3] to analyze important reaction condition parameters such as temperature, pressure, and molar ratio. Solketal yield is predicted under various situations using a nonlinear regression model created from simulation data with temperature between 298K and 323K, pressure between 1 and 10 bar, and acetone and glycerol molar ratio between 1 and 10, which is validated. Under the circumstances, the best conditions for maximum yield are found using optimization algorithms, such as response surface methodology (RSM) and restricted optimization techniques using root mean square error and R-squared to approve the optimization.

Keywords: Optimization; Solketal; MATLAB

References

[1] Saikia K, et al. Sulphonated biomass-based catalyst for solketal synthesis by acetalization of glycerol: A byproduct of biodiesel production. **Fuel Processing Technology** 2022; 238: 107482.
[2] Nanda MR, et al. Thermodynamic and kinetic studies of a catalytic process to convert glycerol into solketal as an oxygenated fuel additive. **Fuel** 2014; 117: 470-477.
[3] Yu BY, et al. Evaluation on the solketal production processes: Rigorous design, optimization, environmental analysis, and control. **Process Safety and Environmental Protection** 2022; 157: 140-155.

Oral TIChE-PE-25

Enhancing low-carbon hydrogen production from biomass gasification via machine-learning-aided multi-objective optimization with TOPSIS

Kitti Kamolram[1], **Phantisa Limlaemthong**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
[*] Corresponding author: phantisa.l@ku.th

ABSTRACT

Biomass gasification is one of the most promising technologies to produce bioenergy, i.e., hydrogen. The modeling and optimization of this process usually struggles from the complication of conventional calculation using thermodynamics and kinetics. Machine learning has emerged and gained momentum recently as a valuable tool regarding modeling and optimization problems. This study proposes Machine-Learning-aided Multi-Objective Optimization and Multi-Criteria Decision Making (ML-aided MOO & MCDM) framework to model and optimize the biomass gasification process to obtain the most suitable operating condition aiming at achieving low-carbon hydrogen production. Several machine learning models were trained and evaluated for predictive models of syngas from biomass gasification, including hydrogen. Gradient Boosting Regressor was selected for further study as it is able to achieve the highest average R^2 score of around 0.89. The selected model was then implemented with multi-objective optimization as an objective function to maximize hydrogen yield and minimize carbon dioxide. The bi-objective optimization result suggests that gasification occurs at around 1,000 degrees Celsius with steam as gasifying agent in fluidized bed reactor could result in the desired optimization objectives. TOPSIS technique, one of commonly used MCDM techniques, was utilized as a tool to rank pareto optimal solutions from MOO, which can finally prioritize the most suitable decision-option for further implementation. These optimal solutions can serve as a useful guideline and, particularly, the refined scope for further detailed process study and optimization.

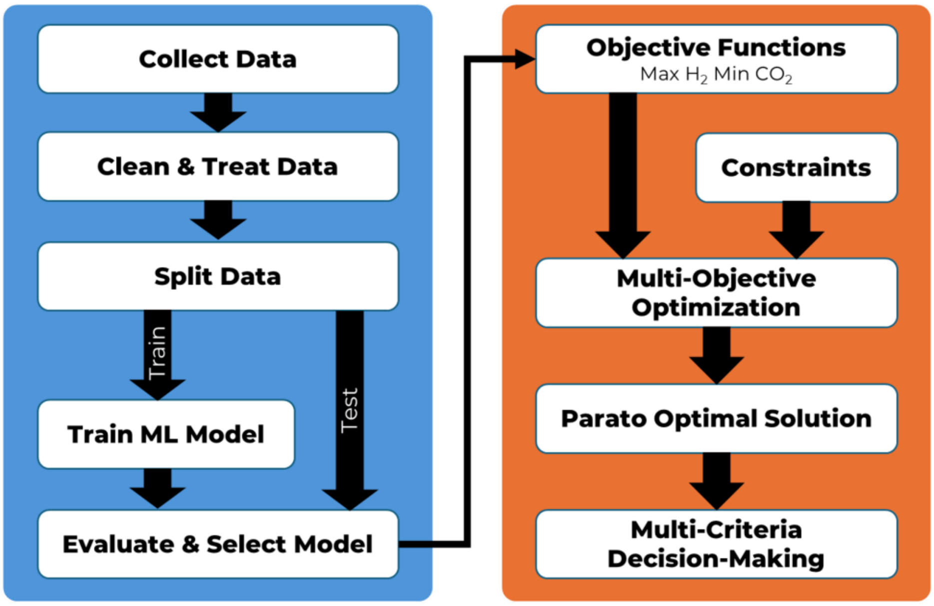


Fig. 1. Concept of this work.

Keywords: Biomass gasification; Machine learning; Multi-criteria decision-making; Multi-objective optimization

Oral **TIChE-SG-01**

Enhancing non-catalytic biomass pyrolysis yield predictions using machine learning and data augmentation

Anchalee Chaichanavongsaroj[1], **Dasakorn Rungrampan**[1], **Phantisa Limleamthong**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Kasetsart University, Bangkok 10900, Thailand
[*] Corresponding author: phantisa.l@ku.th

ABSTRACT

Predicting product yields from biomass pyrolysis is challenging due to the complexity of chemical reactions and the wide variety of influential factors. Machine learning offer an alternative modelling solution by capturing complicated patterns and handling high-dimensional data. However, a deficiency in the number of datasets, particularly the experimental-based dataset, potentially hinders the prediction accuracy of the machine learning models. This study aims to enhance machine learning prediction performance by exploring different algorithms and incorporating data augmentation under non-catalytic fixed-bed pyrolysis reactor condition. Three ensemble models, containing Random Forest (RF), Extra Trees (ET), and Extreme Gradient Boosting (XGBoost), were evaluated. Augmented data were generated using Aspen Plus process simulator, with dataset sizes varied at 5%, 10%, and 15% of the original dataset. Input features include lignocellulosic biomass characteristics (proximate and ultimate analyses), biomass category (e.g., hardwood, softwood) and pyrolysis operating conditions (e.g., particle size, final temperature), while outputs were solid, liquid, and gas yields. Results indicate that XGBoost achieved the highest accuracy, with R^2 score enhancing by the augmentation from 0.68 to 0.72 for the solid-phase yields, slightly increasing from 0.85 to 0.86 for the liquid-phase yield, and remaining stable at 0.86 for the gas-phase yield predictions. The optimal augmented dataset size varied depending on the output predicted. This research demonstrates the potential of machine learning applications in achieving high-accuracy predictions in sustainable process design, providing a strong foundation for further practical process optimization. The research concept is illustrated in Fig. 1.

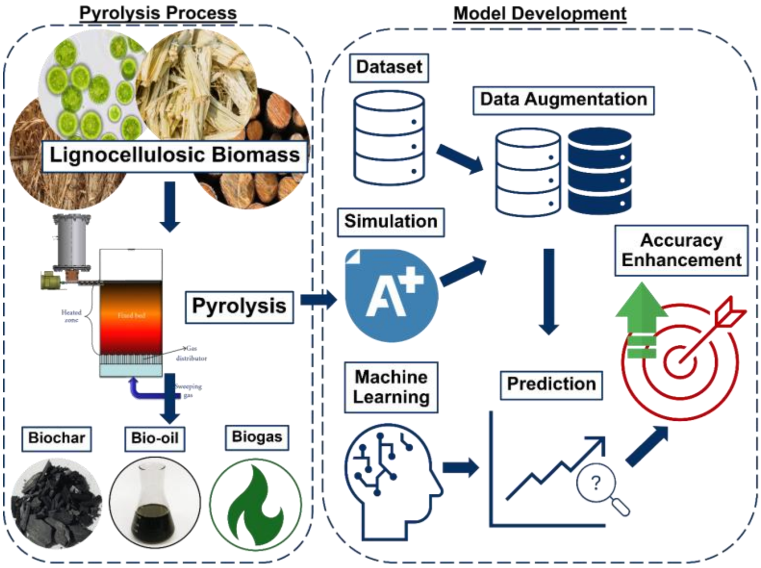


Fig. 1. Research concept.

Keywords: Biomass pyrolysis; Machine Learning; Data augmentation; Process simulation; Prediction model

Oral TIChE-SG-02

Continuous production of 5-hydroxymethylfurfural using monophasic solvents for pharmaceutical applications

Kritsanalak Thongkan[1], **Nattee Akkarawatkhoosith**[1], **Tiprawee Tongtummachat**[1,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[*] Corresponding author: tiprawee.ton@mahidol.edu

ABSTRACT

5-Hydroxymethylfurfural (5-HMF) is a bio-based compound with pharmaceutical applications due to its antioxidant, anti-cancer, and anti-sickling properties and its potential use as a dietary supplement. However, 5-HMF production processes for pharmaceutical use remain underexplored, with most research focusing on maximizing yields using solvents and catalysts unsuitable for pharmaceutical applications. This study aims to develop a safe, cost-effective, and efficient process for 5-HMF production using sugarcane syrup as a low-cost feedstock and citric acid as a catalyst in a microreactor. Various monophasic solvents, including deionized water (DI water), acetone, 1-propanol, 2-propanol, and tetrahydrofuran (THF), with low boiling points were selected to facilitate easy solvent removal by evaporation, ensuring no residual solvents remained in the final product. The results, analyzed using HPLC and ATR-FTIR, indicated that all solvents achieved relatively high syrup conversion rates, with THF yielding the highest selectivity at 41.21% at a residence time of 40 minutes. However, the cost analysis results identified acetone as the most cost-effective solvent. Acetone's low boiling point also facilitates easier removal, improving process efficiency and safety. At a residence time of 80 minutes, using acetone as a solvent provided a 5-HMF yield of 32.02% and selectivity of 34.46%. These findings highlight acetone as the optimal solvent for further process optimization, ensuring a balance between cost-effectiveness, efficiency, and pharmaceutical compliance in large-scale 5-HMF production. The concept of this research is shown in Fig. 1.

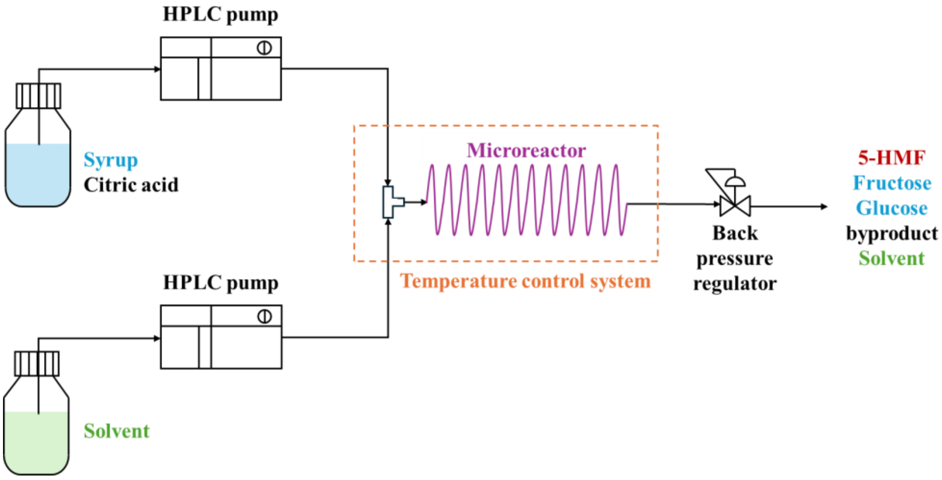


Fig. 1. Concept of this research.

Keywords: 5-hydroxymethylfurfural; Syrup; Microreactor; Monophasic system; Pharmaceutical applications

Oral TIChE-SG-03

Sub-seafloor carbon sequestration as hydrates: Experimental study on CO_2 hydrate formation in clay-rich marine sediments

Viphada Yodpetch[1], **Yue Zhang**[2,*], **Junjie Zheng**[2], **Santi Kulprathipanja**[1], **Praveen Linga**[2,*], **Pramoch Rangsunvigit**[1,*]

[1] The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok 10330, Thailand
[2] Department of Chemical and Biomolecular Engineering, National University of Singapore, Singapore 117575, Singapore
[*] Corresponding author: pramoch.r@chula.ac.th

ABSTRACT

Climate change is a significant environmental challenge, and its mitigation has become an increasingly complex issue. Carbon capture and sequestration is considered a promising technology for controlling the rise of atmospheric CO_2 levels. One of the innovative strategies is hydrate-based CO_2 sequestration in marine sediments, which offers high storage capacity and long-term stability. However, the presence of clay in marine sediments poses a major challenge to this technology, as it significantly affects the thermodynamics and kinetics of hydrate formation. This study investigates CO_2 hydrate formation in simulated clay-rich marine sediments, with clay mass fraction ranging from 0 to 30 wt%. The challenges associated with CO_2 hydrate formation in clay-rich sediments are highlighted. To improve hydrate formation, the effect of L-tryptophan as a promoter was examined. Additionally, experiments were conducted to assess the impact of clay on hydrate dissociation, as well as the influence of temperature and pressure on CO_2 hydrate formation in these sediments. The findings of this study provide valuable insights into CO_2 sequestration through hydrate formation in clay-rich marine sediments and contribute to the advancement of hydrate-based carbon capture and sequestration strategies, Fig. 1 [1].

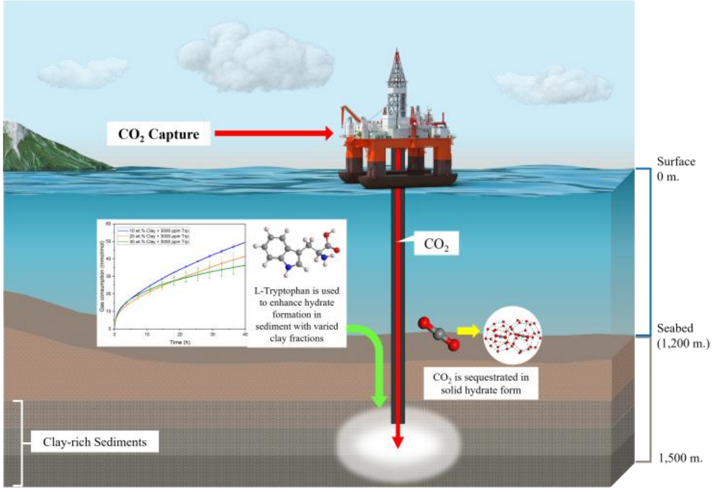


Fig. 1. Schematic illustration of CO_2 sequestration as hydrates in clay-rich marine sediments.

Keywords: Capture; Sequestration; Carbon dioxide; Hydrates; Sediments

References

[1] Yodpetch V, Zhang Y, Zheng J, Kulprathipanja S, Linga P, Rangsunvigit P. Experimental study on CO_2 hydrate formation in clay-rich sediments for sub-seafloor CO_2 sequestration. **Chemical Engineering Journal** 2025; 507: 160533.

Poster **TIChE-SG-04**

Design and development of a sustainable ethylene glycol production process via electrochemical CO_2 reduction

Nichapat Leelalertwong[1,*], **Phuet Prasertcharoensuk**[1]

[1] Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: 6670089121@student.chula.ac.th

ABSTRACT

Addressing the critical issue of rising atmospheric CO_2 concentrations and their impact on global climate change requires innovative technological solutions. This study introduced a novel and sustainable method for the production of ethylene glycol, commonly used in antifreeze, polyester manufacturing, and various industrial applications. Unlike conventional methods relying on coal or biomass-derived resources, our proposed method employed electrochemical CO_2 reduction, significantly decreasing environmental impacts. Central to this process was the innovative “OCEAN” technique, which strategically utilized oxalic acid as a key intermediate, enhancing overall conversion efficiency and minimizing undesirable byproducts. The proposed methodology involved a sequential procedure comprising electrochemical CO_2 reduction followed by catalytic hydrogenation steps. Initially, CO_2 was electrochemically converted into oxalic acid with a conversion efficiency of approximately 74.663%. Subsequently, oxalic acid was hydrogenated to glycolic acid, achieving around 56.715% conversion efficiency. In the final stage, glycolic acid underwent hydrogenation to produce ethylene glycol, attaining a high conversion efficiency of 84.878% and a product purity of 96.011%. Compared to conventional methods for ethylene glycol production, such as coal-based synthesis or biomass conversion, the “OCEAN” technique demonstrated superior conversion efficiencies and reduced environmental impact. Furthermore, this method achieved a 93.716% ethylene glycol yield, outperforming several previously reported methods with typically lower efficiencies. Collectively, this integrated approach enabled a substantial reduction of CO_2 emissions by approximately 62.631%, providing a cleaner, sustainable, and economically viable alternative for industrial chemical manufacturing.

Keywords: Ethylene glycol; Process modeling; Electrochemical CO_2 reduction

Poster **TIChE-SG-05**

Catalytic carbon dioxide desorption from monoethanolamine solvent in fluidized stripper

Sathida Doungsri[1], **Rattanaporn Apaiyakul**[2], **Teerawat Sema**[1,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Petrochemistry and Polymer Science Program, Faculty of Science, Chulalongkorn University,
Bangkok 10330, Thailand
[*] Corresponding author: teerawat.se@chula.ac.th

ABSTRACT

Amine-based absorption, particularly using monoethanolamine (MEA) solvent, is widely employed in an industrial CO_2 capture [1] However, conventional thermal desorption is energy-intensive and inefficient. To solve this problem, catalytic desorption by acid catalyst (e.g., HZSM-5) has been applied, mostly in batchwise operation. Since the actual operation is a continuous process, both catalytic packed and fluidized bed strippers are found to be more promising than the conventional batchwise system [2]. This study investigated a transition from a packed bed to a fluidized bed catalytic HZSM-5 desorption in comparison with the non-catalytic system and evaluated the key operating conditions to optimize the performance of the CO_2 desorption. The fluidized stripper (0.022 m diameter and 0.6 m height) was employed, with CO_2-rich MEA solution preheated to 90 °C. Fixed experimental parameters covered MEA concentration (5 M), initial CO_2 loading (0.5 molCO_2/mol MEA), and HZSM-5 Si/Al ratio of 38.

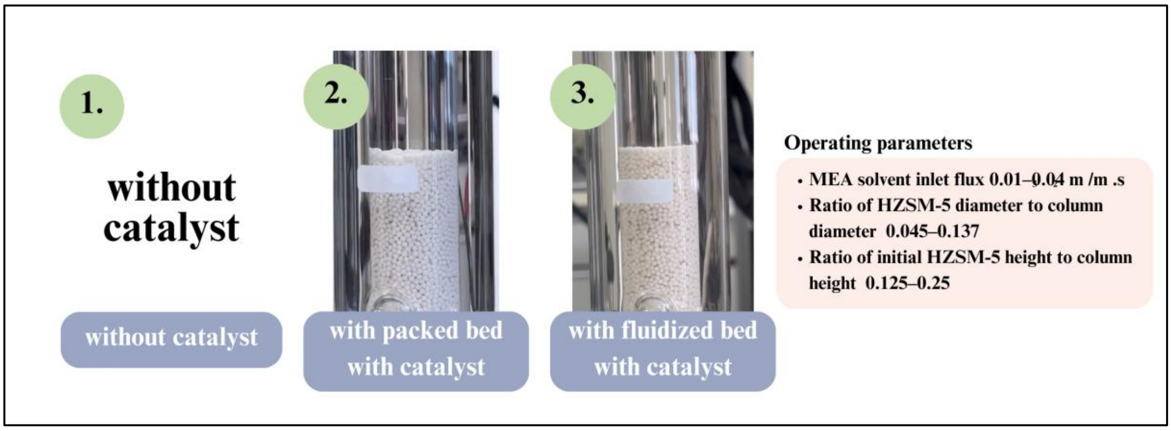


Fig. 1. CO_2 desorption configurations: (1) without catalyst, (2) packed-bed with catalyst, and (3) fluidized-bed with catalyst, under specified operating parameters.

Preliminary results showed that the catalytic fluidized stripper achieved a CO_2 desorption efficiency of 3.8%, compared to 2.1% in the non-catalytic system and 4.5% in the packed-bed stripper. The fluidized bed operation demonstrated faster and more stable CO_2 loading reduction than the non-catalytic system. Interestingly, the packed bed system exhibited slightly higher desorption efficiency due to a longer catalyst-MEA contact time. Despite this, the fluidized stripper offers advantages in mass transfer, catalyst replacement, and system stability, making it potentially a promising approach for continuous CO_2 capture applications. However, further optimization is required to maximize industrial feasibility.

Keywords: CO_2 desorption; Amine regeneration; Fluidization; Solid acid-catalyst; HZSM-5

References

[1] An S, Xu T, Xing L, Yu G, Zhang R, Liu J, Aierken A, Dai Q, Wang L. Recent progress and prospects in solid acid-catalyzed CO_2 desorption from amine-rich liquid. **Gas Science and Engineering** 2023; 120: 205152.

[2] Yang C, Li T, Sema T, Tantikhajorngosol P, Jiang J, Bai X, Jia N, Xiao M, Chan C, Tontiwachwuthikul P. Heat and mass transfer of a novel CO_2 desorption process integrated with highly turbulent catalytic heat exchanger. **Fuel** 2024; 359: 130028.

Oral TIChE-SG-06

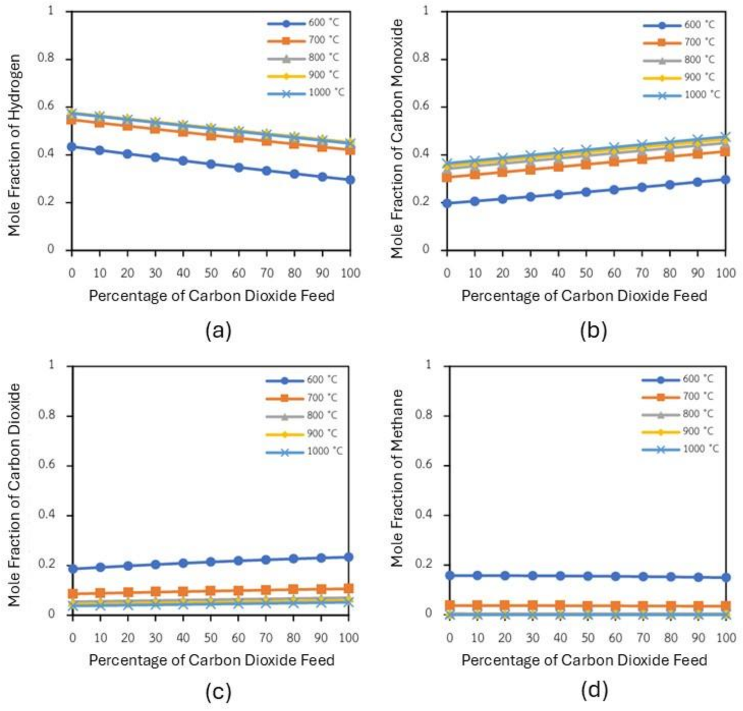
Process simulation of syngas production through glycerol reforming with carbon dioxide and steam for methanol synthesis

Patcharapol Chaladthunyakij[1], **Sarochinee Mitnoom**[1], **Suttapa Thadsoun**[1],
Yaneeporn Patcharavorachot[1,*]

[1] Department of Chemical Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
[*] Corresponding author: yaneeporn.pa@kmitl.ac.th

ABSTRACT

This study focuses on the production of synthesis gas from glycerol through a combined reforming process using carbon dioxide and steam. The goal is to produce synthesis gas suitable for methanol synthesis. The process is simulated using Aspen Plus™ software to determine optimal operating conditions. The research evaluates the molar ratio of synthesis gas components ($H_2/(2CO+3CO_2)$) to ensure suitability for methanol production. Three reforming processes are investigated: carbon dioxide reforming, steam reforming, and combined carbon dioxide-steam reforming. The effects of temperature (600-1000°C) and pressure (1-50 bar) are analyzed. The simulation results indicate that the optimal reforming temperature of all processes is 900°C at a pressure of 1 bar. For carbon dioxide reforming, adjusting the CO_2-to-glycerol feed ratio between 1 and 3 reveals an optimal range [1]. In steam reforming, the optimal steam-to-glycerol feed ratio is found to be 3 [2]. However, for the combined reforming process, as shown in Fig. 1, the synthesis gas molar ratio ($H_2/(2CO+3CO_2)$) remains below the target value of 1.05 at temperatures between 600 and 1000°C [3]. To address this, a water-gas shift reactor and gas separation adjustments should be implemented to achieve the desired molar ratio.



(a) (b)

(c) (d)

Fig. 1. At a pressure of 1 bar and a steam-to-glycerol molar feed ratio of 1, the effects of CO_2 feed percentage and reformer temperature on the molar composition of (a) hydrogen gas (H_2), (b) carbon monoxide (CO), (c) carbon dioxide (CO_2), and (d) methane (CH_4).

Energy analysis indicates that selecting an operating temperature of 900˚C is optimal in terms of product gas composition and thermal efficiency. These findings contribute to the development of an efficient synthesis gas production process for methanol synthesis from glycerol.

Keywords: Synthesis gas; Reforming; Methanol; Glycerol; Carbon dioxide

References

[1] Siew K. W, Lee H. C, Jolius G, Chin S. Y, Makusudur R. K, Yun H. T.-Y et al. Syngas production from glycerol-dry (CO_2) reforming over La-promoted Ni/Al_2O_3 catalyst. **Renewable energy** 2015; 74: 441-447.

[2] Andre B. V, Mona Lisa O. M. d. Glycerol steam reforming in bench scale continuous flow heat recovery. **International journal of hydrogen energy** 2013; 38: 399-400.

[3] Landa Leire, Remiro Aingeru, Valecillos Jos´e, Bilbao Javier, Gayubo Ana G. Syngas production through combined steam-dry reforming of raw bio-oil over a $NiAl_2O_4$ spinel derived catalyst. **Journal of CO_2 Utilization** 2023; 78: 102637.

Oral TIChE-SG-07

A study of the self-heating propensity of raw and torrefied biomasses

Kyaw Thu[1], **Nakorn Worasuwannarak**[1,*]

[1] The Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi,
Bangkok 10140, Thailand.
[*] Corresponding author: nakorn.wor@kmutt.ac.th

ABSTRACT

Torrefied biomass and its parent biomass may undergo self-heating when exposed to oxygen at low temperatures during processing, storage, and transportation. The purpose of this work is to examine the self-heating tendency of raw and torrefied biomasses during low-temperature oxidation. Empty fruit bunch (EFB) and rice straw (RS) with particle size lower than 500 µm were selected as samples in this research. Torrefied samples at 250˚C and 300˚C were labeled as biochar-250 (EFB-250, RS-250) and biochar-300 (EFB-300, RS-300). The thermogravimetry-differential scanning calorimetry (TG-DSC) analyzer (STA 449F3, NETZSCH) was utilized to measure the weight and heat flow changes of raw and torrefied samples under dry air (50 ml/min) at the temperature range of 30-300 ˚C [see Fig.1]. The results revealed that the heat flow (DSC signal) was higher in biochar-300 compared to raw biomass and biochar-250. Moreover, EFB-300 achieved a higher self-heating propensity (13.7 mW/mg) compared to RS-300 (12.7 mW/mg). Therefore, the self-heating tendency was strongly influenced by the biomass type and torrefaction temperature. In summary, this study will be useful for future investigations into kinetic factors for forecasting the self-heating propensity of different biomasses.

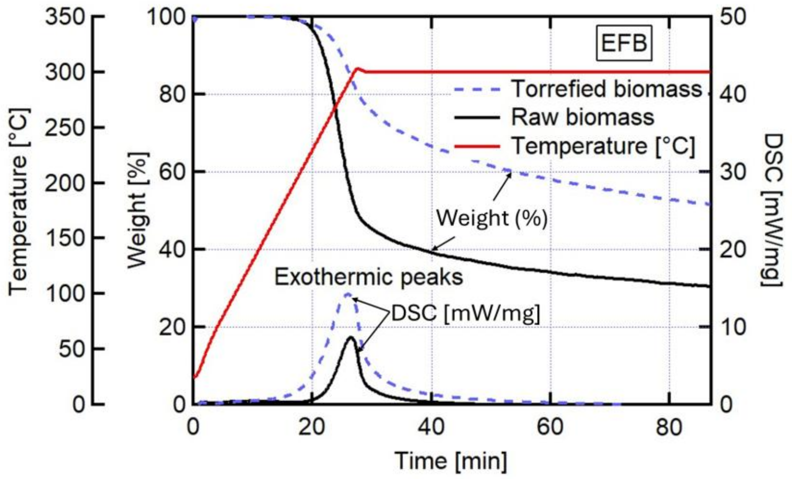


Fig. 1. Weight and heat flow changes of raw and torrefied biomasses at an oxidation temperature of 30-300 ˚C

Keywords: Biomass; Self-heating propensity; Low temperature oxidation; TG-DSC

Oral TIChE-SG-08

Preparation of bio-based polyol from soybean meal for polyurethane foam production

Jidapa Klinputt[1], Chanatip Samart[1,2], Suwadee Kongparakul[1,2,*]

[1] Department of Chemistry, Faculty of Science and Technology, Thammasat University,
Pathum Thani 12120, Thailand
[2] Research Unit in Bioenergy and Catalysis, Thammasat University, Pathum Thani 12120, Thailand
[*] Corresponding author: ksuwadee@tu.ac.th

ABSTRACT

This study investigated the utilization of soybean meal, a cost-effective agricultural byproduct, as a precursor for bio-based polyurethane (PU) foam. Soybean meal was converted into polyols via acid hydrolysis and transesterification, utilizing the amine groups in soybean protein to create urethane-based polyols [1, 2], then reacted with isocyanate to produce PU foam. The chemical structure of bio-based polyols was characterized using nuclear magnetic resonance (NMR) and Fourier-transform infrared spectroscopy (FTIR). The amount of acid value after hydrolysis, amine value after transamidation, and hydroxyl value of polyols were determined by acid-base titration. A comparison of amine value from transamidation (soy hydrolyzate reacted with ethanolamine) and amination (soy hydrolyzate reacted with ethylene diamine) processes have been studied. The results show transamidation process achieved a higher amine value about 3 times than amination process which led higher hydroxyl value in polyol products for ring opening of amine with propylene carbonate. From the process, bio-based polyol contains a hydroxyl value of 111.3 mg KOH/g which can compete with polyether polyol 975 has a hydroxyl value of approximately 100-110 mg KOH/g, a commercially available polyol. The obtained polyol was further used for bio-based polyurethane applications such as PU foam or PU coating.

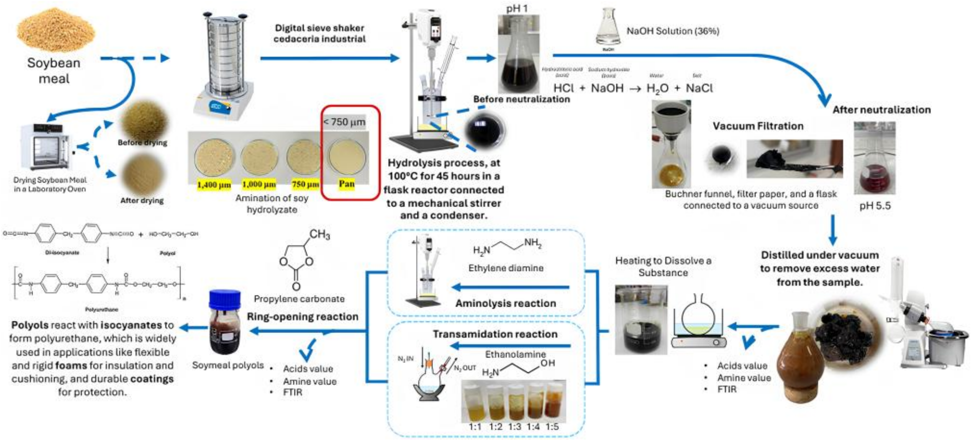


Fig. 1. Process flow for the sustainable conversion of soybean meal into bio-based polyols for polyurethane foam production.

Keywords: Soybean meal; Bio-based polyols; Polyurethane foam; Transamidation; Aminolysis

References

[1] Campanella A, Bonnaillie L, Wool R. Polyurethane foams from soyoil-based polyols. **Journal of Applied Polymer Science** 2009; 112(4): 2567-2578.

[2] Guo Y, Hardesty JH, Mannari VM, Massingill JL. Hydrolysis of epoxidized soybean oil in the presence of phosphoric acid. **Journal of the American Oil Chemists' Society** 2007; 84(10): 929-935.

Poster **TIChE-SG-09**

Syngas production from biomass/plastic waste in supercritical water gasification: Impact of CO_2 Co-reaction and operating conditions

Yaneeporn Patcharavorachot[1,*], **Pumpat Phanusjutabul**[1], **Mongkol Pholchan**[1], **Dang Saebea**[2]

[1] Department of Chemical Engineering, School of Engineering, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
[2] Interdisciplinary Centre for Decarbonisation & Green Energy, Department of Chemical Engineering, Faculty of Engineering, Burapha University, Chonburi 20131, Thailand
[*] Corresponding author: yaneeporn.pa@kmitl.ac.th

ABSTRACT

Nowadays, both biomass and plastic waste are the main solid wastes in worldwide. Waste-to-energy technology is an alternative to manage solid waste generation. Gasification process is the most promising technology that can convert the solid wastes into synthesis gas or syngas. This research has been focusing on supercritical water gasification (SCWG). One of advantages in SCWG is that the feedstock with a high moisture content can be used [1]. Thus, the capital and operating cost is lowered due to the elimination of drying unit. In addition, syngas, a versatile intermediate in clean energy technologies can be enhanced through optimized SCWG process [2]. Although the excess SCW is required to improve hydrogen yield, this may inhibit the CO production and affect to the H_2/CO molar ratio. To resolve this problem, the use of CO_2 as co-reactant is suggested to promote syngas production in SCWG process [3]. In this research, the model of syngas production through SCWG was designed and simulated using Aspen Plus simulator version 9. The simulation results indicate an optimal gasifier temperature of 1000 K and an SCW/F ratio of 3 for all feedstocks. Polypropylene (PP) yields the highest H_2/CO ratio, followed by the mixture of plastic and biomass and rice straw (RS), due to its higher hydrogen content. Increasing CO_2 in the SCWG process enhances CO and H_2O production via the reverse water-gas shift reaction, reducing the H_2/CO ratio in syngas as shown in Fig. 1. Thus, CO_2 addition affects syngas suitability for downstream processes.

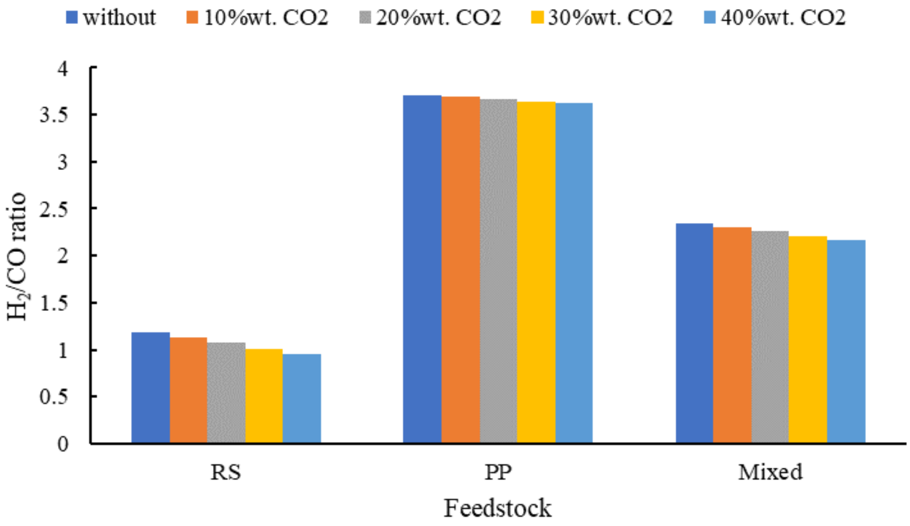


Fig. 1. Effect of CO_2 addition as co-reactant in SCWG process on H_2/CO ratio of syngas at gasifier temperature of 1000 K and S/F ratio of 3.

Keywords: Biomass; Plastic waste; Gasification; Supercritical water; Carbon dioxide

References

[1] Antal MJ, Allen SG. Biomass gasification in supercritical water. **Industrial & Engineering Chemistry Research** 2000; 39(11): 4040-4053.

[2] Guo L, Cao C, Lu Y. Supercritical water gasification of biomass and organic wastes. **Biomass** 2010.

[3] Guo Y, Wang SZ, Xu DH, Gong YM, Ma HH, Tang XY. Review of catalytic supercritical water gasification for hydrogen production from biomass. **Renewable and Sustainable Energy Reviews** 2010; 14(1): 334-343.

Oral TIChE-SG-10

Off-grade epoxy resin and waste tire composites for CO_2 adsorption

Teerapat Inudom[1], **Sirilux Poompradub**[1,2,3,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Center of Excellence on Petrochemical and Materials Technology Chulalongkorn University,
Bangkok 10330, Thailand
[3] Center of Excellence in Green Materials for Industrial Application, Chulalongkorn University,
Bangkok, 10330, Thailand
[*] Corresponding author: sirilux.p@chula.ac.th

ABSTRACT

Global warming is a major environmental concern, driven by the continuous rise of carbon dioxide (CO_2) in the atmosphere. Among the available technologies, adsorption using solid adsorbents stands out for its lower energy requirements and lower corrosion risk. Recently, the epoxy resin (EP) has been successfully prepared into activated carbon by carbonization process. However, this method requires high energy consumption and long preparation time. Waste tire (WT) is another interesting polymer waste material for CO_2 adsorption. It contains carbon black, silica and zinc oxide as components. The oxygen from silica and zinc oxide enhances CO_2 physisorption through electrostatic interactions between oxygen atoms and carbon atoms of CO_2 [1]. Additionally, the hydroxyl groups in silica can act as Lewis bases, bonding with CO_2 to form carboxylate ions [2]. Therefore, this research aims to propose a new method for preparing the polymeric adsorbents using WT mixed with the off-grade EP at various mass ratios of EP:WT (1:1, 1:2, 1:3 and 1:4). It was found that the composite of EP:WT at the mass ratio of 1:3 (EPWT13) exhibited the highest CO_2 adsorption capacity (7.12 $mg_{CO2}/g_{adsorbent}$) under the ambient temperature and atmospheric pressure using 12% v/v CO_2 in nitrogen and the inlet flow rate of 100 mL/min, as shown in Fig. 1. Furthermore, the kinetic study of EPTW13 fitted well with Avrami's model indicating both CO_2 physisorption and chemisorption [3]. Moreover, the EPWT13 showed 8.40% decrease in CO_2 adsorption capacity after five adsorption-desorption cycles.

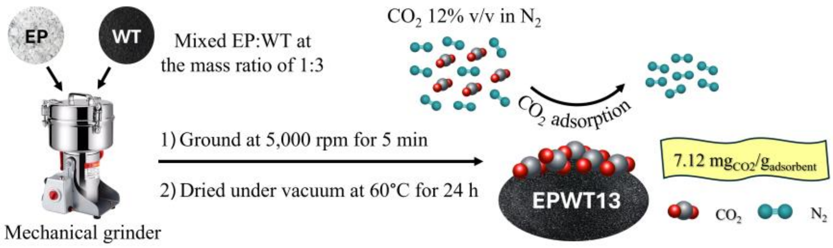


Fig. 1. Schematic of EPWT13 preparation and its CO_2 adsorption

Keywords: Off-grade epoxy resin; Waste tire; CO_2 adsorption; Kinetic adsorption

References

[1] Sharma H, Dhir A. Capture of carbon dioxide using solid carbonaceous and non-carbonaceous adsorbents: a review. **Environmental Chemistry Letters** 2021; 19: 851-873.

[2] Petrovic B, Gorbounov M, Soltani SM. Impact of surface functional groups and their introduction methods on the mechanisms of CO_2 adsorption on porous carbonaceous adsorbents. **Carbon Capture Science & Technology** 2022; 3: 100045.

[3] Smedt JD, Cleemput AV, Craye G, Ghysels S, Marchal W, Arauzo PJ, Ronsse F. Separation of CO_2 from different CO_2/N_2 mixtures using molten salt-derived pelletized activated carbon. **Biomass and Bioenergy** 2025; 194: 107699.

Poster TIChE-SG-11

Mechanical properties, physical characteristics, and biodegradation of rigid polyurethane foam synthesized from castor and palm oil-based polyols

Panchan Sricharoon[1,*], **Atjima Khachon**[1], **Thinnapong Dorbutr**[1], **Narubet Sriprung**[1],
Nutthapart Nithiyasotharanon[1]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi,
Bangkok 10140, Thailand
[*] Corresponding author: panchan.sri@kmutt.ac.th

ABSTRACT

This study aimed to synthesize rigid polyurethane foam as an insulating material using castor oil and palm oil to improve biodegradability and replace petroleum-based polyols. Both oils were modified to increase their hydroxyl values before being polymerized with polymeric diphenylmethane diisocyanate (PMDI). The research varied the weight ratios of castor oil and palm oil and examined their effects on the mechanical and physical properties of the synthesized foam, including microstructure, apparent density, compressive strength, thermal conductivity, and biodegradability through hydrolysis. The foam exhibited a predominantly spherical, closed-cell structure. An increased proportion of palm oil-based polyol led to higher bulk density and compressive strength, which can be attributed to its higher hydroxyl value (437.2 compared to 414.8 for castor oil polyol), influencing the cross-linking density during polymerization [1], as well as the smaller foam cell size associated with higher palm oil content. However, ANOVA analysis indicated no significant change in thermal conductivity at a 95% confidence level, with values remaining within the range of 0.0512–0.0542 W/m·K. All measured properties exceeded the standard values for commercial foam. Additionally, biodegradability in the phosphate buffer solution decreased as the palm oil polyol content increased. Further optimization of synthesis conditions or renewable raw materials is necessary to achieve properties comparable to commercial foam. A summary of the thermal conductivity results for the prepared foams is presented in Fig. 1

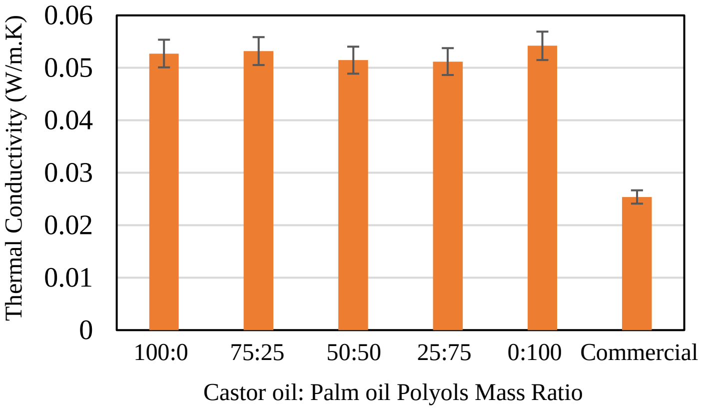


Fig. 1. Thermal conductivity of the rigid polyurethane foam synthesized from different mass ratio of castor oil to palm oil polyols.

Keywords: Renewable material; Rigid polyurethane foam; Insulation; Biodegradability

References

[1] Lim H, Kim SH, Kim BK. Low-temperature hydrothermal synthesis of N-doped TiO_2 from small-molecule amine systems and their photocatalytic activity. **Polymers for Advanced Technologies** 2008; 19(12): 1729-1734.

Poster **TIChE-SG-12**

Evaluating the effectiveness of antioxidants in palm oil-based bio-grease

Eumporn Buarod[1], **Pornpasson Sanenopakul**[1], **Sitthichai Watthanalao**[1], **Parncheewa Udomsap**[1,*], **Suparoek Henpraserttae**[1], **Boonyawan Yoosuk**[1]

[1] National Energy Technology Center, National Science and Technology Development Agency,
Pathum Thani 12120, Thailand
[*] Corresponding author: parncheewa.udo@entec.or.th

ABSTRACT

Bio-grease is a renewable, non-toxic, and environmentally friendly lubricant. Unlike traditional petroleum-based greases, it is formulated using plant-based oils that degrade more easily, reducing harm to ecosystems and wildlife if leaked or disposed of. The characteristics of our in-house made palm oil-based bio-grease comply with the TIS 713-2541 standard, making it suitable for general use. It is a lithium grease, with palm oil as the main component. Palm oil, containing about 50% unsaturated fatty acids, is more prone to oxidation than mineral or synthetic oils with higher saturated hydrocarbon content. Oxidation degrades the grease, forming acids, sludge, and contaminants that reduce lubrication efficiency. To improve the oxidation resistance of bio-greases, antioxidants are added to delay the oxidation process and extend the service life of grease. The 4,4’-Methylenebis-2,6-di-tert butylphenol (MBP) and N,N’-Diphenyl-1,4-phenylenediamine (DPPD) were studied for their effectiveness in bio-grease by measuring Onset Oxidation Temperature (OOT) using Differential Scanning Calorimetry [1]. The OOT results for grease blends showed: DPPD (202°C) > MBP (194°C) > No antioxidant (156°C), as shown in Fig. 1, indicating better performance from the amine antioxidant. The addition of antioxidants slightly altered grease consistency, measured by the spread method using the SKF grease test kit. The spread diameter of the grease with DPPD was 20.3 mm, compared to 18.5 mm for the greases with MBP and no antioxidants, indicating that DPPD softened the grease. While antioxidants improve oxidation resistance. Balancing their effects on other properties is crucial to ensure the grease performs optimally in its intended application.

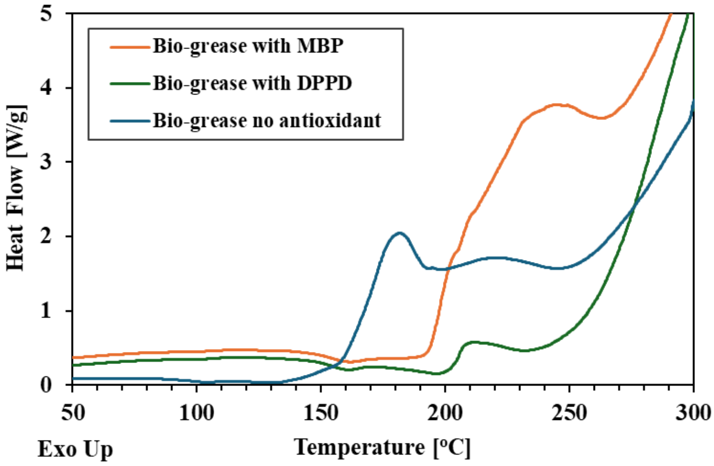


Fig. 1. DSC exothermic of bio-grease with and without antioxidant using temperature ramping method (at 10°C/min under air flow 50 mL/min).

Keywords: Bio-grease; Palm oil-based grease; lithium grease; Oxidation stability; Antioxidant

References

[1] Sharma BK, Adhvaryu A, Perez JM, Erhan SZ. Biobased grease with improved oxidation performance for industrial application. **Journal of Agricultural and Food Chemistry** 2006; 54(20): 7594-7599.

Oral **TIChE-SG-13**

Bio-based coating from chitosan and ethyl cellulose for oil- and water-resistant paper packaging

Oraya Sraphaengnoi[1], **Lunjakorn Amornkitbamrung**[2], **Sanong Ekgasit**[2], **Sarawut Rimdusit**[1,*]

[1] Center of Excellence in Polymeric Materials for Medical Practice Devices, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Department of Chemistry, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: Sarawut.r@chula.ac.th

ABSTRACT

Plastic pollution is a growing global issue, with disposable food packaging as a major contributor [1]. Limited recyclability and poor waste management allow plastics to accumulate in ecosystems. While paper packaging offers better recyclability and biodegradability, its poor oil-water resistance often requires a plastic coating. This coating hinders recyclability, slows decomposition, and exacerbates environmental challenges [2]. Therefore, using a biopolymer coating on paper packaging is a promising solution for improving oil and water resistance while supporting environmental sustainability. In this work, we developed a new biobased, bi-layer coating for paper packaging. The first layer, hydrophilic chitosan, provided oil resistance, while the second layer, hydrophobic ethyl cellulose, enhanced water resistance. This combination created a synergistic effect on the paper's barrier properties. Infrared spectroscopy confirmed the coating's presence, and its composition was optimized to achieve strong oil-water resistance (Kit value of 12, Cobb 60 $<$ 5 g/m^2) with minimal material use. Scanning electron microscopy revealed that the coating fully sealed the paper's porous structure. Overall, this system offers a promising eco-friendly solution for oil- and water-resistant paper packaging.

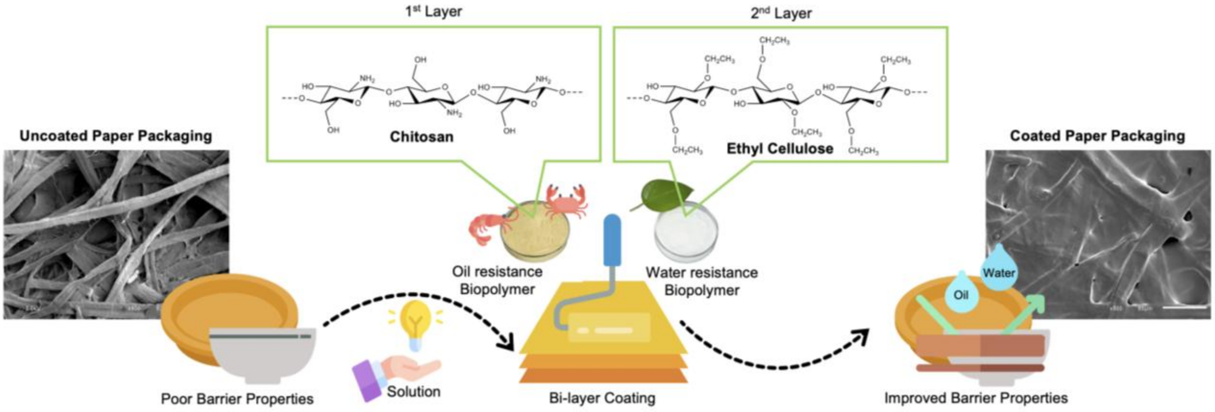


Fig. 1. Illustration of the process for the oil- and water-resistant chitosan/ethyl cellulose bi-layer coating.

Keywords: Paper; Packaging; Coating; Oil-resistance; Water-resistance

References

[1] **Plastic pollution**. UNEP-UN Environment Programme. https://www.unep.org/plastic-pollution. Published January 22, 2025.

[2] Mujtaba M, Lipponen J, Ojanen M, Puttonen S, Vaittinen H. Trends and challenges in the development of bio-based barrier coating materials for paper/cardboard food packaging; a review. **The Science of the Total Environment** 2022; 851: 158328.

Poster **TIChE-SG-14**

Study of calcium carbonate precipitation from CO_2-rich amine-based solution

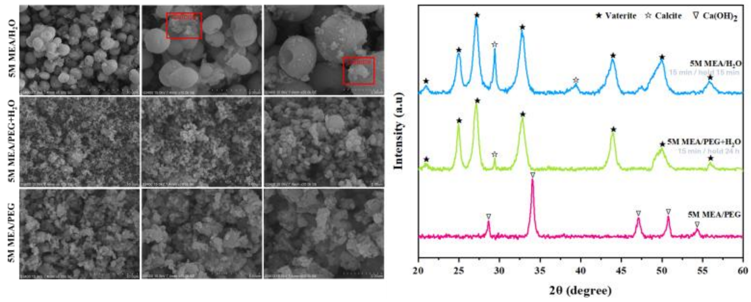
Kannika Jongauksorn[1], **Pattaraporn Kim**[1,*]

[1] Center of Excellence on Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: pattaraporn.k@chula.ac.th

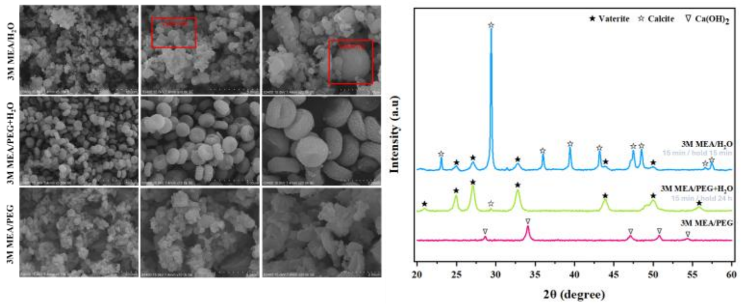
ABSTRACT

The precipitation of calcium carbonate ($CaCO_3$) from CO_2-rich amine solutions is a novel and promising approach to carbon capture and utilization. This process reduces atmospheric CO_2 while producing valuable $CaCO_3$ (calcite or vaterite) for industrial use. Compared to traditional CO_2 capture and utilization methods, which require high energy for CO_2 separation and chemical conversion, $CaCO_3$ precipitation is a low-energy alternative. It occurs under near-ambient conditions and permanently stores CO_2 in solid form, making it a sustainable and cost-effective approach. This study investigates the use of polyethylene glycol (PEG)-modified monoethanolamine (MEA) absorbents to enhance CO_2 absorption and promote $CaCO_3$ precipitation. Absorbent formulations with different MEA concentrations were tested in three systems: MEA/H_2O, MEA/PEG200, and MEA/PEG200 + H_2O, with $Ca(OH)_2$ added to provide Ca^{2+} after CO_2 absorption. The results shown in Fig. 1 indicate that both the MEA/H_2O and MEA/PEG200 + H_2O systems successfully facilitated $CaCO_3$ precipitation. However, the MEA/PEG system, which lacked water, did not produce $CaCO_3$ due to the absence of CO32- formation. As the MEA concentration decreased in the MEA/H_2O system, the dominant phase shifted to calcite, while the MEA/PEG200 + H_2O system consistently produced the vaterite phase, even at lower MEA concentrations. This indicates that the presence of PEG in the system can control the phase that forms. The vaterite phase is rarer and more expensive than calcite, offering distinct advantages in certain applications. SEM and XRD analyses revealed clear differences in the crystallinity and morphology of the precipitates, with vaterite displaying spherical particles and calcite showing well-defined rhombohedral crystals.

a)



b)



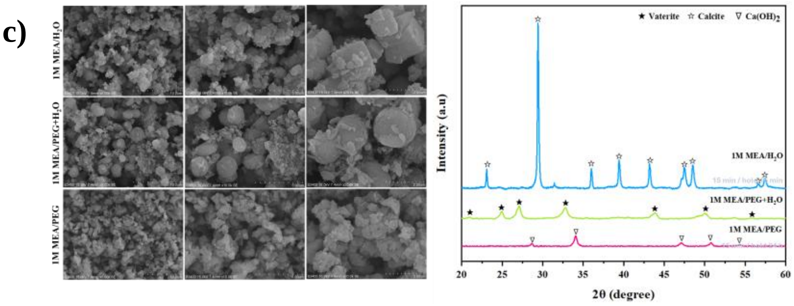


Fig. 1. SEM (left) and XRD (right) patterns of $CaCO_3$ particles obtained in the presence of absorbents based on (a) 5 M, (b) 3 M, and (c) 1 M concentration of MEA.

Keywords: Carbon capture; Absorption; Calcium carbonate; Crystallization

References

[1] Tian W, et al. Nonaqueous MEA/PEG200 absorbent with high efficiency and low energy consumption for CO_2 capture. **Industrial & Engineering Chemistry Research** 2021; 60(10): 3871-3880.

[2] Konopacka-Łyskawa D. Synthesis methods and favorable conditions for spherical vaterite precipitation: A review. **Crystals** 2019; 9(4): 223.

Oral **TIChE-SG-15**

Chitosan-fibroin-based coating solution for prolonging the shelf life of bananas

Wannida Sawangarunporn[1], **Pailin Ngaotrakanwiwat**[1,2,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Burapha University, Chonburi 20131, Thailand
[2] Interdisciplinary Center for Decarbonisation and Green Energy, Faculty of Engineering, Burapha University, Chonburi 20131, Thailand
[*] Corresponding author: pailin@eng.buu.ac.th

ABSTRACT

The synergistic properties of silk-based fibroin from cocoons with high resisting water permeability [1] and chitosan with low oxygen transmission were selected for the coating solution to prolong the shelf-life of Nam Wa bananas [2]. The coating solution primarily consists of fibroin (SF) and chitosan (CS) in different weight ratios: SF 100%, SF 80% and CS 20%, SF 70% and CS 30%, SF 60% and CS 40%, and CS 100%. The effect of the coating solution composition and the number of coating layers were investigated on weight loss and the release of ethylene, a hormone that accelerates fruit ripening. The results showed that the coating protects against direct exposure to the atmosphere, which could reduce the fruit's weight loss. In addition, the coating could reduce the oxygen transmission rate to the fruit, prohibiting its respiration and reducing the release of ethylene. The coating solution consisting of fibroin 80% and chitosan 20% was the most effective coating composition for prolonging the shelf life. Nam Wa bananas coated with this formulation exhibited weight loss of 13% and 12% for single and double coatings, respectively, which were lower than that of uncoated bananas (18%) after storage at 25°C for 7 days. Additionally, the rate of ethylene release of bananas with single and double coating was 3-7 and 1-4 μL C_2H_4/g·hr, respectively, which is lower than that of uncoated bananas (13 μL C_2H_4/g·hr); therefore, the coated bananas with the suitable formulation maintained their freshness for up to 10 days from the onset of ripening.

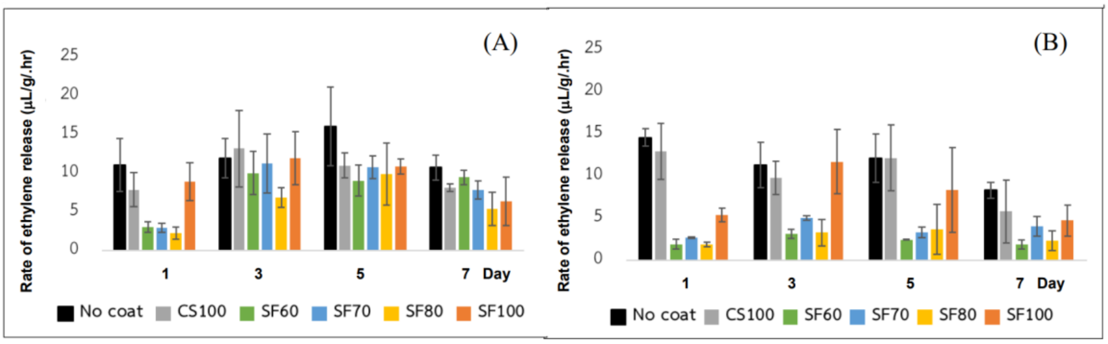


Fig. 1. Ethylene release rate of Nam Wa bananas coated with different coating solutions: (A) single coating and (B) double coatings.

Keywords: Fibroin; Chitosan; Weight loss; Ethylene; Bananas

References

[1] Marelli B, Brenckle M, Kaplan D. L, Omenetto, F. G. Silk fibroin as edible coating for perishable food preservation. **Scientific reports** 2016; 6(1): 25263.

[2] Wantat A, Rojsitthisak P, Seraypheap K. Inhibitory effects of high molecular weight chitosan coating on 'Hom Thong'banana fruit softening. **Food Packaging and Shelf Life** 2021; 29: 100731.

Poster **TIChE-SG-16**

Synthesis of rigid polyurethane foam from modified castor oil and sugar to enhance thermal insulating properties and degradability

Panchan Sricharoon[1,*], **Kwanjira Janrueang**[1], **Yossawadee Jitsukha**[1], **Wanicha Suphap**[1]

[1] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[*] Corresponding author: panchan.sri@kmutt.ac.th

ABSTRACT

varying sugar contents to enhance thermal insulating properties and degradability. Castor oil was converted into polyol and polymerized with polymeric diphenyl methane diisocyanate (PMDI), with the mass ratio of castor oil polyol to sugar systematically varied to assess its impact on foam properties. A mass ratio of 1:3 yielded the highest hydroxyl value of 905.75 mg KOH/g, providing more reactive sites for cross-linking, while the 1:1 ratio foam exhibited optimal properties, including a thermal conductivity of 0.0356 W/m·K, bulk density of 44.84 kg/m^3, and compressive strength of 0.1528 MPa. Although adding sugar improved degradability, it also increased thermal conductivity, bulk density, and compressive strength, exceeding industrial standards. Group 1 foams (ratios 1:0 and 1:1) had smaller, closed-cell structures, while Group 2 foams (ratios 1:2 and 1:3) had larger cells. The increase in sugar content led to higher thermal conductivity, likely due to a reduced Knudsen effect, which allows greater gas-phase conduction in larger pores, as observed in Group 2 foams [1]. This trend is consistent with studies incorporating fillers such as sawdust and sugar beet pulp into polyurethane foams, where excessive filler content disrupted the structure and increased thermal conductivity [2-3]. A summary of the key results for the prepared foams is presented in Fig. 1.

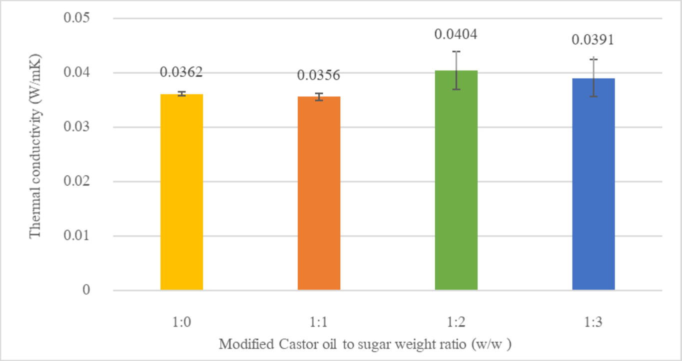


Fig. 1. Thermal conductivity of the rigid polyurethane foam synthesized from different mass ratio of modified castor oil polyol to sugar.

Keywords: Renewable material; Rigid polyurethane foam; Sugar; Insulation; Biodegradability

References

[1] Glicksman LR, Schuetz MA, Miser JR. Measurement and correlation of low-density foam thermal conductivity. **Journal of Cellular Plastics** 1992; 28(2): 122-136.

[2] Strakowska A, Członka S, Kairyte A. Rigid polyurethane foams reinforced with POSS-impregnated sugar beet pulp filler. **Materials** 2020; 13(23): 5493.

[3] Ugarte L, Fernández SG, Rodríuez CP, Prociak A, Corcuera MA, Eceiza A. Tailoring mechanical properties of rigid polyurethane foams by sorbitol and corn derived biopolyol mixtures. **ACS Sustainable Chemistry & Engineering** 2015; 3(12): 3382-3387.

Oral **TIChE-SG-17**

Ethanol-assisted CO_2 hydrogenation to methanol in a trickle-bed reactor

Pattarapol Akeakkharanusorn[1], **Kritchart Wongwailikhit**[1,2], **Rungthiwa Methaapanon**[1,2],
Apinan Soottitantawat[1,2,*]

[1] Center of Excellence in Particle and Materials Processing Technology, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Bio-Circular-Green-economy Technology & Engineering Center, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: apinan.s@chula.ac.th

ABSTRACT

The hydrogenation of carbon dioxide (CO_2) to methanol is a promising approach for CO_2 utilization, contributing to carbon capture technology and sustainable chemical production. However, conventional methanol synthesis requires high temperatures, which limit equilibrium conversion according to thermodynamics principles. Alcohol-assisted methanol synthesis has emerged as a novel method to enhance methanol production at lower temperatures. In this approach, alcohol is used as a catalytic solvent that modifies reaction pathways [1]. The equilibrium results for ethanol-assisted CO_2 hydrogenation to methanol, with ethanol as the catalytic solvent, were obtained using the Gibbs free energy minimization method in Aspen Plus. These results are presented in Figure 1 and Figure 2 for different H_2-to-CO_2 molar ratios. The findings indicate that CO_2 conversion and methanol yield increased as more ethanol was added to the reaction. At high ethanol concentrations, ethanol remained in the liquid phase. This study investigated ethanol-assisted CO_2 hydrogenation in a trickle-bed reactor using a commercial $Cu/ZnO/Al_2O_3$ catalyst. CO_2 and H_2 were introduced in gaseous form, while ethanol was supplied as a catalytic solvent in liquid form. The effects of residence time were examined at a temperature of 150°C and a pressure of 30 bar. The findings revealed that CO_2 conversion and methanol yield increased with a lower LHSV, while yield of the ethyl formate, an intermediate, did not change significantly.

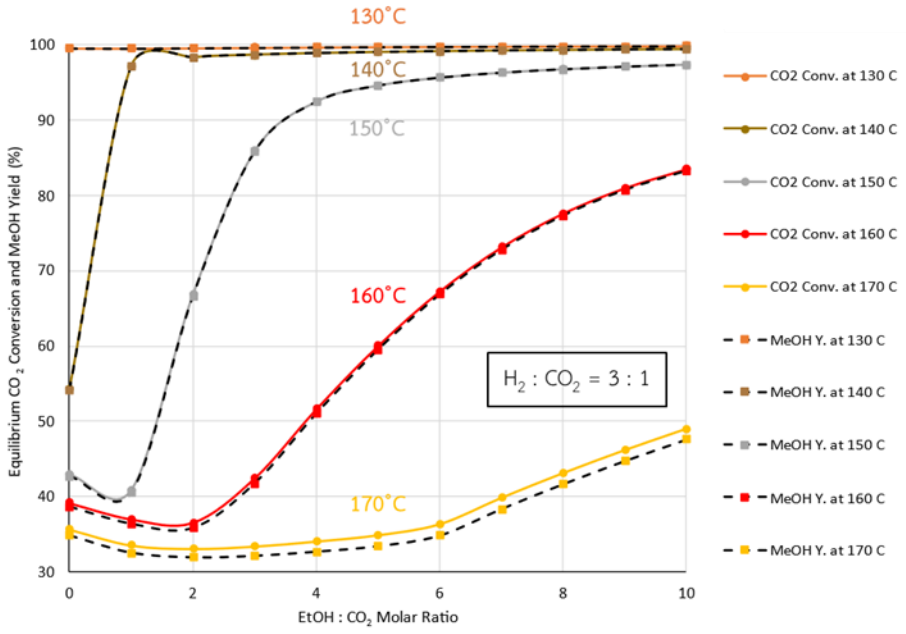


Fig. 1. The equilibrium results of ethanol-assisted CO_2 hydrogenation to methanol using a H_2-to-CO_2 molar ratio of 3 and various ethanol-to-CO_2 molar ratios, at a pressure of 30 bar and different temperatures.

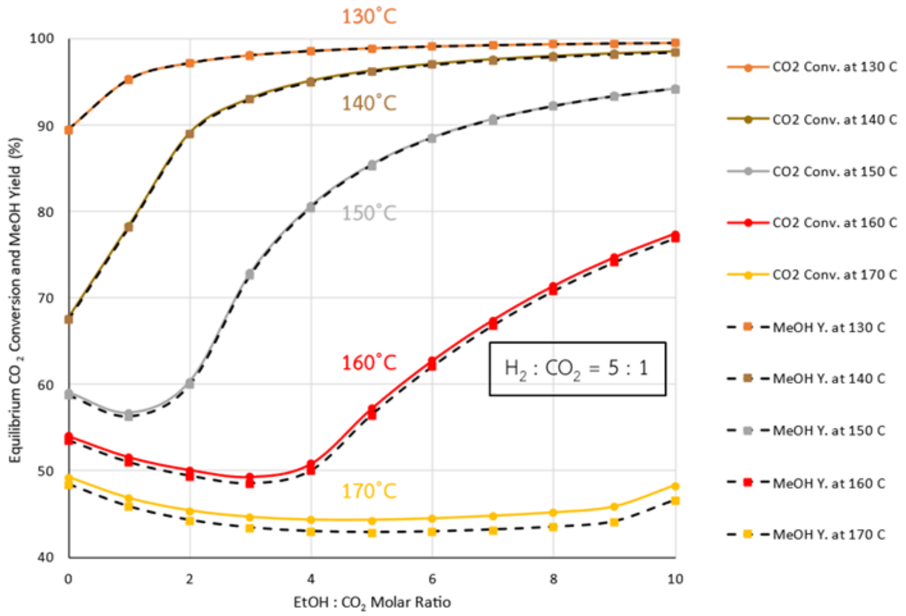


Fig. 2. The equilibrium results of ethanol-assisted CO_2 hydrogenation to methanol using a H_2-to-CO_2 molar ratio of 5 and various ethanol-to-CO_2 molar ratios, at a pressure of 30 bar and different temperatures.

Keywords: Methanol; Hydrogenation; CO_2; Alcohol-assisted; Trickle-bed reactor

References

[1] Meesattham S, Kim-Lohsoontorn P. Low-temperature alcohol-assisted methanol synthesis from CO_2 and H_2: The effect of alcohol type. **International Journal of Hydrogen Energy** 2022; 47(54): 22691-22703.

Oral TIChE-SG-18

Thermal, morphological and mechanical properties of recycled Al film label/LLDPE composites

Siriwan Naknoy[1], **Pollawat Charoeythornkhajhornchai**[2,*]

[1] Department of Biological, Environmental and Materials Engineering, Faculty of Engineering,
Burapha University, Chonburi 20131, Thailand
[2] Department of Advanced Materials Engineering, Faculty of Engineering, Burapha University,
Chonburi 20131, Thailand
[*] Corresponding author: pollawat.ch@eng.buu.ac.th

ABSTRACT

Plastic waste contaminated with aluminum film, particularly metalized film, is a severe environmental issue because it cannot decompose naturally and the problem of multilayered laminates, often consisting of plastic coated with aluminum film by vapor deposition method. However, recycling of multilayered laminates film is difficult due to the complexity of separating materials. Some of the work has highlighted that laminated packaging contributes substantially to landfill waste, creating environmental and sustainability concerns [1]. This leads to long-lasting environmental presence with harmful from heavy metals. Therefore, the effective management of its recycling should be required to solve this issue [2]. This study aims to recycle metalized film into new materials to maximize its reusability by using linear low-density polyethylene (LLDPE) incorporating with metalized film at 5, 7.5, and 10 phr. Morphology, thermal properties, and thermal degradation of aluminum (Al) film were investigated. The results show the amount of aluminum film in the LLDPE matrix slightly increased the melting point due to the effect of the third polymer component and the presence of aluminum particles in the blend. The melt flow index (MFI) of LLDPE containing aluminum film at 5, 7.5, and 10 phr showed significantly increasing notably due to the interference of molecular chain movement caused by aluminum particles, making it hardly to flow. Furthermore, phase separation of the polymer was observed after additional of aluminum film into LLDPE matrix. In addition, Mechanical properties results showed that the tensile strength and modulus decreased, but the elasticity increased because of composition of Al film label in LLDPE matrix as shown in stress-strain curve.

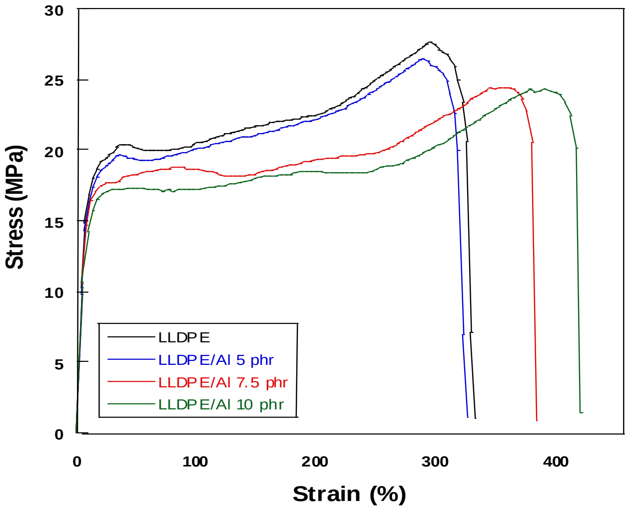


Fig. 1. Stress-strain curve of Al film/LLDPE composites.

Keywords: Linear low-density polyethylene; Metalized film; Thermal properties; Mechanical properties; Morphology

References

[1] Singh N, Hui D, Singh R, Ahuja IS, Feo L, Fraternali F. Recycling of plastic solid waste: A state of art review and future applications. **Composites Part B: Engineering** 2017; 115: 409-422.

[2] Hamad K, Kaseem M, Deri F. Recycling of waste from polymer materials: An overview of the recent works. **Polymer Degradation and Stability** 2013; 98(12): 2801-2812.

Oral **TIChE-SG-19**

Sustainable synthesis of monolaurin via esterification of lauric acid using TPA-modified biochar derived from coconut shells

Junyanat Woraphasphaiboon[1], Kanokwan Ngaosuwan[2,*], Suttichai Assabumrungrat[1,3]

[1] Center of Excellence on Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Chemical Engineering Division, Faculty of Engineering, Rajamangala University of Technology Krungthep, Bangkok 10120, Thailand
[3] Bio-Circular-Green economy Technology and Engineering Center (BCGeTEC), Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: kanokwan.n@mail.rmutk.ac.th

ABSTRACT

Monolaurin as a specified monoglyceride is widely used dietary supplement and emulsifier in food products. It can be produced via glycerol esterification of lauric acid [1]. The glycerol esterification required acid catalyst to accelerate the reaction rate. Therefore, this research proposed the heterogeneous acid catalyst, tungstophosphoric acid on the biochar derived from coconut shell (TPA/CCS). Biochar derived from coconut shell was synthesized by pyrolysis under N2 atmospheric at 600°C for 2 h. Then, 30 wt.% of TPA was loaded on the biochar as illustrated in Fig. 1. The surface morphology of TPA/CCS showed a smoother, more uniform pore structure compared to the CCS biochar, likely due to the sonication process during TPA loading. The reaction was performed at 130°C, with 3:1 glycerol to lauric acid ratio and 1.4 wt.% TPA/CSS loading. The highest lauric acid conversion of 72.9% and monolaurin yield of 49.1% were achieved in 4 h. This TPA/CCS showed great potential for monolaurin production. A similar catalytic activity for monolaurin production was observed for tungstophosphoric acid on magnesium-modified SBA-15 (TPA/MgSBA-15) catalyst [2]. Since, the total acidity of 2 mmol/g catalyst derived from TPA/CCS catalyst, which was higher than that of TPA/MgSBA-15 (1.12 mmol/g catalyst). This suggests that coconut shell biomass a promising sustainable and eco-friendly source produce an effective catalyst for monolaurin production. However, the optimum conditions in terms of glycerol to lauric acid molar ratio, reaction temperature and TPA/CSS loading should be further investigated as well as the reusability of this catalyst.

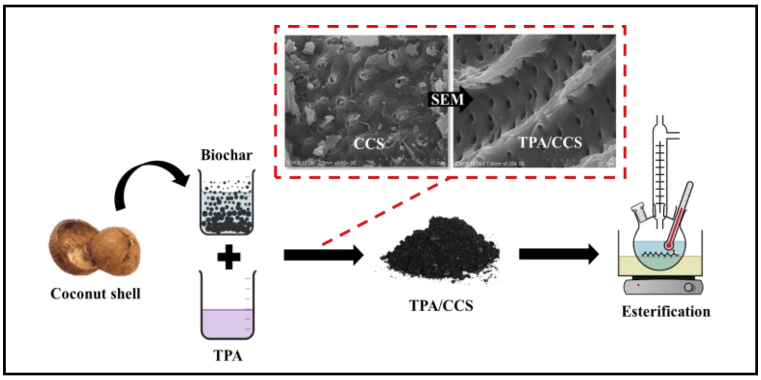


Fig. 1. Schematic diagram of catalyst synthesis and reaction process.

Keywords: Monolaurin; Coconut shell biochar; Tungstophosphoric acid (TPA); Lauric acid; glycerol

References

[1] Khandara U, Subbaramaiah V, Gosu V. Unlocking glycerol monolaurate potential: A comprehensive review of synthesis pathways, catalyst insights, and optimization strategies. **Chemical Engineering Journal** 2024; 488: 150938.

[2] Ooi SY, Hoo PY, Abdullah AZ, Enche Ab Rahim SK, Teoh YP, Shuit SH, Ng QH. Magnesium stabilized 12-tungstophosphoric acid impregnated SBA-15 for selective monolaurin production. **South African Journal of Chemical Engineering** 2022; 41: 51-64.

Oral **TIChE-SG-20**

Mineralization in monoethanolamine solution with calcium chloride solution

Ratipuk Chung-in[1,2], **Rungthiwa Methaapanon**[1,2,*]

[1] Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Center of Excellence in Particle and Material Processing Technology (CEPT), Faculty of Engineering,
Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: rungthiwa.m@chula.ac.th

ABSTRACT

Monoethanolamine (MEA)-based CO_2 capture has been a crucial technology widely applied to reduce CO_2 emissions released from various industries, due to its economic feasibility and high CO_2 absorption rate. However, high energy requirement during MEA regeneration at high temperatures is still a challenge. A potential alternative is to mineralize CO_2 into calcium carbonate ($CaCO_3$) at room temperature, a process which demands low energy and leads to lasting CO_2 storage. [1] In this work, we investigate the simultaneous absorption-mineralization (1 pot), and sequential absorption-mineralization (2 pots) processes, in comparison with direct mineralization with pure water. The highly soluble calcium chloride ($CaCl_2$) is introduced gradually during the operation [2, 3] while controlling the pH range appropriate to the rate of $CaCO_3$ formation. [4, 5] The effect of the MEA concentrations and pH change on $CaCO_3$ yield is investigated. The results showed that MEA in the solution assists in maintaining the pH in the appropriate range for mineralization compared to H2O. Absorption-mineralization in 1 pot occurs simultaneously, which keeps CO_2 concentration in the solution at a lower level, while maintaining the higher pH that is more appropriate for mineralization, when comparing to the 2-pot setup.

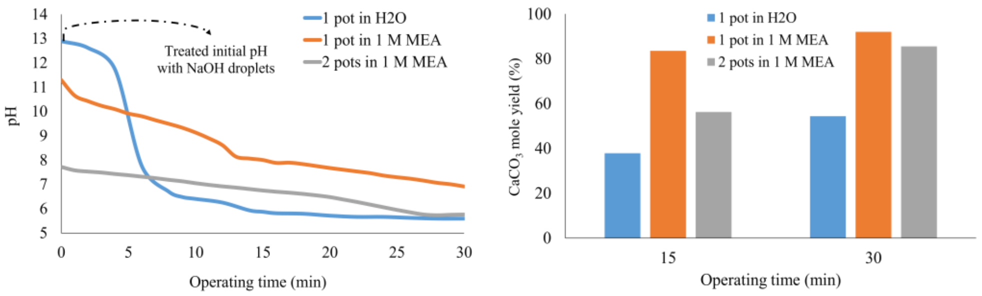


Fig. 1. Comparison of the pH change, and $CaCO_3$ mole yield between direct mineralization with pure water, simultaneous absorption-mineralization (1 pot), and sequential absorption-mineralization (2 pots).

Keywords: CO_2 capture; Mineralization; MEA; $CaCl_2$

References

[1] Zhang W, et al. Coupled CO_2 absorption and mineralization with low-concentration monoethanolamine. **Energy** 2022; 241: 122524.
[2] Arti M, et al. Single process for CO_2 capture and mineralization in various alkanolamines using calcium chloride. **Energy & Fuels** 2017; 31(1): 763-769.
[3] Velts O, et al. CO_2 mineral trapping: Modeling of calcium carbonate precipitation in a semi-batch reactor. **Energy Procedia** 2011; 4: 771-778.
[4] Ma Y, et al. Effects of pH and temperature on $CaCO_3$ crystallization in aqueous solution with water soluble matrix of pearls. **Journal of crystal Growth** 2010; 312(21): 3165-3170.
[5] Chang R, et al. Calcium carbonate precipitation for CO_2 storage and utilization: a review of the carbonate crystallization and polymorphism. **Frontiers in Energy Research** 2017; 5: 17.

Oral **TIChE-SG-21**

Enhancement of CO_2 capture performance of alcohols on MEA-IL-based biphasic solvents

Rimping Prathumpitak[1], **Pattaraporn Kim-Lohsoontorn**[1,2,*]

[1] Center of Excellence on Catalysis and Catalytic Reaction Engineering, Department of Chemical Engineering,
Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[2] Bio-Circular-Green Economy Technology & Engineering Center, BCGeTEC, Faculty of Engineering,
Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: Pattaraporn.K@chula.ac.th

ABSTRACT

CO_2 capture using 30%wt monoethanolamine (MEA) as an absorbent is a common method for CO_2 absorption. MEA has high reactivity with CO_2; however, amine aqueous solutions still have drawbacks such as high regeneration energy consumption, loss of the reactive amine, and equipment corrosion [1]. In this research, the CO_2 capture performance of MEA-IL-based was enhanced by incorporating alcohol to form a MEA/[bmim][Tf2N] /alcohol biphasic system, reducing the stripping volume and regeneration energy consumption [2]. Herein, the CO_2 absorption behavior was analyzed using a CO_2 sensor and the Chittick titration method. The phase separation of MEA/[bmim][Tf2N] with different types of alcohol (methanol, ethanol, propanol, butanol, pentanol and hexanol) was investigated. Only the systems containing butanol, pentanol, and hexanol exhibited the phase separation. In addition, the phases of MEA/10%wt [bmim][Tf2N]/1-hexanol were separated into three phases: upper phase, lower phase, and lower lower phase while the other alcohol system were separated into two phases. The 13C-NMR analysis (Fig. 1.) confirmed that the absorption product occurred, the carbamate of MEA accumulated in lower phase then only this phase was isolated for regeneration. Moreover, the volume of lower phase of the MEA/10%wt [bmim][Tf2N]/1-hexanol (19.8% of the total volume) was lower than the MEA/10%wt [bmim][Tf2N]/1-butanol (23.0% of the total volume). Therefore, the MEA/10%wt [bmim][Tf2N]/1-hexanol biphasic system was expected to enhance the CO_2 capture performance while the reducing regeneration energy consumption.

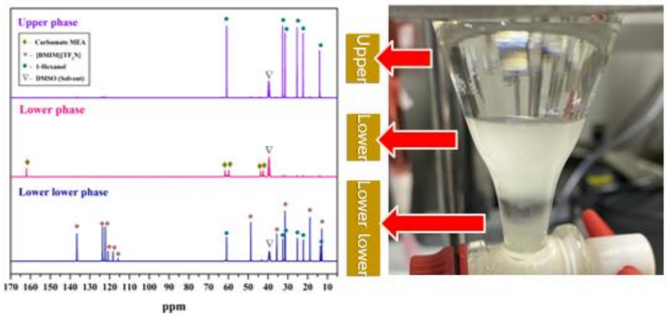


Fig. 1. C-NMR patterns of three phases in MEA/10%wt-[BMIM][TF2N]/1-hexanol after CO_2 absorption.

Keywords: CO_2 capture; Biphasic solvent; Ionic liquid; Nonaqueous absorbents; Phase separation

References

[1] Yang L, Chen J, Ma N, Li X, Huang Z. CO_2 absorption enhancement of fluorinated ionic liquids on nonaqueous biphasic absorbents: Experimental and theoretical study. **Carbon Capture Science & Technology** 2023; 9: 100147.

[2] Hira U, Kamal A, Tahir J. Chapter 11 - Industrial carbon dioxide capture and utilization. **Green Sustainable Process for Chemical and Environmental Engineering and Science** 2023: 231-278.

Poster **TIChE-SG-22**

Accelerated aging testing of three types of transformer oils in 1 phase distribution transformer

Bowornchai Chareonteraboon[1], **Boonyawan yoosuk**[1,*], **Sittikorn Lapapong**[2], **Supakit Chotigo**[3],
Suthisak Sitthichokchai[1,3], **Pathompong Janetaisong**[1]

[1] National Energy Technology Center (ENTEC), National Science and Technology Development Agency,
Pathum Thani 12120, Thailand
[2] National metals and material Technology Center (MTEC), National Science and Technology Development Agency,
Pathum Thani 12120, Thailand
[3] Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi,
Bangkok 10140, Thailand
[*] Corresponding author: boonyawan.yoo@entec.or.th

ABSTRACT

Entec Palm-based Transformer oil (EnPAT) is a less flammable bio-based transformer oil derived from palm oil developed by National Energy Technology Center (ENTEC). Compared to conventional mineral oil, EnPAT exhibits superior characteristics, including fire point above 300 °C and biodegradable. This study determines the thermal and oxidative degradation of transformer insulation oils of three transformer oils: EnPAT, imported bio bio-based transformer oil, and mineral oil. Using a 6 kVA, 20 kV/220 V transformer as a testing chamber, accelerated aging tests were performed following IEC 60076-7 (2018) standards to simulate 70% expected lifespan of transformer [1]. The duration of testing was 34-46 days. F2 monitored through dissolved gas analysis (DGA), furan concentration measurements, and the degree of polymerization (DP) of the cellulose-based paper insulation. Results revealed that mineral oil suffered harsh degradation (DP <200; 2-furaldehyde $>1{,}280$ ppb), while both EnPAT and imported oil-maintained DP values above 400 with furan levels between 250 and 600 ppb, indicating significantly enhanced chemical stability. The estimated degree of polymerization can be determined using 2-furaldehyde concentration with the Chendong equation [2]. The status of degradation was evaluated by Double Engineering Company, and the results are shown in Table 1. The results confirm that EnPAT provides insulation paper protection comparable to imported bio bio-based transformer oil, as evidenced by DP and 2-Furaldehyde analysis, while exhibiting superior performance over conventional mineral oil.

Table 1 Degree of polymerization and 2-furaldehyde concentration in mineral oil, imported transformer oil, and EnPAT after testing.

Oil type	Degree of Polymerization (DP)		Estimated degree of Polymerization (DP value from FURAN analysis)*	2-Furaldehyde (ppb)	Status**
	Type of insulation paper				
	0.18 mm. diamond dot	0.5 mm.			
Before	976	1,086	-	0	-
EnPAT	915	452	606.97	243	Good condition
Imported bio bio-based transformer oil	945	493	500.74	572	Mildlife
Mineral oil	875	356	380.87	1,503	Last third of life

Keywords: Mineral oil; Bio-based transformer oil; Transformer oil; Degree of polymerization (DP)

References

[1] IEC Power transformers – Part 7: **Loading guide for mineral-oil-immersed power transformers**, IEC 60076-7-2018 (Revision of IEC60076-7-2005).

[2] Chendong X, Xue C.D. Monitoring paper insulation aging by measuring furfural contents in oil. In: **7th international symposium on high voltage engineering** 1991; 139-142.

Oral **TIChE-SG-23**

Development of Fibroin-based solid electrolyte for electrochromic windows

Akarawin Pimarnthisakorn[1,2], **Anan Junsukhon**[1,2], **Pailin ngaotrakanwiwat**[1,3,*]

[1] Department of Chemical Engineering, Center of Excellence on Petrochemicals and Materials Technology,
Faculty of Engineering, Burapha University, Chonburi 20131, Thailand
[2] Research Unit of Developing Technology and Innovation of Alternative Energy for Industries, Burapha University,
Chonburi 20131, Thailand
[3] Interdisciplinary Center for Decarbonisation and Green Energy, Faculty of Engineering, Burapha University,
Chonburi 20131, Thailand
[*] Corresponding author: pailin@eng.buu.ac.th

ABSTRACT

The electrochromic window is a promising technology for addressing the energy consumption for thermal comfort in glass buildings. However, the leakage of liquid electrolytes in the electrochromic window draws back the electrochromic windows application. Solid polymer electrolytes have been synthesized to address this issue; nevertheless, they generally exhibit lower ionic conductivity than liquid electrolytes [1]. The fibroin-based solid electrolyte has been investigated as an environmental concern and the reduction of petroleum-based solid electrolytes. This study investigated the effects of the thickness of the electrolyte (7-27 µm) and lithium salt concentration (7.25–21.75 wt%) on the ionic conductivity; consequently, the electrochromic window's optical density and coloration efficiency were examined. Moreover, ATR-FTIR and UV-Vis spectrophotometers characterized the change in the secondary structure of silk fibroin and the light transmission caused by the addition of lithium salt and thickness. The results exhibited that the highest ionic conductivity of 0.4 mS/cm, achieved in the electrolyte containing lithium salt 14.5%wt with a thickness of 10 ± 1 µm, was 3.3 times lower than the liquid electrolyte, as illustrated in Fig. 1. Furthermore, the optimal electrolyte was assembled into the electrochromic window consisting of WO_3 and NiO-based electrodes. After the applied potential of -3.0 V, the transmittance of visible and NIR light decreased from 74.15% to 3.20% and from 74.22% to 3.04%, resulting in the coloration efficiency of 93.58 and 126.73 cm^2/C, respectively.

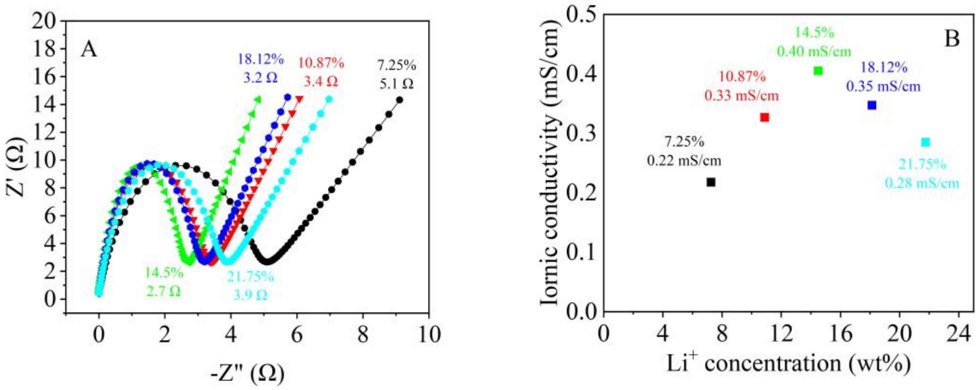


Fig. 1. Ionic conductivity of fibroin-based solid electrolyte: (A) Nyquist plots and (B) effect of Li^+ concentration on ionic conductivity of fibroin electrolyte.

Keywords: Fibroin; Solid electrolyte; Ionic conductivity; Electrochromic window

References

[1] Zhang, Z, Wang, X, Li, X, Zhao, J, Liu, G, Yu, W, et al. Review on composite solid electrolytes for solid-state lithium-ion batteries. **Materials today sustainability** 2023; 21: 100316.

Development and characterization of Bioplastic from banana peel and Chitosan: A Sustainable alternative for eco-friendly packaging

Ulia Fitrass[1,*], **Sandhya Babel**[1]

[1] Sirindhorn International Institute of Technology, Thammasat University, Pathum Thani 12120, Thailand
[*] Corresponding author: ulia.fitrass@gmail.com

ABSTRACT

Plastic waste pollution has become a significant environmental challenge, thus development of sustainable and biodegradable alternatives from waste materials are important. This study focuses on the development of bioplastic using banana peel as the primary material, chitosan as a filler, and glycerol from waste cooking oil as a plasticizer. The objective was to enhance the mechanical properties of bioplastic by incorporating chitosan extracted from crustacean shells through a green extraction process, including demineralization with citric acid, deproteinization using bromelain from pineapple peel, and deacetylation with avocado seed extract. Bioplastic films were formulated with 2% chitosan and characterized for tensile strength and modulus young. Results showed that that using the waste materials, bioplastic was synthesized successfully. Bioplastic with 0% and 2% chitosan have tensile strength of 0.513 MPa and 0.247 MPa, and Young's modulus of 138 MPa and 49.8 MPa, demonstrating improved flexibility but not strong compared to unmodified banana peel bioplastic. The addition of chitosan contributed to better structural reinforcement, making the material more durable and adaptable for practical applications. This study confirms that bioplastic from banana peel and chitosan have significant potential for biodegradable packaging applications. The findings contribute to the advancement of biopolymer-based materials, supporting global efforts to reduce plastic waste and promote environmentally friendly solutions.

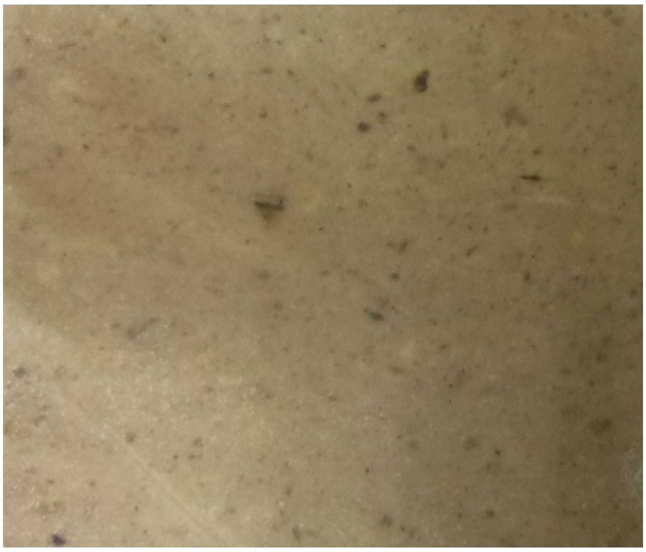


Fig. 1. Bioplastic from banana peel with chitosan 2%.

Keywords: Bioplastic; Banana peel; Chitosan; Mechanical properties

Poster **TIChE-SG-25**

Potential desalination using EDTA modified MOF

Nattawut Krasaesueb[1], **Suda Ittisupornrat**[1,*], **Nuttawan Prasongthum**[2]

[1] Climate change and Environmental Research Center, Pathum Thani 12120, Thailand
[2] Physics, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand
[*] Corresponding author: suwimolteam@yahoo.com

ABSTRACT

The global water shortage crisis, intensified by climate change, has emerged as a critical environmental challenge, with seawater intrusion contributing to saline water contamination. Among various desalination methods, adsorption offers advantages such as energy efficiency, low cost, and ease of operation. The adsorbent has been synthesized by immobilization of ethylenediaminetetraacetic acid (EDTA) into the pores of the Fe-Al-based metal organic framework (MIL-53 (Fe-Al). An EDTA-based MOF was evaluated for its desalination efficiency in batch experiments. The results demonstrated over 50% salt removal from water with an initial salinity of 1.1 ppt within 18 hours. This research highlights the potential of MOFs as green adsorbents for water desalination, contributing to mitigation of climate change impact. Method: MIL-53(Fe, Al) was synthesized using terephthalic acid (TPA), following solvothermal method [1]. The synthesis process is illustrated in Fig. 1. MIL-53(Fe, Al)-EDTA was prepared and batch adsorption test following to [2]. Results: SEM analysis revealed that MIL-53(Fe, Al) exhibited spherical and ellipsoidal morphologies with an average particle size of 105 nm. The BET surface area was 834.4 m^2/g, with a pore volume of 0.711 cm^3/g and an average pore size of 10.4 nm. The salt removal performance showed salinity level decreased from 1.1 ppt to 0.5 ppt within 18 h with initial NaCl concentration 10,000 ppm. Conclusions: This study demonstrates the potential desalination of MIL-53(Fe, Al) performance. The continuous test and long-term stability for enhancing capacity of desalination are needed for further study.

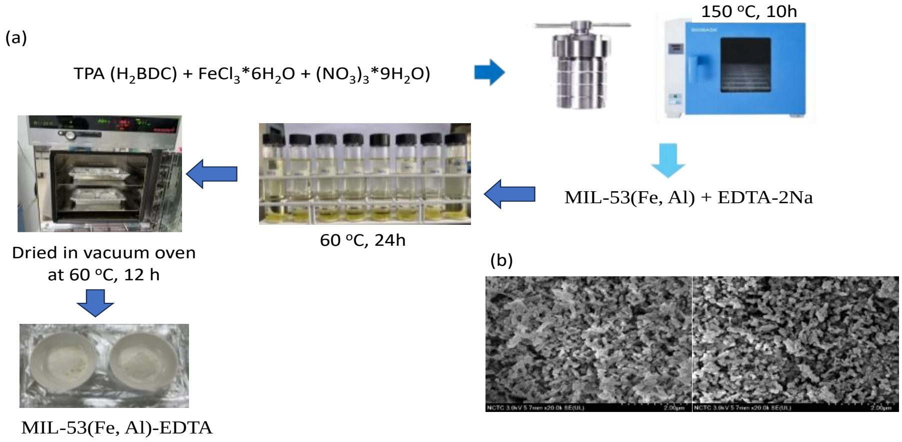


Fig 1. (a) Synthesis of MIL-53 (Fe, Al) and (b) SEM of MIL-53(Fe, Al)

Keywords: Metal-organic frameworks; Terephthalic acid; Desalination

References

[1] Chen, X, Liu, X, Zhu, L, Tao, X, Wang, X. One-step fabrication of novel MIL-53(Fe,Al) for synergistic adsorption-photocatalytic degradation of tetracycline. **Chemosphere** 2022; 291; 133032.

[2] Ji, C, Yu, H, Lu, J. Ren, Y, Lv, L, Zhang, W. High-efficiency and sustainable desalination using thermos-regenerable MOF-808-EDTA: temperature-regulated proton transfer. **ACS Applied Materials & Interfaces** 2021; 13: 23833-23842.

Poster **TIChE-SG-26**

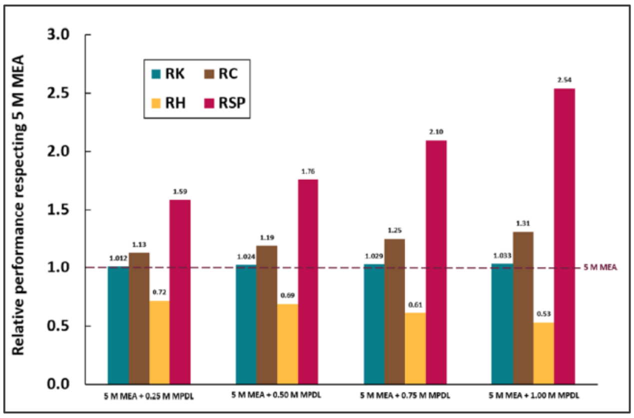
Performance assessment of Monoethanolamine and *N*-Methyl-4-Piperidinol blended solvent for enhancing physical properties, kinetics, absorption capacity, and regeneration heat duty

Rattanaporn Apaiyakul[1], **Paitoon Tontiwachwuthikul**[2], **Axel Misen**[3], **Teerawat Sema**[4,*]

[1] Petrochemistry and Polymer Science Program, Faculty of Science, Chulalongkorn University,
Bangkok 10330, Thailand
[2] Faculty of Engineering and Applied Science, University of Regina, Regina, SK S4S 0A2, Canada
[3] Faculty of Engineering, University of British Columbia, Canada
[4] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: teerawat.se@chula.ac.th

ABSTRACT

In this study, the high potential tertiary N-methyl-4-piperidinol or MPDL (0.25–1.00 M) was blended with 5 M monoethanolamine (MEA) to formulate 5.25–6.00 M MEA-MPDL solvent and compare with the benchmark 5 M MEA. It was found that the density and the Henry's constant slightly decreased, while the viscosity increased as the MPDL concentration in the blend increased. Even though the equilibrium CO_2-loaded viscosity considerably increased (by 34.3–40.2%) as the MPDL content increased, it was still in a great operating region of less than 10 mPa.s. Interestingly, an addition of MPDL into 5 M MEA slightly enhanced overall reaction kinetics constant (kov) (1.2–3.3% increment) and considerably favored absorption capacity (13–31% elevation), and regeneration heat duty (28–47% reduction), respecting 5 M MEA. The proposed strategic blending can maintain the overall solvent reactivity at the same level of the benchmark, while obviously increase the absorption capacity and largely reduce the regeneration heat duty. This highly favors a solvent upgrading for the existing 5 M MEA based CO_2 capture plant. According to the recent data, 5 M MEA + 1.00 M MPDL was suggested. Since the blend was formulated at high concentration, its corrosiveness should also be considered.



🟦 RK = Relative overall kinetics constant
🟫 RC = Relative absorption capacity
🟨 RH = Relative solvent regeneration heat duty
🟥 RSP = Relative solvent performance

Fig 1. Relative performance of MEA-MPDL solvent respecting that of 5 M MEA.

Keywords: Amine; Carbon capture; Carbon dioxide (CO_2); Absorption capacity; Regeneration

References

[1] Xiao M, Cui D, Liu H, Tontiwachwuthikul P, Liang Z. A new model for correlation and prediction of equilibrium CO_2 solubility in N-methyl-4-piperidinol solvent. **AIChE Journal** 2017; 63(8): 3395–3403.
[2] Sema T, Khuenkaew W, Sirirathomsud O. Kinetics of CO_2 absorption in novel tertiary *N*-methyl-4-piperidinol solvent. **International Journal of Greenhouse Gas Control** 2019; 90: 102796.

Poster **TIChE-SG-27**

Synthesis and scale-up of MOF using PET-derived Terephthalic acid

Natthawan Prasongthum[1,*], **Suda Ittisupornrat**[2], **Nuttawut Krasaesube**[2]

[1] Physics, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand
[2] Climate change and Environmental Research Center, Pathum Thani 12120, Thailand
[*] Corresponding author: natpra@kku.ac.th

ABSTRACT

The growing accumulation of plastic waste has prompted efforts to repurpose it in high-value applications, such as the synthesis of metal-organic frameworks (MOFs), to foster sustainability and waste valorization. This study explores the synthesis and scale-up production of MIL-53 using terephthalic acid derived from PET hydrolysis. The optimized synthesis conditions involved reaction times of 5, 10, and 15 h at 150°C. Structural and morphological characteristics of the synthesized MIL-53(Fe) and MIL-53(Fe, Al) were analyzed via SEM, XRD, and BET. The results demonstrated successful synthesis and scale-up of MIL-53(Fe, Al), maintaining its structural integrity and performance, highlighting its potential for industrial applications like gas separation and desalination. Method: MIL-53(Fe) and MIL-53(Fe, Al) were synthesized using both commercial terephthalic acid (TPA) and terephthalic acid derived from PET hydrolysis, following methods outlined in our previous work [1]. The synthesis process is illustrated in Fig. 1. Results: SEM analysis revealed that MIL-53(Fe) and MIL-53(Fe, Al) synthesized from PET-derived terephthalic acid exhibited spherical and ellipsoidal morphologies, similar to those from commercial TPA, with an average particle size of 105 nm. Scale-up synthesis at five times the original batch size resulted in MIL-53(Fe) with hexagonal crystal morphology and an average particle size of 725 nm, closely matching lab-scale samples. The BET surface area was 1015.3 m^2/g, with a pore volume of 0.714 cm^3/g and an average pore size of 9.0 nm. Conclusions: This study demonstrates the successful synthesis and scale-up of MIL-53(Fe, Al) from PET-derived terephthalic acid, maintaining its structural integrity and performance. The findings highlight the potential for utilizing plastic waste in producing high-value materials, offering promising applications in gas separation and desalination.

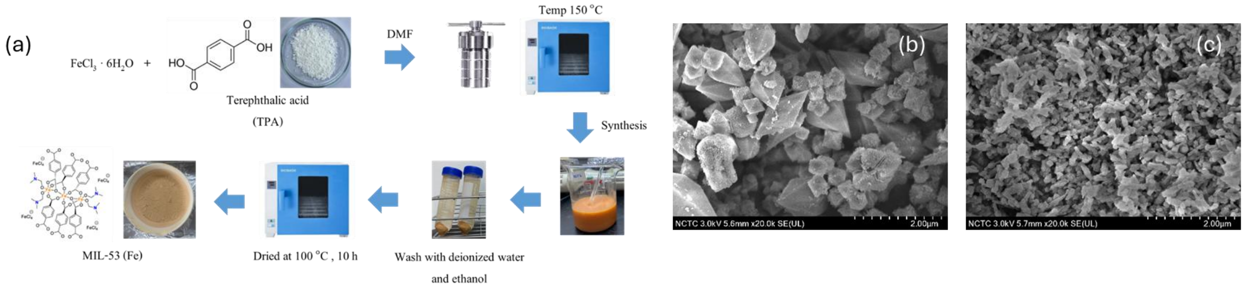


Fig 1. (a) Synthesis method of MIF-53 and SEM of (b) MIL-53(Fe) and MIL-53(Fe, Al).

Keywords: Metal-organic frameworks; Polyethylene terephthalate; Recycling; Terephthalic acid

References

[1] Prasongthum N, Khoduangklang N, Janna K, Suemanotham A, Attanatho L, Reubroycharoen P, et al. Chemical Recycling of Waste PET into Terephthalic Acid by Alkaline Hydrolysis, **The 33rd Thai Institute of Chemical Engineering and Applied Chemistry International Conference TIChE2024**, Phra Nakhon Si Ayutthaya, Thailand, March 7-8, 2024.

Oral TIChE-SG-28

Effect of co-solvents on the oxidative cleavage of oleic acid under ambient pressure

Chakreeya Santhadklang[1], **Varong Pavarajarn**[1,*]

[1] Center of Excellence in Particle and Materials Processing Technology, Department of Chemical Engineering, Faculty of Engineering, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: varong.p@chula.ac.th

ABSTRACT

Pelargonic acid (PA) and azelaic acid (AA) are valuable medium-chain fatty acids (MCFAs) with limited natural availability. Accordingly, efficient synthetic methods for their production are highly desirable for industrial applications [1]. The oxidative cleavage of oleic acid using hydrogen peroxide (H_2O_2) as an oxidizing agent and tungsten oxide (WO_3) as a catalyst is a well-established approach for producing PA and AA. The choice of co-solvent plays a crucial role in enhancing solubility between oleic acid and H_2O_2, which directly affects conversion and yield [2]. The most common co-solvent that has been studied is tert-butanol, but the reaction must be conducted under autogenous pressure because of its relatively low boiling point. Finding co-solvent that could be operated under ambient pressure is the main objective of this study. Fig. 1 shows the overview of this work. This study investigates the oxidative cleavage of oleic acid at 80 °C and 100 °C for 6 hours under ambient pressure, using tert-butanol, isobutyric acid, and ethyl lactate as co-solvents. The reaction intermediates and products were analyzed by GC-FID and GC-MS. The results demonstrated that oleic acid conversion exceeded 97% under all conditions. At 80 °C, tert-butanol provided the highest yield of PA and AA, while at 100 °C, isobutyric acid was the most effective co-solvent. These results emphasize the potential of oxidative cleavage under ambient pressure, which offers advantages in terms of cost reduction, process simplification, and enhanced safety for industrial applications.

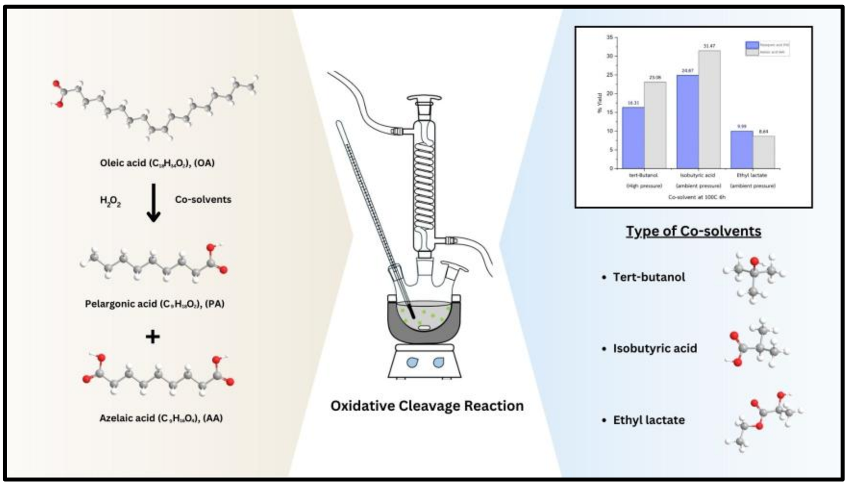


Fig. 1. Overview of oxidative cleavage reaction for converting oleic acid to pelargonic acid and azelaic acid.

Keywords: Oleic acid; Oxidative cleavage; Pelargonic acid; Azelaic acid

References

[1] St-Onge M P, Jones P J H. Physiological effects of medium-chain triglycerides: potential agents in the prevention of obesity. **The Journal of Nutrition** 2002; 132(3): 329-332.
[2] Dyson PJ, Jessop PG. Solvent effects in catalysis: rational improvements of catalysts via manipulation of solvent interactions. **Catalysis Science & Technology** 2016; 6(10): 3302-3316.

Poster **TIChE-SG-29**

Demonstration of zeolite a produced from coal ash applied to CO_2 capture process for amine regeneration approach

Punyaporn Khamdaeng[1], Tosporn Phetyim[1], Natthawan Prasongthum[2], Siriporn Tong-on[3], Wanchana Sisuthog, Amornrat Suemanotham[1], Lalita Attanatho[1], Yoothana Thanmongkhon[1,*]

[1] Expert Centre of Innovative Clean Energy and Environment, Thailand Institute of Scientific and Technological Research (TISTR), Pathum Thani 12120, Thailand
[2] Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand
[3] Expert Centre of Innovative Materials, Thailand Institute of Scientific and Technological Research (TISTR), Pathum Thani 12120, Thailand
[*] Corresponding author: yoothana_t@tistr.or.th

ABSTRACT

The disposal of coal fly ash, a byproduct of coal-fired power plants, presents significant environmental challenges due to its abundance and the costs associated with its removal. However, coal fly ash can be repurposed for more beneficial applications, particularly in the production of construction materials. Additionally, its low price and wide availability make it an attractive resource for other innovative uses. One such application is the synthesis of zeolite A, a high-value material with diverse industrial applications, which can be derived from coal fly ash following circular economy aspects. In this study, zeolite A was synthesized from coal fly ash via a hydrothermal process using a 1-liter electric autoclave at 80°C for 16 hours as seen in Fig. 1(a). The yield of zeolite A was approximately 58-62% by weight. Characterization of the synthesized zeolite revealed its high acidity, a property that can enhance CO_2 release during amine solution regeneration in CO_2 capture processes, 15% by volume of mixed gas. To assess its performance, the prepared zeolite was tested using 5 molar of MEA for regeneration, at 100°C, in a CO_2 capture demonstration unit, as shown in Fig. 1(b). The results illustrated that the zeolite A derived from coal fly ash crucially improved CO_2 desorption, indicating its potential to enhance the efficiency of CCUS technologies by reducing about 30% of energy consumption in desorption step compared to no zeolite application. The performance of synthesized zeolite is similar to the commercial one. This study hints that fly ash-derived zeolite A can be an effective and sustainable material for advancing CO_2 mitigation efforts, offering both environmental and economic benefits.

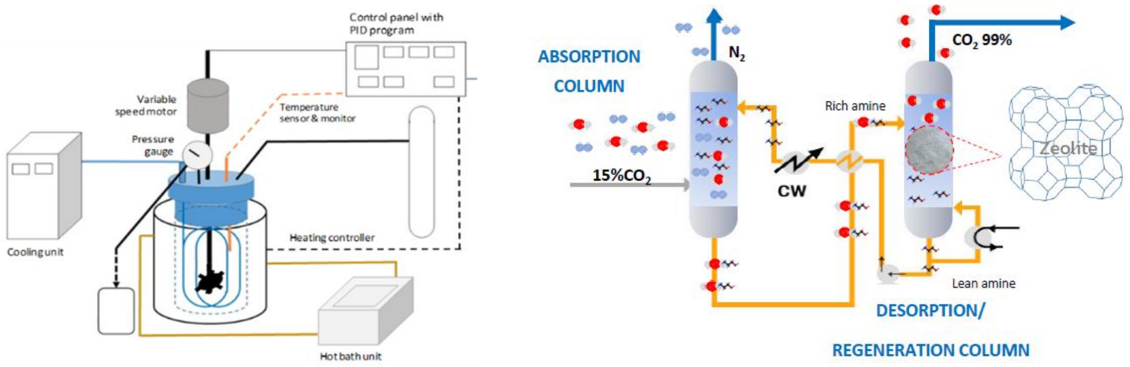


Fig. 1. (a) Hydrothermal reaction using an electric autoclave, (b) CO_2 capture demonstration unit.

Keywords: CO_2 capture; Coal fly ash; Hydrothermal; Zeolite A; Circular economy

Oral TIChE-SG-30

Synthesis of monolaurin through glycerol esterification with lauric acid using 12-tungstophosphoric acid

Kanchisa Chandit[1], Puttiporn Thiamsinsangwon[1,*], Kanokwan Kantheing[1], Kittitep Suebpeng[1], Weerinda Mens[1,*]

[1] Department of Chemical and Materials Engineering, Faculty of Engineering, Rajamangala University of Technology Thanyaburi, Pathum Thani 12110, Thailand
[*] Corresponding author: puttiporn_t@rmutt.ac.th

ABSTRACT

Glycerol, a by-product from biodiesel production, can be used as a precursor for the production of chemicals such as monolaurin which is widely used in food, cosmetic and pharmaceutical industries. This study focuses the production of monolaurin through the esterification of glycerol and lauric acid using 12-tungstophosphoric acid (TPA) as a catalyst. The effects of operating parameters, including molar ratio, reaction temperature and reaction time were investigated to optimize monolaurin production. The results revealed that the optimal conditions for monolaurin production were achieved at a molar ratio of 1:2, reaction temperature of 150°C and reaction time of 60 min, resulting in a lauric acid conversion of 78.1%. The study confirms that the molar ratio, reaction time, and temperature significantly influence the glycerolysis reaction efficiency.

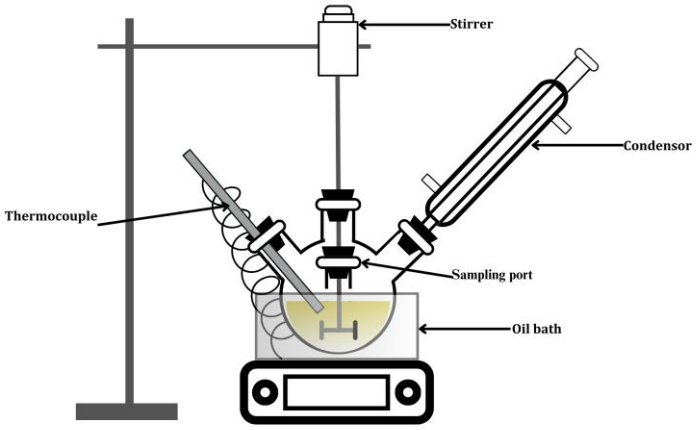


Fig. 1. Scheme of the installation used for the synthesis monolaurin.

Keywords: Esterification; Glycerol; Lauric acid; Monolaurin; 12-Tungstophosphoric Acid (TPA)

Poster **TIChE-SG-31**

Life cycle assessment of CO_2-to-methanol: A comparative study of conventional and alcohol-assisted hydrogenation processes

Naphat Chansonthi[1], **Chayet Worathitanon**[1], **Viganda Varabuntoonvit**[1,2,*], **Pawat Pinthong**[1]

[1] Chemical Engineering Department, Kasetsart University, Bangkok 10900, Thailand
[2] The Center of Excellence on Petrochemical and Materials Technology, Chulalongkorn University,
Bangkok 10330, Thailand
[*] Corresponding author: fengvgv@ku.th

ABSTRACT

The increasing severity of global warming, driven by greenhouse gas emissions, highlights the need for CO_2 reduction and utilization. One promising approach is the conversion of CO_2 into methanol, which can be used as both a fuel and a feedstock in various industries. This study evaluates the life cycle environmental impact and economic feasibility of three methanol production processes: (1) conventional hydrogenation, (2) alcohol-assisted hydrogenation using ethanol, and (3) alcohol-assisted hydrogenation using propanol. A process simulation was developed using Aspen Plus V.14, and data from the simulation model, including mass and energy balances, feedstock consumption, and pollutant emissions, were analyzed through Life Cycle Assessment (LCA). The assessment applied the ReCiPe 2016 midpoint (H) impact method under a cradle-to-gate approach for 1,000 kg of methanol. Additionally, an economic evaluation was conducted for each process. The results indicate that alcohol-assisted processes operate at a lower reaction temperature (150°C) than the conventional process (250°C); however, methanol purification requires significant energy consumption. The environmental impact assessment shows that the propanol-assisted process has the highest global warming potential, followed by the ethanol-assisted process, while the conventional process has the lowest emissions. The high environmental impact of the propanol-assisted process is attributed to its high feedstock consumption, energy demand, and pollutant emissions, particularly Propyl Propionate, which requires complex treatment. From an economic perspective, the conventional process is the most cost-effective, whereas the propanol-assisted process incurs the highest costs, with the ethanol-assisted process being the second most expensive. These findings could be used to assess the trade-offs between environmental and economic performance in CO_2-to-methanol conversion technologies.

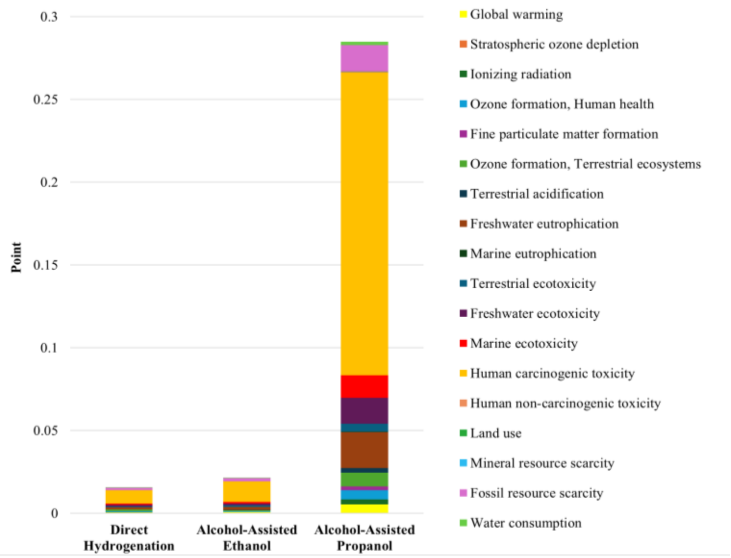


Fig 1. Total normalization results.

Keywords: Methanol production; Alcohol-assisted CO_2 Hydrogenation; Life cycle assessment; Global warming; Economic feasibility

References

[1] Khunathorncharoenwong N, Charoensuppanimit P, Assabumrungrat S, Kim-Lohsoontorn P. Techno-economic analysis of alternative processes for alcohol-assisted methanol synthesis from carbon dioxide and hydrogen. **International Journal of Hydrogen Energy** 2021; 46(48): 24591-24606.

[2] Meesattham S, Kim-Lohsoontorn P. Low-temperature alcohol-assisted methanol synthesis from CO_2 and H_2: The effect of alcohol type. **International Journal of Hydrogen Energy** 2022; 47(54): 22691-22703.

Oral **TIChE-SG-32**

Development of internally circulating fluidized bed reactor performance for enhancing direct air CO_2 capture

Munyapa Limahksohn[1], **Chatiya Tripoonsuk**[1], **Benjapon Chalermsinsuwan**[1,2,3], **Pornpote Piumsomboon**[1,2,3,*]

[1] Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Center of Excellence on Petrochemical and Materials Technology, Chulalongkorn University, Bangkok 10330, Thailand
[3] Advanced Computational Fluid Dynamics Research Unit, Chulalongkorn University, Bangkok 10330, Thailand
[*] Corresponding author: pornpote.p@chula.ac.th

ABSTRACT

Climate change, mainly driven by greenhouse gas emissions such as carbon dioxide (CO_2), poses a critical challenge to global environmental stability. CO_2 capture technologies play a vital role in achieving this goal. Recently, several carbon capture technologies have been proposed. Among them, the gaseous-solid adsorption is a promising alternative. In this research, the internally circulating fluidized bed (ICFB) reactor, combining CO_2 adsorption and sorbent regeneration processes in a single unit, was chosen for the direct air CO_2 capture process due to its compact configuration. This study is operated by using alumina as a solid sorbent and focuses on determining the proper operating regeneration conditions to achieve the best performance of the ICFB system. Since CO_2 desorption is an endothermic process, heating is necessary to improve solid sorbent regeneration and system efficiency. Three key parameters of the process operation were investigated. These are the regeneration temperature, gas velocity in the downer, and heater placement in the downer. Results reveal that the ICFB system can operate continuously. Both downer temperature and heating location consequently have an impact on overall CO_2 capture performance. Under room-temperature adsorption, CO_2 concentration initially drops sharply before gradually increasing and stabilizing. With heat-assisted regeneration, CO_2 concentration in the riser remains lower than the inlet concentration by 30% when the system reaches a steady state, improving adsorption performance. However, excessively high regeneration temperatures negatively impact adsorption. The findings highlight the importance of thermal management in the downer and offer practical insights for optimizing ICFB reactor configurations.

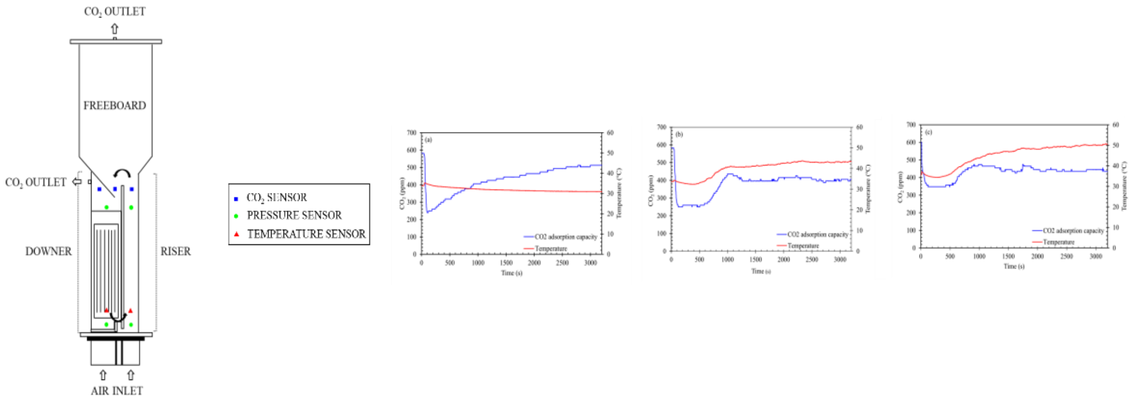


Fig. 1. Schematic diagram of the ICFB reactor and temperature profile (red) and CO_2 concentration (blue) in the riser (a) without thermal regeneration, (b) 80°C regeneration temperature, and (c) 100°C regeneration temperature.

Keywords: Internally circulating fluidized bed reactor; Direct air CO_2 capture; CO_2 adsorption; Heat regeneration

References

[1] Won Y, Kim JY, Park YC, Yi CK, Nam H, Woo JM, et al. Post-combustion CO_2 capture process in a circulated fluidized bed reactor using 200 kg potassium-based sorbent: The optimization of regeneration condition. **Energy** 2020; 208: 118188.

Poster **TIChE-SG-33**

Valorization of mung bean seed coat through recovery of bioactive compounds with pharmacological properties using Percolation extraction

Suthiwat Srinuch[1] , Preuk Tangpromphan[1,2*]

[1] Department of Chemical Engineering. Faculty of Engineering, Kasetsart University, Bangkok 10900 Thailand
[2] Center for High-Value Products from Bioresources: HVPB. Faculty of Engineering, Kasetsart University, Bangkok 10900 Thailand
[*] Corresponding author: fengpet@ku.ac.th

ABSTRACT

Mung bean seed coat (MBC) is an agricultural waste from the milling process and is recognized as a source of beneficial bioactive compounds, such as vitexin and iso-vitexin, which have pharmacological properties, including anti-cancer and antioxidant effects [1]. This study aimed to identify the optimal extraction conditions for MBC to achieve the highest yield of MBC extract (vitexin plus iso-vitexin) using the percolation extraction method. The extraction was carried out in a jacketed cylindrical glass column, with MBC packed in the inner tube and water circulating in the outer tube. The extracting solvent was delivered to the packed bed using a syringe pump. Factors investigated included extraction temperatures of 40, 60, and 80 degrees Celsius, and solvent concentrations of 30, 50, and 70 percent v/v acetonitrile. Samples from the extraction columns were analyzed at various time intervals using HPLC. The experimental results showed that the highest total yield, obtained within 15 minutes under conditions of 60°C and 50% v/v acetonitrile, was 190.76 mg of MBC extract per gram of dried MBC, which is within close range reported in the literature (approximately 151.74 mg/g) [2]. The results are illustrated in Fig. 1. The explanation is that higher temperatures enhanced the solubility of the bioactive compounds in the solvent. The 50% v/v acetonitrile concentration was found to be optimal for the polarity of the target compounds. This finding highlights an effective method for recovering bioactive compounds from MBC in a time-efficient manner. Additionally, the MBC extract obtained was suitable for further purification of vitexin and iso-vitexin.

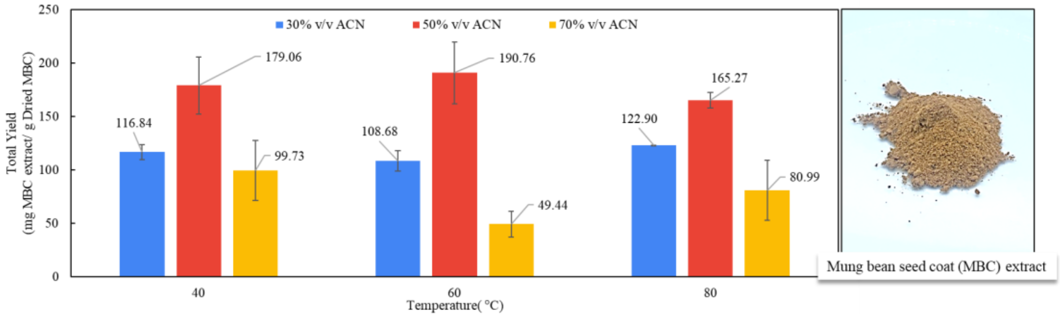


Fig 1. Total yield of MBC extract at various extraction temperatures and solvent concentrations.

Keywords: Mung bean seed coat; Extraction; Percolation; Vitexin; Iso-vitexin

References

[1] Maneewan S, Tangpromphan T, Jaree A. Separation of vitexin and iso-vitexin from mung bean seed coats using a three-zone simulated moving bed (SMB). **Waste and Biomass Valorization** 2021; 12: 6601-6618.

[2] Supasatyankul B, Saisriyoot M, Klinkesorn U, Rattanaporn K, Sae-Tan S. extraction of phenolic and flavonoid compounds from mung bean (*Vigna radiata* L.) seed coat by pressurized liquid extraction. **Molecules** 2022; 27(7): 2085.

Oral TIChE-SG-34

In Situ thermal solvent-free synthesis of zeolitic imidazolate frameworks with high crystallinity and porosity for effective adsorption and catalytic applications

Jichao Wang[2] , Somboon Chaemchuen[1,2*]

[1] Department of Chemical Engineering, Faculty of Engineering, Mahidol University, Nakorn Pathom 73170, Thailand
[2] State Key Laboratory of Advanced Technology for Materials Synthesis and Processing, Wuhan University of Technology, Wuhan 430070, P.R. China
[*] Corresponding author: somboon.cha@mahidol.ac.th

ABSTRACT

A facile and eco-friendly in situ thermal (IST) method was developed to synthesize zeolitic imidazole frameworks based on a 2-methylimidazole (2-MIM) linker. A single-step and a short processing time with the lowest precursor ratio (M/L) and solvent-free provided an advantage of the IST method over the reported traditional synthesis procedures. A variety of synthesis parameters, including temperature, time, precursor, and gas atmosphere, were optimized to obtain excellent crystalline and porosity properties. In the following, different characterization techniques were comprehensively applied to verify the properties of the synthesized materials. The solid crystalline products obtained from different mole ratios after thermal treatment were then characterized by powder X-ray diffraction, as shown in Figure 1a. The observed XRD patterns reveal a crystal transformation in all ratios after the in situ thermal treatment (200 °C) compared with the physically mixed precursor (no thermal treatment). The porosity and surface area of the synthesized materials prepared with different mole ratios were further determined. The nitrogen isotherm type I for all of the ratios but with a different adsorption amount was observed (Figure 1b). The beneficial chemical and physical properties of the synthesized material exhibited potential application for adsorption and catalysis. The IST is a green strategy avoiding solvent, activation, or posttreatment to remove unreacted residual, side-product, and guest molecules from the product. Additionally, the single-step IST process showed scalability for large-scale material synthesis.[1]

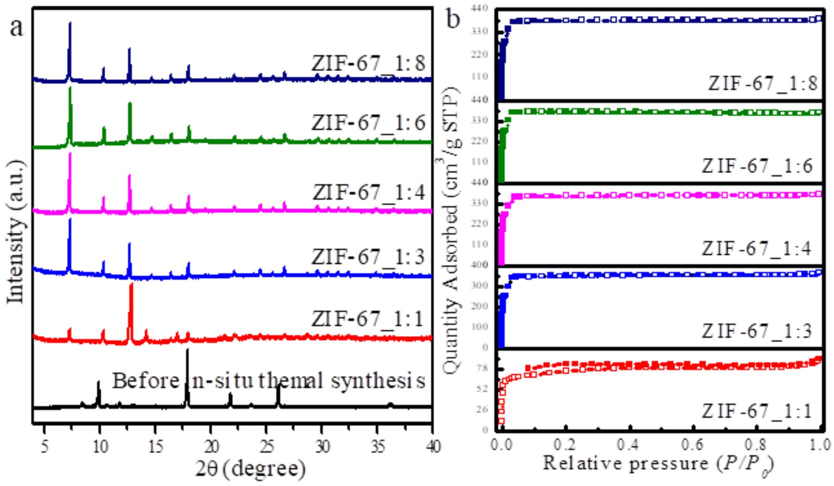


Fig. 1. (a) XRD patterns (b) nitrogen isotherms of ZIF-materials obtained using the IST method.

References

[1] Wang, J, Chaemchuen, S, Klomkliang, N, Verpoort, F. In situ thermal solvent-free synthesis of zeolitic imidazolate frameworks with high crystallinity and porosity for effective adsorption and catalytic applications. **Crystal Growth & Design**, 2021; 21(9): 5349-5359.

Poster **TIChE-SG-35**

Utilization of fusel oil as a sustainable bio-based lighter fluid

Parncheewa Udomsap[1,*], Pornpasson Sanenopakul[1], Sitthichai Watthanalao[1],
Napat Kaewtrakulchai[2], Supachai Jadsadajerm[3], Boonyawan Yoosuk[1]

[1] National Energy Technology Center, National Science and Technology Development Agency,
Pathum Thani 12120, Thailand
[2] Kasetsart Agricultural and Agro-Industrail Product Improvement Institute, Kasetsart University,
Bangkok 10900, Thailand
[3] Department of Industrial Chemistry, Faculty of Applied Science, King Mongkut's University of Technology North
Bangkok, Bangkok 10800, Thailand
[*] Corresponding author: parncheewa.udo@entec.or.th

ABSTRACT

Lighter fluids are widely used to ignite and enhance the combustion of charcoal. However, petroleum-based charcoal lighter fluids produce excessive smoke and high carbon monoxide emissions during combustion. To address these drawbacks, bio-based charcoal lighter fluids with improved combustion efficiency have been developed. Fusel oil, a byproduct of bioethanol production from renewable crops, consists of alcohols ranging from C2 to C7, with isoamyl alcohol as the primary component. It has a flash point of 35°C and a heating value of 30–35 MJ/kg, making it a promising component for charcoal lighter fluid. A formulation containing a 50:50 weight ratio of fusel oil and biodiesel ignites within 5 seconds, reaching a peak flame temperature of 400–500°C for 3.16 minutes. It burns cleanly, producing less smoke and soot than commercial petroleum-based lighter fluids due to its higher oxygen content [1]. Additionally, the CO/CO_2 ratio from the combustion of biobased charcoal lighter fluid (0.005) is lower than that of petroleum-based lighter fluid (0.009), indicating more complete combustion, as shown in Fig. 1. This suggests that the carbon in the biobased lighter fluid is fully oxidized, primarily releasing CO_2 while minimizing CO emissions, which are harmful to both the environment and human health. Further research will explore the optimal fusel oil-to-biodiesel ratio for ignition efficiency and combustion emissions. The development of biobased charcoal lighter fluids from locally renewable feedstocks enhances self-sufficiency, reduces reliance on imports, and provides economic benefits to domestic producers. This innovation supports sustainable energy solutions while mitigating environmental impacts.

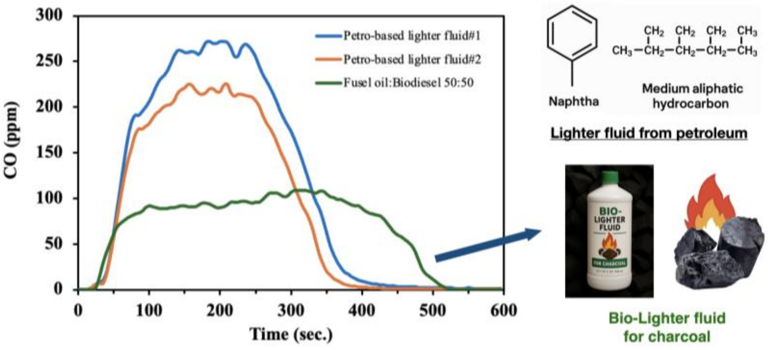


Fig 1. CO emissions of lighter fluid.

Keywords: Fusel oil; Biodiesel; Lighter fluid; Biobased lighter fluid; Charcoal lighter fluid

References

[1] Csefalvay E. Evaluation of Biobased Lighter Fluids. **ACS Sustainable Chemistry & Engineering** 2018; 6: 8417-8426.

Oral **TIChE-SG-38**

Sustainable ethylene synthesis via photocatalytic conversion of succinic acid over metal-TiO$_2$ photocatalysts

Suttida Pomsri[1], **Worached Laothong**[1], **Aroonsri Nuchitprasittichai**[1], **Supunnee Junpirom**[1,*]

[1] School of Chemical Engineering, Institute of Engineering, Suranaree University of Technology,
Nakhon Ratchasima 30000 Thailand.
[*] Corresponding author: supunnee@sut.ac.th

ABSTRACT

The increasing demand for sustainable chemical production has driven interest in utilizing both bio-based and waste-derived feedstocks for valuable chemical synthesis. Succinic acid (SA), a key platform chemical, can be derived not only from biomass but also through chemical recycling of plastic waste, offering a more circular and sustainable route. In this study, SA is photocatalytically converted into ethylene, an essential monomer for polymer production. This work investigates the photocatalytic conversion of SA using metal-doped TiO$_2$ photocatalysts (Fe/TiO$_2$, Pd/TiO$_2$, Cu/TiO$_2$, and Ag/TiO$_2$) under varying reaction conditions. The photocatalysts were synthesized and characterized using X-ray diffraction (XRD) and energy-dispersive spectroscopy (EDS) to confirm their composition and structural properties. Photocatalytic experiments revealed that catalyst weight and pH significantly influence ethylene production. Fe/TiO$_2$ exhibited the highest ethylene yield at pH 3 with a catalyst weight of 0.15 g, while Cu/TiO$_2$ and Ag/TiO$_2$ peaked at 0.10 g. The findings suggest that metal-doped TiO$_2$ enhances photocatalytic efficiency, offering a promising route for sustainable ethylene production from SA.

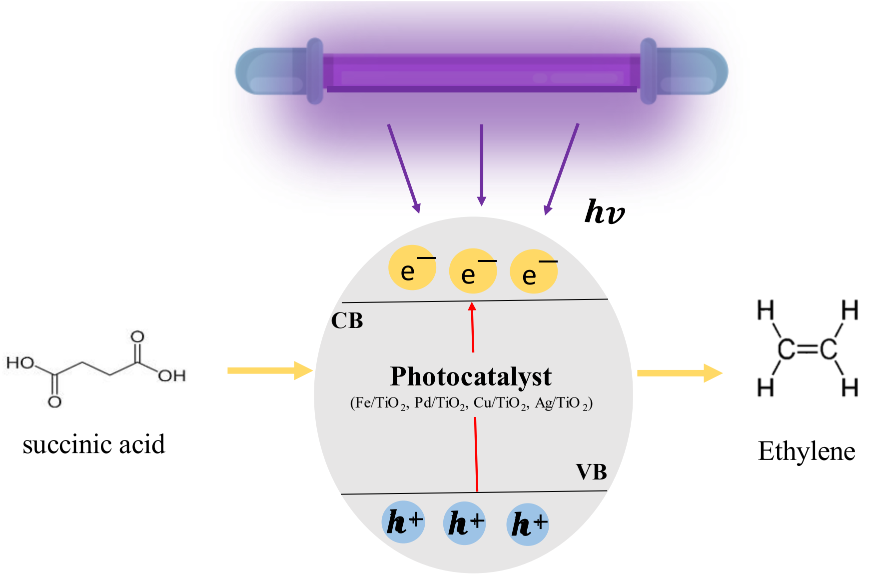


Fig. 1. Diagram of photocatalytic degradation mechanism of succinic acid.

Keywords: Photocatalysis; Succinic acid; Ethylene; Metal-doped TiO$_2$

Oral TIChE-SG-40

Improvement of process layout and increase productivity of new model (cargo extender process) by Kaizen

Natthakritta Nokkhum[1], **Attaso Khamwichit**[1], **Wipawee Dechapanya**[1,*]

[1] Department of Chemical Engineering, School of Engineering and Technology, Walailak University,
Nakhon Si Thammarat 80160, Thailand
[*] Corresponding author: khamwipawee@gmail.com

ABSTRACT

In the automotive parts manufacturing sector, production processes frequently face multifaceted challenges, particularly when implementing new models. These challenges manifest as insufficient output to meet daily production targets, elevated defect rates, and time inefficiencies at various stages of the manufacturing process. This research endeavors to enhance and optimize the production methodology, primarily focusing on augmenting production efficiency to achieve a minimum 10% increase in productivity. Additionally, the study aims to reduce cycle times and process waste, while concurrently improving workplace ergonomics and employee satisfaction. The implementation of Kaizen methodology and ECRS (Eliminate, Combine, Rearrange, Simplify) principles yielded significant improvements in operational efficiency [1,2]. Through rigorous analysis and strategic problem-solving, the cycle time at the identified bottleneck was reduced from 368 to 274 seconds, representing a substantial 25.54% decrease. This optimization resulted in a reduction from 22.83 to 17.67 minutes. Consequently, the daily production capacity experienced a notable increase from 144 to 192 units, (33.33% enhancement in overall productivity). Furthermore, the production line's balance rate rose from 59.36% to 73.08%. In addition, the number of defective pieces was reduced by 52.52%, resulting in a cost saving of 2,258,004 THB/Year. The implemented improvement strategy has demonstrated significant efficacy, yielding multifaceted benefits across key performance indicators. Notably, the approach has not only enhanced productivity to meet customer demands but also achieved substantial cost reductions and optimized resource and energy utilization. This comprehensive methodology presents a viable framework for adoption across diverse industrial production lines seeking to implement lean manufacturing principles.

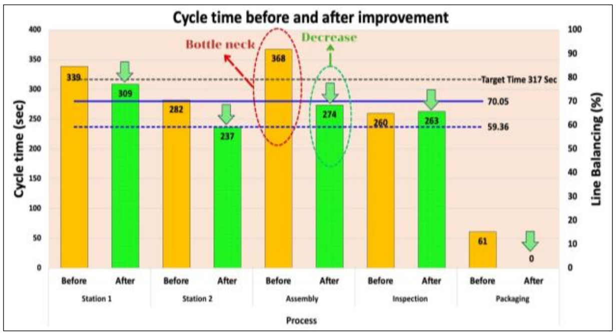


Fig. 1. Cycle time of process after improvement

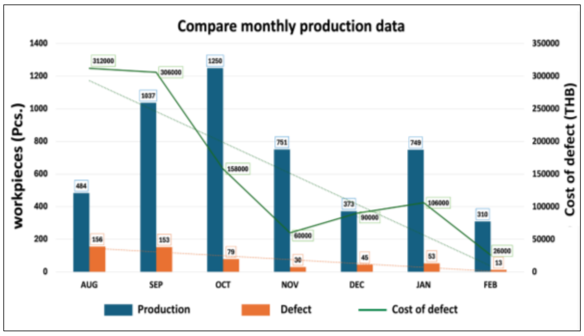


Fig. 2. Production and defect cost analysis.

Keywords: Kaizen; Efficiency improvement; Cycle time

References

[1] Nisa AK, Hisjam M, Helmi SA. Improvement of work method with Eliminate, Combine, Re-arrange, and Simplify (ECRS) concept in a manufacturing company: A case study. **IOP Conference Series: Materials Science and Engineering** 2021; 1096: 012016.

[2] Ram Kumar S, Nathan VN, Mohammed Ashique SI, Rajkumar V, Arun Karthick P. Productivity enhancement and cycle time reduction in Toyota Production System through Jishuken activity: Case study. **Materials Today: Proceedings** 2021; 37: 964-966.

The 34th Thai Institution of Chemical Engineering and Applied Chemistry International Conference (TIChE2025)

Organized by
Department of Chemical Engineering
Khon Kaen University

Join us next year in

TIChE2026
UBON RATCHATHANI

By Ubon Ratchathani University