International Seminar on Chemical Engineering Soehadi Reksowardojo (STKSR) 2020

in conjuction with

SYMPHOSIS 2020

Symposium on Photocatalyst and Photocatalysis 2020

Book of Abstract

Circular Economy for a Better World

Virtual Conference | November 16-17, 2020

Organized by:

Institut Teknologi Bandung

Department of Chemical Engineering, Faculty of Industrial Technology, and Center for Environmental Studies (PSLH)

Indonesia Photocatalyst Society

Sponsored by:

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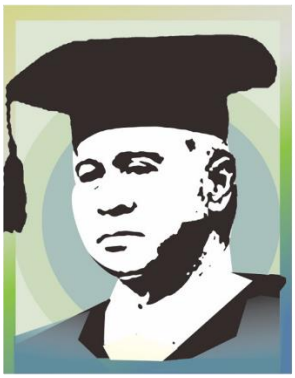
Book of Abstract



International Seminar on Chemical Engineering Soehadi Reksowardojo (STKSR) 2020 in conjunction with Symphosium on Photocatalyst and Photocatalysis 2020

"Circular Economy for a Better World"

16th-17th November 2020

Virtual Conference

***Organized by*:**

Chemical Engineering Study Program
Faculty of Industrial Technology
Institut Teknlogi Bandung

Indonesian Photocatalyst Society

About STKSR-Symphosis 2020

International Seminar on Chemical Engineering Soehadi Reksowardojo (STKSR) 2020 in conjunction with Symposium on Photocatalyst and Photocatalysis 2020

International Seminar on Chemical Engineering Soehadi Reksowardojo or STKSR is an annual seminar held by the Department of Chemical Engineering Institut Teknologi Bandung in honor of Prof. Soehadi Reksowardojo's contribution to the early developments of chemical engineering higher education in Indonesia. This year, STKSR 2020 will be held in conjunction with Symposium on phocatalyst and Photocatalysis (Symhosis) 2020 by virtual conference, starting from November 16th to November 17th, 2020. Bringing forward the theme "Circular Economy for a Better World", we would like to invite scholars and practitioners from all around the world to contribute to these seminars.

Symposium on Photocatalyst and Photocatalysis (Symphosis) 2020 is a platform to disseminate and discuss recent advances in the development and application of photocatalysts. It will be the very first typical symposium on this specific subject to be held in Indonesia. This year's symposium will come up with energy and environment-related issues: Water treatment, CO_2 reduction and H_2 production. In addition to the research discussion involving researchers and academics, this event enables the industrial practitioners to observe any prospects for technology incubation in the field of photocatalyst and photocatalysis. Supported but the Photocatalyst Industry Association of Japan and Ikatan Alumni Habibie, this event features internationally recognized researchers and industrial practitioners as the invited speakers as well as the introduction and official launching of the Indonesia Photocatalyst Society.

This seminar is made because of the importance of natural resources in life. Natural resources are really important but they are limited. This limitation triggers awareness to use the natural resources and products made wisely without reducing the value and to optimize the use of renewable resources. With the theme of "Circular Economy for A Better World", this event is made as a platform to exchange information between researchers, industry and anyone with importance.

Contents

Scientific Committee

- **Prof. Tjandra Setiadi**
  Institut Teknologi Bandung, Indonesia
- **Prof. Ashok Pandey**
  CSIR-Indian Institute of Toxicology Research, India
- **Prof. Ramaraj Boopathy**
  Nicholls State University, USA
- **Prof. S. Vigneswaran**
  University of Technology Sydney, Australia
- **Prof. Ir. Dwiwahju Sasongko, Ph.D.**
  Institut Teknologi Bandung, Indonesia
- **Prof. Danu Ariono**
  Institut Teknologi Bandung, Indonesia
- **Prof Lienda Aliwarga**
  Institut Teknologi Bandung, Indonesia
- **Prof. Yazid Bindar, Ph.D.**
  Institut Teknologi Bandung, Indonesia
- **Prof. Ir. I. Gede Wenten**
  Institut Teknologi Bandung, Indonesia
- **Prof. Mikrajuddin Abdullah**
  Institut Teknologi Bandung, Indonesia
- **Prof. Takashi Ogi**
  Hiroshima University, Japan
- **Dr. Kakeru Fujiwara**
  Yamagata University, Japan
- **Dr. Ferry Iskandar**
  Institut Teknologi Bandung, Indonesia
- **Dr. Pramujo Widiatmoko**
  Institut Teknologi Bandung, Indonesia
- **Dr. Aditya Farhan Arif**
  PT Rekayasa Industri
- **Dr. Hendri Widiyandari**
  Universitas Sebelas Maret, Indonesia
- **Dr. Osi Arutanti**
  Lembaga Ilmu Pengetahuan Indonesia

Organizing Committee

STKSR – SYMPHOSIS Chairman:

Prof. Tjandra Setiadi, Institut Teknologi Bandung, Indonesia

Co-Chairman:

Dr. Eng. Aditya Farhan Arif (PT Rekayasa Industri)
Ardiyan Harimawan, Ph.D. (ITB)

Team Members:

Vita Wonoputri, Ph.D.
Dian Shofinita, Ph.D.
Hary Devianto, Ph.D.
Made Tri Ari Penia Kresnowati, Ph.D.
Anggit Raksajati, Ph.D.
Wibawa Hendra Saputera, Ph.D.
Helen Julian, Ph.D.
Antonius Indarto, Ph.D.
Dr. Eng. Jenny Rizkiana
Guntur Adisurya, M.T.

Owen Khosashi
Fathur Rahman Wibisono
Sendy Susanto
Priscilla Angelica
Claritta Sukmalovelina
Jonathan Sasmito
Reynaldo Jonatan
Vincent Augusta Primayudha
Eprianto Pasaribu

Message from Rector of Institut Teknologi Bandung

On behalf of Institut Teknologi Bandung, it is our great pleasure to welcome the honourable keynote speakers, presenters, and participants of the International Seminar on Chemical Engineering Soehadi Reksowardojo (STKSR) 2020. This year, the seminar is held in conjunction with Symposium on Photocatalyst and Photocatalysis (Symphosis) 2020. The STKSR is a distinguished annual event held by Department of Chemical Engineering, Institut Teknologi Bandung since 1991, where researchers, technologists, and experts around the world share their knowledges and practices in chemical engineering field.

This year, the theme of seminar is "Circular Economy for a Better World". The circular economy arises from a concern on limited resources and abundant waste accumulation in a linear "take, make, and dispose" model of production. In the circular economy, the effective use of resources is enhanced as well as the technology to reuse the waste in a next production cycle. The procedure is mimicking biological ecosystem. The wise of using Indonesia natural resources based on the circular concept is the major target we need to achieve together through this seminar.

Marking its first event of Symposium on Photocatalyst and Photocatalysis (Symphosis) 2020, we happily welcome The Indonesian Photocatalyst Society (IPhoS) as a collaborating organizer. The IPhoS is a collaborative platform for Indonesia researchers, practitioner, and government to spread and discuss recent information and policy in photocatalysis development and application. We have confidence that the development on photocatalyst will support the circular economy in a sustainable manner, such as in waste treatment, carbon dioxide reduction, and solar energy utilization.

Therefore, we support scholars and professionals to share their knowledge and innovations in the STKSR-Symphosis 2020. We believe that this seminar will bring fruitful discussions and collaborations. Together, we are shaping the future of the circular economy. Last but not least, we would like to express our gratitude and appreciation to our sponsors, collaborators, committees, and participants who greatly contribute to the success of the STKSR-Symphosis 2020. Hopefully, this event brings you all the best results.

Message from Chairman of STKSR-Symphosis 2020

On behalf of the organizing Committee of International Seminar on Chemical Engineering Soehadi Reksowardojo, it is my honor to welcome you all to STKSR 2020. This year's seminar is held in conjunction with Symposium on Photocatalyst and Photocalysis 2020, organized by Indonesia Photocatalyst Society (IPhoS).

This year, this seminar raises topic of "Circular Economy for a Better World". As we all aware, the growth of the industries plays a vital role in the growth of economy. However, along with the development of industries, issues of resource depletion and environmental impairment becomes a huge concern. Departed from those issues, term "Circular Economy" becomes popular. In circular economy, a system is built in which resources comes in a cycle, thus eliminating waste produced and minimize resource exploitation. As a country blessed with rich ecosystem variety, Indonesia should and will fight on preserving and improving the environmental quality in order to pass it to the future generation, and ITB will plays major role in that.

This year seminar is also a bit special since it will be held virtually. Current pandemic condition causes us to unfortunately limit our physical movement, and we hope that everyone will stay in healthy condition. However, this limitation should not limit us to disseminate our knowledge, and with the development of technology and human capabilities to adapt, virtual conference has become great solution. We already receive more than a hundred abstracts, showing the great enthusiasm and passion to spread knowledge, and we are very thankful to all of the participant.

Finally, the committees also give our heartfelt gratitude to our sponsors for supporting this seminar. I also personally thank all of the committee members, plenary and invited speakers, oral speakers, and participants in making this virtual conference a grand success. I hope all of you enjoy the seminars and get so many new insights on the topics presented.

Best Regards,

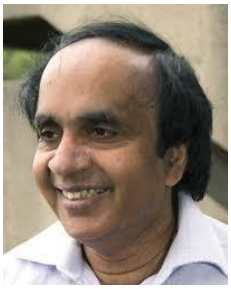
Chairman of STKSR 2020

Sub-theme

1. Advanced Science – Material
2. Bioprocess Technology
3. Chemurgy – Biobased Material
4. Bioenergy – Alternative Energy
5. Food Technology
6. Industrial Application
7. Separation Technology
8. Process Simulation
9. Reaction – Control Engineering
10. Symphosis
11. Kurita

Keynote Speakers

Kari Herlevi
Project Director, Circular Economy, SITRA, Finland



Prof. S. Vigneswaran
School, Civil and Environmental Engineering, University of Technology Sydney, Australia

Prof. Bunsho Ohtani
Institute for Catalysis, Hokkaido University
Design, Preparation, and Detailed Characterization of Photocatalysts Based on Energy-resolved Distribution of Electron Traps.

Prof. Dr. Andrzej Stankiewicz
Head of the Chair of Intensified Reaction and Separation Systems, Delft University of Technology, Netherlands

Prof Dr. Ing. Jiří Jaromír Klemeš
Co-Editors-in-Chief, Journal of Cleaner Production, Brno University of Technology, Brno, Czech Republic

Invited Speakers

Prof. Ramaraj Boopathy

Nicholls State University, United States of America

Prof. Kakeru Fujiwara
Assistant Professor, Department of Chemistry and
Chemical engineering, Yamagata University

Dr. Made Tri Ari Penia Kresnowati, S.T., M.Sc.

Department of Chemical Engineering,
Institut Teknologi Bandung

Dr. Leny Yuliati
Ma Chung Research Center for Photosynthetic
Pigments, Universitas Ma Chung, Indonesia

Dewi Mersitarini
Advisor II CCUS-INV
Direktorat Strategy Portfolio dan Pengembangan Usaha
PT Pertamina (Persero)

Dr. Norhayati Abdullah
Associate Professor of Environmental Engineering
Universiti Malaysia

General Program

International Seminar on Chemical Engineering Soehadi Reksowardojo in conjunction with Symposium on Photocatalyst and Photocatalysis 2020 (STKSR-Symphosis 2020)

"Circular Economy for Better World"

Meeting Platform: Zoom Meeting
All the schedule is Jakarta Time (GMT+7)

Day 1 : Monday, November 16th 2020

08.00 – 08.30	Registration	
08.30 – 08.55	Opening ceremony	
	08.30 - 08.35	Opening by MC Sing the National Anthem "Indonesia Raya"
	08.35 – 08.40	Remarks by Chairman of STKSR-Symphosis 2020
	08.40 – 08.50	Opening Speech by the Rector of ITB
	08.50 – 08.55	Moderator introduction
08.55 – 09.25	Plenary Speaker 1: **Prof. S. Vigneswaran** Civil and Environmental Engineering, University of Technology Sydney, Australia	
09.25 – 09.40	Discussion	
09.40 – 09.45	Introduction of Plenary Speaker 2	
09.45 – 10.15	Plenary Speaker 2: **Prof. Bunsho Ohtani** Institute for Catalysis, Hokkaido University, Japan	
10.15 – 10.30	Discussion	
10.30 – 10.35	Wrap up and Remarks from Moderator	
10.35 – 10.40	MC Announcement	
10.40 – 10.50	Break	
10.40 – 12.20	Parallel Session I Room A : **Dr. Kakeru Fujiwara** Room B : **Dr. Made Tri Ari Penia K.** Room C : **Dewi Mersitarini**	
12.20 – 13.20	Break	
13.20 – 13.25	Re-Opening by Room MC	
13.25 – 14.55	Parallel Session II Room A : **Dr. Leny Yuliati**	
14.55 – 15.05	Break	
15.05 – 15.10	Re-Opening by Room MC	
15.10 – 16.25	Parallel Session III	
16.25 – 16.30	Closing by Room MC (Acknowledgement of sponsors and reminder the event on the 2nd day)	

Day 2 : Tuesday, November 17th 2020

08.00 – 08.30	Registration
08.30 – 08.35	Opening by Room MC
08.35 – 08.40	Moderator Introduction
08.40 – 10.10	Parallel Session IV Room A : **Prof. Ramaraj Boopathy**
10.10 – 10.20	Break
10.20 – 10.25	Reopening by Room MC
10.25 – 11.55	Parallel Session V
11.55 – 12.00	Room MC closing and announcement regarding next session
12.00 – 13.10	Break
13.10 – 13.15	Reopening by MC (Acknowledgement of sponsors) and Introduces Moderator
13.15 – 13.20	Moderator introduction and opening
13.20 – 13.50	Plenary Speaker 3: **Prof. Dr. Ing. Jiří Jaromír Klemeš** Brno University of Technology, Czech
13.50 – 14.05	Discussion
14.05 – 14.10	Moderator introduces Plenary Speaker 4
14.10 – 14.40	Plenary Speaker 4: **Kari Herlevi** Project Director, Circular Economy SITRA, Finland
14.40 – 14.55	Discussion
14.55 – 15.00	Moderator introduces Plenary Speaker 5
15.00 – 15.30	Plenary Speaker 5: **Prof. Dr. Andrzej Stankiewicz** Founder and Chairman of the Board of the European Process Intensification Centre
15.30 – 15.45	Discussion
15.45 – 15.50	Wrap up and Remarks from Moderator
15.50 – 16.20	Closing Remarks
16.20 – 16.30	Closing by MC

Parallel Session I

Day 1 : Monday, November 16th 2020

*presentation session include 10 minutes presentation and 5 minutes Q&A

Time	Event	Abstract Code
	Room A (Symphosis)	
10.50-11.10	Prof. Kakeru Fujiwara	INV01
11.10-11.20	Q&A	
11.20-11.35	Presentation I	S02
11.35-11.50	Presentation II	S07
11.50-12.05	Presentation III	S04
12.05-12.20	Presentation IV	S03
	Room B (Bioprocess Technology)	
10.50-11.10	Dr. Made Tri Ari Penia Kresnowati	INV02
11.10-11.20	Q&A	
11.20-11.35	Presentation I	B02
11.35-11.50	Presentation II	B03
11.50-12.05	Presentation III	B04
12.05-12.20	Presentation IV	B07
	Room C (Industrial Application)	
10.50-11.10	Dewi Mersitarini	INV03
11.10-11.20	Q&A	
11.20-11.35	Presentation I	I01
11.35-11.50	Presentation II	I02
11.50-12.05	Presentation III	I03
12.05-12.20	Presentation IV	I05
	Room D (Kurita Awardees)	
10.50-11.00	KWEF Welcome Address	-
11.00-12.20	Dr. Norhayati Abdullah, UTM	-
11.20-11.35	Thailand Best Awardee 2018	-
11.35-11.50	Indonesia Best Awardee 2018	-
11.50-12.05	Vietnam Best Awardee 2018	-
12.05-12.20	Announcement	-
	Room E (Bioenergy – Alternative Energy and Chemurgy – Biobased Material)	
10.50-11.05	Presentation I	C01
11.05-11.20	Presentation II	E07
11.20-11.35	Presentation III	C05
11.35-11.50	Presentation IV	E11
11.50-12.05	Presentation V	E08
12.05-12.20	Presentation VI	E12

Parallel Session II

Day 1 : Monday, November 16th 2020

*presentation session include 10 minutes presentation and 5 minutes Q&A

Time	Event	Abstract Code
	Room A (Symphosis)	
13.25-13.45	Dr. Leny Yulianti	INV04
13.45-13.55	Q&A	
13.55-14.10	Presentation I	S01
14.10-14.25	Presentation II	S05
14.25-14.40	Presentation III	S06
14.40-14.55	Presentation IV	S09
	Room B (Separation Technology)	
13.25-13.40	Presentation I	M01
13.40-13.55	Presentation II	M04
13.55-14.10	Presentation III	M09
14.10-14.25	Presentation IV	M10
14.25-14.40	Presentation V	M05
14.40-14.55	Presentation VI	M08
	Room C (Food Technology)	
13.25-13.40	Presentation I	F10
13.40-13.55	Presentation II	F04
13.55-14.10	Presentation III	F05
14.10-14.25	Presentation IV	F08
14.25-14.40	Presentation V	F11
14.40-14.55	Presentation VI	F07
	Room D (Kurita Awardees)	
13.25-13.40	Presentation I	K01
13.40-13.55	Presentation II	K02
13.55-14.10	Presentation III	K03
14.10-14.25	Presentation IV	K08
14.25-14.40	Presentation V	K09
14.40-14.55	Presentation VI	K10
	Room E (Bioenergy – Alternative Energy and Chemurgy – Biobased Material)	
13.25-13.40	Presentation I	C04
13.40-13.55	Presentation II	E04
13.55-14.10	Presentation III	C08
14.10-14.25	Presentation IV	E05
14.25-14.40	Presentation V	E09
14.40-14.50	Presentation VI	E13

Parallel Session III

Day 1 : Monday, November 16th 2020

*presentation session includes 10 minutes presentation and 5 minutes Q&A

**proposal presentation session includes 7 minutes presentation and 3 minutes Q&A

Time	Event	Abstract Code
	Room A (Advanced Science and Materials)	
15.10-15.25	Presentation I	A02
15.25-15.40	Presentation II	A03
15.40-15.55	Presentation III	A04
15.55-16.10	Presentation IV	A16
16.10-16.25	Presentation V	A17
	Room B (Bioprocess Technology)	
15.10-15.25	Presentation I	B01
15.25-15.40	Presentation II	B06
15.40-15.55	Presentation III	B08
	Room C (Food Technology)	
15.10-15.25	Presentation I	F09
15.25-15.40	Presentation II	F02
15.40-15.55	Presentation III	F03
15.55-16.10	Presentation IV	F06
16.10-16.25	Presentation V	F01
	Room D (Kurita Awardees)	
15.10-15.20	Proposal Presentation I	K04
15.20-15.35	Presentation I	K12
15.35-15.45	Proposal Presentation II	K05
15.45-15.55	Proposal Presentation III	K06
15.55-16.05	Proposal Presentation IV	K07
16.05-16.15	Proposal Presentation V	K11
16.15-16.30	Presentation II	K13

Parallel Session IV

Day 2 : Tuesday, November 17th 2020

*presentation session include 10 minutes presentation and 5 minutes Q&A

Time	Event	Abstract Code
	Room A (Bioprocess Technology)	
08.40-09.00	Prof. Ramaraj Boopathy	INV05
09.00-09.10	Q&A	
09.10-09.25	Presentation I	B10
09.25-09.40	Presentation II	B09
09.40-09.55	Presentation III	B05
09.55-10.10	Presentation IV	B11
	Room B (Advanced Science and Materials)	
08.40-08.55	Presentation I	A01
08.55-09.10	Presentation II	A05
09.10-09.25	Presentation III	A06
09.25-09.40	Presentation IV	A07
09.40-09.55	Presentation V	A09
09.55-10.10	Presentation VI	A11
	Room C (Industrial Application)	
08.40-08.55	Presentation I	I04
08.55-09.10	Presentation II	I06
09.10-09.25	Presentation III	I07
09.25-09.40	Presentation IV	I08
09.40-09.55	Presentation V	I09
09.55-10.10	Presentation VI	I10
	Room D (Reaction and Control Engineering)	
08.40-08.55	Presentation I	R05
08.55-09.10	Presentation II	R06
09.10-09.25	Presentation III	R10
09.25-09.40	Presentation IV	R08
09.40-09.55	Presentation V	R09
09.55-10.10	Presentation VI	R07
	Room E (Bioenergy – Alternative Energy and Chemurgy – Biobased Material)	
08.40-08.55	Presentation I	C02
08.55-09.10	Presentation II	C06
09.10-09.25	Presentation III	E06
09.25-09.40	Presentation IV	C07
09.40-09.55	Presentation V	E10

Parallel Session V

Day 2 : Tuesday, November 17th 2020

*presentation session include 10 minutes presentation and 5 minutes Q&A

Time	Event	Abstract Code
Room A (Advanced Science and Materials)		
10.25-10.40	Presentation I	A15
10.40-10.55	Presentation II	A14
10.55-11.10	Presentation III	A12
11.10-11.25	Presentation IV	A13
11.25-11.40	Presentation V	A10
Room B (Process Simulation)		
10.25-10.40	Presentation I	P03
10.40-10.55	Presentation II	P02
10.55-11.10	Presentation III	P01
11.10-11.25	Presentation IV	P04
11.25-11.40	Presentation V	P05
Room C (Bioenergy – Alternative Energy, Chemurgy – Biobased Materials and Industrial Application)		
10.25-10.40	Presentation I	E01
10.40-10.55	Presentation II	I11
10.55-11.10	Presentation III	E02
11.10-11.25	Presentation IV	C03
Room D (Reaction and Control Engineering)		
10.25-10.40	Presentation I	R03
10.40-10.55	Presentation II	R02
10.55-11.10	Presentation III	R11
11.10-11.25	Presentation IV	R01
Room E (Separation Technology)		
10.25-10.40	Presentation I	M03
10.40-10.55	Presentation II	M06
10.55-11.10	Presentation III	M07
11.10-11.25	Presentation IV	M11
11.25-11.40	Presentation V	M12

List of Accepted Abstracts

ORAL PRESENTATION

Registration Number	Title	Author	Paper Code
Topic: Advanced Science and Materials			
003	Effect of Bubble Size on Electrochemical Reduction of Carbon dioxide to Formic Acid	Pramujo Widiatmoko, Wibawa Hendra Saputera, Hary Devianto, Isdiriayani Nurdin, Esperanza Rivana, Albert Angkasa	A01
021	An Overview of Synthetic Polymer-based Membrane Modified with Chitosan for Fuel Cell Application	Sabrina Rahmi Adiyar, Adhi Satriyatama, Ni Kadek Adnya Kusuma Sari, Aida Nurul Azjuba	A02
023	Electrospun Zeolite Fiber Dye Removal	Saepurahman, Raed Hashaikeh, Rino R. Mukti	A03
028	The Synthesis of Magnetic Molecularly Imprinted Polymer Against Di-(2-ethylhexyl) Phthalate	Asyifa Rizqi Utami, Muhamad Ali Zulfikar, Deana Wahyuningrum	A04
041	Optimization of Electrode Material Composition from Activated Carbon, Multi Wall Carbon Nanotube, and Graphene for Enhance Performance of The Supercapacitor	H. Rustamaji, T. Prakoso, H. Devianto, P. Widiatmoko, I. Nurdin, J. Rizkiana	A05
042	Production of Activated Carbon from Palm Empty Fruit Bunch as Supercapacitor Electrode Material	N. N. Wulandari K, H. Rustamaji, W. U. Fibarazy, T. Prakoso, J. Rizkiana, H. Devianto, P. Widiatmoko, I. Nurdin	A06
044	Fabrication of Dye Sensitized Solar Cell (DSSC) Module	Leo Setiadarma, Jeremy Putra Wirjo Santoso, Pramujo Widiatmoko, Hary Devianto, Isdiriayani Nurdin	A07
045	Development of Organoclay for Removal of Fe(III) and Mn(II) From Acid Mine Drainage Model	Elvi Restiawaty, Yazid Bindar, Rizqan Jamal	A08
048	Wettability Improvement of Carbon Nanotube for Supercapacitor Electrode	H. Devianto, N. Luthfiana, P Widiatmoko, I. Nurdin, T. Prakoso	A09
050	Agglomeration Issues of Biosynthesized Nanoparticles - A Review	S. Khairunnisa, V. Wonoputri, T.W. Samadhi	A10
051	Supercapacitor Cell Based on Gel Polymer Electrolyte and Activated Carbon from Oil Palm Empty Fruit Bunch as Electrode Material	W.U. Fibarzi, N. N. Wulandari K., H. Rustamaji, T. Prakoso, J. Rizkiana, H. Devianto, P. Widiatmoko, I. Nurdin	A11
089	Effects of Fe-Doped Electrolyte and Feed Flow Rate Evaluation in Home Made Solid Oxide Fuel Cell	Hary Devianto, Isdiriayani Nurdin, Pramujo Widiatmoko, Kafi Adi Prasetya, Basil Pradipta	A12

Registration Number	Title	Author	Paper Code
093	Kapok Fiber Modification by Reduced Graphene Oxide for Oil Absorbent	Graecia Lugito, Tjokorde Walmiki Samadhi, Tirto Prakoso, Muhammad Lauda, Vincent Laurent Tanujaya	A13
095	Synthesis of Bionanocatalyst to Produce Fatty Acids as Precursor of Green Diesel	Yogi Wibisono Budhi, Muhammad Wildan Hakim, Harris Fikren Taufik, Arie Wibowo, Ardiyan Harimawan, Neng Tresna Umi Culsum	A14
099	Lipase Immobilization onto Cellulose Nanocrystals (CNCs) for Lipolysis Triglycerides	E. Restiawaty, F. A. Yatasya, Ellys, N. T. U. Culsum, Akhmaloka, Y. W. Budhi	A15
120	Utilization of Kaolin as a Filling Material for Rubber Solid Tire Compounds for Two-wheeled Electric Scooters	Nasruddin, Sri Agustini, Muhammad Sholeh	A16
121	The Effect of Nanostructured Silica Synthesis Temperature on the Characteristics of Silica Filled Natural Rubber Composite	Muhammad Sholeh, Rochmadi Rochmadi, Hary Sulistyo, Budhijanto Budhijanto, Martin Doloksaribu	A17
Topic: Bioprocess Technology			
020	Numerical Investigation of Double Chamber Acetate-Fed Microbial Fuel Cell in Unsteady-State Condition	I. Subadri, A. Satriyatama, I. D. M Budi, A. Harimawan	B01
035	Evaluation of Heat Distribution and Aeration of Xylanase Production from Palm Oil Empty Fruit Bunches Using Tray Bioreactor	Diah Meilany, MTAP Kresnowati, Tjandra Setiadi	B02
040	Combining Biodelignification and Hydrothermal Pretreatment of Oil Palm Empty Fruit Bunches (OPEFB) for Monomeric Sugar Production	I. M. Hidayatullah, M. D. A Husnam H. Radiyan, M. T. A. P. Kresnowati, S. H. Suhardi, T. Setiadi	B03
043	Syngas Fermentation for Production of Ethanol	N. A. Isitqomah, M. T. A. P Kresnowati, T. Setiadi	B04
052	Phenolic Compound, Antioxidant and Antibacterial Properties of Electrospun PVP Nanofiber Loaded with *Bassela rubra linn* Extract and Alginate from *Sargassum sp.*	Eka Lutfi Septiani, Okky Putri Prastuti, Siti Machmudah, Sugeng Winardi, Wahyudiono, Hideki Kanda, Motonobu Goto	B05
061	The effect of POME Sources and Salt Addition on Microbial Fuel Cell Performance	S. Zakiyyah, A. Harimawan, H. Devianto	B06
064	Estimation of the Biomass Yield and Stoichiometric Coefficient During Bioproduct Formation through Thermodynamic Approach : A Case Study of Biosurfactant Production	R. S. Adiandri, R. Purwadi, Hoerudin, T. Setiadi	B07
074	Microbial Biosurfactant Potential on Cadmium Heavy Metal Bioremediation in Co-Contaminated Environment	Wuddan Nadhirah Rodiana, Kaim Maspudin, Isty Adhitya Purwasena, Indriani Dea Astuti	B08

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108	Modeling and Simulation of Biobutanol Fermentation by *Clostridium saccharoperbutylacetonium* N1-4	Elvi Restiawaty, Ardiyan Harimawan, Novaldio Rizki, Fauz Irfan Rafi	B10
114	Medium Optimization for Production of *Monascus purpureus* Pigment through Solid-state Fermentation	G. A. Ismail, A. D. Fitriana, U. Sukandar	B11
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004	Tobacco Extract as Corrosion Inhibitor for Carbon Steel in H_2S-containing NaCl Solution	Della Silvia, Clarissa Prakarsa, Isdiriayani Nurdin, Pramujo Widiatmoko, Hary Devianto	C01
017	An Improved Mechanical Properties of Wheat Bran-Based Polylactic Acid Plasticized with Glycerol	A. Satriyatama, V. A. A. Rochman, R. E. Adhi	C02
037	Eco-Friendly Metal Oxides Catalyst Prepared from Cakalang Fish Bone (*Katsuwonus pelamis*) Through a Thermal Decomposition Method	Muliadi Ramli, Desi Novita, Murniana, Febriani, Saiful, Nasrullah Idris	C03
063	Catalytic Process Development of Bio-BTX from Lignocellulose Derived Product: Preliminary Study Using Transition Metal Catalysts	Haryo Pandu Winoto, C.B. Rasrendra, Jenny Rizkiana, Johanes Kurniawan Leo, Andre Citawijaya	C04
069	Estimation of Xylose Recovery from Lignocellulosic Biomass	M. T. A. P. Kresnowati, D. C. Januardi, S. V. Utomo	C05
084	A Study of Producing Natural Red Color on Ikat Weaving Threads	D. P. Dala Ngapa, Y. Daud, A. C. Sabuna	C06
086	Identification of Biomordant in Merbaun Village, West Amarasi District, Kupang Regency	A. K. Taimenas, J. Ngginak, A. C. Sabuna	C07
115	Characteristics of Hydrochar and Liquid Fraction from Hydrothermal Carbonization of Seaweed (*Sargassum Spp.)*	Tirto Prakoso, Jenny Rizkiana, Heri Rustamaji, Guoqing Guan	C08
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005	Bio-Hydrocarbon Production from Pyrolysis of Mixed-Metal (Ca, Mg, Zn) Basic Soap	E. Puspawiningtyas, M. Pratiwi, Subagjo, T. H. Soerawidjaja, T. Prakoso	E01
012	Cost-Benefit Analysis of Palm Kernel Shells as a Diesel Fuel Substitution for Hot-Mixed Asphalt	Evi Gravitiani, Nuri Resti Chayyani, Sunu Herwi Pranolo, Prabang Setyono, Ary Setyawan	E02
033	Cogasification Performance of Deashed Coal with Various Biomass	Jenny Rizkiana, Sandy Fajar Maulana, Ghiffary Azka Nur Aulia, Nasywa Kamilah, Reyhan Fitri Ananda, Winny Wulandari, Dwiwahju Sasongko	E04

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034	Mass Balance Analysis of Bioethanol Production from Sweet Sorghum (*Sorghum bicolor*)	Muhammad Lauda, Nadiya Rahmawati, Wayda Rahma Putri Fajar, Aliya Ramadhani, Rahmah Amirah June, Meiti Pratiwi, Jenny Rizkiana	E05
038	Mini Solar Water Heating Biodiesel Plant by Homogeneous Catalyzing	Rinjani Ratih Rakasiwi, Syaifurrahman, Usman A. Gani	E06
083	Water Electrolysis for Hybrid Assisted Hydrogen Producing Using Photovoltaic-Conventional Electricity	Pramujo Widiatmoko, Isdiriayani Nurdin, Hary Devianto, Tatto Bustomi, Muhammad Mara Ikhsan, Rizky Eka Rachmatillah A.	E07
085	Modelling Effect of Vacuum and Atmospheric Drying on Torrefaction of Oil Palm Trunk (OPT)	Dendy Adityawarman, Vika Fujiyama, Hyung Woo Lee, Retno Gumilang Dewi, Johnner P. Sitompul	E08
092	Novel Approach of Biodiesel Production to Support Circular Economy in Biodiesel Industry	Aghietyas Choirun Az Zahra, Ilya Arina Rusyda, Andini Hizbiyati, Felix Geovani, Nabila Zahara, Bramantha Jiwandaru, Meiti Pratiwi, Astri Nut Istyami, Dwiwahju Sasongko, Jenny Rizkiana	E09
096	The Potential of Biogas in Energy Transition in Indonesia	Elisabeth Rianawati, Saut Sagala, Ichsan Hafiz, Johannes Anhorn, Sinshaw Alemu, Jorge Hilbert, Dwight Rosslee, Mutala Mohammed, Yaseen Salie, Dominik Rutz, Michael Rohrer, Angela Sainz, Franz Kirchmeyr, Aleksejs Zacepins, Frank Hofmann	E10
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123	Life Cycle and Economic Assessment of Integrating Gasification Unit into Production Unit of Pellet from Fallen Leaves and Twigs	Fadil Abdul Rahman, Gendewa Utomo, Indra Purwadi, Herri Susanto	E12
124	Pilot Plant Design for Production of Drop-in Bio-fuels by Decarboxylation of Palm Oil Metal-soap	R Purwadi, A N Istiyami, M Pratiwi, G F Neonufa, E Puspawiningtiyas, L Elizabeth	E13
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032	Statistical Mixture Design for Modelling and Optimization of Feed Mixture in the Chemical Interesterification to produce Cocoa Butter Alternatives	R. Jenny, Nathania, P. P. Oktalia, L. Dianika	F03
047	Pediocin and Grape Seed Extract as Antimicrobial Agents in Nanocellulose Biobased Food Packaging: A Review	Timotius Weslie, Vincent Felixius, Zulfah Amala, Dian Shofinita	F04
049	Taro Ice Cream: Addition of *Colocasia esculenta* Stem to Improve Antioxidant Activity Improvement in Ice Cream	A. H. Asaduddin, U. N. Maulani, A. Y. Sari, K. Hawari, A. A. Ayusari	F05
062	Production of Coconut Oil and Protein for Food and Cosmetic Ingredients	Dianika Lestari, Amilah Ridho Rahmani, Danu Ariono	F06
071	Effect of Stabilization Pre-treatment on Phenolic Compounds and Antioxidant Activity in Rice Bran	Zahara Mardiah, Dian Shofinita, Johnner P. Sitompul	F07
073	Preliminary Evaluation of Halal Protein Hydrolysate Production in Indonesia	Made Tri Ari Penia Kresnowati, Cantika Rahayu Affandi, Cindi Pratiwi	F08
104	Techno-economic Analysis of the Production of Natural Food Colorant from Dragon Fruit Peel	Dian Shofinita, Yazid Bindar, Riskie Ulvat Dinnita, Fariz Rizqi	F09
125	Fermented Cassava as an Alternative Flour for Pasta Making	R Purwadi, C F Teguh, D A Mazaya	F10
126	The Effect of Size and Solid Content in Hydrolysis of Sweet Potato Starch Using Endogenous Beta-amylase Enyme	R Purwadi, D Lestari, C A Lohoo J L Tirtaadji	F11
Topic: Industrial Application			
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025	Techno-Enviro-Economical Study of Hydrogenated Vegetable Oil Production from Crude Palm Oil and Renewable Hydrogen	Alya Hafiza Vivadinar, Widodo Wahyu Purwanto	I02
027	Multi-Objective Optimization of Blending Strategy of FAME, HVO, and Petroleum Diesel	Shanti Mustika, Widodo Wahyu Purwanto	I03
055	Simulation of CO_2 Capture Process for Coal Based Power Plant in South Sumatra Indonesia	M. Eviani, H. Devianto, P. Widiatmoko, L.F. Sukmana H.R. Fitri, F. Yusupandi	I04
076	Life Cycle Analysis for Silica Production from Three Different Routes: Conventional, Fume, and Green Routes	Soen Steven, Yusrin Ramli, Davin Pratama, Elvi Restiawaty, Yazid Bindar	I05
077	Study on Indonesian Plastic Marine Debris Based on National Balance and Seashore Approaches	Akhmad Zainal Abidin, Soen Steven	I06

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088	Energy and Exergy Analysis on the Rotary Kiln Unit of RKC-2 PT. Semen Gresik - Tuban Plant	Mala Hayati Nasution, Irwan Rasyid Syahputra, Darul Rahman	I08
078	Study on Indonesian Plastic Marine Debris Based on River Survey	Akhmad Zainal Abidin, Soen Steven	I07
090	Circular Economy on Organic Waste Management with MASARO Technology	A.Z. Abidin, H. Bramantyo, C. Egiyawati, M.K. Baroroh	I09
091	Circular Economy on Inorganic Waste Management with MASARO Technology	A.Z. Abidin, E.V Yemensia, K.W. Wijaya, A.P. Rahardjo	I10
097	Integrated Biorefinery Technology : Monetization of Oil Palm Empty Fruit Bunch to Biofuel & Bio-based Chemicals, and Beyond	Rina Mariyana, Azka Azkiya Choliq, Yusuf Nugroho, Ronny Purwadi, MTAP Kresnowati, Krisna Septiningrum, Frans B.M. Dabukke	I11
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014	The Influence of Climate Change on Long-term Projection Water Balance in Southeast Asia Mangrove Forest	Anjar Dimara Sakti, Muhammad Rais Abdillah, Luri Nurlaila Syahid, Tanakorn Sritarapipat, Jeark A. Principe, Nguyen Thi Quynh Trang, Adam Irwansyah Fauzi, Aditya Dimas Pramudya, Lissa Fajri Yayusman, Ketut Wikantika	K02
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046	Bacterial Immobilization in Super-Adsorption Composite Material and Its Application on Decolorization and Biodegradation of Methylene Blue Dye on Batik Industrial Wastewater	Adi Setyo Purnomo, Hamdan Dwi Rizqi	K04
056	KURITA Overseas Research Grant 2020 : Nanocellulose-based Magnetic Nanocomposite as Superadsorbent of Toxic Heavy Metal Ions	Athanasia Amanda Septevani, Deni Shidqi Khaerudini	K05
065	Biomonitoring and Multidrug-Resistant Pathogenic Bacteria in Coastal Water and Sediment of Semarang City, Central Java	Mada Triandala Sibero	K06
066	Biological Properties Screening of *Polycarpa aurata* from Bara Caddi, Makassar	Mada Triandala Sibero, Agus Trianto, Tao Zhou, Enjuro Harunari, Yasuhiro Igarashi	K07
094	Public Risk Perception and Public Acceptance of the Existing Flood and Drought Mitigation Measure in Bandung City	Linggar Y Asmara, Saut Sagala, Danang Azhari, Elisabeth Rianawati	K08

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111	Assessment of Characteristic Algae Organic Matter and its Impact in Oxidation Ditch Algae Reactor	Euis Nurul Hidayah, Elita Nurfitriyani Sulistyo, Okik Hendriyanto Cahyonugroho, Ni Made Maya, Aulia Ulfah Farahdiba	K10
112	Cellulose-Based Fish Scale Inspired Superoleophobic Membrane : A review	Abdul Halim	K11
116	Microwave-Assisted Synthesis of TiO_2/GO Composite and Its Adsorption-Photocatalysis Property under Visible Light	Sarno Setiawan, Andri Hardiansyah, Christina Wahyu Kartikowati, Aditya Farhan Arif, Sigit Priatmoko, Osi Arutanti	K12
018	Glyphosate-Based Herbicide Reduction and Bioelectricity Generation by Constructed Wetlands Coupled Microbial Fuel Cells	Kiki Gustinasari, Ellina Sitepu Pandebesie, Joni Hermana	K13
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013	Non-Solvents Selection for Cellulose Acetate/Polyethylene Glycol-grafting-Graphene Oxide (CA/PEG-g-GO) Membranes	Arnesya Ramadhani, Retno Dwi Nyamiati, Imanuel Berin, Naufal Ahmad Murtadho, Yeni Rahmawati, Siti Nurkhamidah	M01
019	Preparation and Characterization of Antibacterial Polysulfone/*Lantana camara* Membranes for Wastewater Ultrafiltration	Zulfah Amala, Adhi Satriyatama, Ignatius Dozy Mahatmanto Budi, Ardiyan Harimawan, Muchlis	M02
024	Effect of Additive on Microstructure, Hydrophilicity and Ultrafiltration Performance of Polyethylene Terephthalate Membranes	Samuel P. Kusumocahyo, Syarifa K. Ambani, Shelly Marceline, Franzesca Michelle	M03
026	Selective H_2S Absorption Using the Mixture of NaOH-$NaHCO_3$-Na_2CO_3 Buffer Solution as Solvent	A Indarto, A Raksajati, D Ariono, H K Purwanto, A N Baskoro	M04
054	Separation of Potassium from the Model Solution	Ratna Puspita, Herri Susanto	M05
058	Effect of Graphene Oxide on the Performance of Cellulose Acetate / Polyethylene Glycol Membrane by Blending Method	Retno Dewi Nyamiati, Bertiningrum Cintya Devi, Bagus Arief Febriansyah, Arnesya Ramadhani, Yeni Rahmawati, Siti Nurkhamidah	M06
072	Vacuum Regeneration Technology Using Contactor Membrane for CO_2 Desorption Process from Diethanolamine Solvent	Yeni Rahmawati, Ahmad Farid Arroyid, Moch. Ainun Hikam, Siti Nurkhamidah	M07
082	Oxidation Process for Removing Carbamate Residue from Pesticide Manufacturing Waste	Gallan Kusuma, Endarto Yudo Wardhono, Rahmayetty	M08

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098	Progress, Challenges, and Prospects of Forward Osmosis (FO) and Pressure Retarded Osmosis (PRO) as An Alternative Solution for Water and Energy Crisis	Graecia Lugito, Danu Ariono, Mochamad Rizqy Trihutama Putra, Zoealya Nabilla Zafra	M09
101	Regeneration of Spent Bleaching Earth for PLA-Nanocomposite Filler	Johnner P. Sitompul, Hizkia M. V. Gultom, Tika Paramitha	M10
118	Purification of Vitamin E from Palm Fatty Acid Distillate through Neutralization, Extraction, and Adsorption Method	Anggita Veningtia Sari, Dianika Lestari, Ardiyan Harimawan	M11
127	Effect of Dimethyl Sulfoxide (DMSO) as a Green Solvent and the Addition of Polyethylene Glycol (PEG) in Cellulose Acetate/Polybutylene Succinate (CA/PBS) Membrane's Performance	R. D. Nyamiati, Y. Rahmawati, A. Altway, S. Nurkhamidah	M12
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009	Natural Gas Network Design using Superstructure Method in East Java Indonesia	Rendra Panca Anugraha, Renanto, Juwari	P01
022	Simulation Study of Heating Process under Ultrasound Irradiation in the Manufacture or Microcellular Thermoplastic Foam using Temperature-Induced Foaming	Fajar Firstya Adam, Calvin Baggery, Jeremy Samuel, Prida Novarita Trisanti, Sumarno	P02
031	Local Equilibrium Modelling in Simulating Experimental Breakthrough Curves of Cadmium Biosorption using Fixed Bed Reactor	Awalina Satya, Ardiyan Harimawan, Keryanti Keryanti, Tjandra Setiadi	P03
087	Recovery of Ammonium Chloride from Wastewater of Polyvinyl Chloride Thermal Stabilizer Plant by Evaporative Crystallization with Mechanical Vapor Compression : Process Performance and Economic Evaluation	I Dewa Gede Arsa Putrawan, Adli Azharuddin, Yona Octavia	P04
119	Kappa Number and Viscosity Analysis in Oxygen Delignification of Manihot Esculenta Crantz: A Comparison of Prediction and Experimental Data	Safitri Wulansari, Dinda Bazliah, Aria Darmawan, Hikmatun Ni'mah, Achmad Roesyadi, Firman Kurniawansyah	P05
Topic: Reaction and Control Engineering			
015	Isomerization of Raw Turpentine using Various Combination of Strong and Weak Acid Catalysts for Cinole Production	Nicolaus Elka Yudhatama, Diva Almira Chairany, Muhammad Mufti Azis, Antonius Indarto	R01
016	Depolymerization Kinetics of Aqueous Cassava Starch under Sonication Process using Free-Radical Depolymerization Model and its Correlation with Radical Products from Accoustic Cavitation	Bramantyo Airlangga, Dewangga Widyanindra A, Ahmad Adnan Billah A, Prida Novarita Trisanti, Juwari, Sumarno	R02

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057	Effect of Buffer Concentration on Palm Oil Lipolysis using Plant Latex Lipase	Astri Nur Istyami, Muhammad Helmi Risansyauqi, Wayda Rahma Putri Fajar, Meiti Pratiwi, Ronny Purwadi	R03
067	Kinetics Study and Performance Analysis of Indonesian Rice Husk Pyrolysis	Laksmi Dewi Kasmiarno, Soen Steven, Jenny Rizkiana, Elvi Restiawaty, Yazid Bindar	R05
068	Isomerization of Raw Turpentine for Cineole using Response Surface Methodology (RSM) : Influence of Acid Ratios and Residence Time	Diva Almira Chairany, Nicolaus Elka Yudhatama, Muhammad Mufti Azis, Antonius Indarto	R06
102	Effects of Operating Conditions on the Production of Sodium Stearoyl 2-Lactylate	Lienda Handojo, Dian Shofinita, Karina Yuventia, Lindawaty	R07
106	Application of Reverse Flow Reactor for Vent Gas Emission Reduction in Catalytic Oxidation Unit at Purified Terephthalic Acid Plant	Fadhly Mahdy Hanafiah, Yogi Wibisono Budhi	R08
107	Development of Feed Modulation in Fixed Bed Reactor for Dry Reforming of Methane	Intan Clarissa Sophiana, Abdur Rashid, Yogi Wibisono Budhi	R09
110	Synthesis of α-Terpinene from Raw Turpentine	Ilham Ardiyanto Putra, Muhammad Mufti Azis, Tatang Hernas Soerawidjaja, Antonius Indarto	R10
122	Activity Test of CuO/γ-Al_2O_3 as Catalyst of Methanol Dehydration to Dimethyl Ether at Atmospheric Pressure	Edi Susanto, Aisyah Ardy, Herri Susanto	R11
Topic: Symphosis			
010	Synergistic Effect of TiO_2 and ZnO Photocatalysts for 4-Nitrophenol Photodegradation under Ultraviolet Irradiation	Yehezkiel Steven Kurniawan, Krisfian Tata Aneka Priyangga, Leny Yuliati	S01
011	Processing of Palm Mill Oil Effluent Using Photocatalytic: A Literature Review	Lya Agustina, Suprihatin Suprihatin, Muhammad Romli, Prayoga Suryadarma	S02
039	Titania Modified Silica from Sugarcane Bagasse Waste for Photocatalytic Wastewater Treatment	Wibawa Hendra Saputera, Candra Egiyawati, Jenny Rizkiana, Dwiwahju Sasongko	S03
053	Optimization of UV Light Source Conditions for Photocatalytic Activity of Methyl Orange using TiO_2	Siti Oryza Zativa, Muhammad Ali Zulfikar, Anita Alni	S04
060	Improved Visible Light Activity of Copper Oxide / Carbon Nitrides Photocatalyst Prepared by Photodeposition of Phenol Degradation	Christyowati Primi Sagita, Leny Yuliati	S05
070	High Photocatalytic Activity of Zink Metatitanate Materials for Phenol Photodegradation	Krisfian Tata Aneka Priyangga, Yehezkiel Steven Kurniawan, Leny Yuliati	S06

Registration Number	Title	Author	Paper Code
070	High Photocatalytic Activity of Zink Metatitanate Materials for Phenol Photodegradation	Krisfian Tata Aneka Priyangga, Yehezkiel Steven Kurniawan, Leny Yuliati	S06
105	TiO_2/CNCs Hybrid Photocatalyst for CO_2 Photoreduction: TiO_2/CNCs Synthesis	Haroki Madani, Daffa Rifqi Pratama, Mikail Boron Alfisyahri Budiman, Meiti Pratiwi, Arie Wibowo, Yogi Wibisono Budhi	S07
117	TiO_2/AC Composite for Adsorption-Photocatalytic of Methyl Orange	Christina W. Kartikowati, Anggun L. Wulansari, Bambang Poerwadi, Supriyono, Aditya Farhan Arif, Triastuti Sulistyaningsih, Osi Arutanti	S09

SYMPHOSIS 2020

Keynote Speaker's Abstracts

Kari Herlevi

The Future is Carbon-Neutral Circular Economy that Protects Biodiversity

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Abstract

We need globally a transition to a fair and competitive economy that tackles the root causes of biodiversity loss, climate change and overconsumption of resources, by facilitating the development and scaling of the best circular solutions from Finland and the world.

Alternative Water Sources towards Water Security

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Abstract

Australia is the driest habitable continent on earth. Maintaining water security in a low water supply climate is crucial for meeting human needs and economic development in Australia. This is possible through a suite of measures such as water reuse, storm water harvesting and desalination.

(i) Although offering necessary insurance against extended periods of low rainfall, desalination plants using reverse osmosis are typically not used to their full potential, in large part due to the high cost of operating the desalination processes. One way to operate more sustainably at full potential is to address biofouling through early detection. Recovery of valuable resources in the desalination process can offset the operating cost.

(ii) Cities and towns need to expand the capacity of their water supplies by potable and non-potable water reuse. Sustainable approaches to remove persistent micro pollutants from wastewater provides avenues for safe reuse while phosphorus recovery provides pollution mitigation and its sale gives economic incentives.

(iii) Stormwater is an alternative water resource and its high rate treatment and harvesting could supplement traditional urban water supplies for irrigation and other uses.

Bunsho Ohtani

Design, Preparation and Detailed Characterization of Photocatalysts Based on Enegry-resolved Distribution of Electron Traps

Bunsho Ohtani

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Abstract

How can we design solid photocatalysts? What is the decisive factor controlling photocatalytic activities? So-called band-structure model (BSM), electrons in a valence band (VB) of a photocatalyst is photoexcited to a conduction band (CB), leaving positive holes in VB, and electrons and holes reduce and oxidize, respectively, substrates adsorbed on the surface of the photocatalyst, does suggest preferable band positions for redox reaction uniquely decided only by crystalline structure. The other possible factors, e.g., particle size and surface structure, cannot be discussed within BSM. Recently, we have developed reversed double-beam photoacoustic spectroscopy (RDB-PAS) which enables measure energy-resolved density of electron traps (ERDT). Those electron traps (ETs) seem to be predominantly located on the surface of almost all the metal oxide particles, with exception of nickel oxide and therefore they reflect macroscopic surface structure in ERDT patterns. Using ERDT pattern with the data of CB-bottom position (CBB), i.e., ERDT/CBB patterns, it has been shown that metal oxide powders can be identified without using the other analytical data such as X-ray diffraction patterns or specific surface area, and similarity/differentness of a pair of metal-oxide samples can be quantitatively evaluated as a parameter, zeta, degree of coincidence of ERDT/CBB patterns. In this talk, a novel approach of functional-material design based on the ERDT/CBB patterns is introduced.

Andrzej Stankiewicz

Process Intensification and Advanced Materials

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Abstract

The majority of research articles published in the field of PI so far, have focused on new equipment concepts, e.g. microreactors or high-gravity devices, or on innovative processing methods, e.g. hybrid separations or alternative energy forms and transfer mechanisms. An aspect that has been insufficiently addressed in the literature until now is the role of (advanced) materials in process intensification. Enormous developments in the materials science and engineering witnessed in the last decennia have opened interesting new opportunities and possibilities for intensification of chemical processes. The lecture examines the role that materials already play or can play in process intensification. Various categories and types of materials are presented, that have been shown to intensify chemical and catalytic reactions, mass transfer, heat transfer and momentum transfer operations, respectively. Also, the "Yin-Yang" relation between PI and materials, and the role of process intensification in manufacturing of new, advanced materials are discussed.

Jiří Jaromír Klemeš

Plastics: Material for the future? Lessons learned from COVID-19 pandemics

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Abstract

The plastic, more correctly to be addressed as polymers, are one of the most important materials of the present time and obviously of the future. The plastics have been branded as an evil, which must be replaced, in some cases at any cost. However, a coldblooded analysis and assessment are needed comparing all pros and cost based on environmental footprints quantification with full life cycle assessment. This should include assessment of possible health risks, consumed energy, released emissions and effluents, as well as consumption of raw materials, water and dealing with the wastewater. The assessment of recyclability, reprocessing and environmental burden is needed. The presentation tends to contribute to the discussion of what recommendations should be developed to the industry and business to minimise the environmental impacts based on COVID-19 pandemics. A Plastic Footprint has been assessed, and a novel Plastic Waste Footprint introduced.

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SYMPHOSIS 2020

Invited Speaker's Abstracts

Wastewater Treatment in the Aquaculture Industry with a Circular Economy Concept

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Abstract

The circular economy is an economic system aimed at eliminating waste and the resources are used continuously. In other words, nothing is wasted everything in the production process is reused, recycled or repurposed. In this paper I describe a circular economy in the shrimp production process. The wastewater from shrimp aquaculture industry contains high concentration of nitrogen and carbon. The new technology for shrimp farming is called recirculating raceway system. This is a zero-water exchange system capable of producing high-density shrimp yields. However, this system produces wastewater characterized by high levels of ammonia, nitrite, and nitrate due to 40% protein diet. The high concentration of nitrate and nitrite (>25 ppm) are toxic to shrimp causing high mortality of shrimp. So treatment of this wastewater is imperative in order to make shrimp farming viable. One simple method of treating high nitrogen wastewater is the use of a sequencing batch reactor (SBR). A SBR is a variation of the activated sludge process, which accomplishes many treatment events in a single reactor. Removal of ammonia and nitrate involved nitrification and denitrification reactions by operating the SBR aerobically and anaerobically in sequence. Initial SBR operation successfully removed ammonia, but nitrate concentrations were too high because of carbon limitation in the shrimp production wastewater. Specifically, the initial chemical oxygen demand concentration of 1996 mg/L was reduced to 4 mg/L within eight days of reactor operation. Ammonia in the wastewater was nitrified within three days. The denitrification of nitrate was achieved by the anaerobic process and more than 99% removal of nitrogen was observed. The treated water is recycled into the production system and the sludge is repurposed for coastal restoration activities.

Kakeru Fujiwara

Controlling Pd Clusters on TiO_2 from Nano to Atomic Size by Scalable Flame Spray Pyrolysis

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Abstract

Reducing the particle size of noble metals on supports can maximize noble metal performance and minimize its use. Here Pd clusters onto TiO_2 particles were prepared in one step by scalable flame aerosol technology while controlling the Pd cluster size from a few nanometers to that of single atoms. The presence of single Pd atoms on TiO_2 was confirmed by FTIR using NO as probing molecule. The fraction of single Pd atoms on TiO_2 surface linearly increases up to 0.1 wt.% of nominal Pd-content and above that, formation of Pd clusters or particles takes place.The photocatalytic NO_x removal of the flame-made materials is up to 10 times faster than that of commercial TiO_2 (P25, Evonik). Such superior performance can be attained by only 0.1 wt% Pd loading on TiO_2 because of the presence of isolated Pd atoms on TiO_2. The performance of single Pd atoms is attributed to their high resistance to nitrate and NO_x poisoning.

Made Tri Ari Penia Kresnowati

Circular Economy of Palm Oil Industry: Bioprocess Technology for Biorefinery of Oil Palm Empty Fruit Bunches

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Abstract

Oil palm is an important plantation commodity in Indonesia. The main products, palm oil and palm kernel oil are produced from the oil palm fruit whereas this industry also produces various kind of biomasses that can be potentially utilized as the raw material for various biochemicals in the biorefinery platform. This presentation discusses several case studies in the implementation of bioprocess technology in the utilization of oil palm empty fruit bunch (EFB) for producing biochemicals, from the high value biochemicals i.e. carotenes and xylitol to the bulk chemicals i.e. raw xylanase and ethanol. The potential combination of those processes to increase the economics of the industry is also discussed.

Keyword : biorefinery, EFB, oil palm biomass.

Leny Yuliati

Carbon Nitride Photocatalyst: How to Enhance the Photocatalytic Activity

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Abstract

Carbon nitride is an interesting organic semiconductor that has been recognized as a visible light active photocatalyst. Even though carbon nitride has a good capability to degrade organic pollutants, the photocatalytic activity is still considered low and further improvement is required. Several methods have been reported to increase the photocatalytic activity of carbon nitride. One reported approach is to synthesize crystalline carbon nitride with the help of potassium chloride-lithium chloride salt melt [1]. The obtained material was shown to have good crystallinity, increased absorption in the visible region, and maintained a high specific surface area. All these factors were proposed to be important to obtain high photocatalytic activity. Another method is generating mesoporosity in the carbon nitride with the help of silica nano colloidal as the hard template [2]. The uniform mesoporosity and large specific surface area resulted in better photocatalytic activity. The photocatalytic activity of carbon nitride could be also enhanced by promoting electron-hole separation and interfacial charge transfer [3,4]. This could be achieved by introducing other materials that can induce charge mobility, including coupling with other semiconductors, dye sensitization, and also co-catalyst. As an example, reduced graphene oxide could be employed to achieve such a purpose. The addition of reduced graphene oxide was demonstrated to give higher photocatalytic activity as the rate of heterogeneous electron transfer was increased, better diffusion and less resistance were achieved, and the photocurrent response was improved. By obtaining excellent properties after the modifications, the photocatalytic activity of carbon nitride could be further enhanced and the wider applications as photocatalyst under visible light irradiation could be expected.

Keywords: carbon nitride, crystallinity, interfacial charge transfer, mesoporosity, photocatalyst

References:

[1] M. H. M. Hatta,H. O. Lintang, S. L. Lee, L Yuliati, Turk. J. Chem., 43 (2019) 63–72.
[2] S. C.Lee, H, O. Lintang, L.Yuliati, Chem. An Asian J. 7(9) (2012) 2139–2144.
[3] P. Tiong, H.O. Lintang, S. Endud, L. Yuliati, RSC Adv. 5 (114) (2015) 94029–94039.
[4] L. Yuliati, P. Tiong, H. O. Lintang, Mater. Res. Express. 6 (2019) 074004.

Dewi Mersitarini

CO_2 Conversion to Value Added Product

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Abstract

As stated in Paris agreement that Indonesia commit to reach emission reduction by 29% in 2030 and 41% with international collaboration for mitigating global climate change.

Pertamina as National Energy Company shows the commitment to support Government target by actively developing the Research and Development of Carbon Capture Utilization and Storage Research and Development. The CCUS team is performing development of non-conversion scheme such as CO2 injection to Geological storage and Conversion scheme by using CO2 as feedstock and synthesize it into other value added product such as Precipitated Calcium Carbonate, Methanol, SynGas then DME, Polimer and Bioconversion by cultivating microalgae.

In this seminar, to be related to industrial topic then I will present the CO2 Conversion scheme that will develop CO2 based Chemical and fuel which furthermore will impact to Development of New Business Portfolio in Pertamina.

And I hope by delivering this presentation will inspire the audience to contribute more on the R&D of CO2 utilization which will mitigate Global Climate Change

Circular Economy in Wastewater Treatment – The Current Atmosphere of Hope

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Abstract

The potential of industrial uses for recycled water would entail an entirely different ecosystem for wastewater treatment. Sewerage companies are pushing for ties with the UN's Sustainable Development Goals (SDGs) that calls for higher water-reuse efficiency and reduced proportions of untreated wastewater. Malaysia's commitment to the SDGs mean it is looking to increase the reuse of effluent by one-third by the year 2030 which sums up about 2,000 mld of its current effluent production. Companies are open to potential public-private partnerships (PPP) particularly with water companies and property developers for industrial developments accounting for the commercial aspects and benefits. The recovery and reuse of resources are key points, leading to a decrease in the consumption of raw materials, waste reduction, and improvement of energy efficiency. This is the reason why the concept of the circular economy can be applied in any industrial activity, including the wastewater treatment sector.

SYMPHOSIS 2020

Advanced Science and Materials

A-01

Effect of Bubble Size on Electrochemical Reduction of Carbondioxide to Formic Acid

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Abstract

A variety of technologies to diminish greenhouse gases CO_2 emission have been extensively explored in recent years. One promising technology called electrochemical reduction of CO_2 have been developed to convert CO_2 into value-added chemicals, such as methanol, ethanol, ethylene, and formic acid. One of important parameter that need to be considered is the size of CO_2 bubbles. In general, decreasing bubbles size can increase retention time of carbon dioxide in an electrolyte. In this research, effect of the microbubble size on the effectiveness of electrochemical reduction of carbon dioxide to formic acid was studied. Bubbles with average diameter 0.321 and 0.952 mm were generated through perforated glass apparatus. The FTIR analysis showed peak at 1634 cm^{-1} which attributed to C=O bonding of formic acid. Smaller bubble size showed relatively more stable and higher electric current during electrolysis, indicating better retention time of carbon dioxide in the electrolyte.

Keywords: Microbubbles; Electrochemical Reduction of CO_2; Formic Acid; Retention Time; Size Effect; Electrolyte Composition

A-02

An Overview of Synthetic Polymer-based Membrane Modified with Chitosan for Fuel Cell Application

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Abstract

The materials used for fuel cell membrane must have a high proton conductivity, a strong enough wall to block the reactant flow rate, and be chemically or mechanically stable in the environment around the fuel cell. To improve the effectiveness of fuel cell membranes and reduce production costs, several synthetic polymer membranes have been developed, including polyethersulfone, polysulfone, polyvinyl alcohol, and polystyrene. Membranes from this polymer have the advantage of being cheap, commercially available, and allowing its structure to store moisture so it can operate at higher temperatures, yet it has low hydrophilic property. Chitosan, as a biopolymer that has strong hydrophilicity property resulted from numerous hydrophilic groups (e.g. –OH, $–NH_2$ and $–NR_3$ þ), can be used for various chemical modifications including to increase mechanical and chemical stability and modification to the possibility of producing ion exchange and increasing ionic conductivity which is a requirement for fuel cell membrane. The purpose of this study is to review the use of chitosan as synthetic polymer-based membrane modification from its structure and properties. Recent achievements and prospect of its applications have also been included.

Keywords: Cell Performance; Chitosan; Fuel cell; Membrane; Synthetic Polymer

A-03

Electrospun Zeolite Fiber for Dye Removal

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Abstract

Zeolite fibers are promising material for adsorption application due to high surface area and high ion exchange capacity. Direct application of zeolites particles as adsorbent is not practical as it requires separation after the adsorption. Structured zeolites in the form of fiber offer faster and easier adsorbent separation. Electrospinning is a fast, easy, reproducible way to produce zeolite fiber. In continuation of our work [1], we expanded our strategy to include silica as alternative to alumina as binder. Zeolite fiber containing LTL nanozeolite as active adsorbent and silica as binder has been successfully fabricated using electrospinning technique. The fabricated zeolite fiber formed a mat and had a diameter of 400-450 μm seen under electron microscope. The zeolite mat demonstrated significant mechanical strength while at the same time, unlike our previously, retained the higher surface area. The fabricated fiber was tested for methylene blue removal and the results herein described.

Keywords: Fibers, Zeolite, Silica, Zeolite LTL, Electrospinning, Methylene Blue.

A-04

The Synthesis of Magnetic Molecularly Imprinted Polymer Against Di-(2-ethylhexyl) Phthalate

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Abstract

Magnetic molecularly imprinted polymer (MMIP) was prepared against di(2-ethylhexyl)phthalate, using methacrylic acid as a functional monomer, ethylene glycol dimethacrylate as a crosslinker and benzoyl peroxide as an initiator. MMIP was characterized using Scanning Electron Microscope and infrared spectrophotometer. IR spectrum shows successful preparation of MMIP. The peak at 586 cm^{-1} is a typical vibration of Fe-O. The strong peaks at 1728 cm^{-1}, 1261 cm^{-1}, and 1153 cm^{-1} are stretching vibration of C=O and C-O of methacrylic acid and DEHP. The peak at 1462 cm^{-1} due to C-C aromatic vibration of DEHP. A broad absorption band at 3468 cm^{-1} due to the stretching vibration of hydroxy bonds. The MMIP has a spherical morphology with the diameter 0.1-0.5µm. Experimental results show the potential of magnetic molecularly imprinted polymer for recognition of di-(2-ethylhexyl) phthalate.

Keywords: di(2-ethylhexyl) phthalate; Imprinted Polymers; Magnetite

A-05

Optimization of Electrode Material Composition from Activated Carbon, Multi Wall Carbon Nanotube, and Graphene for Enhance Performance of the Supercapacitor

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Abstract

Supercapacitor has received widespread attention as one of the most promising energy conversion and storage devices due to its high power density, good energy density, long life cycle, and is used in a wide range of electronic applications. Optimization of the composition of the electrode material mixture of activated carbon (AC), multiwall carbon nanotube (MWCNT), and graphene (GR) and also supercapacitor performance test has been successfully carried out. The synergistic effect between AC, CNT, and GR validate AC/ MWCNT/GR as a promising electrode for supercapacitor, show greatly improved electrochemical performance compared to AC pure, pristine MWCNT, and GR electrodes. The electronic conductivity of AC and GR can be enhanced by the surrounding MWCNT, while restacking sheets GR and aggregation MWCNT particles could be effectively suppressed by AC. The optimum mixture composition of AC, MWCNT and GR for supercapacitor electrode were 70%, 20% and 10%wt, respectively, giving the highest capacitance value of 33.12 Fg^{-1} in M KOH electrolyte at scan rate of 2 mVs^{-1}.

A-06

Production of Activated Carbon from Palm Empty Fruit Bunch as Supercapacitor Electrode Material

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Abstract

Activated carbon is prepared by carbonization out by hydrothermal carbonization. Hydrother-mal carbonization is a process that carried out with aqueous media in a pressurized reactor at a lower temperatur that the pyrolysis process. This research focused on production of activated carbon from empty fruit bunch by hydrothermal carbonization process using $CaCl_2$ as activat-ing agents. Ratio of raw material/activating agent/water was 1:2:3. Hydrothermal carbonization was carried out at 275℃ for an hour. Furthermore, hydrochar was activated at a temperatur of 800℃ in presence of CO_2 for 2 hours. Activated carbon was modified with 1 M nitric acid (HNO_3). A self-supporting and flexible activated carbon/graphene/carbon nanotube (AC/GP/CNT) electrode has been rationally designed for constructing high-performance supercapacitor. The CNT is beneficial for improving the electronic conductivity of the electrode, while AC particles could effectively suppress the aggregation of GP and CNT due to their blocking effect. The synergistic effect among the AC-Ca, GP and CNT validate the AC-Ca/GP/CNT as a promising electrode for supercapacitor, exibiting greatly enhanced electrochemical performances in comparison with the pure GP, pure CNT and AC-Ca electrode. The AC-Ca/GP/CNT electrode delivers a high specific capacitance of 53.51 F g^{-1}

Keywords: Biomass; Activated Carbon; Hydrothermal; Electrode; Supercapacitor

A-07

Fabrication of Dye Sensitized Solar Cell (DSSC) Module

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Abstract

Solar energy in the equatorial country of Indonesia is the most promising alternative energy source because of constant sunlight exposure throughout the year. DSSC has the ability to utilize diffused light, which more suitable in humid-cloudy climate of Indonesia. In this study, the characteristics and reproducibility of the TCO glass for the DSSC module as well as the effect of the number of cells in a module with the same total active area to the performance of the DSSC module are determined. The conductive glass was fabricated using spray pyrolysis method. UV-vis spectrophotometer and four-point probe was utilized to study the glass transmittance and resistance, respectively. The number of cells in the DSSC module was varied to 1 and 2 with the total active area of 60 cm^2. The produced conductive glass showed transmittance, resistance, and figure of merit of 77,45-85,32%; 5,85-17,82 Ω/sq; and (9,10-13,21) × 10^{-3} $Ω^{-1}$, respectively under confidence level of 95%. Reproducibility test showed consistent result with deviation for transmittance, resistance, and figure of merit were 2,47%; 25,78%; and 9,41% respectively. The two-cell DSSC module was tested with light to electric conversion efficiency of 6,68 × 10^{-4} %.

Keywords: Conductive Glass; DSSC Module; Efficiency; Figure of Merit; Reproducibility; Total Area

A-08

Development of Organoclay for Removal of Fe (III) and Mn (II) from Acid Mine Drainage Model

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Abstract

Mining sector is one of biggest non-tax state revenue for Indonesia, it is necessary to minimize it negative outcome. Acid mine drainage (AMD) is one of wastes sourced from mining activities that has low pH and high concentration of iron and manganese. Adsorption is the inexpensive and easy methods that can be used to remove heavy metals from a solution. Montmorillonite is one type of adsorbent originated from clay mineral that is widely available in Indonesia. Montmorillonite will be modified by homogenizing the exchangeable cation and adding other compounds to increase the number of active sites. This modification aims to increase the adsorption ability of montmorillonite to adsorb Fe (III) and Mn (II) ions. After the CEC value was obtained next step was modification of montmorillonite. Modifications were made by addition of benzalkonium chloride to form organoclay, variation made by addition certain amount of surfactant based on CEC, the variation are montmorillonite treated with 1 x CEC, 2 x CEC, and 3 x CEC. Organoclays was used to study the effect of time on adsorption. After adsorption the concentration of Fe (III) and Mn (II) in AMD model were determined by using atomic adsorption spectroscopy. The most effective adsorbent for of removing Fe (III) and Mn (II) was Organo-Na-Montmorillonite 3 CEC. The highest percent removal for Fe (III) was 78.08% and for Mn (II) was 44.22% from initial concentration 10 mg/L using 1% adsorbent. Adsorption and desorption took place simultaneously because H_2SO_4 in AMD model is a leaching agent that can desorb Fe (III) dan Mn (II) from adsorbent, so the equilibrium point can not be determined. The largest maximum adsorption capacity was obtained from Organo-Na-Montmorillonite 3 CEC for removal of Fe (III) is 0.85 mg g while for removal of Mn (II) is 0.44 mg/g.

Keywords*:* Organoclay; Atomic Adsorption Spectroscopy; Benzalkonium chloride; Adsorption

A-09

Wettability Improvement of Carbon Nanotube For Supercapacitor Electrode

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Abstract

Carbon Nanotube (CNT) has outstanding properties such as electrical conductivity, specific surface area, charge transport capability, mesoporosity and very high electrolyte accessibility. Based on these properties, CNTs are very suitable to be used as high-performance supercapacitor electrodes which can be seen from the capacitance. One of the factors that can lead to increase capacitance is the high interface interaction between CNT and the electrolyte. The interface interaction of CNT and electrolyte can be improved by increasing the CNT wettability using hydrophilization. CNT is synthesized by pyrolysis with Palm Oil Mill Effluent (POME) as the main raw material. In this study, hydrophilization was carried out using chemical activation HNO_3 with various concentrations and activation times (1M for 1, 3, 6 hour and 13M for 1 hour). The results of CNT structure were characterized using Scanning Electron Microscopy (SEM), Transmission Electron Microscope (TEM), and X-Ray Diffraction (XRD), as well as electrochemically characterized using cyclic voltammetry (CV), Electrochemical Impedance Spectroscopy (EIS) dan galvanostatic charge-discharge (GCD), as supported data to evaluate which concentration and activation time with the highest efficiency to improve CNT performance as a supercapacitor. Based on CV characterization, capacitance of CNT before hydrofilization, and after hydrofilization using HNO_3 (1M for 1 hour, 3 hour, 6 hour and 13M for 1 hour) were 10 F/g, 13.30 F/g, 14.28 F/g, 26.95 F/g and 24.5 F/g respectively. When CNT hydrophilized at 13M for 1 hour, capacitance decreased. Due to surface damage of CNT, therefore the performance of supercapacitor decreased. This was supported with the results of the GCD characterization, where some charges could not completely release.

Keywords: CNT; Supercapacitor; Hydrophilization; Activating Agent; Characterization

A-10

Agglomeration Issues of Biosynthesized Nanoparticles – A Review

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Abstract

Materials with nanoscale particle size have different properties from its bulk phase, which allows for wider application of the material. There are various methods to synthesize nanoparticles, namely physical, chemical, and biological method. Nowadays, nanoparticle synthesis method is focused on biological method because of its advantages, such as environmentally friendly, relatively simple procedures, and lower production costs. The principle of synthesis by biological method is to utilize activity of living organism or their metabolites to carry out formation of the nanoparticles. Biosynthesis by co-precipitation method using extracts from biological agents is considered the most efficient among other biological methods. Biochemical compound in the extract have a dual role in synthesis, they act as a reducing agent which reduces metal salt to metal ion, and as a capping agent which stabilizes the nanoparticle. Biosynthesis has been shown to be able to synthesize nanoparticles as well as physical and chemical method. However, several studies report that the synthesized nanoparticles have low stability regardless of the presence of their capping agent, resulting in agglomeration of nanoparticles, which reduces its efficiency. Until now, studies on particle deagglomeration especially during nanoparticle biosynthesis have not been widely carried out. This review will explain the phenomenon of agglomeration during biosynthesis. Moreover, deagglomeration treatment using physical and chemical approaches will be examined.

Keywords: Agglomeration; Biosynthesis; Nanoparticle

A-11

Supercapacitor Cell Based on Gel Polymer Electrolyte and Activated Carbon from Oil Palm Empty Fruit Bunch as Electrode Material

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Abstract

The supercapacitor is an interesting technology since it can store more energy and can be charged-discharged faster than the usual capacitor. The main components that will affect the performance of supercapacitors are electrodes and electrolytes. Activated carbon is an interesting material to be used as the electrodes as is a renewable material which has quite good electrical properties. In this research, activated carbon is produced from oil palm empty fruit bunches by hydrothermal carbonization process using CaCl2 as an activating agent. The main focus of the present research is the use of gel polymer electrolyte (GPE) to overcome the disadvantages of using liquid electrolytes such as leakage, volatilization, and corrosion inside. The constituent components of supercapacitors will affect the electrochemical characteristics of supercapacitors. The optimum condition of the polymer gel used as the electrolyte is in the ratio 1: 1 (PVA: KOH) with a specific capacitance of 22.47 F/g. The addition of KI in GPE increased the specific capacitance to 27.16 F/g while using liquid KOH was 25.03 F/g.

Keywords: Activated Carbon; Hydrothermal; Electrodes; Supercapacitors; Gel Polymer Electrolyte (GPE)

A-12

Effects of Fe-Doped Electrolyte and Feed Flow Rate Evaluation in Home Made Solid Oxide Fuel Cell

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Abstract

Indonesia is a country with the biggest energy consumption in South East Asia, with the population of 264 million inhabitants and the energy needs percapita reaching 808 kWh each year. With the annual growth rate reaching 1,1%, the need for environmentally friendly energy is always increasing. One alternative method to convert chemical energy to electrical energy is fuel cell, which converts chemical energy directly to electrical energy. Solid Oxide Fuel Cell (SOFC) is one type of fuel cell that has several advantages over other types of fuel cells. To achieve low-cost SOFC and produce performance that rivals other power generations, cheaper and more optimal fabrication is needed.

To achieve low cost SOFC, the materials used are nickel oxide (NiO) for the anode, Calcia Stabilized Zirconia (SCZ) for the electrolyte and Calcia Cobalt Oxide Zinc Oxide (CCZO) as its cathode. In this configuration, the zirconia is partially stabilized by calcia. Metal oxide can be used as a doping to the electrolyte to increase the stability of the electrolyte. Fe_2O_3 is a metal oxide that has a smaller particle diameter than zirconia and calcia, thus increases its potential to move through lattices, forming a denser electrolyte and higher performance. The effect of the amount of fuel utilization also needs to be known.

Using scanning electron microscopy and ASTM C373-88, it was determined that 3%-mole Fe doping on the electrolyte increased the electrolyte density from 83% to 90%. Using electrochemical impedance spectroscopy, it can be concluded that SOFC with Fe doped electrolyte has a lower resistance than SOFC without Fe doping, thus increasing its performance. To predict the effect of fuel utilization, SOFC modeling using Aspen Plus software was performed. Using a correction factor, an equation of power with respect to fuel utilization for the SOFC was generated.

Keywords: Doping; Fuel Utilization; Model; Simulation; SOFC

A-13

Kapok Fiber Modification by Reduced Graphene Oxide for Oil Absorbent

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Abstract

The industrialization of synthetic fiber has resulted in an economic depression for both domestic and global kapok fiber industries as well as the farmers. On the other hand, the development of oleochemical industry demands a separation process that is less cost- and energy-intensive. Supporting the sustainable development goals (SDGs) number 1, 8, 9, 12, and 13, in this study, the under-tapped kapok fiber has been utilized to show its potential value as oil sorbent material. Despite having high oil sorption capacity and being biodegradable, the raw cotton fiber has low oil selectivity, low oil retention, and a fragile structure. In the kapok fiber has been modified with reduced graphene oxide (rGO) to obtain hydrophobic-oleophilic absorbent with high absorption capacity, high oil selectivity, high oil retention, and strong structure to maximize the recovery yield. Modification has been done by soaking kapok fiber in GO supernatant and reducing them with ascorbic acid, then freeze-drying the fiber to get a robust superhydrophobic sponge. Techno-economic and life-cycle analyses have been conducted and the results indicate that kapok-rGO sorbent is economically viable with a potential GPM greater than 36,27%, and environmentally beneficial as it can potentially decrease product carbon emissions by 32.8 ton equivalent CO_2.

Keywords: Kapok Fiber; rGO; Biodegradable Sorbent; Liquid Waste; Separation Proses.

A-14

Synthesis of Bionanocatalyst to Produce Fatty Acids as Precursor of Green Diesel

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Abstract

The development of alternative sources of substitute for petroleum for diesel fulfillment has emerged, one of which is the use of biomass or vegetable oil. Green diesel is the most prospective choice because it has similar properties to conventional diesel. One of the green diesel production methods is by using vegetable oil hydrolysis to produce fatty acids which will then be processed through the hydrotreatment process. Hydrolysis of vegetable oils, also known as lipolysis, can use lipase as a catalyst and the process can be operated under mild conditions. This study aims to immobilize lipase in cellulose nanocrystals (CNCs) to produce fatty acids from vegetable oils. CNCs was chosen as a support for lipase immobilization because it has a large surface area, biocompatibility, low toxicity, and abundant hydroxyl groups on the surface, making it suitable for immobilized lipase support. Characterization was performed using X-ray Diffraction (XRD), Transmission Electron Microscopy (TEM), and Fourier Transform Infrared Spectroscopy (FTIR). The optimum immobilization conditions were obtained at enzyme loading of 1.5 mg, immobilization time of 2 hours, and CNCs/EDC ratio of 1: 2. Based on the highest enzyme activity, which was 6.72 µmol / min.mL with specific enzyme activity of 16.89 µmol / min.mg. Lipase/CNCs with optimum immobilization conditions had higher enzyme activity for palm oil substrate than olive oil. In addition, the thermal stability test showed the highest relative enzyme activity at 25 ° C. In the lipolysis of palm oil to fatty acids, the performance of lipases /CNCs was still lower than free lipases even though they could be used 6 times.

Keywords: Cellulose Nanocrystals; Fatty Acids; Green Diesel; Immobilization; Lipase

A-15

Lipase Immobilization onto Cellulose Nanocrystals (CNCs) for Lipolysis Triglycerides

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Abstract

Over the past decade, the technology of enzyme immobilization has been developed because it is able to produce reusable immobilized enzymes to cut production costs. This research aims to synthesize cellulose nanocrystals (CNC) from sugarcane bagasse. The CNC was then used as a matrix in immobilization of lipase to be applied in triglyceride lipolysis. Lipase was immobilized onto CNC through covalent bonding method at 25°C dan pH 7 with immobilization period variation of 0.5–4.5 hours. The immobilized lipase will be utilized to catalyze lipolysis reaction of triglyceride from palm oil, with lipolysis period 2–10 hours, reaction temperature of 25–60°C, and pH of 6.25–11.25. Lipase was successfully immobilized onto CNC so it can be utilized to obtain degree of hydrolysis of 10%. The optimum immobilization time and lipolysis was 1.5 hours and 6–8 hours respectively. Both free lipase and immobilized lipase had the optimum temperature at 40°C. There was optimum pH shift of lipolysis from pH 7.25 for free lipase to pH 8.25 for immobilized lipase.

Keywords: CNC; Covalent Method; Fatty Acid; Lipase; Degree of Hydrolysis

A-16

Utilization of Kaolin as a Filling Material for Rubber Solid Tire Compounds for Two-wheeled Electric Scooters

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Abstract

Kaolin is a mining material widely used as a filler in the manufacture of various types of finished goods made from natural rubber. Kaolin in this study was used as a special filler for solid tyres for two-wheeled electric scooters commonly used by children. The purpose of this study was to determine the effect of the kaolin loading on the curing properties of the rubber compound, the mechanical properties of the vulcanizate, and the thermal properties of the rubber vulcanizate. Kaolin loading was varied from 22 to 42 phr. The compounds were mixed on a two-roll mill. The vulcanization process took place at 140°C for 17 minutes. The test results showed that kaolin loading had a strong effect on the maximum torque, scorch time, optimum vulcanization time, and mechanical properties of the vulcanizate. Thermogravimetric analysis (TGA) showed that thermal stability of the vulcanizate was influenced by kaolin loading.

Keywords: kaolin; natural rubber; solid tires; two-wheeled scooter tires

A-17

The Effect of Nanostructured Silica Synthesis Temperature on the Characteristics of Silica Filled Natural Rubber Composite

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Abstract

This work discussed the processing, curing, mechanical, and morphological characteristics of natural rubber (NR) filled with nanostructured silica (NS). NS was synthesized at 60-90°C using bagasse ash as raw material. NR was mixed with NS using Haake Rheomix equipped with roller rotors. Curing kinetics of NR compounds was studied using the data obtained from a moving die rheometer. Lower compounding temperature and lower compound viscosity were observed with increasing synthesis temperature. Highest bound rubber content was found at natural rubber filled with silica synthesized at 70°C. The modulus and state-of-mix were found to increase with increasing synthesis temperature. The curing curve obtained showed that the vulcanization kinetics follow autocatalytic model.

SYMPHOSIS 2020

Bioprocess Technology

B-01

Guidelines Numerical Investigation of Double Chamber Acetate-Fed Microbial Fuel Cell in Steady-State Condition

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Abstract

Microbial fuel cells (MFCs) are electrochemical devices that utilize the capacity of microorganisms to oxidize organic substrate involving biochemical pathways. MFCs offer great potential for simultaneous wastewater treatment and energy recovery. Several studies have been done based on experiments while simulation and modelling remain unexplored. Basically, MFCs have a lot of similarities to chemical fuel cell systems, which modelling and simulation have been widely developed. Hence, a study should be done to develop the model in order to widen the implementation of MFCs. Numerical modelling of a fuel cell is an effective tool for evaluating work parameters with less cost and time. Models could also be easily modified for various operation conditions and configurations to generate experimental data on MFCs. A number of papers on simulation and modelling focused on cell voltage as function of cell current density or the current density as function of substrate concentration. In this paper, steady state models of a double chamber acetate MFCs under continuous operation would be investigated. MFCs model based are developed by integrating biochemical reactions, Butler-Volmer expressions, and electrochemical equations using MATLAB 2018a software. The parameters and constants data reported from recent literature are used. Results show that periodic changes in flow rate of fuel could boost the power output. This result also gives the prediction of cell voltage and power density. Nevertheless, models with various configurations or conditions could be readily developed to scale-up or create more efficient MFCs using simple methods.

Keywords: Microbial Fuel Cells; Mathematical Model; Power Density; Cell Voltage; Steady-state

B-02

Evaluation of Heat Distribution and Aeration on Xylanase Production from Palm Oil Empty Fruit Bunches Using Tray Bioreactor

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Abstract

Indonesia imports ±99% of its industrial enzyme supply, mostly from China, India, Japan, and parts of Europe. Xylanase is one of the enzymes that is widely used in industries, especially the pulp and paper, animal feed, and bakery. Previous research has shown that Aspergillus fumigatus ITBCCL170 can produce xylanase enzyme by using the Solid State Fermentation (SSF) process in a tray fermenter using OPEFB as substrate. To improve fermentation productivity, a tray bioreactor model for solid-state fermentation was developed and further used to simulate the effects of aeration and heat distribution on biomass growth and enzyme production. The results showed that solid-state fermentation in a tray bioreactor is indeed far from an ideal condition. Yet, parallel aeration can increase cell and enzyme production which needed further validation.

Keywords: Xylanase; SSF; OPEFB; Air Series Flow Pattern

B-03

Combining Biodelignification and Hydrothermal Pretreatment of Oil Palm Empty Fruit Bunches (OPEFB) for Monomeric Sugar Production

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Abstract

Oil palm empty fruit bunches (OPEFB) is the most abundant agro-industrial waste in Indonesia. It has 22.03-35% hemicellulose content. There are many xylan and glucan in hemicellulose, which can be utilized to obtain xylose and glucose and proceed to another monomeric sugar-based chemical. However, xylose and glucose slowly cannot be converted, consequently in the presence of lignin. This paper reported the delignification of OPEFB using white-rod fungi followed by hydrothermal pretreatment to enhance the xylose and glucose (as monomeric sugar) formation. The study was conducted by comparing the performance of two different species of white-rot fungi (*Marasmius sp.* and *Phanerochaeta chrysosporium*) in OPEFB mass loss, the ability to degrade lignin, and hydrolysis of OPEFB that had been treated enzymatically (temperature of 30oC, agitation speed of 150 rpm, 48 days) at various cultivation times. The analysis was carried out by observing how much lignin was degraded, and monomeric sugar was formed. The best lignin degradation ability was achieved by *Marasmius sp.* (26.67%) during 20 days of cultivation. Furthermore, the best xylose recovery (166 mg/g OPEFB) and glucose recovery (283 g/g OPEFB) occurred in bio-delignification using *Marasmius sp.* for 30 days, followed by hydrothermal pretreatment for 15 minutes at a temperature of 160oC. Overall, the combination of these two pretreatments increased monomeric sugar yield over the length of cultivation time

Keywords: Biodelignification, Enyzmatic Hydrolysis, Hydrothermal Pretreatment, OPEFB, Monomeric Sugar

B-04

Syngas Fermentation for Production of Ethanol

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Abstract

The global demand for fossil fuels has increased sharply in the past 50 years. Plant biomass is one of the fourth largest non-fossil renewable energy sources in the world after geothermal, solar, and wind. To facilitate transportation of this energy source and to provide a more efficient energy source, biomass can be first converted into another energy form, such as ethanol. Syngas fermentation enables the conversion of all biomass components, including lignin into ethanol, thereby increasing the product from the biomass quantity. The development of the syngas fermentation process will be reviewed in this article, which focuses on the types of microorganisms used, the effect of syngas composition, and the gas-liquid mass transfer so that it can be used as a reference for optimizing the syngas fermentation process.

Keywords: Biomass; Biofuel; Syngas Fermentation; Acetogen; Clostridium; Ethanol

B-05

Phenolic Compound, Antioxidant and Antibacterial properties of Electrospun PVP Nanofiber loaded with *Bassela rubra linn* extract and Alginate from *Sargassum sp*.

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Abstract

An alternative wound dressing based on nanofiber mats have been developed recently. The antioxidant and antibacterial activity play an important role in wound healing process. This study aims to combine the properties of *Bassela rubra linn extract* (BRLE) and Alginate from brown macroalgae into Polivynil Pyrrolidone (PVP) nanofiber using electrospinning method. Firstly, the optimization step was conducted to obtain the best operation voltage and distance. Afterwards, the nanofiber composites of PVP/BRLE/Alginate were injected into electrospinning tool in various Alginate concentrations of 1%, 2%, and 3% (w/w) respectively. The morphology of PVP nanofiber observed by Scanning Electron Microscopy (SEM) conveys that the closest distance and the highest voltage were the best. Meanwhile, the in vitro analysis through 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay and antibacterial activity to *S. aureus* and *E. choli* bacteria show a quite strong radical scavenging ability around 60% and adequate antibacterial property as good as reference a well-known material consecutively.

Keywords: Nanofiber, Electrospinning, Total Phenolic Compound, Antioxidant, Antibacterial

B-06

The Effect of Pome Sources and Salt Addition on Microbial Fuel Cell Performance

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Abstract

Indonesia is the biggest palm oil-producing country globally and produces high amounts of palm oil waste (Palm Oil Mill Effluent, POME). Microbial fuel cell (MFC) is an alternative technology that can generate electricity by utilizing POME waste as a substrate. The performance of MFC, measured from the current and power density production, is strongly influenced by the substrate sources and the ionic conductivity. This study aimed to determine the effect of POME sources and salt addition on MFC performance. In this study, two sources of POME were used: (1) the waste from sterilization/boiling (Prb) process and (2) from the fatpit or so-called Effluent (Eff), which was combined with the addition of Na salt with concentrations of 0.05, 0.1, and 0.5% to increase the ionic conductivity. The highest power density and current density were obtained by the POME source from boiling (Prb) based on potentiodynamic measurements. This result showed that the performance of MFC in variations of Prb was better than Eff. The addition of salt showed a positive trend in Prb by producing a P_{max} value reached 1,876 mW/m^2, and the value of current density (i) was 6.2 A/m^2 for the Prb of 0.5% Na). In contrast, for Eff, the P_{max} was only 663 mW/m^{2,} with the i value was 3.33 A/m^2 for the Eff of 0.05% Na. The effect of salt addition also influenced the result of ohmic resistance. MFC produced the lowest ohmic resistance with the highest salt concentration (0.5% Na), i.e., 3.381 Ω for Prb, and 3.824 Ω for Eff.

B-07

Estimation of the Biomass Yield and Stoichiometric Coefficient During Bioproduct Formation through Thermodynamic Approach: A Case Study of Biosurfactant Production

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Abstract

Microbial growth occurs on a wide variety of compounds. The important parameter in biotechnological processes is the yield (Y_{DX}) of biomass (X) on the available substrate (electron donor). Because of its prime importance, biomass yield for many different microbial systems has been studied extensively. Besides biomass yield, a stoichiometric coefficient determination is also important because it can predict the number of reactants and products needed. This paper aims to explain how to determine the biomass yield on electron donor (Y_{DX}) and stoichiometric coefficient during bioproducts formation through a thermodynamic approach. The case study focused on the biosurfactant production process. From the result of the calculation shows that the electron donor and incubation temperature affect the biomass yield on the electron donor (Y_{DX}). For biosurfactant production, glucose obtains a higher value of Y_{DX} than propionate. By using the same electron donor, the higher incubation temperature, the lower of Y_{DX} value. Y_{DX} value is useful for determining the stoichiometric coefficient of biomass growth during the formation of biosurfactants through elemental mass balance. Type of electron donor and temperature affect the stoichiometric coefficient of biomass growth during the biosurfactant production process.
A itu

B-08

Microbial Biosurfactant Potential on Cadmium Heavy Metal Bioremediation in Co-Contaminated Environment

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Abstract

Heavy metals pollution due to anthropogenic and industrial activities become significant environmental pollution issues that could lead to many health problems. Besides metals several compounds usually exist in the contamination sites that could reduce the remediation activities. These compounds could be found in form of organic pollutants. Biological methods to overcome these issues become promising, such as biosurfactant products that contain both hydrophilic and hydrophobic and could be produced by microbes that use organic compound as growth substrate such as hydrocarbon. The negative charge of biosurfactant could interact with positive charge of heavy metals, while the hydrophobic characteristic will bind the organic pollutant. In the beginning of this study, it was confirmed that SDS (Sodium Dodecyl Sulphate), a negative charge (anionic) commercial surfactant, could significantly bind Cadmium heavy metals on water environment compared to Glycolipid group that is positive charge (cationic) of microbial biosurfactants measured by using AAS (Atomic Absorption Spectrometry). Therefore, this study aims to screen 26 microbial biosurfactants isolated from Indonesia oil reservoir to find potential anionic biosurfactant candidates for green bioremediation agents on heavy metal and organic pollutant co-contaminated environments. The methods use in this early study are growing microbes in hydrocarbon supplemented media in 37^{o}C incubation temperature, biosurfactant production and screening on its charge and its activity on emulsifying light oil by measuring the emulsification index (E24). Four biosurfactants produced by microbes isolated from the oil reservoir in this study shows good (52,38 - 59,52 %) emulsification index (E24) and have negative charge (anionic) that are potential for bioremediation agent on co-contaminated environmental studies. Several potential biosurfactants on its 10X Critical Micelle Concentration (CMC) are evaluated to bind Cadmium heavy metals and measured by using AAS.

Keywords: Biosurfactant; Heavy Metal; Bioaccumulation; Bioremediation; Organic Pollutant; Cadmium

B-09

Cultivation of 'Botryococcus Braunii' Microalgae for Hydocarbons Production and CO_2 Bio-fixation

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Abstract

The CO_2 fixation for climate change mitigations through photosynthesis can be carried out by growing intensively managed microalgae. The capability of microalgae in the CO_2 fixation is favourable compare to trees or crops, yielding three to five times more biomass per land area than typical crops or plants. Another interesting feature of microalgae is microalgal farms can use arid, semi-arid land or highly saline water, which are practically not suitable for agriculture and other biomass production activities. In addition, algae biomass contains fibre, fatty acid, lipid, protein, polysaccharide, and hydrocarbon. These materials could be extracted for biofuels or biochemicals. Biofuels derived from microalgae are environmentally friendly and carbon neutral. However, microalgal farming seen only for producing biomass as sources of fuels and chemicals probably uneconomical. The yields of microalgal farm to produce fuels/chemicals are also low. Therefore, microalgal farm with the objective of solely producing fuels/chemicals is economically unfeasible. If it is designed for CO_2 mitigation measures and all at once for fuels/chemicals production, such endeavour could be economically justifiable. This paper presents results of a research on microalgae cultivation for producing biomass and hydrocarbons for biofuels that simultaneously fixing the CO_2 emissions from coal power plant effluent through photosynthesis process, which also for the implementation of circular economy concepts. A strain of 'Botryococcus Braunii' microalgae, which known can produce high hydrocarbons and lipids throughout its growth period has been used. The research identified and evaluated the effect of cultivation medium and CO_2 concentration to the growth rate, biomass production, lipid and hydrocarbon content and type. The microalgae were cultivated in fermenter (bioreactor) supported with airlift system for supplying CO_2/air and for mixing process. Results of the research show that modified Chu13 (MChu13) is appropriate cultivation medium for the growth, hydrocarbon/lipid production, and CO_2 fixation from Botryococcus braunii. The magnitude of biomass production in MChu13 is 0.145 g/L.9days, while in modified BG11 is 0,118 g/L.9days, Bold Bassal Medium (BBM) is 0.09 g/L.9days, and Bristol is 0.023 g/L.9days. This biomass production rate is in lined with the CO_2 fixation rate.

Keywords: biofixation, *Botryococcus braunii*, circular economy, CO_2 emissions, hydrocarbon, lipid, microalgae, mitigation measures, photosynthesis, uplift fermenter, vertical grow reactor

B-10

Modeling and Simulation of Biobutanol Fermentation by *Clostridium saccharoperbutylacetonicum* N1-4

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Abstract

Biobutanol exhibits high octane number, non-hygroscopic, non-corrosive and can be mixed with gasoline without engine modification. Furthermore, the use of biobutanol as a fuel can reduce the negative impact of environmental due to the use of fossil-based fuel. Therefore, research on the development of biobutanol is still very much needed, including research on modeling and simulation of biobutanol production by fermentation. With modeling and simulation, we can predict various biobutanol production behavior. This paper deals with the modeling and simulation of the production of biobutanol from glucose in batch bioreactor using *Clostridium saccharoperbutylacetonicum* N1-4. *C. saccharoperbutylacetonicum* N1-4 exhibits a good growth ability on simple and complex sugars, such as glucose, sucrose, or starch. This study concerned with the kinetics models of biobutanol production as developed by Sinto based on the *C. acetobutylicum* metabolic pathway which consists of the glycolysis, acidogenesis and sonventogenesis pathways with several simplification of reactions. In this study, modeling was carried out by adapting the rate parameter value of k_{13} indicating the rate constant of cell death. The adapted models were applied to determine the effect of the initial concentration of glucose and organic acids on the production of butanol and compared to the experimental data from previous research. Model simulations were performed by using MATLAB R2015b software. The butanol yield was affected by the initial glucose concentration. The highest butanol yield of 77% was obtained at a glucose concentration of 22 g/L. The simulation results exhibit that the biobutanol yield decreases when the glucose concentration is higher than 22 g/L. These results are consistent with previous experimental data. The simulation results also show the effect of the concentration of acetic acid in the fermentation medium and can be optimized. From the simulation results, the presence of 7.5 g/L acetic acid can increase the biobutanol production by 20%. However, previous experimental data showed that a concentration of 2.5 g/L acetic acid was preferred. The simulation results also show the effect of the addition of butyric acid and lactic acid on the production of biobutanol.

Keywords: Butanol Production; *Clostridium saccharoperbutylacetonicum* N1-4; Grisales Model; Residual R^2; Shinto Model

B-11

Medium Optimization for Production of *Monascus purpureus* Pigment through Solid-state Fermentation

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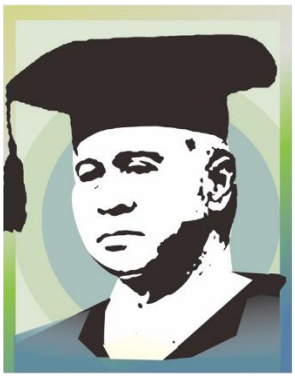
Abstract

Colorants are component that is commonly added to many kinds of product, including food products. Regardless of its effectiveness and lower price, the effects of synthetic colorants towards human's health become a challenge for food colorant industries. Production of natural food colorant using microorganism as the producing agent is a promising prospect because microorganism has a high growth rate. *Monascus purpureus* can produce a set of natural pigments consist of yellow (monascin and ankaflavin), orange (rubropunctatin and monascorubrin) and red (rubropunctamine and monascorubramine) pigment. The objective of this research is to optimize the micronutrient composition in the medium for the production of Monascus pigment through solid-state fermentation using the job's tears (Coix lacryma-jobi L) as the substrate. Response surface method (RSM) is used to optimize the concentration of four substrate components: MSG, NaCl, KH_2PO_4, and $MgSO_4$. From the experiment, it is found that the maximum red pigment is produced with added micronutrient with composition of (w/w): MSG 1,496%, NaCl 1,0%, KH_2PO_4 3,515% and $MgSO_4$ 0,206%. The yellow pigment is maximally produced with additional micronutrition with composition of (w/w): MSG 1,5%, NaCl 1,0%, KH_2PO_4 2% and $MgSO_4$ 0,2%. Biomass is maximally produced in the medium with with additional micronutrition with composition of (w/w): MSG 1,41%, NaCl 1,01%, KH_2PO_4 5,0% and $MgSO_4$ 0,2%. Among those nutrients, MSG gives the biggest impact on the increasing of pigment and biomass production.

Keywords: *Monascus purpureus*; Solid-state Fermentation; Pigment, Coix lacryma-jobi L; Response Surface Methodology



SYMPHOSIS 2020

Chemurgy and Biobased Materials

C-01

Tobacco Extract as Corrosion Inhibitor for Carbon Steel in H_2S-containing NaCl Solution

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Abstract

Presence of hydrogen sulphide and chloride ions increase corrosion rates of carbon steel. Organic inhibitors have been developed to minimize the corrosion. In this study, the effectiveness of tobacco extract as corrosion inhibitor to carbon steel in H_2S-containing NaCl solution has been explored. The experiment was conducted under room temperature and pressure. It was found that the tobacco extract decrease corrosion rate of carbon steel in the solution. Inhibition efficiency of 1000 and 2000 ppm tobacco extract in NaCl solution are in range of 24 to 69%. Increasing flowrate and inhibitor concentration significantly affect the corrosion rate of carbon steel. In presence of NaCl, the corrosion forms magnetite (Fe_3O_4) as a corrosion product. Meanwhile, presence of H_2S lead to formation of mackinawite (FeS) structure.

Keywords: Carbon Steel; Corrosion; Flow Rate; Hydrogen Sulfide; Tobacco Extract

C-02

An Improved Mechanical Properties of Wheat Bran-Based Polylactic Acid Plasticized with Glycerol

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Abstract

Polylactic Acid (PLA) is a natural polymer that can be used as a raw material for making plastics. PLA plastic manufacturing has developed rapidly since the crude oil supply is getting lower, besides PLA plastic is environmentally friendly. In this research, the development of PLA from starch and wheat bran was developed by using glycerol as a plasticizer. PLA film is made by lactic acid fermentation. After fermentation, PLA mixed with wheat bran with a ratio of 20:80 (w/w) and a variety of glycerol concentration of 0%; 1%; 3%; 5%; and 7%, then heating at 200 °C for 5 minutes. The film later printed in plastic size dimension of 15cm × 20cm and incubated at 50 °C for 5 hours, then dried in room temperature of ± 27 °C. The effect of glycerol addition as a plasticizer on PLA is analyzed using mechanical tests, swelling, solubility, and chemical resistance. Film with 1 wt% of glycerol composition is optimal composition of tensile strength value of 1.22 MPa, 0.014% elongation, swelling value of 0.40, solubility of 0.0207%.

Keywords: Polylactic Acid; Wheat Bran; Mechanical properties; and Glycerol

C-03

Eco-Friendly Metal Oxides Catalyst Prepared from Cakalang Fish Bone (*Katsuwonus pelamis*) Through a Thermal Decomposition Method

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Abstract

Cakalang fish bones (*Katsuwonus pelamis*) which have been widely found and disposed as biomass wastes around the local fish market in Banda Aceh, Indonesia have been successfully utilized as a biomineral source material to obtain an eco-friendly metal oxide catalysts. The metal oxides prepared from fish bone particles through a thermal decomposition method in air atmosphere. Physocochemical Characterization using XRD, SEM-EDX indicated that application of thermal decomposition for calakang bone particle has produced calcium, phosphorus, magnesium and sodium as mixed oxide compound. The mixed oxide particle had showed catalytic activity in transesterification of coconut oil with methanol resulting in methyl laureate and methyl octanoate.

Keywords: Cakalang Fish; *Katsuwonus pelamis*; Metal Oxide Catalyst; Transesterification

C-04

Catalytic Process Development of Bio-BTX from Lignocellulose Derived Product: Preliminary Study Using Transition Metal Catalysts

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Abstract

Lately the increase of biofuel production has simultaneously lead to the lignocellulose material disposal activities. As a waste produced by biofuel industry, lignocellulose materials are not utilized fully yet due to its complex polymeric structure. As one compound of lignocellulose, lignin possesses lowest economic value due to its recalcitrant nature. In this work, guaiacol as one of monomeric substance originated from lignin is used as a representative molecule to be valorized due to the existence of both hydroxyl and methoxy moiety groups in it.

One important reaction of lignin monomeric substance (phenolic compounds) valorization is oxygen removal. Aromatic substances such as Benzene and Toluene are produced through oxygen removal from guaiacol molecule. Hydrodeoxygenation of guaiacol is aimed to remove oxygen atoms from it. Though conventionally hydrogen for Hydrodeoxygenation process is supplied by external molecular hydrogen, in this work it is supplied from hydrogen atom abstraction of methyl cyclohexane. Therefore, in a one pot catalytic reaction system, methyl cyclohexane dehydrogenation is sole hydrogen provider for subsequent hydrodeoxygenation of guaiacol and this novel concept of circular hydrogen economy has been proven its feasibility through heterogeneous catalytic reaction scheme conducted in this work.

Metal supported on zeolite beta is selected as heterogeneous catalysts in order to evaluate the feasibility of one-pot hydrodeoxygenation and dehydrogenation reaction. Of every catalytic reaction attempt, multiple products consist of alkylated phenol, phenol itself, and toluene are observed proofing the feasibility of this concept. Possible interaction of catalyst surface acidity and metal contents are also probed through distribution of byproducts. Overall, sequential dehydrogenation and hydrodeoxygenation has been proven through catalytic reaction catalyzed by metal supported zeolite beta catalyst and this work can potentially pave the way of for further application.

Keywords: heterogeneous catalyst; Hydrodeoxygenation; dehydrogenation

C-05

Estimation of Xylose Recovery from Lignocellulosic Biomass

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Abstract

Lignocellulosic materials are potential raw materials for (bio)chemical industries due to their abundance. Its hemicellulosic content, for example, can be hydrolysed to xylose and later converted to various valuable biochemical products, e.g. xylitol. Due to the variability in characteristics and composition of the lignocellulosic materials, however, deep research is required before the utilization of each type of lignocellulosic materials. This paper presents the development of an empirical model to estimate the yield of xylose from various lignocellulosic materials. Comprehensive literature study was conducted to build lignocellulosic database, in which the yields of xylose from various lignocellulosic materials that were processed by using different pretreatment condition were mapped. An empirical model was developed to establish a correlation between the type of lignocellulosic materials as well as pretreatment operating (severity factor) and the yield of xylose. Several correction factors, such as biomass composition, lignin structure, and the succeeding hydrolysis process have been proposed to improve its accuracy.

Keywords: Biomass Composition; Empirical Model; Lignin Structure; Lignocellulosic Material; Severity Factor; Xylose Recovery

C-06

A Study of Producing Natural Red Color on Ikat Weaving Threads

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Abstract

The aims of this study are: a) to find out what materials that used to produced red color on ikat weaving threads. b) to find out what factors that effects the making of red color on ikat weaving threads. c) to find out the process of plants processing that used as natural red colorant for thread. d) to find out the kinds of red color that produced from natural colorant plants. The samples were took from Kupang Regency area consists of three village that are: Oesao village, Sharaen village, and apraen village. The sample that took from three village are: Noni root, teak leaves, betel nut, and cerry fruit as the additional sample that obtained from Dutalia Supermarket in Kupang city. The mothode that used in this study is qualitative mothode with documenting technique and experiment. This study was done on January to March in Biology Laboratorium of Artha Wacana Christian University Kupang. The result of this study was found 11 red colours that produced from 4 kinds of plant that used for coloring the jark they are: Noni root produced 4 colors (deep maroon, strawberry red, cardinal red, and teraccota. Cerry fruit produced 5 colours (coral pink, powder pink, hot pink, baby pink, and water melon pink). Teak leaves produced the red violet colour and the last is Betel nut produced 2 colours (rust brown).

Keywords: Natural Red Colors; Ikat Weaving Threads

C-07

Identification of Biomordant in Merbaun Village, West Amarasi District, Kupang Regency

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Abstract

East Nusa Tenggara (NTT) is a province that has cultural diversity. One of the cultures that are the pride of the people of East Nusa Tenggara is the handicraft of weaving. In the observation stage related to this research, a small group of weaving craftsmen (*Runpah* and *Narwastu*) were found who still use plants as natural dyes. The color produced from these plants is very distinctive, besides the plant organs that can be used in coloring such as stems, bark, fruit skins, leaves, fruits, roots and rhizomes. The use of dyes in the manufacture of woven fabrics means that the resulting color fades faster. This study aims to determine the types of mordant / biomordant plants in weaving in Merbaun Village, West Amarasi District, Kupang Regency, the mordant plant organs used, the processing method for mordant plants and the color produced when given the mordant treatment. The method used in this research is descriptive qualitative. The results of the research in Merbaun Village found 8 types of plants that were used as mordans, including: Kelumpang (*Sterculia foetida L*), Hibiscus (*Hibiscus rosa-sinensis L*), kesambi (*Schleichera oleosa L*), candlenut (*Aleurites moluccana (L*.) Willd, kapok kapok alas (*Bombax ceiba L*)), pomegranate (*Punica granatum L*.), Loba(*Symplocos sp*.), and *Utaruna*, plant organs that are used, namely, fruit skins, leaves, bark, fruit and pulp. The processing process is burning, pounding, soaking, cooking and the resulting colors are yellow and red.

Keywords: Biomordan; Identification; Merbaun; Amarasi Barat; East Nusa Tenggara

C-08

Characteristics of Hydrochar and Liquid Fraction from Hydrothermal Carbonization of Seaweed (*Sargassum Spp.*)

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Abstract

Hydrothermal carbonization (HTC) of seaweed (Sargassum spp.) was performed to investigate the effect of process parameters including kind of activation agent and biomass to water ratio (BTW) on characteristics of hydrochar and liquid fraction products. Hydrothermal carbonization was conducted at temperature 180^{o} C for one hour using $CaCl_2$ and $ZnCl_2$ as an activating agent and choline chloride as a catalyst. Hydrochar was characterized by N_2 sorption-desorption measurement, TGA, and FTIR. The liquid product was analyzed by HPLC with the Aminex HPX-87H column. It is found that yield solid product for reaction condition using no activation agent, $CaCl_2$, and $ZnCl_2$ is 33.76, 33.65, and 35.12, respectively. The porosity analysis showed that the hydrochar was mesoporous. Liquid fraction contained various valuable chemical species including, glucose, furan compounds, (furfural, furfuryl alcohol, hydroxymethylfurfural), volatile fatty acid (succinic acid, lactic acid, formic acid, acetic acid, levulinic acid, and propionic acid.

Keywords: Seaweed; Activation Agent; Hydrothemal Carbonization; Hydrochar; Mesoporous; Valuable Chemical

Bioenergy and Alternative Energy

E-01

Bio-Hydrocarbon Production from Pyrolysis of Mixed-Metal (Ca, Mg, Zn) Basic Soap

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Abstract

Pyrolysis of mixed metal (Ca, Mg, Zn) basic soap was studied for production of several hydrocarbon components. The reactions were carried out in batch reactor at atmospheric pressure and temperature 450 °C. Th basic soaps were mwde by react oleic acid with mixed metal hydroxydes. The effect of metal ratio has been studied. Based on GC-DHA analyse of crude pyrolysis showed that the maximum octane number of gasoline range hydrocarbons (89.63) and iso alkane (31.32 %) were reached at metal ratio Ca : Mg : Zn = 0.15 : 0.85 : 1. Pyrolysis of oleic mixed metal soap also produced alkane, olefin, napthene and aromatic components.

Keywords: Hydrocarbon; Metal soap; Pyrolysis; Oleic Acid; Gasoline

E-02

Cost-Benefit Analysis of Palm Kernel Shells as a Diesel Fuel Substitution for Hot-Mixed Asphalt

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Abstract

Indonesia is one of the biggest oil palm producing countries. Solid waste from processing palm oil into crude palm oil (CPO) includes palm shells. This palm shell waste can be used as an alternative to diesel fuel for aggregate heating. This study aims to analyze the investment of the use of palm shells as an asphalt burner replacing diesel. Primary data were obtained from field and laboratory identification.
In contrast, secondary data were obtained from relevant agencies, the Department of Public Development and Public Housing, PT Bara Energi Biomass and PT Damai Citra Mandiri. The method used is a quantitative descriptive analysis by calculating the annual costs and benefits over the machine's life, ten years. This study uses the Cost-Benefit Analysis. Four investment criteria are calculated: (1) Net Present Value (NPV), (2) Benefit-Cost Ratio (BCR), (3) Payback period (PbP), (4) Internal rate of return (IRR). The results found that palm shells' use as an asphalt burner for diesel substitutes showed high costs and top benefits. The calculation of economic feasibility with investment criteria shows that the NPV has a positive value, which means it is feasible. BCR shows a ratio of costs and benefits is more than one; it indicates that investment in asphalt production activities is feasible. The calculation of investment in replacing diesel fuel with palm shells shows a positive value of PbP since the first year. The internal rate of return shows that the investment value has met the minimum standard of general interest or replacement.

Keywords: palm shell, hot-mixed asphalt, aggregate heating, bioenergy, cost-benefit analysis

E-04

Cogasification Performance of Deashed Coal with Various Biomass

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Abstract

Cogasification of lignite and EPFB is present as a production of energy sources that aim to get a synergy effect. However, not all cogasification gives better product quality than fuel parent gasification. In this study, demineralization acted as lignite pre-treatment stage is achieved through HF leaching at 70°C for 4 hours. The mixing ratio varied by lignite to empty palm fruit bunches (EPFB) are 1: 2, 1: 1, and 2: 1 both for non-demineralized lignite (BLM) and lignite demineralized (BLD). The negative synergy effect of two combination is caused by the high content of silica and alumina from the empty palm fruit bunches (EPFB). The lignite demineralization cogasification produces a lower H2 yield than BLM because it also dissolves the mineral content which functions as a catalyst for cogasification synthesis.

E-05

Mass Balance analysis of Bioethanol Production from Sweet Sorghum (*Sorghum bicolor*)

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Abstract

Current fossil fuel reserves cannot keep up with the world's need for fuel, leading to a global energy crisis. The issue raises attention to renewable energy sources. Indonesia has committed to using 15% bioethanol in gasoline mixture by 2025, as outlined in Presidential Decree No. 5 of 2006. This article discusses past studies on sweet sorghum plants in their use as a raw material for bioethanol production from various aspects. The study shows that sweet sorghum juice has high potential to be converted into bioethanol due to its high sugar content. Pretreated sweet sorghum seeds and bagasse also have great potential to be converted into bioethanol due to their rich oligomer and polymer sugar content. The main challenge of producing bioethanol from sweet sorghum is the low economic competitiveness of utilizing sweet sorghum as an energy crop when compared to utilizing sweet sorghum as a food crop. The present study focuses on the mass balance analysis of bioethanol production from sweet sorghum. It is expected that the results of the present study may give a preliminary overview of the bioethanol production potential from sweet sorghum.

E-06

Mini Solar Water Heating Biodiesel Plant by Homogeneous Catalyzing

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Abstract

Biodiesel can be generated by the catalytic vegetable oil- transesterification at 45-60oC. The heat requirement for a reaction can be obtained from solar thermal energy. West Kalimantan is crossed by the Equator where the sun shines for 10-15 hours /day. Palm Oil Production reaches 2.2 million tons making biodiesel has great potential to be produced. Implementation from the ideas is mini plant technology with solar water heaters for biodiesel production. Solar water heaters as a source of thermal energy are used as heating fluid in reactor plant. This technology is simple, without the need for electrical energy, low operating costs and environmentally friendly. The purpose of this research is to produce biodiesel by using a homogeneous catalyst of 2% KOH in a mini biodiesel plant with solar water heaters. Solar heaters are designed flat which is capable of producing hot water at 60oC, consists of a heat collector and a water storage tank made of stainless steel and polystyrene as an insulator. Transesterification is carried out for 1 hour at 65oC using homogenous catalyst of 2% - KOH mass. The biodiesel yield obtained 83.42%, fulfills the requirements according to SNI in the Acid Number which is 0.42mg KOH/g and the Methyl Ester content is 99,07%.

***Keywords**:* biodiesel; equator; homogeneous; methyl ester; transesterification

E-07

Water Electrolysis for Hybrid Assisted Hydrogen Production Using Photovoltaic-Conventional Electricity

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Abstract

The usage of conventional electricity sources as a complement of solar energy can stabilize the energy supply for the hydrogen production through electrolysis. In this study, the configuration of water electrolysis system and its electricity source was examined to determine the most optimum operating condition. The experiment was carried out using KOH 3M electrolyte in a double chamber cell. The variations were type (nickel and stainless steel) and shape of electrode (spiral wire and mesh). Electrolyte flow rates were varied at 0; 3.72; and 10 mL/s. Electrolysis of water was carried out at time range of 09.00 to 16.00 with 100Wp and 1000Wp photovoltaic modules. The result showed that the optimum condition for electrolysis using a conventional power source at a working voltage of 2.6 V were achieved with nickel mesh electrodes and electrolyte flow rate of 3.72 mL/s, capable of producing 140 mL of hydrogen with current efficiency of 70.5%. Water electrolysis using photovoltaic produces 5.625 L of hydrogen with stable irradiation at time range of 09.00 – 15.00, voltage of 1,98 – 15.0V, and currents from 0.05 to 3.13A with 71,8% efficiency. The use of hybrid systems can stabilize the production of hydrogen for electrolysis at a voltages of 2.6;5;10; and 15V for 7 hours, At the highest voltage, utilized conventional electrical was 581.08 kJ (with saving of 81.64%), producing 6.6L hydrogen with 60.69% current efficiency and 38.9% electricity conversion efficiency.

Keywords : Efficiency; Electrolysis; Hybrid; Hydrogen; Photovoltaic

E-08

Modeling Effect of Vacuum and Atmospheric Drying on Torrefactio of Oil Palm Trunk (OPT)

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Abstract

This paper aims to simulate vacuum and atmospheric drying on torrefaction of oil palm trunk (OPT) with various operational conditions in order to obtain the highest caloric value of OPT. The simulation was validated with available experimental data during vacuum and atmospheric drying on torrefaction of OPT. The processes were modeled with software Aspen Plus® for dynamic/steady state approach during drying and torrefaction. The model of drying characteristic during vacuum and atmosperic condition were well predicted dynamically for every part of OPT from outer to inner part of OPT as shown in objective function of the model and experimental data range from 10^{-2} to 10^{-4}.

Keywords: modeling and simulation, oil palm trunk, vacuum and atmospheric drying, torrefaction, caloric value

E-09

Novel Approach of Biodiesel Production to Support Circular Economy in Biodiesel Industry

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Abstract

Current development of industry nowadays is more towards sustainability and greener production that minimize the production of waste, for example the production of biodiesel energy from Refined, Bleached, and Deodorized Palm Oil (RBDPO). However, biodiesel production is still could not eliminate the hazardous waste that is glycerine pitch. Glycerine pitch is a waste found in the glycerine purification unit which is a unit used to produce the high grade glycerine, a side product of biodiesel production. Up until now, the existing glycerine pitch is still not well managed and remains as a hazardous waste. The novel approach will be focusing on utilizing glycerine pitch waste into other higher added-value product by process modification of existing biodiesel production process, that is the change of the catalyst used. Instead of using sodium methoxide (Na-CH3O), potassium methoxide (K-CH3O) will be used. Later on, the potassium will be carried away within the process and discharged together with the glycerine pitch. Feeding the glycerine pitch containing potassium metal into salt recovery plant could produce potassium chloride (KCl) that is further used for fertilizer in the palm tree plantation. KCl also a raw material for KOH production that later is fed into methoxylate plant producing potassium methoxide. These scenarios made are a form of circular economy supporting sustainability and waste reduction.

E-10

The potential of Biogas in Energy Transition in Indonesia

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Abstract

Indonesia is an agrarian country that has a rich bioenergy potency in liquid (biodiesel, bioethanol). The Government of Indonesia (GoI) has set the target to achieve 23% of renewable energy utilization into the national energy mix by 2025. In addition, the GoI also aims to increase the production of biofuel to 7.21 million kilolitres by 2019. Theoretically, biogas technology will be a strategic measure in achieving the target, however, at the moment the biogas technology market in Indonesia is still in a nascent state, especially for the direct utilization of biogas for electricity production. Alternatively, biogas provides Indonesia with a promising source of energy, which can be injected directly into natural gas grids and hitchhike existing distribution infrastructure, resulting in reduced costs along the production-distribution pipeline. For this reason, biomethane has been the focus of some developing countries (e.g Argentina, Republic of South Africa) in moving toward energy transition. This paper examines the state of biogas market in Indonesia using literature review. The status of natural gas is mapped out through its available potential and the existing initiation of national programs related to biogas. Finally, the study provides recommendations on how biogas technology could accelerate the energy transition in Indonesia.

Keywords: Energy Transitition; Biogas, Indonesia

E-11

Biogas Utilization in KPBS Pangalengan: History and Challenges

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Abstract

Pangalengan has been known as business center of dairy farming in southern Bandung area since Dutch colonization. The Dairy Farmer Cooperative of South Bandung (KPBS) Pangalengan is organizing the collection of raw milk from dairy farmer and sent them to further production system. There are three districts i.e. Pangalengan, Kertasari dan Pacet. In this paper, we highlight the history and challenges of biogas utilization in Pangalengan working field. Although utilization of biogas from dairy manure was long time ago initiated in the area, coverage of biogas application is still as low as 14%. A breakthrough is required to overcome the challenge.

Keywords: Biogas; KPBS Pangalengan; Current Situation; Utilization; Productivity; Challenges

E-12

Life Cycle and Economic Assesments of Integrating Gasification Unit into Production Unit of Pellet from Fallen Leaves and Twigs

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Abstract

Conversion of fallen leaves and twigs from urban waste into pellets can be a way out to reduce the amount of waste to the landfill. However, the need for mechanical energy or electricity in pellet production is very high. A case study has been conducted to evaluate the advantages and disadvantages of integrating a gasification technique into the production unit. In this integration unit, the source of electricity for the pellet production was based on the conversion of a portion of pellet product. Three scenarios for supplying the electricity were compared: (i) scenario-A: from PLN (national grid, coal fired power plant), (ii) scenario-B: diesel-generator set; and (iii) scenario-C: diesel-genset and gasification unit. Total CO_2 emissions in the production of pellet were as follows (kg CO_2 eq /ton pellet): 533, 298 and 108 for scenarios A, B and C respectively. Due to the addition cost of investment, the integrated pellet production and gasification unit needed a Pay Back Period of about 5.6 years, while those of diesel based electricity and PLN were 5.1 and 4.8 years respectively. Data for this study was obtained from experiments on a pellet production unit with a design capacity of about 9 ton/week. The diesel engine was run in dual fuel modes using producer gas from the gasificaiton of pellet. Unfortunately, the performance of some components in the production unit were far below the design capacity.

Keywords: Pellet; Gasification Of Pellet; Economic Feasibility; Life Cycle Assessment; Dual Fuel Diesel Engine

E-13

Pilot Plant Design for Production of Drop-in-bio-fuels by Decarboxylation of Palm Oil Metal-soap

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Abstract

Drop-in biofuel has advantages compare with biodiesel i.e. it can be blend at any portion to the conventional fuel. The drop-in biofuel can be prepared from fatty-acid by-product of palm-oil industries. The fatty-acid firstly converted to basic metal soap, and further conversion to drop-in biofuel by decarboxylation process. The absence of rare-metal catalyst and mild operating condition are advantages of this process thus the method is possible to be carried out in remote area. This study was focused on development of pilot plant for production of drop-in biofuels through decarboxylation of palm oil metal soap. The study included a preliminary step for determination of best formula as well as best operating condition of soap making and decarboxylation process. Furthermore, the design and construction of equipment with capacity of 20 kg feed/day were carried out. The pilot plant could produce 0.8 kg biofuel/kg fatty-acid with diesel fraction of 0.46 and gasoline fraction of 0.15. The cetane number of diesel fraction was 60 while the octane number of gasoline fraction was 85. Moreover, the calcination of metal-carbonate was also carried out to recover metal oxide which was useful in making metal-soap. The metal recycle process yielded a significant saving to the biofuel production cost.

Food Technology

F-01

Food Safety Analysis and Improvement Concept of β – Carotene Extraction from Fungal Fermented Oil Palm Empty Fruit Bunches (OPEFB); Extraction Method and Solvent Selection

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Abstract

Oil palm is one of the main agricultural commodities in Indonesia. Beside CPO and PKO as the main downstream product, the palm oil industry also produces solid wastes such as shells, fibers, and oil palm empty fruit bunches (OPEFB). OPEFBs are often dumped nearby the palm oil plantations and being left to be decomposed, but several literature studies indicated that OPEFB still contained oil residue rich in β – carotene as well as other lipids components dissolved on it. β – carotene is among the major products of the food industry which have been widely employed as nutrients, food colorants, and additives. It serves as antioxidants and so-called pro-vitamin A. The previous research used n-Hexane as a solvent in β – carotene extraction from fungal – fermented OPEFB, whereas n-Hexane has a moderate toxicity level and low solubility of β – carotene which is only 600 ppm. Quality and food safety aspects of β – carotene extract haven't been reviewed or analyzed yet. This paper will be focused on the food safety analysis and improvement concept that can be applied in the extraction method and appropriate solvent selection to obtain high-quality extracts of food-grade β – carotene from fungal – fermented OPEFB. Toxicity level and the Hansen Solubility Parameter (HSP) simulation results are the main criteria for solvent selection, while thermal stability, operational cost, and practical aspects are being considered to choose a better extraction method. Based on the HSP simulation results and all criteria mentioned before, n-Hexane can be substituted with 3 recommended solvents; D-Limonene, Tetrahydrofuran (THF), or Tetrahydrofurfuryl Alcohol. The maceration method at room temperature is being preferred to the soxhletation method. Moreover, food safety analysis is being reviewed based on HACCP principles.

Keywords: β – carotene; Extraction; OPEFB; Food Safety; Solvent Selection; HACCP; Hansen Solubility Parameter

F-02

Interesterification of Indonesian Vegetable Oil for Cocoa Butter Alternatives: Its Effect on Slip Melting Point Changes

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Abstract

Palm stearin (PS), palm olein (PO), and coconut oil (CO) were used as feed for chemical interesterification to produce fat product with similar slip melting point (SMP) to cocoa butter alternatives. Chemical interesterification was conducted at 75ºC for 8 hours using sodium ethoxide as catalyst. The objective of the research was to determine effect of feed composition on slip melting point profile changes during interesterification reaction. The feed composition was determined using Mixture Design method. The experimental data showed that SMP of interesterification product was changed throughout the reaction time. The SMP of chemical interesterification product was affected by the reactivity of the dominant fatty acid in the feed blends. The reactivity of fatty acid in the feed blend directed fatty acid positioning on the triglyserides at the end of reaction. Feed composition determined predominated portion of unsaturated fatty acids and saturated fatty acids in the mixture, and therefore, affected the gradient changes of SMP. Vegetable oil feed mixture which produced interesterification product with the most similar SMP values to cocoa butter (33-34ºC) were pure coconut oil feed and palm stearin - palm olein mixture feed (50:50).

Keywords: Chemical Interesterification; Slip Melting Point; Palm Stearin; Palm Olein; Coconut Oil

F-03

Statistical Mixture Design for Modeling and Optimization of Feed Mixture in the Chemical Interesterification to produce Cocoa Butter Alternatives

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Abstract

This study contains modelling and optimize method for the mixture of Palm stearin (PS), palm olein (PO) and coconut oil (CO) for chemical interesterification feedstock to produce cocoa butter alternatives (CBA). The objective of the study is to determine the best composition of the mixture which has the most similar melting profile with cocoa butter. Statistical mixture design was employed to determine the experimental variation by using Simplex Axial Design type. Each feedstock composition was then chemically interesterified using sodium ethylate as catalyst at temperature of 75 oC for 8 hours. Based on the melting profile analysis of all the obtained product, it was found that the use of pure coconut oil (CO-100) and pure palm stearin (PS-100) gave the best result in which the melting profiles resembled cocoa butter alternatives. CO-100 melting profile gave the least value of Sum of Square Error when it compared with Cocoa Butter Substitute while PS-100 melting profile gave the similar result when it compared with Cocoa Butter Equivalent (CBE) and Cocoa Butter Replacer (CBR). However, PS-100 product does not meet the other specifications, such as Iodine value and slip melting point. Therefore, in can be concluded that pure coconut oil is the best feedstock to produce cocoa butter alternative substitution product.

Keywords: Chemical Interesterification, Melting Profile, Mixture Design, Optimization

F-04

Pediocin and Grape Seed Extract as Antimicrobial Agents in Nanocellulose Biobased Food Packaging : A Review

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Abstract

The food industry is a life-long and highly demanded industry as the food itself is a human essential need. Correlated with this industry, food safety has become an urgent discussion since the foodborne disease has gradually increased. One of the causes of the disease is *L. monocytogenes*, usually discovered in fresh meat, ready-to-eat meat, vegetables, and milk. *L. monocytogenes* causes an infection known as Listeriosis. Food packaging takes an essential role as it protects the food from outer contaminants to increase the shelf life. The high usage of conventional food packaging derived from fossil fuel contributes to the environmental issue as it creates long-term wastes. Therefore, biobased food packaging has been in favour as it is biodegradable. However, it lacks antimicrobial properties, so the development of biobased material as the antimicrobial food packaging is a potent solution in the food safety scope. This review paper intends to summarize current advancements in incorporation of antimicrobial agents with nanocellulose biobased food packaging to increase the functional value of the packaging. Pediocin as the antimicrobial agent produced by *Pediococcus Sp*. integrated with Grape Seed Extract (GSE) which gives an antioxidant property boosts the antimicrobial effect to the food packaging. Observations show that incorporation of these antimicrobials agents obstructs the growth of *L. monocytogenes* in biobased food packaging. The incorporation of antimicrobial agents into nanocellulose matrix shifts the tendency of making biobased packaging that give advantages on better mechanical strength and longer shelf life. Overall, this greener antimicrobial food packaging could be a solution to environmental waste as well as food-borne pathogens.

Keywords: Antimicrobial; Food Packaging; Grape Seed Extract; Nanocellulose; Pediocin

F-05

Taro Ice Cream: Addition of *Colocasia esculenta* Stem to Improve Antioxidant Activity Improvement in Ice Cream

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Abstract

Colocasia esculenta (*C. esculenta*) is a widely cultivated plant for consumption and traditional medicine of both leaves and tubers in Asian countries. Meanwhile, the recent evidences showed lack studies about the stem of *C. esculenta* as medicinal agent. Besides, ice cream is a food, which contains milk that play beneficial role as antioxidant for consumers. Addition of *C. esculenta* in ice cream may improve antioxidant activity by its phytochemical compounds. Thus, the aim of this nutritional food study is to determine the antioxidant activity, phytochemical compounds and nutritional minerals. The methods used were done by thin layer chromatography (TLC) test and antioxidant assays characterized using 2,2-diphenyl-1-picrylhydrazyl (DPPH) as free radical scavenging method and using curcumin as the standard. The nutritional minerals that tested on the study are Vitamin C, Vitamin E, Potassium, and Calcium. Present study revealed that the extract had antioxidant activity that measured at 675.283pg/ml. The stem extract of *C. esculenta* positively contained a wide range of chemical compounds including Flavonoid, Terpenoid, Saponin, and Steroid based on TLC assays. Saponin had wide range spot and highest restriction factor (Rf = 0.594), and steroid have highest hRx value compared to Stigmasterol (hRx = 83.72). Based on nutritional minerals test, *C. esculenta* contained vitamin C as much as 636.6625 mg/100 gram samples. It also contained 0.5890 % vitamin E, 0.28825 % Potassium, and 0.31817 % Calcium. Literature studies had been done to improve obtained data. Flavonoids, Terpenoid, Saponin, and steroid had been proved as a potent treatment for oxidative stress. Vitamin C and E were also have evidence as antioxidant properties. Activity of antioxidant enzymes were improved in Potassium and Calcium treatment studies. Therefore, the addition of *C. esculenta* in ice cream could improve the activity of antioxidant by its phytochemical and mineral compounds.

Keywords: *C. esculenta*; Ice Cream; Antioxidant

F-06

Production of Coconut Oil and Protein for Food and Cosmetic Ingredients

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Abstract

Coconut (Cocos nucifera) is a tropical plant that is almost spread throughout the archipelago. Coconut is a plant of the genus Cocos which is widely used in various fields ranging from food to cosmetics. Most parts of coconut can be utilized so that the coconut is dubbed a versatile plant and has high economic value. This tree has a fruit which is also called coconut. Coconut fruit is the most widely used and processed. Coconut meat can be directly consumed or processed into coconut milk, coconut flour (desiccated coconut), and cooking oil. Coconut oil was obtained from dried or fresh coconut flour using Soxhlet extraction method with organic solvents. Defatted coconut flour contained high protein of approx. 19-20%. Coconut protein has a good quality comparable to other vegetable protein sources. This research investigated the effect of solvent to solid ratio and oil content on coconut protein extraction yield and recovery from coconut flour. Based on experiments, the highest value of extracted protein and yield was obtained after coconut flour extraction at solvent to flour ratio of 30 g/g. Coconut protein isolate and coconut whey protein were expected to have different functional properties which need to be further evaluated to determine its application, as cosmetics or food ingredients.

Keywords: coconut oil, coconut protein, protein extraction, food ingredients, cosmetic ingredients

F-07

Effect of stabilization pre-treatment on phenolic compounds and antioxidant activity in rice bran

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Abstract

Rice bran is a by-product of the rice milling process and a rich source of bioactive phytochemicals. However, the shelf life of the rice bran is very short due to rancidity. In order to improve its shelf life, the rice bran is stabilized, which generally uses the heating method. This study aimed to evaluate the influence of the stabilization of rice bran on its phenolic content and antioxidant activity. The stabilization was conducted at 105 °C for 5 min using two types of convective drying, i.e. natural convective and force convective drying. Natural convection is the fluid motion induced by density differences due to the variation of temperature in the fluid. Whereas forced convection occurs when the fluid is forced to flow through the surface of the sample by an external means, which in this case is a fan. Total phenolic content (TPC) and antioxidant assays were performed on rice bran that was exposed to natural convective and force convective stabilization. TPC was determined using the Folin-Ciocalteu assay and the in vitro antioxidant activity of the rice bran extracts was investigated using 2,2-diphenyl-1-picrylhydrazyl (DPPH). Rice bran stabilization using natural and force convective drying significantly increased the TPC, in which force convective drying gave highest TPC when compared to non-stabilized rice bran (NS-RB) of black rice bran, i.e. 4952.93, 5362,55, and 4663,97 mg/100g GAE, respectively. In brown rice bran, the TPC was only significantly higher for force convective heating i.e. 2882,59 mg/100g GAE, while the TPC for natural convective heating did not differ from the control. Although antioxidant activity analysis for stabilized brown rice bran both using natural or force convective drying did not show any different compared to those in control. However, the antioxidant activity of stabilized black rice bran using natural convective drying significantly improved the antioxidant activity from 80,08% to 82,23%. It can be shown that rice bran stabilization using natural and force convective drying did not reduce the phenolic content and antioxidant activity. In fact, it might even improve it in some cases. The study exhibited that the stabilization by natural or force convective drying is an effective technique that can be applied to pre-treatment the rice brain to increase its shelf life, while at the same time ensuring that essential phenolic compounds with antioxidant activity remain intact.

Keywords: Radical scavenging activity, lipase inactivation, rice bran shelf life, reduce rancidity

F-08

Preliminary Evaluation of Halal Protein Hydrolysate Production in Indonesia

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Abstract

Protein hydrolysate is widely used in industry, for example as a substrate for microbial fermentation. With respect to the halal certification of the final fermentation products, the halal status of all media component, including protein hydrolysate, needs to be clarified as well. Indonesia has abundant protein-rich natural resources as well as protein-rich industrial by-products that have not been utilized optimally. Industrial production of halal protein hydrolysate has been overlooked. This research explored the potential of using protein-rich industrial/agricultural by-products, such as cassava leaves, soybean waste (tofu and soy sauce dregs), cow waste (bones and cow skin), fish waste (fish bones and skin), chicken waste (chicken feet and skin), cheese whey, and corn steep liquor, to be processed using a halal and green processes to produce halal protein hydrolysate. The best combination of raw material and protease was obtained by simulating the breaking of the peptide bond of the raw material by protease to determine the effectiveness of the protein hydrolysis process of each combination. Further simulations were carried out using the Analytical Hierarchy Process (AHP) method, to consider the availability/accessibility of raw materials, the protein content of the raw materials, the cleavage of peptide bonds by the enzyme, the price of the enzymes, and the ease of processing which included pre-treatment of raw materials.

Keywords: Agricultural Byproduct; AHP; Industrial Byproducts; Protease; Protein Hydrolysate

F-09

Techno-economic Analysis of the Production of Natural Food Colorant from Dragon Fruit Peel

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Abstract

The use of dragon fruit is currently only limited to the flesh of the fruit, which is the raw material for juice, while the peel of the dragon fruit has not been utilized and disposed of as waste. Dragon fruit skin contains pigments that can be used as natural food colorant with high levels of antioxidants. However, the natural colorant in the form of liquid has high water content and short shelf life. Therefore, drying using either a spray dryer or freeze dryer can be done to minimize the problem. Increasing the effectiveness of the drying process can be done by adding maltodextrin as a carrier agent that can increase the product yield. In this study, the economics of the production of natural food colorants has been evaluated, specifically related to the effect of the drying process, spray drying temperatures of 140, 170, and 190^{0}C, and the addition of carrier agents 0%, 20%, and 40%. The production and transportation costs of liquid extract, spray-dried powder, and freeze-dried powder were USD 6,01/kg, USD 28,89/kg and USD 56,6/kg dry solid, respectively. It was also found that the spray drying operating conditions that produce powder with a minimum production cost was at the inlet temperature of 170^{0}C and the addition of 40% maltodextrin.

Keywords: Carrier Agent; Dragon Fruit Skin; Spray Dryer; Antioxidant; Pigment; Betacyanin

F-10

Fermented Cassava as an Alternative Flour for Pasta Making

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Abstract

Cassava is widely cultivated in South East Asia countries like Indonesia. However, ordinary cassava flour can not substitute wheat flour due to lack of gluten. Fermented cassava flour (fercaf) is cassava flour which is fermented by lactic acid bacteria and may serve as substitute to wheat flour, especially in pasta production. Nevertheless, a number of modification should be exercise in product formulation to meet the ordinary 'wheat base' product specification. The current study was focus on these modifications i.e. addition of other flour and addition of hydrocolloids. The properties of pasta such as elasticity, yield, cooking weight, hardness, stickiness as well as sensory property were determined to evaluate the best pasta formulation. The results show that pasta made from fercaf with the addition of rice and corn flour gave strong and elastic texture while hydrocolloid addition increased water-binding of the pasta. The final pasta formulation included ratio of fercaf:rice flour:corn flour by 70:10:20 and addition of 2,5% xanthan gum.

F-11

The Effect of Size and Solid Content in Hydrolysis of Sweet Potato Starch Using Endogenous Beta-amylase Enzyme

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Abstract

Sweet potatoes are commodities that have potential to be used as raw materials for sweeteners due to its high content of endogenous amylase enzymes. The enzymes may pre-hydrolyze starch in sweet potatoes into maltose, thus reduce the additional enzymes required to complete the hydrolysis process. The main objective of the current study is to investigate the effect of particle size and solid to liquid ratio in hydrolysis process of sweet potato starch using endogenous enzymes. The extent of hydrolysis process is measured by dextrose equivalent of the crude maltose solution. Hydrolysis process consists of liquefaction and saccharification process. The liquefaction process is carried out at 71.5°C and pH 6 for 25 minutes while saccharification process is carried out at 53°C and pH 5,5 for 72 hours. Dextrose equivalent is measured using Lane-Eynon method. The results show that the access of enzyme to the potato tubers is the key of hydrolysis process. The smaller size of tubers give bigger surface area while lower solid-to-liquid ratio increases enzyme mobility but decreases sugar concentration. Base on the results, a simulation shows that the pre-hydrolysis of sweet potatoes using endogenous enzymes can save almost a half of enzymes required for traditional hydrolysis process.

Indutsrial Application

I-01

Cradle to Gate Life Cycle Assessment of Palm Oil Industry

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Abstract

Crude palm oil production Indonesia especially in Aceh every year continues to increase. This increase was due to the consumption of its derivative products such as cosmetics, food and fuel also increased. The increasing demand for CPO has caused palm oil companies expanding their plantations. Based on data from the Ministry of Agriculture in 2018, the total area of Indonesian palm oil reaches 14.3 million hectares. The focus of this study aims to evaluate the cradle to gate impact produced at the nursery stage and the process of producing palm oil in Global Warming Potential (GWP). Life cycle assessment is used to evaluate the impact of product for its entire life cycle. This research was conducted with simulation using SimaPro 7.1 software and impact 2002+ method. The results of the data processing with the simulation show that fertilization stage has the greatest impact on the environment. Utilization of liquid waste into biogas can reduce impact on the environment so the life cycle of CPO is more environmentally friendly

Keywords: Crude Palm Oil; Global Warming Potential; Life Cycle Assessment; SimaPro, Environment

I-02

Techno-Enviro-Economical Study of Hydrogenated Vegetable Oil Production from Crude Palm Oil and Renewable Hydrogen

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Abstract

From the perspective of technical, environment, and economics, hydrogenated vegetable oil (HVO) production with renewable hydrogen from biomass gasification (BG), geothermal electrolysis (GEO-E), and solar photovoltaic electrolysis (PV-E) is compared to steam methane reforming (SMR). The purpose of this study is to evaluate the energy efficiency, greenhouse gases emission factor, and production cost of HVO from various hydrogen production technologies. Production technologies are simulated using Aspen Plus ®. HVO is produced by hydrotreating and hydroisomerization reactions. The processes produce three main products: HVO, green naphtha, and bio-jet fuel. The feedstock used to produce hydrogen from BG is empty fruit bunch (EFB). Renewable electricity produced by geothermal combination of flash system and organic Rankine cycle (ORC) and solar photovoltaic (PV) with battery. Technical analysis is done by calculating the energy efficiency of overall system. Production cost of HVO is calculated by levelized cost of energy (LCOE). Life cycle analysis (LCA) is carried out to calculate CO 2 -eq intensity. The result shows that HVO production with SMR has the highest energy efficiency, 55.67%, which then followed by BG, 31.47%, PV-E, 9.34%, and GEO-E, 7.89%. The order of LCOE obtained from lowest to highest is HVO production from hydrogen produced by SMR (15.78/GJ-HVO), BG ($16.37/GJ-HVO), GEO ($22.83/GJ-HVO), and PV ($27.29/GJ-HVO). However, for CO 2 -eq intensity, the order is HVO productions with the hydrogen produced by GEO-E, PV-E, SMR, and BG are 1.63 kgCO 2 -eq/kg HVO, 1.86 kgCO 2 -eq/kg HVO, 5.57 kgCO 2 -eq/kg HVO, and 16.52 kgCO 2 -eq/kg HVO, respectively.

Keywords: CPO; HVO production; renewable hydrogen; LCA; LCOE

I-03

Multi-Objective Optimization of Blending Strategy of FAME, HVO, and Petroleum Diesel

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Abstract

The utilization of biofuels based on palm oil could decrease greenhouse gasses (GHG) emitted by fossil fuels. The aim of this research is on the optimization of blending strategy of Fatty Acid Methyl Esters (FAME), Hydrogenated Vegetable Oil (HVO), Diesel CN48 (DCN48), and Diesel CN53 (DCN53) to meet the fuel quality standard, Euro2 and Euro4 by minimizing levelized cost of fuel supply and GHG emission. The process simulation is performed by Aspen Plus software, proceed by Life Cycle Analysis (LCA) calculation. The optimization is carried out by General Algebraic Modelling System (GAMS) with Cplex solver. The result showed the percentage of the optimal blending composition of fuel quality Euro2 were FAME 43.9-51.1%, HVO 2.6-40.1%, DCN48 15.3-17.6%, and DCN53 46.3-100% with LCOE was 0.55-0.864 USD/Litre and GHG intensity 599.46-3000.78 gCO_{2eq}/Litre. For Euro4 specification consists of FAME 32.5%, HVO 28.6%, and DCN53 38.8% with LCOE were 0.637-0.786 USD/Litre and GHG intensity of 902.69-2863.03 gCO_{2eq}/Litre.

Keywords: Blending; Optimization; FAME; HVO; Petroleum Diesel; LCOE; GHG Intensity

I-04

Simulation of CO_2 Capture Process for Coal based Power Plant in South Sumatra Indonesia

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Abstract

Indonesia committed to reduce greenhouse gas emission by 26% in 2025. Carbon dioxide (CO_2) emission from flue gas in coal power plant must be captured to reduce greenhouse gas emission. Technology to decrease greenhouse gases on a large scale and in a relatively short period is Carbon Capture and Storage (CCS). Chemical absorption method is more advantageous CCS technology than other method owing to high efficiency, low cost, and mature technology. Compared with amine-based chemical solvent, potassium carbonate is an alternative chemical solvent for CCS technology due to low cost, little toxicity, slow corrosiveness, low degradation and its high stability as well as CO_2 absorption capacity. In this study, ChemCAD was used to simulate CO_2 capture facility and we applied two production capacity of CO_2. The recovery of CO2 reaches 99% for production capacity of 75 tons per day, and the recovery CO_2 for a production capacity of 150 tons per day reaches 99.96%.

Keywords: CO_2 Emission; Carbon Capture and Storage; Potassium Carbonate; ChemCAD

I-05

Life Cycle Analysis for silica production from three different routes: conventional, fume, and green routes

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Abstract

This study performed life cycle analysis (LCA) for producing 1 tonne of silica from conventional, fume, and green routes with the consideration of raw material, transportation, utility systems, production process, and environmental impact. The results show that conventional route needs 3.86 tonnes of sandstone, fume route needs 4.72 tonnes of sandstone, and green route needs 6.56 tonnes of rice husk. For the conventional and the fume routes, energy in the form of electricity is supplied from 90.76 kg and 293.90 of coal combustion, while the green route does not depend on fossil fuel. About 55% of energy from rice husk combustion is able to supply the energy for silica production and the rest can be used for electricity generation which enhances the economic value. The lowest CO_2-eq emission (0.007 tonnes) is nominated to the green route, while the conventional and fume routes are 4.41 and 3.92 tonnes, respectively. The wastewater produced from conventional, fume, and green routes is 27.13, 32.63, and 23.78 tonnes, successively. This study concluded that green route is the most sustainable, low environmental impact, and has an attractive economic value on the surplus energy, but wastewater demineralization is essential to be applied.

Keywords: Conventional Route; Silica Fume; Green Silica (Bio-silica); Rice Husk; LCA; Sustainable

I-06

Study on Indonesian Plastic Marine Debris Based on National Balance and Seashore Approaches

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Abstract

The study was based on the Indonesian 2019 data of plastic production, plastic raw material and finished-product balance, plastic recycling industry, plastic consumption, and plastic distribution. Indonesian plastic industries have a total capacity of 2.66 MT/y, total production of 2.31 MT/y, imports about 1.67 MT/y, and recycles about 1.655 MT/y. From the national balance approach, the after-used plastic is categorized into material still consuming (53.2%), material recycled (17.4%), and plastic waste (29.4%). About 90% of the plastic waste is recycled again (0.654 MT/y), go to landfill (0.868 MT/y), and the rest is mismanaged and become marine debris (0.17 MT/y). However, from the seashore approach, after-used plastic is burned and buried (3.227 MT/y), recycled (1.655 MT/y), go to landfill (0.868 MT/y), and the rest could generate marine debris (0.004 MT/y). Both results are dissimilar with Jambeck and clarify that Indonesia is not the second biggest country contributed to plastic marine debris.

Keywords: Plastic; Marine Debris; National Balance; Seashore Approach

I-07

Study on Indonesian Plastic Marine Debris Based on River Survey

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Abstract

Due to the Jambeck's research, conclusion, and claim, some academicians, scientist, as well as several associations such as The Indonesian Olefin and Plastic Industry Association (INAPLAS), Indonesian Plastic Recycle Association (ADUPI), and Indonesian Plastic Recycle Industry Association (APDUPI) conducted a deeper plastic balance examination to clarify Indonesian plastic marine debris amount. This study continued the previous work, which was using river survey method to conduct a more accurate calculation in actual condition. From the river survey, Indonesian plastic marine debris result is about 0.038 MT/y and it will reduce to 0.004 MT/y if the trash trap is strictly-applied. This result was not much different compare to the seashore approach but also clarify again that Indonesia is not the second biggest country contributing to plastic marine debris. Asides from conserving the marine and river environment, installing a trash trap on the river could increase local people's income at once.

Keywords: Plastic; Marine Debris; River Survey; Trash Trap

I-08

Energy and Exergy Analysis on the Rotary Kiln Unit of RKC-2 PT. Semen Gresik – Tuban Plant

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Abstract

Cement industry is an industry that intensively uses energy in the process. One of the main units in a cement plant that consumes the most energy is the rotary kiln. Rotary kiln is used for calcination process of cement raw material into clinker. It operates at 900-1450°C. It obtains energy from coal combustion process. Energy conservation in rotary kiln can be used to optimize production costs. Energy conservation can be carried out through energy identification. One method of energy identification is through energy and exergy analysis. In this study, energy and exergy analysis was carried out at the rotary kiln unit of RKC-2 PT. Semen Gresik - Tuban Plant. The analysis was carried out based on the calculation of the mass balance, energy balance, enthalpy balance, entropy balance and exergy balance. These calculations are used to obtain energy efficiency, exergy efficiency and irreversibility. Based on the research results, the energy efficiency, exergy efficiency, and irreversibility were 69,2%; 50,48% and 49,52% respectively.

Keywords: Rotary Kiln; Energy; Exergy; Irreversibility

I-09

Circular Economy on Organic Waste Management with MASARO Technology

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Abstract

Organic waste is one of the problems in the world. Organic waste can be divided into fast-decomposed waste (such as food scraps) and slow-decomposed waste (such as leaves, leather, and hard fruits). Fast-decaying organic waste is usually ended up in landfill, while the slow-decaying organic waste will be processed through composting. One of the most common method to manage organic waste is by landfill accumulation. However, this method has no positive impact and does not reflect the circular economy principle while also environmentally unfriendly. So, a new method that is able to process organic waste through an environmentally friendly recovery process is needed.

MASARO technology presents a solution to solve these problems through an organic waste processing unit also known as IPPO (Organic Fertilizer and Feed Industry). This technology will characterise household waste into five criteria including organic waste, plastic / film, fuel, recycling, and hazardeous materials. The organic waste will be separated into organic waste that is slow-decomposed and fast-decomposed waste. Slow-decompose waste will be composted while fast-decaying waste will be used to produce POCI (Special Liquid Organic Fertilizer) and KOCI (Special Liquid Organic Concentrate). This production is carried out by a two-stage fermentation process. The POCI / KOCI can be applied to the farm industry. This combination can produce a high economic value and environmentally friendly system.

The application of the circular economy principle has been carried out with this IPPO. Organic waste with small economic value is used as raw material to produce higher economic value POCI/KOCI. These products can be used for farm industry and become one of the economy resources while also producing organic waste. The waste will be used as raw material for IPPO and forming a circular economy. Therefore, IPPO is able to solve organic waste problem in an environmentally friendly manner and suitable for sustainable development.

Keywords: Organic Waste; Waste Processing; IPPO; POCI / KOCI; Circular Economy

I-10

Circular Economy on Inorganic Waste Management with MASARO Technology

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Abstract

The study was based on indonesia and global waste managament issue especially on inorganic waste handling and the circular economy of the method to solve the problem. Inorganic waste is one of the problems in the world. Management of inorganic waste especially non-recycled waste does not reflect the circular economy principle and not environmentally friendly. It needs a new method that can process this type of waste through an environmentally friendly recovery process. MASARO technology presents a solution to this problem by processing non-recycled inorganic waste through a plastic refinery unit. The application of the circular economy principle has been carried out in this MASARO plastic refinery. All inorganic waste is processed into other useful products, such as: fuel, planting media, wood preservatives and organic pesticides. There is no inorganic waste is ended up in TPS and TPA. Therefore, MASARO plastic refinery is environmentally friendly to solve inorganic waste and suitable for sustainable development.

Keywords: Inorganic Waste; Plastic Refinery; Circular Economy; Environment

I-11

Integrated Biorefinery Technology: Monetization of Oil Palm Empty Fruit Bunch to Biofuel & Bio-based Chemicals, and Beyond

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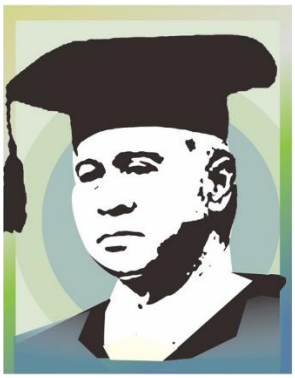
Abstract

As the largest producer of palm oil, Indonesia has abundant oil palm empty fruit bunch (EFB), as one of the solid wastes produced from palm oil mill, which utilization has not yet been optimal although it has a potency to be used as feedstock for biofuel and bio-based chemicals. However, due to the recalcitrant characteristic of EFB as lignocellulosic material, EFB conversion into biofuel and bio-based chemicals has been a challenge, especially in regard to its economic viability. To obtain the economically viable of the conversion of EFB, the integrated EFB biorefinery technology concept was proposed to produce multiple products which are precursors for biofuel and bio-based chemicals. This paper presents the integrated EFB biorefinery technology concept, economic analysis of the technology, the role of the technology for circular bioeconomy in Indonesia, and the biorefinery industrialization concept in Indonesia as part of an effort for "Making Indonesia 4.0".

Keywords: Oil Palm Empty Fruit Bunch, Integrated Biorefinery, Biofuel, Bio-based Chemical



SYMPHOSIS 2020

Kurita Awardees

K-01

Silk Fibroin-based Biocomposite Adsorbent for Heavy Metals and Organic Dye Removal in Aqueous Solution

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Abstract

Groundwater in Kariangau Industrial Area, Balikpapan, East Kalimantan was contaminated by organic matter and heavy metal ions, showing relatively high COD. This environmental issue stems from the discharge of untreated wastewater from textile and coal mining industries. Therefore, technology of water and wastewater treatment removing diverse contaminants prior releasing to the environment requires advancement. Herein, we developed a green synthetic route of silk fibroin (SF)-based adsorbent extracted from silkworm cocoons, which was composited with soursop seeds (SS) *via* a sol–gel approach, for bio sorbent of pollutants. The SF/SS adsorbent with various compositions, *i.e.* (1:1, 3:2, and 4:1) SF/SS ratio, were characterized by scanning electronic microscopy (SEM), Fourier transform infrared (FTIR) spectroscopy, and Brunauer-Emmett-Teller (BET). Systematic investigation on the performance of SF/SS adsorbent for organic dye (crystal violet, CV) and heavy metal ion (Cu^{2+} of $CuSO_4.5H_2O$) was undertaken considering factors affecting adsorption characteristic, *i.e.* contact time, compositions of adsorbent, initial concentration of dye and heavy metal ions. The adsorption equilibrium performance was evaluated using *Langmuir* and *Freundlich* isotherm adsorption models, whilst *pseudo*-first and second order model was employed to assess the adsorption kinetic. The resultant mesoporous SF/SS adsorbent shows maximum adsorption capacity of 78.6 and 69.2 $mg \cdot g^{-1}$ with 120 min removal of 91.3 and 87.3 % for CV and Cu^{2+} respectively. *Freundlich* model demonstrates the best fitting for CV and Cu^{2+} removal whilst *pseudo second order* model fits best for CV removal with a reaction rate of 9.1×10^{-3} $mg^{-1} \cdot min^{-1}$. The results suggested that SF/SS composite adsorbent can be used as an efficient adsorbent to remove both heavy metal and organic dye waste.

Keyword: Macromolecules; Bio-sorbent; Silkworm Cocoons; Soursop Seed; Copper Ion; Crystal Violet

K-02

The Influence of Climate Change on Long-term Projection Water Balance in Southeast Asia Mangrove Forest

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Abstract

Mangrove forests play crucial roles on preventing abrasion, serving as an ecosystem for flora and fauna, and as a place of carbon traffic. Southeast Asia's mangrove forests have high species richness and structure compared to mangrove forests in the world. However, serious attention in terms of enforcement and management need to be given to the mangrove areas in Southeast Asia since over the past 50 years, approximately one-third of them have been lost. The threats happened due to the increase in population, development in coastal areas, and climate change. This research will be analyzed how the water balance in mangroves is affected by climate change, and how the resulted changes will affect the degradation of mangroves forest itself. The objectives of this research are to identify long-term mangrove's vulnerability, and to identify the influence of global warming and El Nino on water balance in mangrove forests from 2001 to 2019 and its projection to 2050. We analyse the water balance by using data input from remote sensing products CHIRPS and MODIS Evapotranspiration, and model data from CNRM-CM5.1 (RCP 2.6,4.5, 6.0, 8.5). From these results, the effect of climate change and variability that makes changes in the water surplus and deficit in mangrove plants will also be investigated and can be used for mangrove adaptation strategy for policy maker. Mangrove forests play crucial roles on preventing abrasion, serving as an ecosystem for flora and fauna, and as a place of carbon traffic. Southeast Asia's mangrove forests have high species richness and structure compared to mangrove forests in the world. However, serious attention in terms of enforcement and management need to be given to the mangrove areas in Southeast Asia since over the past 50 years;, approximately one-third of them have been lost. The threats happened due to the increase in population, development in coastal areas, and climate change. This research will be analyzed how the water balance in mangroves is affected by climate change, and how the resulted changes will affect the degradation of mangroves forest itself. The objectives of this research are to identify long-term mangrove's vulnerability, and to identify the influence of global warming and El Nino on water balance in mangrove forests from 2001 to 2019 and its projection to 2050. We analyse the water balance by using data input from remote sensing products CHIRPS and MODIS Evapotranspiration, and model data from CNRM-CM5.1 (RCP 2.6,4.5, 6.0, 8.5). From these results, the effect of climate change and variability that makes changes in the water surplus and deficit in mangrove plants will also be investigated and can be used for mangrove adaptation strategy for policy maker.

Keywords: Mangrove Forest; Southeast Asia; Water Balance; Climate Change; Remote Sensing

K-03

Distribution of Microplastics in Water and Aquatic Biota in Surabaya River, Indonesia

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Abstract

Microplastics (MPs/MP) have been considered as an emerging environmental threat worldwide. It occurs due to its persistent, ubiquitous presence, and potential ecotoxicological risks to almost all aquatic environments. The MPs could release chemical additives and adsorb persistent organic pollutants. It also could be ingested mistakenly by aquatic biota due to its similarity with the size and color of their original prey. This situation could impact water resource quality, aquatic biota biodiversity, even human health. Additionally, rivers have been estimated as the main pathway of plastic transport from the land to the ocean. Surabaya River, is the main lower part of the Brantas, which is one of the top 20 plastic polluted rivers globally. The Surabaya River takes important roles in clean water supply for Surabaya City, aquatic biota habitat, and irrigation. This study aimed to investigate the distribution and characteristics of the MPs in water and aquatic biota in the Surabaya River. Fish and bivalve were selected as the representative aquatic biota due to their specific habitat, movement, and feeding behavior. Water and biota samples were collected from five sampling sites in the river. The MP abundance in the water was 9.66 - 21.16 particles/m^3. The highest MP abundance (21.16 particles/m^3) was found at Joyoboyo, the lower part of the Surabaya River. The MP abundance in the fishes of *Oreochromis niloticus*, *Barbonymus gonionotus*, and in the bivalves of *Elongaria orientalis* were 105.25 – 138.83; 62.13 – 155.00; and 36.00 – 76.17 particles/individual, respectively. The MPs in the water were dominated by film shaped, transparent colored particles. Meanwhile, the MPs in the fishes and the bivalves were generally found in transparent and black fibers. Only small amounts of film particles were discovered in the biota. Moreover, most of the MPs in the water and the biota were in large sized (1 – 5 mm) particles.

Keywords: Biota; Distribution; Microplastics; Pollution; River

K-04

Bacterial Immobilization in Super-Adsorption Composite Material and Its Application on Decolorization and Biodegradation of Methylene Blue Dye on Batik Industrial Wastewater

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Abstract

The Batik industry is one of the industries that is growing rapidly in Indonesia. However, the Batik industry can also cause serious problems for the environment and humans, one of which is textile dye waste. As many as 280,000 tons of dyes are produced annually worldwide, and 50,000 tons become waste. Disposing of dye waste into the environment has become a problem because it can cause toxic pollution and reduce water quality such as COD and BOD. Methylene blue (MB) dye is a cationic dye which has wide application in the Batik industry, that may cause some adverse effects such as heartbeat disorders, shortness of breath and eye injury in humans and animals. Various methods of handling dyes waste; such as chemical oxidation, flotation, electrocoagulation, adsorption, and photodegradation have not been considered successful, where efficient, environmentally friendly, and inexpensive methods for removing dyes from dissolved systems remain a challenge. The purpose of this study is to synthesize and characterize the "new super material" that consisting of combination of bacteria (*Ralstonia pickettii*, *Pseudomonas aeruginosa*, *Bacillus subtilis*) which is immobilized in combination of alginate-PVA-bentonite-activated carbon material composite and to evaluate its degradation ability in MB dye. The new immobilized systems offer fast dye adsorption speed by absorbent, supported by the bio-regeneration process by the bacteria, thus it is expected that this system can degrade dyes more efficiently. The effect of the combination of the composite will be evaluated and characterized for its properties (FTIR, DSC-TGA, SEM, BET). The "new super material" is then applied to decolorize MB dye and the metabolites of degraded products will be identified by LCMS. This research is expected to produce prototype and method for handling the problem of batik dye wastewater.

Keywords: Decolorization; Degradation; Methylene Blue; Immobilization; Batik; Water Waste

K-05

KURITA Overseas Research Grant 2020: Nanocellulose-based magnetic nanocomposite as superadsorbent of toxic heavy metal ions

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Abstract

Considerable quantities of heavy metal pollution through massive industrial activities highly risk not only human but also general well-being, as they are not biodegradable, easily accumulated, persistence in living organism and supply food chain. Adsorbent based on biomass waste from oil palm empty fruit bunch (EFB) nanocellulose (NC) had been developed in our previous work to significantly reduce organic water pollutant up to 93% COD and adsorb lead up to 86% which were double than NC from rice-straw. Nevertheless, the metal removal of the EFB-NC is merely selective only to Pb while limitedly adsorb others as Cd and Cr. As the current global water challenge is susceptible to the contamination of different types of heavy metals, it is highly important to further push the current research project based on natural resources into high adsorptive performance against various toxic metals. This research is aimed to develop highly functionalized superadsorbent nanocomposites based on our previous material EFB-NC and the magnetite (Fe_3O_4) particle (MP) derived from mill scale waste in steelmaking industry. The presence of MP can provide high adsorption towards various metals as well as an easy post-separation, while the EFB NC as a matrix of nanocomposite will benefit mechanical strength, chemical stability and avoiding tendency for agglomeration of MP characters. The significance of this project offers a solution in providing clean and healthy water using novel nanocomposite as well as reducing the burden of environmental pollution by utilizing the industrial by-product (MP) and biomass waste (EFB-NC).

Keywords: Nanocellulose; Magnetic Particle; Adsorption; Heavy Metals; Oil Palm Empty Fruit Bunch

K-06

Biomonitoring of Multidrug-Resistant Pathogenic Bacteria in Coastal Water and Sediment of Semarang City, Central Java

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Abstract

Multidrug-resistant (MDR) bacteria have been a massive global health problem for these past decades. Previous studies proved that these MDR bacteria can survive in the aquatic environment by living in the water and in the sediment. Thus, this survival strategy threatens the community health around the coastal region. In line with the increasing population, the use of antimicrobial agents (antibiotic, hand sanitizer, soap, detergent, etc) in daily life and aquaculture trigger the occurrence of MDR bacteria which can cause an outbreak anytime. Moreover, those antimicrobial wastes stream down into the coastal regions. Semarang as the capital city has the highest number population in Central Java furthermore, the geographical aspect forces the citizen to live close to the coastal regions. It means that Semarang's citizens in the coastal regions have a high risk to be impacted by the MDR bacteria which are spread through the water. This research will be the first study which reported about MDR bacteria that live in coastal environment and its threats for the future where Semarang can be used as the pilot location. The objectives of this study were to isolate the pathogens bacteria from water and sediment in Semarang coastal regions, to determine its antimicrobial resistance (AMR) profile, and 3. identify the diversity of MDR bacteria. Sampling will be done around coastal regions in Semarang city. Water and sediment will be collected as the source of pathogens. Bacterial isolation will be done by serial dillution method, the isolation media are McConkey and Hektoen Enteric Agar. Antimicrobial profiling will be done by paper disc and microdilution to determine the minimum inhibition concentration (MIC) and detection of several genes that responsible to virulence and drug-resistance. Diversity study will be done by a molecular approach using bacterial DNA barcoding in the 16S rRNA gene.

Keywords: Abstract; Acceptance; Forward; International; Submitted; Template

K-07

Biological Properties Screening of *Polycarpa aurata* From Bara Caddi, Makassar

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Abstract

The Food and Drug Administration (FDA) has legalized several bioactive compounds from marine organisms to be used as a drug, and one of them is produced by tunicate (ascidians). Indonesia as a tropical and maritime country has plenty species of tunicates that is neglected as source of bioactive compounds. This study focused on characterization of bioactive compounds and its biological activities of a tropical tunicate, *Polycarpa aurata*, which was collected from Makassar. Sample was extracted using methanol for 24 h by maceration. The bioactive compounds were characterize using thin layer chromatography (TLC) and phytochemical analysis. Antibacterial activity was performed against multidrug-resistant (MDR) *Bacillus cereus*, Methicillin-resistant *Staphylococcus aureus* (MRSA), *Salmonella enterica* ser. Typhi and a non-MDR *Escherichia coli*. Antioxidant activity was analysed using 2,2-diphenyl-1-picrylhydrazyl (DPPH) method; toxicity using Brine Shrimp Lethality Test (BSLT) method and α-glucosidase inhibition using UV spectrophotometer. The result showed that crude extract of *P. aurata* contained flavonoid, saponin, steroid and triterpenoid. The crude extract inhibited all pathogenic bacteria in its lowest concentration (0.5 mg), toxicity at 87.90 ppm; antioxidant 734.37 ppm; however, the crude extract did not inhibit the activity of α-glucosidase. This study indicated that *P. aurata* from Makassar need a further study as a new antibiotic and anticancer candidate.

Keywords: Antibacterial; Antioxidant; Cytotoxic; Phytochemical; Tunicate

K-08

Public Risk Perception and Public Acceptance of The Existing Flood and Drought Mitigation Measure in Bandung City

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Abstract

Flood and drought are hydrometeorological problems that annually occurred in Bandung City. This problem occurs due to static natural conditions such as geographical, topographical conditions, as well as dynamic natural conditions such as climatological matters that are exacerbated by climate change and human activities. Flood and drought risk management in urban areas generally emphasizes physical development by ignoring various social dimensions. Therefore, this research aims to understand people's knowledge and attitudes towards disasters, represented by the public risk perception towards flooding and drought, as well as public acceptance of the existing programs that have been provided by the municipality. To identify public risk perception and their acceptance of existing programs use statistical descriptive methods. While the data collection use questionnaire with 99 samples. This research shows the affected communities can assess the risks, emotion, and expectation for the future risk, and the implemented program by municipality is mostly accepted by the community. Public risk perception and public acceptance of a program are prominent factors that determine the success or failure of a program by ensuring the compatibility of the program and the community. Thus, this research is critical to give the public perspective on implementing a community-based disaster mitigation program.

Keywords: Flood; Drought; Public Risk Perception; Public Acceptance

K-09

Gravity-driven Mesh Filter Bioreactor for a Low-Cost Small Scale Wastewater Treatment

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Abstract

A small-scale and decentralized wastewater treatment is one solution to treat dirty water produced from household and small home industries, when centralized wastewater treatment plant with a larger footprint is not possible. Membrane bioreactors, combining aerobic treatment with filtration, has long been known as a mature technology for a compact wastewater treatment system. However, its usage in developing countries are hindered by the high cost of the membrane. As an alternative, gravity-driven mesh-filter bioreactor (GD-MFBR) is explored in this study to treat a low strength wastewater. Bioreactors filled with activated sludge were fed with a synthetic wastewater and run in fed-batch mode with HRT values of 6-8 days. Polyester mesh filters with five different pore sizes, 74-210 µm, were used to prepare the filtration modules. The filtration modules were installed inside reactor (horizontal or vertical arrangement) and filtration was carried out at the end of each cycle. Experiments were carried out for a number of Run, consisting of each 9-10 cycles. For each cycle and run of experiments, turbidity, Total Solid (TS), chemical oxygen demand (COD) and fluxes were measured and recorded. Results showed that the GD-MFBR could produce a good effluent quality, with COD removal up to 89%. The smaller the pore sizes of the filter, the lower the effluent turbidity and COD concentration. Fouling layer developed on the filter surface during GD-MFBR operation was mainly reversible and easily removed for cleaning. During the operation, it was indicated that fluctuated fluxes and turbidity removal could occur due to the unstable fouling layer which easily detach from the filter. The aforementioned phenomena tended to occur in set-up with a vertical filtration module and with a bigger pore size mesh filter.

Keywords: Mesh Filter; Bioreactor; Gravity; Wastewater

K-10

Assessment of Characteristic Algae Organic Matter and its Impact in Oxidation Ditch Algae Reactor

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Abstract

Microalgae as a bioremediation technology for wastewater treatment have been develop to improve the environmental quality. Oxidation ditch algae reactor (ODAR), a trench-shaped tub, is one of the biotechnology application for treating wastewater. In the wastewater system and algae, bacteria and algae are interconnected. Symbiotic relationships with bacteria will reduce organic wastewater. Algae can reduce high nutrient, which are usually found in domestic waste. The mechanism is waste enters oxidation ditch and mixes with activated sludge, bacteria will metabolize. The results of this metabolic process are carbon dioxide, ammonium ions, nitrates and phosphates which will be used for algae growth. When autotrophic algae produce new protoplasm, oxygen will be produced which can be used by bacteria to carry out metabolism in addition to supplying oxygen from aeration and stirring processes. Our previous studies have shown that ODAR with Chlorella sp has high efficiency in removing organic pollutant and less sludge. However, the presence of organic substances produced by algae may comprise various forms and differing concentrations of polysaccharides, proteins, lipids, nucleic acids and other dissolved organic substances. Those released organic matter will contribute to the concentration of dissolved organic matter. The aim of this research are to investigate the physico-chemical characteristics of algae organic matter from two different species (Chlorella sp and Spirulina sp) in ODAR and to assess the impact of released algae organic matter as potential causes of further treatment process, such as membrane fouling, formation of disinfection by-products, etc. The experiment will be carried out by using ODAR filled domestic wastewater (DWW) as control, DWW-Chlorella sp, and DWW-Spirulina sp under various volume ratio. All sample will be analysed for BOD, NO^{3-}, PO_4^{3-}, chlorophyll-a. Fluorescence Excitation Emission Matrices (FEEM) combined with and Fourier Transformation Infrared (FTIR) will be conducted to identify the properties of organic matter qualitatively. TOC analyser, ultraviolet (UV) at wavelength 254 and 210 nm, and FEEM extracted by Fluorescence Regional Index (FRI) will be used to characterize organic matter quantitatively. UV absorbance ratio index (URI), and fluorescence ratio index will be applied to reveal the impact of released organic matter to the environment.

Keywords: Wastewater; Algae Organic Matter; Oxidation Ditch; Fluorescence

K-11

Cellulose-Based Fish Scale Inspired Superoleophobic Membrane: A review

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Abstract

The bioinspired technology is promising the efficiency because its mimicking the nature structures that have involved in natural selection for thousands of years. By mimicking the fish scale structure, a functional membrane is developed to separate oil/water mixture. Even oil and water is immiscible liquid, the current separation process is need long resident time, large space and high energy consumption. Fish scale has an oleophobic properties that repel oil and penetrate only water so that keep the fish skin always clean even though live in muddy environment. In the membrane, this property is useful to prevent membrane blocking by repelling the oil and keeping the membrane surface always clean (self-cleaning ability). This article will review the current development of bioinspired technology for membrane application.

Keywords: Bioinspired Technology; Fish Scale; Membrane; Anti-fouling; Self-cleaning

K-12

Microwave-Assisted Synthesis of TiO_2/GO Composite and Its Adsorption-Photocatalysis Property under Visible Light

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Abstract

The photocatalytic performance of low-grade Titanium Dioxide (TiO_2) anatase was successfully improved by compositing with graphene oxide (GO) via microwave-assisted, activated by UV and Xe light. The various experimental conditions were conducted. X-ray diffraction (XRD), Particle size analyzer (PSA), Prepared TiO_2/GO photocatalyst was characterized by several instruments such as Specific surface area (BET) and Scanning electron microscopy (SEM). Effect of various annealing times (30 to 120 minutes) and temperatures (200-1000°C) were studied to reach the optimum pure TiO_2 as a further based material in composite with GO. The result showed that both annealing time and temperature influenced crystallinity and particle size only, not the phase structure of TiO_2. A similar phenomenon was founded by adding GO in a small concentration. A comparison of photocatalytic activity under UV and Xe irradiation has been proposed to show the GO effect independently. Under UV irradiation, the presence of GO enhancing the active sites of the catalyst. 1.0 wt% of GO succeeds in decomposing 8ppm of RhB more than 90%. Meanwhile, under Xe irradiation, the efficiency of the degradation of RhB was only 30%, resulted in using 1.2wt% of GO. Interestingly, the photodecomposition rate (k) of TiO_2/GO composite under Xe irradiation was 3 times over pure TiO_2 higher than that of UV irradiation (1 time). The study present that the small concentration of GO affected not only the active site of the TiO_2/GO composite but also the electronic properties, which give different effects under different energy activated.

Keyword: Photoadsorption; Rhodamine B; Organic Dye; Water Treatment

K-13

Glyphosate-Based Herbicide Reduction and Bioelectricity Generation by Constructed Wetlands Coupled Microbial Fuel Cells

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Abstract

Glyphosate herbicides carried to water bodies will have an impact on aquatic biota, both directly and through the food chain. One alternative technology that can be used to treat agricultural wastewater is using constructed wetlands (CWs). The new approach of combining microbial fuel cells (MFC) into CWs is known to be able to improve the performance of CWs. The combination of Constructed wetlands - microbial fuel cells (CWs-MFCs) is also capable of producing electricity. Plant types and electrode spacing were evaluated in this study. The result showed that mixed plant and 30 cm electrode spacing had the best performance in glyphosate removal efficiency (99.85±0.01%). The highest voltage produced was on the *Typha angustifolia* and 30 cm electrode spacing.

Keywords: Constructed Wetland; Microbial Fuel Cell, Nutrient Removal, Wastewater Treatment, Bioelectricity

Separation Technology

M-01

Non-Solvents Selection for Cellulose Acetate/Polyethylene Glycol-grafting-Graphene Oxide Membranes

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Abstract

Fabrication process of membrane is key factor for producing reverse osmosis membrane with a good performance for desalination process. One of the methods to fabricate membrane is phase inversion where casted membrane was immersed in the non-solvent. Non-solvent is important parameter to determine that phase inversion is success or not in resulting the morphology of the membrane. As known that morphology of the membrane contributes to the performance of the membrane. In this study, several non-solvents have been used to fabricate CA/PEG-g-GO membrane. Non-solvent used in this study were water, isopropanol, methanol, isopropanol-water and methanol-water. The morphology of the membrane was analyzed using a Scanning Electron Microscope (SEM). The thermodynamic and kinetic properties of non-solvent/solvent/polymer CA/PEG systems are studied and correlated with membrane morphology. Membrane performance was determined by salt rejection, permeate flux, and permeability. The experiment results show that the best non-solvent is isopropanol followed by water, isopropanol-water, methanol, and methanol-water. CA/PEG-g-GO membrane with water as non-solvent has a salt rejection (% R) of 75%, flux (F) of 1,985 L/m^2.hr, permeability of 0.0005 L/m^2.h.kPa and the morphology is sponge-like with the pore size in average is 0.471 µm.

Keywords: Non-solvent; Membrane Morphology; Phase Inversion; Desalination; Cellulose Acetate; Graphene Oxide

M-02

Preparation and Characterization of Antibacterial Polysulfone/*Lantana camara* Membranes for Wastewater Ultrafiltration

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Abstract

Various human activities such as industry, transportation, and household could effect in increasing the total wastewater production. Along with wastewater, small particles such as fine particles and bacteria are become serious water pollutants due to the negative impact on human health. Wastewater treatment using ultrafiltration membrane has gained interest due to its low energy consumption, high efficiency, and less chemical requirements. Polysulfone has been widely applied in preparation of membranes due to the good resistance to chemicals, mechanical strength, and thermal stability. *Lantana camara* is one of invasive plants in Indonesia that have antimicrobial behaviour. Recent studies reported that *Lantana camara* is potential for improving the wastewater performances of membranes. At present study, polysulfone-based ultrafiltration membrane was prepared by phase inversion method. As additive, *Lantana camara* is introduced in membrane matrix via additive blending method ranged from 0.2-1% (w/w). Morphology and chemical groups of membrane were characterized using SEM and FT-IR. For antibacterial assay, *E. coli* was used to analyse the inhibition zones. The water contact angle and equilibrium water content (EWC) increased when *Lantana camara* loading increased to 1%.

Keywords: Antibacterial; Phase Inversion; *Lantana camara*; Wastewater Treatment

M-03

Effect of Additive on Microstructure, Hydrophilicity and Ultrafiltration Perfomance of Polyethylene Terephthalate Membranes

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Abstract

Ultrafiltration is a pressure-driven separation process through a porous membrane that can separate particles or macromolecules from a solution. Ultrafiltration is mostly applied for water treatment processes in various industries such as pharmaceutical, chemical, food and beverage industries. Commercial ultrafiltration membranes are mostly fabricated from polymer materials such as polysulfone, polyethersulfone and cellulose acetate. These polymers are expensive, and for the time being they are not produced in Indonesia. In this work, polyethylene terephthalate (PET) was used as the polymer material to prepare ultrafiltration membranes. PET is commonly used as a packaging material for foods and beverages due to its low price and excellent mechanical properties. The PET membranes were prepared via a phase-inversion technique using polyethylene glycol (PEG) as the additive. It was observed that the addition of PEG improved the flexibility and the hydrophilicity of the membranes. The microstructures of the membranes could be controlled by the concentration and molecular weight of the PEG. The result of the ultrafiltration experiment showed that the membrane with a high porosity and pore size exhibited a high water permeate flux. In the ultrafiltration experiment using a model feed solution of an aqueous solution containing Bovine Serum Albumin (BSA) with a molecular weight of 66,000 Da, the membranes showed high rejection values of up to 90%.

Keywords: Ultrafiltration; Membrane; Polyethylene Terephthalate (PET); Water treatment; Polyethylene Glycol (PEG)

M-04

Selective H_2S Absorption Using the Mixture of NaOH-$NaHCO_3$-Na_2CO_3 Buffer Solution as Solvent

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Abstract

One of the important steps in natural gas processing is the removal of CO_2 and H_2S (acid gas) impurities. The removed H_2S could not be directly emitted to the environment as the amount of SO_2 (H_2S thermal oxidation product) emitted to the environment should be below 2,600 mg/Nm^3, as stated in Regulation of the Indonesian State Minister for the Environment No. 13 of 2009. Therefore, selective separation of H_2S from acid gas is required to remove H_2S from acid gas mixture. One of the separation methods applied is absorption with NaOH solvent. The addition of sodium carbonate (Na_2CO_3) and sodium bicarbonate ($NaHCO_3$) buffer to NaOH solution could suppress CO_2 absorption, thereby increasing the selectivity of H_2S absorption. This study aims to evaluate the effect of buffer addition to increase H_2S absorption selectivity using NaOH. This study showed that buffer addition could increase H_2S selectivity by suppressing CO_2 absorption. An increase in the L/G ratio leads to an increase in CO2 absorption, thus H_2S selectivity decreases. Based on the simulation results, in 0.006 – 0.030 L/G ratio range and greater than 2%-mass NaOH solvent concentration, the addition of $NaHCO_3$ with mass ratio greater than 1.5:1 to NaOH and the addition of Na_2CO_3 at 1.26 times $NaHCO_3$'s mass proved to increase H_2S absorption selectivity up to 17.3%. The combination of L/G ratio of 0.006 and solvent with composition of 5%-mass NaOH, 15%-mass $NaHCO_3$, and 18.9%-mass Na_2CO_3 produced the highest H_2S selectivity of 23.1 (H_2S selectivity increase of 379.7%). The combination of L/G ratio of 0.006 and solvent with composition of 5%-mass NaOH, 10%-mass $NaHCO_3$, and 12.6%-mass Na_2CO_3 resulted on optimum H_2S selectivity of 9.6 (H_2S selectivity increase of 123.1%).

Keywords: Absorption; Acid gas; NaOH; Selectivity; Sodium Bicarbonate; Sodium Carbonate

M-05

Separation of Potassium from the Model Solution

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Abstract

Potassium content in biomass ashes, especially OPEFB was quite high and had not been utilized maximally. Currently one of the efforts that being developed was to utilized potassium as a raw material in the fertilizers production. To be utilized as fertilizers raw material, potassium in biomass ashes must be separated from other components, for example through the extraction process. A mixture of potassium and other salts was produced from this process. Regarding the effort to separate potassium from mixed salt solution had been done research to separate potassium from the model solutions which contained of NaCl, KCl, $MgCl_2$, and $CaCl_2$ with concentrations of 8,388 mg/L, 164,191 mg/L, 7,443 g/L, dan 39,598 mg/L respectively. These concentrations were based on main elements in OPEFB ashes. The potassium chloride salt separation from model solution could be done by evaporation and a combination of evaporation and ethanol addition. By evaporation method, precipitation start at 30% evaporation where precipitate assumed as a mixture of salts. The increase of evaporation degree led to the greater precipitate created which assumed as KCl dominantly. The addition of ethanol to solution produced potassium chloride precipitate. The solution used was the filtrate from the remaining solution of evaporation and precipitate which dissolved in distillation water. The addition of ethanol to model solution with evaporation degree below 30% was proven to produce precipitate which presumed as potassium chloride. From this research can be conclude that addition of ethanol not only can be used to take potassium chloride from model solution, but also increase the acquisition of potassium.

Keywords: Potassium Separation; Model Solution; Evaporation; Degree of Evaporation; Salt Precipitation; Addition of Ethanol

M-06

Effect of Graphene Oxide on the Performance of Cellulose Acetate/ Polyethylene Glycol Membran by Blending Method

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Abstract

Polymeric membrane must be strong during the reverse osmosis process. Carbon-based materials like carbon nanotubes (CNTs), graphene, and its derivative graphene oxide (GO) have strong mechanical strength, high resistance to strong acids/ alkaline and organic solvents, and easy in accessibility. In this study, Graphene Oxide (GO) were blending into Cellulose Acetate/ Polyethylene Glycol (CA/PEG) membranes prepared by phase inversion method. Performance of the membrane was evaluated from the water flux, salt rejection, and permeability. Morphology, hydrofilicity, tensile strength were investigated by using Scanning Electron Microscopy (SEM), Fourier-Transformed Infra-Red (FTIR) and contact angle analysis, and Dynamic Mechanical Analysis (DMA), respectively. The experiment results show that hydrophilicity and porosity increase with the addition of GO with the addition of 0.005% GO exhibits the highest value of them resulting membrane with better flux and salt rejection values as compared to the GO-free membrane. With the addition of 0.005 wt% GO resulted in salt rejection (%R) 83.3% and flux permeate (F) 2475 L/m^2.h. and tensile strength of 0.0148 MPa. Membrane with CA/PEG GO has more advantages, where GO affects the porosity of the membrane by increasing the pore size such as fingers and reducing the thickness of the wall which will result in increased membrane performance ability.

Keywords: Cellulose Acetate; Graphene Oxide; Blending Method; Membrane

M-07

Vacuum Regeneration Technology Using Contactor Membrane for CO_2 Desorption Process from Diethanolamine Solvent

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Abstract

The desorption is a technology to regenerate or release gas from the rich solvent, which is generally simultaneous with the absorption for the application in the industry. This was done to reduce the needs of solvent, especially when using an expensive solvent. Desorption used contactor membrane is a new development compared to the absorption process. The objective of this research is to study the effect of liquid flow rate, vacuum pressure and membrane contact area to the desorption flux and CO_2 desorption efficiency with diethanolamine (DEA) as a solvent. Two different membrane contact area has been used in this study named as Module 1 and 2 with membrane contact area of 0.84 and 1.4 m^2, respectively. The results showed that desorption flux and efficiency of CO_2 desorption decrease with the increasing of solvent flowrate. The desorption efficiency on Module 2 could reach 75% with a lower liquid flow rate of 100 mL/min and a vacuum pressure of 35 kPa while Module 1 only achieved 50% of desorption efficiency. The liquid flow rate has a dominant effect on the total mass transfer resistance (K_{OL}) because the mass transfer resistance in the liquid phase is greater than that in the gas phase.

Keywords: Carbon dioxide; Desorption; Diethanolamine; Membrane contactor; Vacuum regeneration

M-08

Oxidation Process for removing carbamate residue from pesticide manufacturing waste

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Abstract

Oxamyl ((methyl no-dimethyl-n- (methyl carbamoyl)oxy-l-thiooxamimidate) is a type of carbamate ester, which is generally applied as an active ingredient of pesticides. The by-product of the oxamyl manufacturing industry is classified as hazardous and toxic materials due to high toxic and non-biodegradable substances with a high COD (Chemical Oxygen Demand) value. Currently, the degradation of the oxamyl waste is still using conventional methods with a high economic cost, in which the final product is used as a substitute material of cement production. It potentially pollutes the environment if the process does not run properly. Advanced Oxydation Processs (AOP) technology is an effective method in decomposing carbamate. This study aims to obtain the optimum conditions in the degradation of oxamyl waste using AOP technology. In this work, the AOP system is combined with ozonation, assisted by UV (ultraviolet) waves (λ <300 nm), and a peroxy acid catalyst, H_2O_2, to produce OH^- free radicals. The process is carried out to decompose O_3 into O_2 and one O atom, which has enormous energy to accelerate the degradation reaction of oxamyl compounds. Some of the parameters to be observed are the effect of the amount of H_2O_2, and Persulfate catalysts on the rate of oxamyl degradation and calculating the number of process cycles needed. The result shows that the AOP can degrade oxamyl waste from the initial value of COD from 7117.96 ppm to 1117 ppm.

Keywords: Waste Treatment; Oxamyl Hazardous Waste; Advance Oxidation Process Technology

M-09

Progress, Challenges, and Prospects of Forward Osmosis (FO) and PressureRetarded Osmosis (PRO) as An Alternative solution for Water and Energy Crisis

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Abstract

Blue energy is found fascinating to be implemented in Indonesia, the largest archipelago country of which 70% territory is covered with water. The utilization of osmotic-driven membranes in addressing water and energy scarcity has received much attention. Forward osmosis (FO) and pressure-retarded osmosis (PRO) are two osmotic driven membrane processes that utilize draw solution with higher osmotic pressure than the feed solution to drive the water flux. These processes are less energy-intensive compared to other pressure-driven membranes. However, the applications of these processes are still limited due to three main challenges, which are the production of high-performance membrane materials for high water flux and selectivity, the selection of draw solutions, and the need for post-treatment to recover the draw solution. In this study, the progress of recent development to overcome the challenges is reviewed and analysed, then the potentials of the utilization of osmotic-driven membrane in addressing the water and energy crisis are measured and discussed. The review is based on asymmetric polyamide (PA) membranes with strong porous support performing in FO and PRO processes. Draw solution plays a significant role in attaining good performance in osmotic-driven membrane processes. To reduce the complexity of the required post-treatment, FO/PRO/RO hybrid processes have been proposed and analysed in terms of its energy consumption and carbon footprint. The results indicate positive prospects of these hybrid processes pushing forward the research on continuous and self-sustaining osmotic-driven water and energy productions.

Keywords: Osmotic-driven Membrane; Forward Osmosis; Pressure-retarded Osmosis; Asymmetric Membrane; Water-energy Crisis

M-10

Regeneration of Spent Bleaching Earth for PLA-Nanocomposite Filler

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Abstract

This paper concerns on regeneration of spent bleaching earth (SBE) as a filler in biodegradable nanocomposite. The nanocomposite were produced from two different production methods, solvent casting and extrusion. SBE can be used as filler after being regenerated by removing oil and impurities. A regeneration method for SBE was applied using chemical treatment. Regeneration process was proved to be succesful as shown in FTIR with the absence of peak at 2850 cm^{-1} – 2930 cm^{-1} and 1730 cm^{-1} indicating the disappearance of free fatty acids and ester bonds from regenerated bleaching earth (RBE). The RBE was then applied as filler for PLA-Nanocomposite Filler, biodegradable plastic, a suitable substitute for conventional plastic. The production of nanocomposite used two different surfactants, namely octadecyl amine (ODA) and trimethyl stearyl ammonium chloride (TSC) at two different concentration (20 mmol and 40 mmol). The mechanical property of PLA-Bentonite nanocomposite was then analyzed for tensile strength and permeability. The highest tensile strength and lowest gas permeability was obtained by nanocomposite that used 40 mmol TSC as surfactant, with 12.48 MPa and 0.017 g/day, respectively. Moreover, addition of regenerated bleaching earth to PLA-Nanocomposite during production using extrusion and solvent casting had slight different effect. XRD pattern of all extruded PLA-nanocomposite samples indicated the formation of exfoliated structure, as shown in XRD pattern with very low intensity peak around 2 nm at 2 = 5, while only a few of samples of PLA-nanocomposite created by solvent casting indicating the same structure.

Keywords: Bentonite; SBE; Regeneration; Surfactant; Filler; Nanocomposite; Exfoliation.

M-11

Purification of Vitamin E from Palm Fatty Acid Distillate through Neutralization, Extraction, and Adsorption Method

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Abstract

Vitamin E is one of the compounds in palm fatty acid distillate (PFAD) which was carried away due to thermal treatment in the deodorization unit in the refining of crude palm oil (CPO). The process of purifying vitamin E can be done by combining several common processes such as neutralization, extraction, and adsorption. The neutralization process is carried out to remove the content of free fatty acids (FFA), which are the saponifiable compounds and the largest component in PFAD. FFA in PFAD were first neutralized using magnesium oxide and most of FFA removed during process. Vitamin E and the remaining FFA are carried away during the extraction process with hexane due to similar polarity. Vitamin E extracted from neutralized PFAD was then subjected to batch adsorption process using incubator shaker with silica as the adsorbent. The adsorption process in this study resulted in a vitamin E uptake percentage of 98%. Isopropanol is used as solvent in the desorption process and produces a vitamin E recovery percentage of 96,9%. The concentration of final concentrate was obtained with vitamin E purity of 5,6% (12282 ppm) and the amount increased 9.2 times compared to concentrate from neutralization followed by extraction process. The concentrate has strong antioxidant activity as evidenced by the IC50 value of 23,3 ppm.

Keywords: Palm Fatty Acid Distillate; Neutralization; Extraction; Adsorption; Vitamin E

M-12

Effect of Dimethyl Sulfoxide (DMSO) as a Green Solvent and the Addition of Polyethylene Glycol (PEG) in Cellulose Acetate/Polybutylene Succinate (CA/PBS) Membrane's Performance

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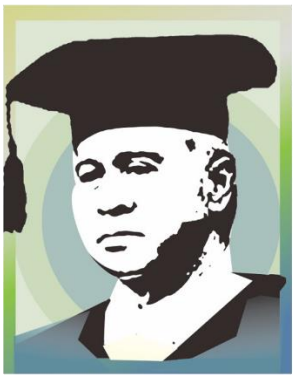
Abstract

In this study, performance of CA/PBS membranes, prepared with the non-toxic solvent dimethyl sulfoxide (DMSO) compared to Dimethylformamide (DMF), was investigated. The membranes were prepared using immersion precipitation technique at coagulation bath at temperatures of 25^{o}C. Ternary diagram was used to show the interaction between polymer (CA/PBS), solvents (DMF or DMSO) and isopropanol as non-solvent by measuring the cloud point instead of Hansen solubility parameter differences. The effect of Polyethylene Gycol (PEG) to the membrane performance was also investigated. Morphology and tensile strength were analyzed by using Scanning Electron Microscopy (SEM) and Dynamic Mechanical Analysis (DMA), respectively. Experimental results proved that DMSO could be used to replace (DMF) as solvent, as the membranes had a higher value of salt rejection (84.9%). With the addition of PEG, salt rejection, mechanical property, and porosity of CA/PBS membrane also increases. The best result shows that PEG with concentration of 7% wt of polymer, the salt rejection is 86.667 %; tensile strength is 68.366 kPa; porosity is 82.3281% and the morphology is sponge-like with the pore size diameter in average is 0.262 µm.

Keywords: cellulose acetate, DMSO, green solvent, membrane, PBS



Process Simulation

P-01

Natural Gas Network Design using Superstructure Method in East Java Indonesia

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Abstract

East Java is one of the provinces in Indonesia which has total natural gas reserves of 4.66 trillion standard cubic feet (TSCF) spread across several locations. Natural gas in this province is used by a variety of consumers, such as petrochemical industries, power plants, industrial fuel, transportation and household needs. However, there are obstacles in the utilization of natural gas due to differences in operating time and differences capacity between suppliers and consumers. Therefore, to optimize the utilization of natural gas in East Java, a natural gas network design is required which is considering the operating time and the capacity of suppliers (source point) and consumers (sinks point). In this study, a natural gas network design of East Java area was developed by modelling superstructure methods which consider the operating time and capacity. The superstructure natural gas network model developed in this study was optimized using GAMS software. From 5 source points and 6 sink points, an optimum natural gas network design has been obtained with a total gas distribution of 4832.8 billon standard cubic feet (BSCF) in a period of 30 years. Due to mismatch of operating time, it is also known that the amount of excess gas supply from this area (export gas) is 1364.1 BSCF and the demand for gas supply from other areas (import gas) is 1105.7 BSCF. With this superstructure method, it is possible to know the optimum network configuration and the natural gas balance in an area which has different operating time, flowrate and capacity between sources and sinks.

Keywords: Natural Gas Network; Superstructure; Optimization; East Java

P-02

Simulation Study of Heating Process under Ultrasound Irradiation in the Manufacture of Microcellular Thermoplastic Foam using Temperature-Induced Foaming

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Abstract

Microcellular Thermoplastic Foam which characterised by micron or nano-sized cellular structure can be manufactured through Temperature-Induced Foaming. Recently, some advancement in the process of making, have been proposed. One of them is the application of Ultrasound Irradiation at the heating or foaming stage, after the dissolution of gases in the thermoplastics. Much of publication regarding to the experimental evidence have been reported. However, lack of the phenomena described and some mechanism behind it, still vaguely debated which now will be elaborated by this study. One-dimensional heat conduction in the thermoplastic polymer slab will be modelled as our simulation approach. The heat generated from acoustic cavitation bubble implosion as the consequences of ultrasound irradiation in the heating medium is considered. Then the cell density is calculated using classical nucleation-theory-based equation with some error-optimized fitted parameters and integrated with the temperature over time. Finally, the simulated results is validated with experimental data which concludes that with the increase of foaming temperature, cell density increased, however at above 323.15 K, cell density is little bit plateau, not much increased as before. This trend is similar as the foaming with ultrasound even though, the cell density is higher compared with those without ultrasound in especially at 323.15 K. Comparison with experimental data, both of simulation results has a similar tendency in nucleation cell density. At lower temperature, for 323.15 and 313.15, cell density is underpredict, whereas at higher temperature, almost approaching the experimental data. This was because the coalescence and unification of the cells are not taken into account in our modified classical nucleation theory.

Keywords: Microcellular Thermoplastic Foam; Heat Transport; Conduction; Foaming; Ultrasound; Cell Density

P-03

Local Equilibrium Modelling in Simulating Experimental Breakthrough Curves of Cadmium Biosorption using Fixed Bed Reactor

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Abstract

The removal of cadmium ions from synthetic wastewater was performed in a fixed bed column packed with dried biomass of cyanobacterium *Aphanothece sp*, acting as a natural cation exchanger. A modeling approach for the fixed bed biosorption column is carried out. The Advection-Dispersion-Reaction (ADR) equation has been implemented as the primary modeling equation for the particular case of Local Equilibrium (L.E.). An apparent axial dispersion coefficient (D_L) has been used as a critical parameter of the models. Three simulation parameters consisted of bed lengths, volumetric flow rates, and initial concentration of cadmium in aqueous solution. The primary assumption of the model is that the biosorption equilibrium was rapidly attained. The overall dispersion coefficient made the model applicable (with specific requirements) when mass transfer resistances are present in the liquid and solid phases. In this study, D_L values ranged from 1.37E-06 to 2.72E-06 m^2/sec. Deviation on the predicted breakthrough curve will have occurred on low volumetric flow rates and low initial Cd^{2+} concentration.

Keywords: Local Equilibrium Modelling; Fixed Bed Reactor; Cadmium; Biosorption; Cyanobacterium; Aphanothece sp

P-04

Recovery of ammonium chloride from wastewater of polyvinyl chloride thermal stabilizer plant by evaporative crystallization with mechanical vapor recompression: Process performance and economic evaluation

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Abstract

This research is aimed to evaluate the recovery of NH_4Cl from wastewater of organotin based polyvinyl chloride stabilizer plant by mechanical vapor recompression (MVR) evaporative crystallization. At first, a series of experiments were carried out to collect crystallization and physical data. An MVR evaporative crystallization was then developed and simulated. The concentration of NH_4Cl in the wastewater significantly influences the specific work of compressor and specific loads of heater, preheater, and crystallizer. The crystallization temperature was found to affect the crystallization specific load and the flow rate ratio of the recycled wastewater to NH_4Cl crystal. The specific work and energy loads as well as recycle ratio are affected by the processing capacity. Both MVR and conventional evaporative crystallization processes are economically feasible to cut the off-site wastewater treatment cost. The economics of the MVR process is lower than that of the conventional process. However, the MVR process needs only 0.2 MW of external energy, much lower than the conventional process external energy demand that achieves 1.4 MW, for a treating capacity of 2.5 tons of wastewater per hour.

Keywords: Ammonium chloride; Polyvinyl chloride; Thermal stabilizer; Wastewater; Mechanical vapor recompression; Evaporative crystallization

P-05

Kappa Number and Viscosity Analysis in Oxygen Delignification of Manihot Esculenta Crantz: A Comparison of Prediction and Experimental Data

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Abstract

The oxygen delignification of cassava stem waste (Manihot esculenta crantz) kraft pulps were studied under vary conditions. Kappa number and viscosity are two important parameters for the quality of resulting pulp, which are influenced by some operation conditions. Therefore, it is important to get the analysis of the Kappa number and viscosity beforehand. The aim of this study was to obtain a prediction of the Kappa number and viscosity for various conditions and to determine the best operating condition for producing qualified pulp. The prediction was carried out by governing kinetic model of oxygen delignification reaction from experiment data. Based on analysis of prediction, the optimum condition was reached at pressure of 2 bar, temperature of 80 ^{o}C, alkali charge of 2%, reaction time of 53 minutes with pulp viscosity of 878.73 ml/g. In addition, the experimental data fitted well to the prediction data from the obtained kinetic model.

Reaction and Control Engineering

R-01

Isomerization of Raw Turpentine using Various Combination of Strong and Weak Acid Catalysts for Cineole Production

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Abstract

There has been large interest to isomerize raw turpentine to produce a number of derivative products that has higher economic value. This process is often conducted using homogenous acid catalysts. Catalyst screening is often challenging to target a certain derivative product, such as cineole. The aim of present work is investigate various combination of strong and weak acid catalyst to obtain cineole. Strong acids used in this research were PTSA, hydrochloric acid, sulfuric acid. In addition, the weak acids were oxalic acid dihydrate, citric acid, and formic acid. Commercial turpentine was mixed with strong and weak acid with 4:1:6 ratio respectively, heated up to 85℃ for 6 hours for each combination of strong and weak acid. The result from GC-MS analysis shows that combination of hydrochloric acid and formic acid gave the highest cineole yield around 9.67% along with other valuable product such as camphene, limonene, and α-terpinolene.

Keywords: Acid; Catalyst; Cineole; Isomerization; Turpentine; α-pinene;

R-02

Depolymerization Kinetics of Aqueous Cassava Starch under Sonication Process using Free-Radical Depolymerization Model and its Correlation with Radical Production from Accoustic Cavitation

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Abstract

The technology of biopolymer degradation to produce its derivative compounds is an important topic nowadays. The use of environmentally friendly methods, such as sonication, is a promising method for obtaining biopolymer derivative compounds. Sonication create accoustic cavitation in liquid body to produce radicals and microjets that can substitute acid substance in the degradation process. Through the sonication process, starch-based compounds can be degraded to oligosaccharides and reducing sugars, which have a variety of benefits in the food, pharmaceutical and fermentation industries. Many experiments have been conducted to investigate the role of sonication in starch degradation. However, there is much process model that can describe the role of sonication in depolymerization. This work aims to evaluate the ability of sonication in producing reducing sugars and lower-molecular-weight starch by using the Free-radical depolymerization model and correlating it with the production of radicals from acoustic cavitation. Experiments were carried out using horn-type sonication with a power of 500W with various amplitude. The reducing sugar analysis was carried out by the DNS method and the average molecular weight was estimated with Ubbelohde viscosimetry. From the simulation results, sonication with 30% of the maximum amplitude gives the largest radical production which well correlates with the production of reducing sugar. The experimental results show a maximum yield of reducing sugar of 0.570 g / L in the process usingS30 for 60 minutes.

Keywords: Biopolymer; Starch; Ultrasound Processing; Radicals; Reducing Sugar

R-03

Effect of Buffer Concentration on Palm Oil Lipolysis using Plant Latex Lipase

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Abstract

Fatty acid is an intermediate substance of various oleochemical products. Fatty acid production can be established by triglyceride hydrolysis using lipase enzyme from *Plumeria sp.* latex. To obtain maximum results, lipase needs a specific environmental pH, thus buffer solution is utilized. The concentration of buffer might affect the lipolytic performance of enzyme. This study investigated the effect of concentration of buffer on Plumeria sp. latex lipase activity. Enzyme activity was analyzed by acid value analysis of lipolysis product. This study showed that the highest lipase activity was gained by utilization of ammonia/ammonium chloride buffer with 0,5 M concentration. Lipase activity on 0,5 M buffer concentration is 79,153%. Lower concentration tends to yield high deviation. Apart from concentration, it is suggested to utilize various type of buffer. By optimizing the lipolysis reaction condition, it is expected thate fatty acids production technology can be developed using an energy-efficient and cost-efficient method.

Keywords: Fatty Acid; Buffer; Lipase Enzymes; Lipolysis

R-05

Kinetics Study and Performance Analysis of Indonesian Rice Husk Pyrolysis

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Abstract

Rice husk is abundantly available biomass in Indonesia and it can be a potential source of high-value energy source. In the present work, pyrolysis of rice husk was subjected to various temperature and used as a method to produce bio-oil. The decomposition profile of rice was examined at different heating rates (10, 20, 30, and 40oC/min) using a thermogravimetric analysis (TGA) method. The pyrolysis kinetic were evaluated using three different kinetic models: Kissinger-Akahira-Sunose (KAS), Ozawa-Flynn-Wall (OFW), and Coats-Redfern (CR). The activation energy for KAS, OFW, and CR was centered at 251.62 kJ/mol, 253.32 kJ/mol, and 33.92 kJ/mol, respectively. Varying activation energy with conversion was observed, which reveals that the pyrolysis of rice husk processes through complex reaction. The production of bio-oil from rice husk using pyrolysis method was studied at different temperature conditions (300, 400, 500, 600oC). Results showed that bio-oil and gas products increase at higher temperature. The highest yield of bio-oil was produced at 600oC with 46.3 grams (37%-wt). The specific test showed that the density, viscosity, and acid value of bio-oil decreased at higher temperatures indicating that different pyrolysis condition might lead to the different bio-oil quality.

Keywords: Slow Pyrolysis; Rice Husk; Temperature; Kinetics; Thermogravimetric Analysis

R-06

Isomerization of Raw Turpentine for Cineole using Response Surface Methodology (RSM): Influence of Acid Ratios and Residence Time

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Abstract

Turpentine is a potential non-wood product from pine tree forest in Indonesia. Turpentine has a wide application in industry mainly as solvent. Isomerization of turpentine is an attractive route to obtain a higher value fine chemical such as cineole. Acid catalyst is often used for this purpose and screening of numerous combination of acid catalysts is often challenging. Therefore, an investigation of isomerization operating condition is important. The aim of present work is to investigate the influence of several acids ratios, and residence time. The raw turpentine was obtained from PT Perhutani Anugerah Kimia (PAK) Trenggalek, East Java. Here, we have investigated the influence of raw turpentine to acid catalyst ratios as well as residence time using central composite design (CCD) of 2^2 factorial design. In this work, the strong acid catalysts used is hydrochloric acid (HCl) and the weak acid catalysts is formic acid (HCOOH). The result from GC-MS analyses showed that isomerization of raw turpentine using combination of HCl and formic acid can produce cineole compound along with other valuable products such as camphene and limonene. Herein, we have reported the highest yield of cineole as high as 11.5% which is in close agreement with model prediction. It is expected that this work may provide a useful path for cineole production in a larger production scale.

Keywords: Acid; Catalyst; Cineole; Isomerization; Ratio; Residence Time; Turpentine; α-pinene

R-07

Effects of Operationg Conditions on the Production of Sodium Stearoyl 2-Lactylate

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Abstract

Emulsifiers as food additives are commonly added to processed foods to maintain food shape and to stabilize an emulsion system. One of emulsifier that is often used in bread is sodium stearoyl-2 lactylate (SSL). Sodium stearoyl-2 lactylate is an emulsifier that can be obtained from the reaction of lactic acid and stearic acid, followed by the addition of sodium hydroxyde. This research aims to determine how reaction condition affect the SSL production. The ratio of stearic acid: lactic acid: sodium hydroxyde, and also the temperature and reaction time of the SSL production were varied. Parameters that were analyzed to examine the quality of SSL produced are acid value, saponification value, and color of SSL. The result shows that the acid value and saponification of the product increased as the reaction temperature and time increased.

Keywords: Emulsifier; Acid Value; Stearic Acid

R-08

Application of Reverse Flow Reactor for Vent Gas Emission Reduction in Catalytic Oxidation Unit at Purified Terephthalic Acid Plant

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Abstract

PTA (Purified Terephthalic Acid) manufacturing process generates waste gases containing VOC (Volatile Organic Compounds) that have negative health effects, one of it is benzene. Catalytic oxidation method consists of a recuperative (need external energy to reach the reaction temperature) and reverse flow reactor (RFR) which uses the principles of auto thermal (requires no external energy). Fuel consumption for heating the feed gas is a major operating cost in the catalytic oxidation, so that the fuel reduction becomes important. The objective of this study is to assess the technical possibility of RFR to lower the fuel consumption; and to assess the operating conditions for autothermal conditions. The mathematical model consisted of the unsteady state mass and energy balances and was numerically solved using a software package of FlexPDE verion 6.32. The recuperative system was simulated in the steady state condition, while RFR with the same amount of catalyst was simulated in the unsteady state condition. As the key parameter, the switching time was varied to consider the performance of RFR. At various switching times and inlet concentrations, the autothermal was achievable even heat extraction was required to prevent the catalyst overheat. At the feed gas linear velocity of 1.2 m/s and the switching time of 7.5 s or higher, RFR provides energy saving that is equivalent to US$ 0.1208/ton feed gas up to US$ 0.7248/ton of feed gas compared to recuperative system.

Keywords: Reverse Flow Reactor; Switching Time; VOC Emissions; Catalytic Oxidation; Purified Terephthalic Acid; Modeling and Simulation

R-09

Development of Feed Modulation in Fixed Bed Reactor for Dry Reforming of Methane

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Abstract

Interest in the dry reforming of methane is motivated by the need for reduction of carbon dioxide emissions and the low cost of natural gas. Methane and carbon dioxide as reactants will react during the reaction to produce synthesis gas. The synthesis gas formed with a ratio of hydrogen to carbon monoxide is near to one, which makes it suitable for producing dimethyl ether, acetic acid, and alcohol via oxo-alcohol synthesis. The dry reforming of methane is a reversible reaction and endothermic, so it requires a large amount of energy to maintain operating conditions. Moreover, DRM reaction requires high operating temperatures to achieve maximum equilibrium conversion. However, in the high-temperature region, the catalyst is prone to deactivate due to sintering. When the reaction is operated at a lower temperature, it can cause carbon deposits on the surface of the catalyst. In this paper, several variations of the feed modulation are simulated to determine the best conditions to achieve the highest performance. The models consist of the mass and energy balances, involving dynamic, convective, dispersion or conductive, and source terms. The initial and boundary conditions at the proper use are applied. The proper time scale becomes the most important parameter to affect the dynamic behavior of the reactor.

Keywords: Carbon Deposition; Catalytic; Dynamic; Modelling and Simulation; Reactor

R-10

Synthesis of α-Terpinene from Raw Turpentine

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Abstract

α-Terpinene is one of monoterpene compounds usually produced from aromatic plants especially pine trees. It is mostly used for cancer inhibitor and pharmaceutical industry. Raw turpentine from pine tree has several derivatives, such as: α-pinene, β-pinene, limonene, δ-carene, camphene, terpineol, etc. Commonly, α-terpinene presents as a side product from hydration of α-pinene or turpentine to terpineol. In this study, synthesis of α-terpinene was conducted in a hope to obtain higher yield of product. The methods were managed in a single reaction step. First, the reaction of raw turpentine with water and acid catalysts to form terpineol for 3 hours at 85°C. Second, drawn off the water from the mixture then continue the reaction for 3 more hours at the same temperature.

Keywords: α-terpinene; Turpentine; Acid Catalyst; Homogeneous Reaction; Pine

R-11

Activity Test of $CuO/\gamma\text{-}Al_2O_3$ as Catalyst of Methanol Dehydration to Dimethyl Ether at Atmospheric Pressure

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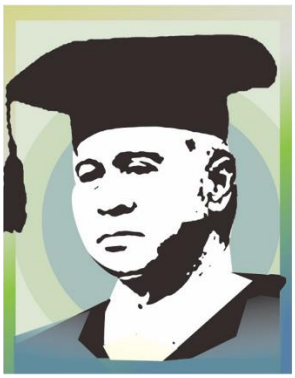
Abstract

Dimethyl ether (DME) is already used as a propellant and intermediate chemicals. Now, Indonesia will use DME as alternative energy for Liquid Petroleum Gas (LPG), as a result of the continued increase in LPG imports. In this study, DME was synthesized by dehydration of methanol process. The γ-Al2O3 and modified $CuO/\gamma\text{-}Al_2O_3$ ITB use as catalysts for the process. The objective of this research was to compare of catalytic activity of both catalysts at methanol dehydration to DME. The catalyst activity test was carried out in a tubular fixed-bed reactor (ID 1 cm and length 21 cm). Methanol dehydration was carried out at 1 bar, GHSV 1,100-2,200/h, methanol 1.9-4 mL/h, N_2 10-30 mL/min (27.5℃ and 0.93 bar). The downstream gas of the reactor was analyzed using gas chromatography and the condensate was analyzed using a refractometer. The $\gamma\text{-}Al_2O_3$-ITB catalyst gives the highest performance with 89.6% of methanol conversion, 6.6% of DME yield, and 16.6% of DME selectivity. Whereas $CuO/\gamma\text{-}Al_2O_3$ catalyst has a lower performance by 85.5% of methanol conversion, 1.4% of DME yield, and 3.7% of DME selectivity.

Keywords: $CuO/\gamma\text{-}Al_2O_3$; Dimethyl Ether; LPG; Methanol Dehydration; Modified catalyst; Impregnation



SYMPHOSIS 2020

Symphosis

S-01

Synergistic Effect of TiO_2 and ZnO Photocatalysts for 4-Nitrophenol Photodegradation under Ultraviolet Irradiation

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Abstract

Since phenolic compounds can seriously damage our health, their concentration in the industrial wastewater should be reduced before their disposal. A photodegradation process offers a green and simple process utilizing light irradiation in the presence of heterogeneous photocatalyst material. Titanium dioxide (TiO_2) and zinc oxide (ZnO) materials have been reported for their remarkable photocatalytic activity under ultraviolet (UV) irradiation. However, the electron-hole recombination on these photocatalyst materials demarcates their photocatalytic efficiency. In the present work, we reported a synergistic effect of combined P25 TiO_2 and ZnO in the TiO_2-ZnO composite for 4-nitrophenol degradation under UV irradiation. While it was obtained that the adsorption capability of TiO_2-ZnO composite material (4.2%) toward 4-nitrophenol lay between those of the P25 TiO_2 (2.8%) and the ZnO (10%) materials, the TiO_2-ZnO composite material exhibited a higher photocatalytic activity (65%) than both of the P25 TiO_2 (26%) and the ZnO (59%). The kinetic study showed that the TiO_2-ZnO composite gave a higher reaction rate constant (0.197 h^{-1}) than the P25 TiO_2 (0.047 h^{-1}) and the ZnO (0.172 h^{-1}) materials. From the fluorescence study, it was proposed that the electron transfer from the P25 TiO_2 to the ZnO was responsible for the photocatalytic activity enhancement.

Keywords: 4-Nitrophenol; Photocatalyst; Synergistic Effect; TiO_2/ZnO Composite; Ultraviolet

S-02

Processing of Palm Mill Oil Effluent Using Photocatalytic: A Literature Review

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Abstract

Oil extraction of palm oil fruit (*E. guineensis*) is achieved by combination of some methods such as pressing, sterilization, digestion, stripping, classification, purification and vacuum drying of the extracted oil. The process requires excessive use of water and produces a large amount of wastewater with high concentration of pollutants, known as palm oil mill effluent (POME). This wastewater is highly viscous liquid and brownish in colour with a temperature of 80-90°C. It is extremely poisonous with very low pH between 4.2-4.5, high chemical and biochemical oxygen demand. Various methods and technologies have been adopted for POME treatment, including coagulation-flocculation, anaerobic-aerobic treatment, and membrane technology. The biological treatment was mostly employed to treat POME and the treated POME by the biological treatments was called as Palm Oil Mill Secondary Effluent (POMSE). Unfortunately, the treated waswater still contains high concentration of organic materials. The color of the effluent still is dark brown. The remaining pollutants from these biological process are generally difficult to degrade biologically, thus requiring suitable processing methods for its removal, so that can be discharged to the environment safely or even reused or recycled. One of the challenging processing methods is photocatalytic process. This method is able to utilize abundant resources in the form of sunlight and is also effective to degrade a wide variety of reclcitant organic pollutants in the wastewater. This paper present the current research and development of photocatalytic degradation process for processing of palm oil mill secondary effluent. The review and analysis are focused on synthesis of photocatalyst and the photoreactor design. Based on the results of the literature review and analysis, some recommendations are formulated for future research potential for their application in advanced POMSE management so that it can be reused for various purposes.

Keywords: POME; POMSE; Photocatalytic; Photoreactor Design; Synthesis of Photocatalyst

S-03

Titania Modified Silica from Sugarcane Bagasse Waste for Photocatalytic Wastewater Treatment

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Abstract

Photocatalytic oxidation is one of the technologies to overcome pollution that can be applied for air and water purification. TiO_2 has been widely used as a photocatalyst, however, several disadvantages of TiO_2 including low absorption of visible or solar radiation, rapid recombination of electron and hole as well as low stability limits its practical applications especially for wastewater treatment. Thus, to overcome this problem, this study aims to develop highly adsorbent photocatalyst using TiO_2/SiO_2 composites with sugarcane bagasse waste act as SiO_2 source. The experimental results show that the photocatalytic performance of TiO_2/SiO_2 composite in the decolorization of methyl orange exhibits three-fold enhancement compared to neat TiO_2. Several catalyst characterizations were obtained including X-ray diffraction (XRD), scanning electron microscopy (SEM), and X-ray fluorescence (XRF). Characterization data show that a phase transformation was obtained from amorphous to crystalline phase by increasing TiO_2 content. These results proved that the feasibility of SiO_2 from sugarcane bagasse waste coupled with TiO_2 can be utilized for wastewater degradation.

Keywords: Photocatalysis; TiO_2/SiO_2; Sugarcane Bagasse Waste; Methyl Orange; Wastewater Treatment

S-04

Optimization of UV Light Source Conditions for Photocatalytic Activity of Methyl Orange using TiO_2

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Abstract

Methyl orange is one of the azo compounds which carcinogenic and damages the water system if untreated properly. This compound is used in the textile industry as a coloring agent. Dyestuff waste produced from the textile industry is generally a non-biodegradable organic compound, which cause environmental pollution, especially at the aquatic environment. As organic waste, it is necessary to treat this compound to be harmless and safe for the environment. One of the method to remove dye waste is by using photocatalytic reaction using TiO_2 as semiconductor. In this study, optimization of UV light source conditions of the photocatalytic reaction was carried out inside a photoreactor system using TiO2 synthesized by hydrothermal method. Optimization of the distance of UV lamps from the surface of methyl orange solution and UV lamps power has been done under the artificial UV light source with 254 nm wavelength. The percentage of degradation was determined by measuring the absorbance of methyl orange solution before and after degradation using UV-Vis spectrophotometer. It shows that the optimum photocatalytic activity for the distance of UV lamps and UV lamps power is 20 cm and 20 Watt respectively. Physically, there was color changing during the reaction from orange to colorless.

Keywords: Photocatalytic Activity; TiO_2; Methyl Orange

S-05

Improved Visible Light Activity of Copper Oxide/Carbon Nitrides Photocatalyst Prepared by Photodeposition for Phenol Degradation

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Abstract

A series of copper (II) oxide deposited on carbon nitride (CuO/CN) as visible light active photocatalyst was successfully prepared via a photodeposition method. The CuO modification was carried out to improve the photocatalytic activity of CN due to its fast electron-hole recombination. The CuO loading was varied from 0.05 to 0.5 wt% and the photodeposition was carried out at room temperature under UV light illumination. The CuO/CN samples were confirmed to have similar optical properties and functional groups to those of the unmodified CN. Meanwhile, the emission intensity of the CN decreased with the increase of the copper species loading, which could correspond to the suppression of charge recombination on the CN. After 24-h reaction under visible light irradiation, the best photocatalyst, *i.e.* the CuO(0.1)/CN, gave 41.7% phenol degradation, which was almost two times higher than the unmodified CN (21.3%). However, the photocatalytic activity decreased when the added copper species was more than 0.1 wt%. Therefore, the optimum amount of copper species deposited to the CN surface would have a prominent contribution to improve the photocatalytic activity. It was also confirmed that both holes and hydroxyl radicals were important for the photocatalytic degradation of phenol on the CuO(0.1)/CN.

Keywords: Carbon Nitride; Copper Oxide; Phenol Degradation; Photocatalyst; Photodeposition

S-06

High Photocatalytic Activity of Zinc Metatitanate Materials for Phenol Photodegradation

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Abstract

In this work, we synthesized zinc metatitanate ($ZnTiO_3$) through a sol-gel method using a 1:1 mol ratio of zinc nitrate and titanium(IV)isopropoxide as the precursors. The calcination temperature was set to 700, 900, and 1100 °C to give ZM-700, ZM-900, and ZM-1100, respectively. These products were characterized using X-ray diffractogram (XRD), diffuse-reflectance ultraviolet-visible (DR UV-Vis), Fourier transform infrared (FTIR), and fluorescence spectroscopies. The XRD analyses showed that the ZM-700 contained both cubic-$ZnTiO_3$ and rhombohedral-$ZnTiO_3$ phases with a small part of ZnO, while the ZM-900 contained only cubic-$ZnTiO_3$ with the additional formation of cubic-Zn_2TiO_4. In contrast, the ZM-1100 contained cubic-Zn_2TiO_4 and rutile TiO_2 as the main phases with a very small part of the $ZnTiO_3$ phase. From the FTIR analysis, it was confirmed that the ZM materials showed the vibration signals of Ti-O and Zn-O. Since $ZnTiO_3$ was the main phase in the ZM-700 and the ZM-900, these materials gave similar fluorescence spectra to each other. The study of phenol photodegradation under UV light revealed that the reaction followed first-order, in which the reaction rate constants were similar for ZM-700 and ZM-900. This study demonstrated that the formation of $ZnTiO_3$ was crucial to obtain high photocatalytic activity on the ZM materials.

Keywords: $ZnTiO_3$; Photocatalyst; Phenol; Degradation

S-07

TiO_2/CNCs Hybrid Photocatalyst for CO_2 Photoreduction: TiO_2/CNCs Synthesis

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Abstract

CO_2 conversion into chemical through photocatalysis is an excellent solution to resolve the greenhouse gas effect. It can reduce the amount of CO_2 while creating chemicals that can replace fossil-based fuels with the nature-provided abundant solar energy. TiO_2 is the most common photocatalyst that used to carry out a photocatalysis reaction, including CO_2 conversion. However, unmodified TiO_2 gives a very low conversion of CO_2. Herein, the attempts to increase TiO_2 photocatalyst performance is carried out by dispersing nano-sized TiO2 to cellulose nanocrystals surface as support. So, a larger active site of TiO_2 is expected to results in larger CO_2 conversion. The research consisted of CNCs extraction from oil palm empty fruit bunch (OPEFB) by oxidation method using APS, characterization of CNCs, TiO_2/CNCs synthesis by using the sol-gel, and TiO_2/CNCs characterization. CNCs and TiO_2/CNCs product were characterized by using Fourier-Transform Infra-Red (FTIR), X-Ray Diffraction (XRD), Dynamic Light Scattering (DLS), and Transmission Electron Microscope (TEM). The chemical change from OPEFB to CNCs was observed through Infra-Red Absorbance Curve. It is found that the CNCs product has an average diameter of 172 nm and crystallinity index of 71.8%. Under TEM observation, TiO_2 was found to be successfully dispersed on the surface of CNCs.

Keywords: Photoreduction; Titanium Dioxide; Cellulose Nanocrystals; Fuel Cell; Photocatalyst

S-09

TiO_2/AC Composites for Adsorption-Photocatalytic of Methyl Orange

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Abstract

Herein, the adsorption-photocatalytic performance of composite titanium dioxide (TiO_2) and Activated Carbon (AV) to decompose methyl orange was investigated systematically. This work demonstrated the synthesis of TiO_2/AC composite via the sol-gel method. After getting the composite TiO2/AC under different ratios of AC, the prepared particles were then annealed at 500°C for 2 h. The presence of AC detected by Fourier transform infrared (FTIR) spectra at 1028nm. Based on Brunauer–Emmett–Teller (BET) analysis, the result showed that the prepared particles specific surface area increased by increasing the AC ratio. The prepared photocatalyst was used to decompose methyl orange under UV light irradiation for 90 minutes. From the photocatalytic performance, the additional AC did not influence the adsorption process significantly under dark conditions. Interestingly, during the irradiation process, methyl orang could be decomposed until 62.5%, which means 15% higher than that of bare TiO_2. The present result showed that an additional AC could enhance photocatalytic performance due to its ability as an electron transfer and avoid the recombination process between electrons and holes.

Keywords: TiO_2/Activated Carbon Nanocomposite; Photocatalyst; Methyl Orange

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