

PROCEEDINGS International Conference

# ChESA

Chemical Engineering on Science and Application



## ChESA 2013

Banda Aceh, 18-19 September 2013

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Dr. Abrar Muslim (Indonesia)

Prof. Dr. Koichi Fujie (Japan)

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## **WELCOME SPEECH FROM THE RECTOR**

Assalammualaikum Wa Rahmatullahi Wa Barakatuh,  
In the Name of Allah, the Most Beneficent, the Most Merciful  
May the peace, the mercy, and the blessings of Allah be upon you.

Distinguished Participants, Ladies and Gentlemen,  
On behalf of Syiah Kuala University, I would like to welcome you all to the 7th International Conference of Chemical Engineering on Science and Applications 2013.

It is an honor for me to attend this conference, which is held at the seventh time, of course beginning with lecturers from Chemical Engineering Department of Syiah Kuala University. The conference event is unique in that it springs up from the thinking how to share knowledge based on our area of expertise. It is rewarded if Chemical Engineering lecturers would not only share their creative ideas in the Faculty but also in a forum such as this international conference. Because of the reason, this conference wants to provide the forum to gather the ideas to implement innovative knowledge into our daily activity successfully.

I sincerely hope this conference is inspiring and also one to be expected again next time. The organizing committee is committed to make this conference a success with its ready applications to not only university but government. Therefore, I extend my greetings to all parties who may benefit from the conference to apply it in managing activities in their areas.

Currently, the Chemical Engineering Department of Syiah Kuala University agree on topics: Food and Biochemical Engineering, Catalytic Reaction Engineering, and much more. The topics come from the belief to develop clean energy technology for community welfare. There is an argument put forward by many scholars that we approach an ideal society when we can combine ideas to support technology development. Therefore, this conference is just a trigger for us to get involve more towards local, national, and international development.

Last but not the least, my deepest gratitude goes to the Organizing Committee, institutions, and companies who have directly and indirectly supported the well-running of this seminar. Although we try to be professional, on behalf of Rector of Syiah Kuala University, please accept our sincere apologies for inconveniences that crop before, during, or after the event.

May God bless us all with the health to make this event a successful and enjoyable one!

Thank you.

Prof. Dr. Ir. Samsul Rizal, M.Eng  
Rector of Syiah Kuala University

## MESSAGE FROM THE CHAIRMAN

Assalamualaikum Wr. Wb.

Honorable Guests, Presenters, and Participants,

First of all, I would like to thank you for your valuable contributions to this conference that is conducted by Chemical Engineering Department of Syiah Kuala University. Our department is one of the largest department in Engineering Faculty. It was established in 1963 driven by a spirit to form a department to bring Acehnese to become educated, knowledgeable, and technocrate. Therefore, we try to give our best in contributing our ideas in the field of Chemical Engineering Science and Applications so that we can cooperate to improve our daily lives. We understand that it takes time to achieve the target; however, we believe one effort is much better than nothing.

I am also happy to inform that the committee is very lucky to have 5 Plenary Speakers, i. e. from Japan and Indonesia, who supported us from the very beginning with their capabilities to try and personally come and meet you all. Although there may be many other competitive International Seminars held with similar topics around the world, I am happy to report that the Chemical Engineering on Science and Applications manages to successfully attract more than 100 academicians to present their abstracts, i. e. from Iran, Japan, Malaysia, Taiwan, and Indonesia. So, I am proud to announce that the 58 abstracts accepted to be presented in this seminar has gone through a professionally selective process. For that reason, I personally congratulate you all as distinguished speakers to this event!.

This conference has collaborated with four international journals, i.e. Bulletin of Chemical Reaction Engineering and Catalysis, International Journal of Science and Engineering, International Journal of Renewable Energy Development, and [International Journal of Waste Resources](#). All selected conference papers are then peer-reviewed to meet the highest standards of publication. The peer review of each manuscript is rigorous and concentrates on objective and technical concerns to determine whether the research has been sufficiently well conceived, well executed, and well described.

I also would like to give a special welcome to The Government of Aceh, Pertamina, PT. Medco E&P Indonesia, PT. Arun, Exxon Mobil, PT. Pupuk Iskandar Muda, Bank Mandiri, PT. Lafarge Cement Indonesia, PT, PLN, Bank Mandiri, and individuals who sponsor this conference. We can never thank them enough for that! A way to express our gratitude would be to make every effort to make this conference a full success.

Finally, I expect all participants have memorable moment through this conference and enjoy your stay in Banda Aceh.

Thank you.

Sincerely,

Chairman of Committee

Dr. M. Faisal, S. T., M. Eng



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TECHNICAL PROGRAM OF THE 7<sup>TH</sup> INTERNATIONAL CONFERENCE OF CHEMICAL  
ENGINEERING ON SCIENCE AND APPLICATIONS (ChESA), BANDA ACEH, 18-19  
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Wednesday, 18 September 2013				Moderator
Opening Season				
08.00 – 09.00	Registration Session			Committee
09.00 – 09.04	MC (Izzan)			MC
09.04 – 09.10	Reciting Al-Quran (M. Mufid Al Izza)			MC
09.10 – 09.15	Organizing Committee Report Dr. M. Faisal, Chairman Seminar Committee			
09.15 – 09.20	Welcome To Aceh by Governor of Aceh			
09.20 – 09.25	Welcome Speech Prof. Dr. Samsul Rizal, M. Eng, Rector of Syiah Kuala University and opening sign by Rapai			
09.25 – 09.40	Art Performing (Aceh Dance)			
09.40 – 09.45	Photo session			
09.45 – 10.10	Coffee break and Poster Session 1			Committee
Seminar Season				
10.10-10.40	Keynote Lecture 1 : Prof. Dr. Koichi Fujie Title: <b>Evaluation and Reduction of Whole Effluent Toxicity in Sewage Treatments for Effective Use of Limited Water Resources</b> (Graduate School of Environment and Information Sciences, Yokohama National University 79-7, Tokiwadai, Hodogaya-ku, Yokohama, 240-8501, Japan)			Prof. Dr. Y.H. Taufiq-Yap
10.40-11.10	Keynote Lecture 2 : Prof. Dr. Ichiro Naruse Title: <b>Resources, Energy and Environment</b> (Energy Science Division, EcoTopia Science Institute Nagoya University Resources, Energy and Environment Energy Science Division, EcoTopia Science Institute Nagoya University)			
11.10-11.40	Keynote Lecture 3 : Ministry of Education and Culture of Indonesia)			
11.40-11.45	Oral Session Preparation			Committee
11.45-12.30	Oral Session 1			
	Room 1 (3 presenter)	Room 2 (3 presenter)	Room 3 (3 presenter)	
12-30-14.00	Lunch break			Committee
14.00-15.15	Oral Session 2			
	Room 1: 1 long & 10 short presenter	Room 2 (5 presenter)	Room 3 (5 presenter)	
15.15-15.30	Coffee break and Poster Session 2			
15.30-16.45	Oral Session 3			
	Room 1	Room 2 (5 presenter)	Room 3 (5 presenter)	
19.30 – 22.00	Gala Dinner/Banquet / Best Poster Award and (Art Performance, Aceh Dance)			
Thursday, 19 September 2013				Moderator
09.00 – 09.30	Keynote Lecture 4 : Prof. Dr. Hideto Matsuyama Title: <b>Several Approaches of Membrane Fouling Reduction in Water Treatment</b> (Center for Membrane and Film Technology, Department of Chemical Science and Engineering, Kobe University, 1-1, Rokkodai, Nada, Kobe 657-8501, Japan)			Dr. Abrar Muslim, M.Eng
09.30 – 09.50	Keynote Lecture 5 : Assc. Prof. Dr. Kazuhiko Nishi Title: <b>Potential of an asymmetrical agitation in industrial mixing</b> (Department of Materials Science and Chemical Engineering, Yokohama National University, 79-5 Tokiwadai, Hodogaya, Yokohama, 240-8501, Japan)			
09.50 – 10.10	Coffee break			Committee
10.10 – 10.15	Oral Session 4 Preparation			
10.15 – 11.45	Oral Session 4			
	Room 1 (7 presenter)	Room 2 (8 presenter)	Room 2 (7 presenter)	

11.50 – 12.30	Lunch break	Committee
14.00 – 18.00	Conference Tour	

**Detailed Schedule For Oral Session  
(Wednesday, 18 September 2013)**

**Room I, Coordinator : Wahyu Rinaldi, ST., M.Sc./Dr. Cut Meurah Rosnelly, MT.**

**Topic: 1. Separation and Purification (SP)**

**Oral Session 1**

**Time: 11.45-12.30**

**Moderator : Dr. M. Faisal, ST. M.Eng.**

Time	Code	Presenter	Institution	Title
11.45 – 12.00	SP-01	Bastian Arifin <sup>1</sup> , Sri Aprilia <sup>1</sup> , Amri Amin <sup>2</sup> , Fauzi Muhammad Djuned <sup>3</sup>	<sup>1</sup> Department of Chemical Engineering, Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia <sup>2</sup> Engineering Faculty of Abulyatama University, Banda Aceh-Indonesia <sup>3</sup> Bioresource division School of Industrial Technology, University Sains Malaysia, Penang-Malaysia	Hybrid Water Treatment System by Conventional Method and Ultrafiltration Membranes
12.00 – 12.15	SP-02	A.Azarmehr	National Iranian Gas Company	Advantages of DEA over MEA for Sweetening Unit of a Gas Plant
12.15– 12.30	SP-03	Aswati Mindaryani <sup>1</sup> , M. Arif Wibisono <sup>2</sup>	<sup>1</sup> Chemical Engineering Dept, University of Gadjah Mada <sup>2</sup> Mechanical and Industrial Engineering Dept., University of Gadjah Mada	Absorption of CO <sub>2</sub> from biogas with banana stems ash solution in preparation for power generation
12.30-14.00	Lunch break			

**Oral Session 2; Time: 14.00-15.15**

**Moderator : Dr. M. Dani Supardan, ST., MT**

14.00 – 14.15	SP-04	Reyhane Saadi <sup>1</sup> , Zahra Saadi <sup>1</sup> , Reza Fazaeli <sup>2</sup>	<sup>1</sup> Department of Chemical engineering, Faculty of engineering, South Tehran Branch, Azad University, Tehran, , Iran <sup>2</sup> Department of Chemical engineering, Faculty of engineering, South Tehran Branch, Azad University, Tehran, Iran	Adsorption of Ni (II) onto Nanostructured γ-alumina in a Fixed-bed Column
14.15 – 14.45	See detail	Short Oral Presentation		
15.30 – 15.45	Coffee break and Poster Session 1			
19.30 – 22.00	Gala Dinner/Banquet (Art Performance, Aceh Dance)			

**Room II, Coordinator : Dr. Hesti Meilina, ST., MP./Ir. Pocut Nurul Alam, MT.**

**Topic: 1. Material Sci. Eng, Polymer and Petrochemical Technology (MPPT); 2. Agro Industrial Technology (AIT)**

**Oral Session 1;**

**Time : 11.45-12.30**

**Moderator : Zuhra, ST. M.Sc.**

Time	Code	Presenter	Institution	Title
11.45 – 12.00	MPPT-01	Nurul Shuhada Mohd Makhtar <sup>1*</sup> , Miradatul Najwa Muhd Rodhi <sup>1</sup> , Mohibah Musa <sup>1</sup> , Ku Halim Ku Hamid <sup>1</sup>	<sup>1</sup> Faculty of Chemical Engineering, Universiti Teknologi Mara Shah Alam, 40450, Malaysia	The Chemical Compound Presence in Green Material Derived From Tacca leontopetaloides Starch: FT-IR Analysis
12.00 – 12.15	MPPT-02	Arina Binti Abdullah, Ms. Norhayati Binti Talib, and Noor Fitrah Binti Abu Bakar	Faculty of Chemical Engineering, Universiti Teknologi Mara	Direct Current Electrophoretic Deposition (DC-EPD) of TiO <sub>2</sub> /Activated Carbon Composite in Non-

Time	Code	Presenter	Institution	Title
				Aqueous Suspension with Different Applied Voltages
12.15– 12.30	MPPT-03	Yohandri Bow, Ibnu Hajar, Rusdianasari	Department of Chemical Engineering, State Polytechnic of Sriwijaya, Palembang 30139, Indonesia	Modified Carbon Composite Electrode with Zeolit in Degradation of Dissolved Chlorine
12.30-14.00	Lunch break			

## Oral Session 2;

Time :14.00-15.15:

### Material Sci. Eng, Polymer and Petrochemical Technology (MPPT)

Moderator : Dr. Mahidin, ST. M.Eng.

14.00 – 14.15	MPPT-04	Nur Azrini Ramlee <sup>1</sup> , Chantara Thevy Ratnam <sup>2</sup> , Nur Hashimah Alias <sup>1</sup> , Mohd Faizal Abd Rahman <sup>2</sup>	<sup>1</sup> Faculty of Chemical Engineering, University Technology MARA Shah Alam, 40450 Shah Alam, Selangor, Malaysia. <sup>2</sup> Malaysian Nuclear Agency (Nuclear Malaysia), Bangi, 43000 Kajang, Malaysia.	Dynamic Mechanical and Gel Content Properties of Irradiated ENR/PVC blends with TiO <sub>2</sub> Nanofillers
14.15 – 14.30	MPPT-05	Renita Manurung, Ahmad Rozi Tanjung, Ida Ayuningrum	Department of Chemical Engineering, University of Sumatera Utara, Medan 50239, Indonesia	Effect of Concentration of Catalyst (BF <sub>3</sub> -Diethyl Etherate) on Synthesis of Polyester From Palm Fatty Acid Distillate (PFAD)
14.30 – 14.45	MPPT-06	Rohaizu. R., Wanrosli W. D.	School of Industrial Technologies, Universiti Sains Malaysia, 11800 Minden, Pulau Pinang	Production of iridescence nanocellulose film from oil palm empty fruit bunch microcrystalline cellulose (OPEFB-MCC)
14.45 – 15.00	MPPT-07	M. Nizar Machmud <sup>1,*</sup> , Reza Fahmi <sup>2</sup> , Rohana Abdullah <sup>3,4</sup> , Coco Kokarkin <sup>5</sup>	<sup>1</sup> Department of Mechanical Engineering, Faculty of Engineering, University of Syiah Kuala, Jln. Tgk. Syech Abdurrauf No. 7, Darussalam, Banda Aceh, 23111 Indonesia <sup>2</sup> Undergraduate student at Department of Mechanical Engineering Faculty of Engineering, University of Syiah Kuala, Jln. Tgk. Syech Abdurrauf No. 7, Darussalam, Banda Aceh, 23111 Indonesia <sup>3</sup> Department of Agrotechnology, Faculty of Agriculture, University of Bandung Raya, Jln. Cikutra No. 171 Bandung, 40124 Indonesia <sup>4</sup> Post Graduate Student at Post Graduate School of Agriculture, University of Padjadjaran, Jl. Raya Bandung Sumedang KM 21, Jatinangor, 45363 Indonesia <sup>5</sup> Ministry of Marine Affairs and Fisheries Republic of Indonesia, Directorate General of Aquaculture, Balai Budidaya Air Payau (BAP) Ujung Batee, Jln. Krueng Raya Km. 16, Ujung Batee, PO. BOX. 46, Banda Aceh, 23000 Indonesia	Characteristics of Red Algae Bioplastics/Latex Blends under Tension
15.10 – 15.15	MPPT-08	Nurul Amira Shazwani, Z.* , Ku Halim, K.H., Mohibah, M., Miradatul Najwa, M.R.	Faculty of Chemical Engineering, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia	Study on the Effect of Calcination Temperature of Agarwood Waste for Silica Production
15.15 – 15.30	Coffee break and Poster Session 2			



**Oral Session 3;****Time :15.30-16.45****Topic: 1. Material Sci. Eng, Polymer and Petrochemical Engineering (MPPE); 2. Agro Industrial Technology (AIT)****Moderator : Dr. Nasrul A.R, ST. M.T**

15.30 – 15.45	MPPT-09	Fauzi Muhammad Djuned, Teku Muhammad Asnawi, Wan Rosli Wan Daud	Bioresource, Paper and Coating Department, School of Industrial Technology, Universiti Sains Malaysia.	Cellulose Diacetate from Oil Palm empty fruit bunches
15.45– 16.00	MPPT-10	Abdul Gani Haji <sup>1</sup> , Gustan Pari <sup>2</sup> , Muhammad Nazar <sup>1</sup> and Habibati <sup>1</sup>	<sup>1</sup> Department of Chemistry, FKIP Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia <sup>2</sup> Forest Product Research and Development Center, Bogor, Indonesia	Characterization of activated carbon produced from urban organic waste
16.00 – 16.15	MPPT-11	M. Nizar Machmud <sup>*,1</sup> , Fauzan Fadi <sup>2</sup> , Zahrul Fuadi <sup>1</sup> , Coco Kokarkin <sup>3</sup>	<sup>1</sup> Department of Mechanical Engineering, Faculty of Engineering, University of Syiah Kuala, Jln. Tgk. Syech Abdurrauf No. 7, Darussalam, Banda Aceh, 23111 Indonesia <sup>2</sup> Undergraduate student at Department of Mechanical Engineering, Faculty of Engineering, University of Syiah Kuala, Jln. Tgk. Syech Abdurrauf No. 7, Darussalam, Banda Aceh, 23111 Indonesia <sup>3</sup> Ministry of Marine Affairs and Fisheries Republic of Indonesia, Directorate General of Aquaculture, Balai Budidaya Air Payau (BAP) Ujung Batee, Jln. Krueng Raya Km. 16, Ujung Batee, PO. BOX. 46, Banda Aceh, 23000 Indonesia	Alternative Fiber Source from Gracilaria Sp and Eucheuma Cottonii for Papermaking
16.15 – 16.30	MPPT-12	Hefzollah Mohammadian <sup>*1</sup> , Mohammad Bagher Heidari <sup>1</sup> , Elaheh Esfandiarjahromi <sup>2</sup>	<sup>1</sup> Department of of Telecom, South Pars Gas Complex, Azad University of Bushehr, Iran. <sup>2</sup> Department of Instrument, South Pars Gas Complex, Shiraz University, Iran	Analysis the Different Types of Nano Sensors on Based of Structure and it's Applications on Nano Electronics
16.30 – 16.45	AIT-01	Arina Sauki <sup>1</sup> , Muhammad Hazman Md Shahid <sup>1</sup> , Ku Halim Ku Hamid <sup>1</sup> , Azlinda Azizi <sup>1</sup> , Siti Khatijah Jamaludin <sup>1</sup> , Tengku Amran Tengku Mohd <sup>1</sup> , Nur Hashimah Alias	Faculty of Chemical Engineering,Universiti Teknologi MARA,40450 Shah Alam, Selangor, Malaysia.	Utilization of Agarwood Distillation Waste in Oilwell Cement and Its Effect on Free Water and Porosity
19.30 – 22.00	Gala Dinner/Banquet (Art Performance, Aceh Dance)			

**Room III. Coordinator : Ir. Yanna Syamsuddin, M.Sc./Zuhra, ST. MSc.****Topic: 1. Environmental & Safety Technology (EST); 2. Waste Treatment and Management (WTM), 3. Environmental Modeling EM).****Oral Session 1; Time: 11.45-12.30****Moderator : Dr. Suhendrayatna, M.Eng.**

Time	Code	Presenter	Institution	Title
11.45 – 12.00	EST-01	Nur Fatin Dahlia, M.S <sup>*1</sup> , Ku Halim, K.H <sup>2</sup>	<sup>1</sup> Faculty of Applied Sciences, Universiti Teknologi MARA, Shah Alam, Selangor 40450, Malaysia <sup>2</sup> Center of Environmental Research, Faculty of Chemical Engineering, Universiti Teknologi MARA, Shah Alam, Selangor 40450, Malaysia	Development of Empty Fruit Bunch as Bio-Matrix for Methane Production from Aged Leachate in an Anaerobic Digester (EE)
12.00 – 12.15	EST -02	Nurhaslina C.R,	Faculty of Chemical Engineering	Decolorization of Textile

		Nazihah M.	Universiti Teknologi MARA, Shah Alam, Selangor	Wastewater Using Lactobacillus delbrueckii
12.15– 12.30	EST -03	Hisbullah and Syahiddin Dahlan Said*	Department of Chemical Engineering University of Syiah Kuala, Banda Aceh, Indonesia	Effect of Baffled Bioreactor Compartment Design on COD Removal Performance: A Preliminary Study
12.30-14.00	Lunch break			

#### Oral Session 2; Time: 14.00-15.15

**Moderator : Dr. Syaifullah Muhammad, ST. M.Sc.**

14.00 – 14.15	EST-04	Kamariah Noor Ismail, Ku Halim Ku Hamid, Nurul Huda Abdullah, Mohibah Musa	Fakulti Kejuruteraan Kimia, Universiti Teknologi MAR, 40450 Shah Alam, Selangor, Malaysia	Mercury Emission from Kapar Energy Ventures (KEV) Power Plant Using Coal as Combustion Media
14.15 – 14.30	EST- 05	Siti Salwa Abdullah, Ku Halim Ku Hamid, Hanafiah Zainal Abidin, Mohibah Musa	Fakulti Kejuruteraan Kimia, Universiti Teknologi MAR, 40450 Shah Alam, Selangor, Malaysia	Coagulant from Chemically Modified Fish Scale for Textile Wastewater Treatment
14.30 – 14.45	EST-06	Feni Amriani <sup>1</sup> , Fatimah <sup>2</sup> , Iriany <sup>3</sup>	Department of Chemical Engineering, University of North Sumatera, Padang Bulan, Medan 20155, Indonesia	Physical And Biology Pretreatment of Water Hyacinth Biomass For Cellulase Enzymes Production From Aspergillus Niger And Trichoderma Reesei
14.45 – 15.00	WTM-01	Rusdianasari <sup>1</sup> , Susila Arita <sup>2</sup> , Eddy Ibrahim <sup>3</sup> , Ngudiantoro <sup>4</sup>	<sup>1</sup> Department of Chemical Engineering, State Polytechnic of Sriwijaya, Palembang 30139, Indonesia Doctoral Candidate of Environmental Science, Sriwijaya University, Palembang 30139, Indonesia <sup>2</sup> Department of Chemical Engineering, Sriwijaya University, Indralaya 30662, Indonesia <sup>3</sup> Department of Mining Engineering, Sriwijaya University, Indralaya 30662, Indonesia <sup>4</sup> Department of Mathematics, Sriwijaya University, Indralaya 30662, Indonesia	Application of Electrocoagulation Process for Coal Stockpile Wastewater Treatment
15.00 – 15.15	EM -01	Eddy Kurniawan*, Erna Maulinda, Amri Aji	Department of Chemical Engineering, Malikussaleh University, Reuleut, Aceh Utara 24351, Indonesia	The Mathematical Model of Reduced Levels of Ammonia, Nitrite and Nitrate Fertilizer Industry Wastewater Using Activated Charcoal from Waste Coffee Grounds
15.15 – 15.30	Coffee break and Poster Session 2			

#### Oral Session 3;

**Time: 15.30-16.45 :**

#### 1. Clean Energy Technology, 2. Catalytic Reaction Engineering (CE-CR)

**Moderator : Dr. Farid Mulana, ST. M.Eng.**

15.30 – 15.45	CECR-01	Muhammad Yerizam <sup>a</sup> , Muhammad Faizal <sup>b</sup> , Marsi <sup>c</sup> , Novia <sup>b</sup>	<sup>a</sup> Doctoral Candidate of Environmental Science, Sriwijaya University Chemical Engineering Department of State Polytechnic of Sriwijaya, Jl. Sriwijaya Negara. Bukit Besar, Palembang	Composition Variation Effect of Rice Straw and Coconut Shell to Biobriquette Characteristics
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			30139, Indonesia <sup>b</sup> Departement of Chemical, Engineering Faculty, Sriwijaya University, Indralaya 30662 <sup>c</sup> Departement of Agriculture, Agriculture Faculty, Sriwijaya University, Indralaya 30662	as Alternative Fuel
15.45– 16.00	CECR-02	Husni Husin <sup>*1</sup> , Mahidin <sup>1</sup> , Zuhra <sup>1</sup> , Fikri Hasfita <sup>2</sup>	<sup>1</sup> Department of Chemical Engineering, Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia <sup>2</sup> Department of Chemical Engineering, Malikussaleh University, Lhoekseumawe, Aceh Utara 24300, Indonesia	H <sub>2</sub> evolution on Lanthanum and Carbon co-doped NaTaO <sub>3</sub> Photocatalyst
16.00 – 16.15	CECR-03	Khairil <sup>*1</sup> , Mahidin <sup>2</sup> , Asri Gani <sup>2</sup> and Ibrahim <sup>1</sup>	<sup>1</sup> Department of Mechanical Engineering, Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia <sup>2</sup> Department of Chemical Engineering, Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia	Fundamental Study on Desulfurization Characteristics of Bio-briquette at Low Temperature Using Calcium Based Adsorbent
16.15 – 16.30	CECR-04	Mahidin <sup>*1</sup> , Asri Gani <sup>1</sup> , Abrar Muslim <sup>1</sup> , Husni Husin <sup>1</sup> , Khairil <sup>2</sup>	<sup>1</sup> Department of Chemical Engineering, Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia <sup>2</sup> Department of Mechanical Engineering, Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia	<i>Development of Desulfurization Process for Bio-briquette Using Natural Calcium-based Adsorbent and Its Kinetics Evaluation for Design Purpose</i>
16.30 – 16.45	CECR-05	Nurhayati <sup>1</sup> , Chieh-Lun Cheng <sup>1</sup> , Jo-Shu Chang <sup>1,2,3*</sup>	<sup>1</sup> Department of Chemical Engineering, National Cheng Kung University, Tainan 701, Taiwan <sup>2</sup> Center for Bioscience and Biotechnology, National Cheng Kung University, Tainan 701, Taiwan <sup>3</sup> Research Center for Energy Technology and Strategy, National Cheng Kung University, Tainan 701, Taiwan	High-Productivity Ethanol Production by Modified PVA-Immobilized Zymomonas mobilis through Continuous Culture combining Vacuum Membrane Distillation under Very High Gravity Fermentation Conditions
19.30 – 22.00	Gala Dinner/Banquet (Art Performance, Aceh Dance)			

**Detailed Schedule For Short Oral Presentation  
Wednesday, 18 September 2013**

**Room 1; Time: 14.15 – 14.45**

**Moderator : Dr. M. Dani Supardan, ST. MT.**

Time	Code	Presenter	Institution	Title
14.15-14.18	EST-07	Mikako Orikawa, Hirotsugu Kamahara, Yoichi Atsuta, Hiroyuki Daimon*	Department of Environmental and Life Sciences, Toyohashi University of Technology, 1-1 Hibarigaoka, Tempaku-cho, Toyohashi-shi, Aichi, 441-8580, Japan	Application of Hydrothermal Treatment on High Concentrated Sewage Sludge for Anaerobic Digestion Process
14.18-14.21	MPPT-13	Cut Meurah Rosnelly & Umi Fathanah	Department of Chemical Engineering, Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia	Purification of Sugar Cane Juice by Ultrafiltration Membrane
14.21-14.24	CECR-06	Mahlinda and Rifki	Institute For Industrial Research and Standardization of Banda Aceh Jl. Cut Nyak Dhien No.377 Lamteumen Timur Banda Aceh	<i>Development Of Semiautomatic Biodiesel Apparatus Based In Control Relay</i>
14.24-14.27	EST-09	Izarul Machdar *, Wahyu Rinaldi	Department of Chemical Engineering, Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia	Assessment of Water Balance in a Small Island: A case Study in Sabang Island, Aceh

Time	Code	Presenter	Institution	Title
				Province
14.27-14.30	CECR-07	M. Husin Ismayanda , Cut Meurah Rosnelly	Department of Chemical Engineering, Syiah Kuala University,Darussalam, Banda Aceh 23111, Indonesia	Study On The Effect of KOH Catalyst On Biodiesel Preparation From Cotton Seed Oil In Stirred Tank
14.30-14.33	FB-07	Asri Gani* <sup>1</sup> , Husni <sup>2</sup> , Akhmad Baihaqi <sup>3</sup> , M. Faisal <sup>1</sup>	<sup>1</sup> Department of Chemical Engineering, Syiah Kuala University, Aceh, Indonesia <sup>2</sup> Department of Agrotechnology, Syiah Kuala University, Aceh, Indonesia <sup>3</sup> Department of Agribusiness, Syiah Kuala University, Aceh, Indonesia	Pyrolysis of Palm kernel Shell into Liquid Smoke: Potential Application for Biopesticides in Aceh Province
14.33-14.36	MPPT-14	Umi fathanah, Mirna Rahmah Lubis, Cut Meurah Rosnelly, Ryan Maulana	Department of Chemical Engineering, Syiah Kuala University, Aceh, Indonesia	Making and Characterizing Bioplastic from Cassava (manihot utilissima) Peel Starch with Sorbitol Plasticizer
14.36-14.39	EST-10	M. Faisal* <sup>1</sup> , Hiroyuki Daimon <sup>2</sup> , Koichi Fujie <sup>3</sup>	Department of Chemical Engineering, Syiah Kuala University, Aceh, Indonesia; <sup>2</sup> Department of Environmental and Life Science,Toyohashi University of Technology,Toyohashi, Japan; <sup>3</sup> Graduate School of Environment and Information Sciences Yokohama National University,Yokohama, Japan	Removal of Organic Matter in Eutrophication Ponds at Various Oxygen Supply Conditions
14.39-14.42	EST-11	M. Faisal* <sup>1</sup> , Izarul Machdar <sup>1</sup> , Farid Mulana <sup>1</sup> , Hiroyuki Daimon <sup>2</sup>	<sup>1</sup> Department of Chemical Engineering, Syiah Kuala University, Aceh, Indonesia <sup>2</sup> Department of Environmental and Life Science,Toyohashi University of Technology,Toyohashi , Japan	Waste Management Option and Renewable Energy from Tofu Processing Waste in Banda Aceh City

**Detailed Schedule For Oral Session  
Thursday, 19 September 2013**

**Room I, Coordinator : Dr. Cut Meurah Rosnelly, MT./ Wahyu Rinaldi, ST., M.Sc.**

**Moderator : Prof. Dr. Bastian Arifin, M.Sc.**

Time	Code	Presenter	Institution	Title
09.00-09.50	Keynote Lecture 4 & 5			
09.50-10.15	Coffee break:			
<b>Oral Session 4:</b>				
<b>Time: 10.15-12.00</b>				
<b>Topic: 1. Food and Biochemical Engineering (FB)</b>				
10.15 – 10.30	FB-01	Nur Afiah Arham, Nurul Amal Nadhirah Mohamad, Junaidah Jai*, Jagannathan Krishnan	Department of Chemical Engineering, Universiti Teknologi MARA, Shah Alam 40450, Malaysia	Optimization of Extraction Parameters of Bioactive Component from Palm Leaves ( <i>Elaeis guineensis</i> ) Using Response Surface Methodology
10.30 – 10.45	FB-02	Wan Zahira Hanis Wan Zin * <sup>1</sup> , Miradatul Najwa Muhd Rodhi <sup>1</sup> , Norazlina Idris <sup>2</sup>	<sup>1</sup> Faculty of Chemical Engineering, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia <sup>2</sup> Faculty of Engineering, Universiti Selangor, Jalan Timur Tambahan, 45600 Bestari Jaya, Selangor, Malaysia	Enzymatic Hydrolysis of Crude Xylanase From <i>Aspergillus niger</i>
10.45 – 11.00	FB-03	Reiza Mutia* <sup>12</sup> , Dayang Norulfairuz Abang Zaidel <sup>1</sup> , Ida Idayu Muhammad <sup>1</sup>	<sup>1</sup> Department of Bioprocess Engineering, Faculty of Chemical Engineering, Universiti Teknologi Malaysia, 81310 UTM Johor Bahru, Johor, Malaysia <sup>2</sup> Scholarship Grantee of Amanah	A Review On Cocoa Butter Equivalent Production Via Enzymatic Interesterification



			Pelalawan Foundation, Indonesia	
11.00 – 11.15	FB-05	Irfan*1, Asmawati1, Fachrizal1, Cut Erika1	Department of agricultural Product Technology, Syiah Kuala University, Darussalam Banda Aceh 23111, Indonesia	Physicochemical properties of Pectin From cocoa Pod husk Extraction Time and pH
11.15 – 11.30	FB-06	Hamid Tavakolipour, Mohsen Mokhtarian	Sabzevar Branch, Islamic Azad University, Iran	Application of fuzzy logic system to monitoring equilibrium moisture content of pistachio powder during storage
11.30-11.45	FB-07	Rafeqah Raslan*, Rahimah Mustafa, Nurul Nadia Azmi, Lim Ying Pei, Shareena Fairuz Abdul Manaf.	Faculty of Chemical Engineering, University Teknologi MARA, Shah Alam , Malaysia	Analysis of the fouling mechanism during ultrafiltration of Momordica Charantia juice
11.45– 12.00	MPPT-15	Rozanna Dewi <sup>1</sup> , Harry Agusnar <sup>2</sup> , Basuki Widyosentono <sup>2</sup> , Halimah <sup>2</sup>	<sup>1</sup> Universitas Malikussaleh, <sup>2</sup> Universitas Sumatera Utara	Synthesis and Characteristics of Modified Thermoplastic Starch (TPS)
12.00 – 13.30	Lunch break			

**Room II, Coordinator : Ir. Pocut Nurul Alam, MT./ Dr. Hesti Meilina, ST., MP.**

**Oral Session 4; Time: 10.15-12.15**

**Topic: 1. Fundamental of Chemical Engineering and applied Industry (ChEA), 2. Environment and Information Sciences (EIS)**

**Moderator : Dr. Hesti Meilina, ST., MP.**

Time	Code	Presenter	Institution	Title
10.15 – 10.30	ChEA-01	Meisam Sadi <sup>1</sup> , Mahmood Farzaneh-Gord <sup>1</sup> , Koroush Akhlaghi <sup>2</sup> , Hasan Eftekhari <sup>2</sup>	<sup>1</sup> Department of Mechanical Engineering, Shahrood University, Semnan, Iran <sup>2</sup> South khorasan gas company, Iran	Numerical simulation of a vortex tube and study the interior behavior of working fluid
10.30 – 10.45	ChEA-02	Azlinda Azizi <sup>1</sup> , Mohd Shahrul Nizam Ibrahim <sup>1</sup> , Ku Halim Ku Hamid <sup>1</sup> , Arina Sauki <sup>1</sup> , Nurul Aimi Ghazali <sup>1</sup> , Tengku Amran Tengku Mohd <sup>1</sup>	Faculty of Chemical Engineering, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia.	Agarwood Waste As a New Fluid Loss Control Agent in Water Based Drilling Fluid
10.45 – 11.00	ChEA--03	Kourosh Akhlaghi <sup>1</sup> , Mahmood Farzaneh-Gord <sup>2</sup> , Mohammad Mohammadpour <sup>3</sup>	1 : National Iranian Gas Company, South Khorasan Gas Company, Iran 2,3: The Faculty of Mechanical Engineering, Shahrood University of Technology, Shahrood, Iran	Feasibility of utilizing small- scale liquefied natural gas cycle in natural gas pressure reduction point
11.00 – 11.15	ChEA-04	Mariana <sup>1</sup> , Farid Mulana <sup>1</sup> , Purwana Satriyo <sup>2</sup>	<sup>1</sup> Department of Chemical Engineering, Syiah Kuala University, Darussalam, Banda Aceh 23111, Indonesia <sup>2</sup> Department of Agriculture Engineering, Syiah Kuala University, Darussalam, Banda Aceh 23111	Reaction Kinetics of Ca(OH) <sub>2</sub> and SiO <sub>2</sub> in a Stirred Batch Reactor
11.15 – 11.30	ChEA-05	Ali Haghtalab, Marziyeh Zare	Tarbiat modares University	Computation of Carbon Dioxide Solubility in Ionic Liquids using Local Composition and Pitzer Models
11.30-11.45	EIS-01	Noorhazila Hamdan *, Ku Halim Ku Hamid, Miradatul Najwa Muhd Rodhi, and Mohibah Musa	Faculty of Chemical Engineering, Universiti Teknologi Mara Shah Alam, 45000, Malaysia	Identification of Carcinogenic Volatile Organic Compounds in New Car Cabin at Tropical Climate
11.45– 12.00	EIS-02	Zulfian <sup>1</sup> , Lindawati <sup>2</sup> , Nizarli <sup>3</sup> , Faisal Amir <sup>2</sup>	Jurusan Teknik Kimia, Universitas Syiah Kuala <sup>1</sup> , Laboratorium Akustik, Universitas Syiah Kuala <sup>2</sup> , Jurusan Arsitektur, Universitas Syiah Kuala <sup>3</sup>	The Study of Speech Intelligibility in the Al-Mizan Mosque, Syiah Kuala University

12.00 – 12.15	ChEA-06	Nasrullah, R.C.L. <sup>1*</sup> , Wan Rosli Wan Daud <sup>2</sup> , I. Mazlan <sup>2</sup> , Teku M. Asnawi <sup>1,2</sup> , Adisalamun <sup>1</sup>	<sup>1</sup> Department of Chemical Engineering, Syiah Kuala University, Banda Aceh, Indonesia, <sup>2</sup> Division of Bioresource, Paper and Coatings Technology, School of Industrial Technology, Universiti Sains Malaysia, 11800 Penang, Malaysia.	The Effect of Delignification on Paper Properties of Acetosolv Oil Palm Frond Fibers Pulp
12.15–13.30	Lunch break:			

**Room III, Coordinator : Zuhra, ST. M. Sc./ Yanna Syamsuddin, M.Sc.**

**Oral Session 4; Time 10.15-12.00**

**Topic: 1. Clean Energy Technology- Catalytic Reaction Engineering (CE-CR), 2. Process and Control Engineering (PC)**

**Moderator: Dr. Husni Husin, M.T.**

Time	Code	Presenter	Institution	Title
10.15 – 10.30	CECR-08	Z.A Shajaratun Nur <sup>1,2</sup> , Y.H. Taufiq-Yap <sup>*1,2</sup> , M.F. Rabiah Nizah <sup>1,2</sup> , Aminul Islam <sup>1,2</sup>	<sup>1</sup> Catalysis Science and Technology Research Centre, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia. <sup>2</sup> Department of Chemical, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.	Transesterification Reaction of Palm Oil via Modified Dolomites for Biodiesel Production
10.30 – 10.45	CECR-09	Z. Helwani <sup>a,*</sup> , N. Aziz <sup>b</sup> , M.R. Othman <sup>b</sup>	<sup>a</sup> Department of Chemical Engineering, Riau University Pekanbaru 28293, Indonesia. <sup>b</sup> School of Chemical Engineering, Universiti Sains Malaysia 14300 Nibong Tebal, Penang, Malaysia.	Continuous biodiesel production in a fixed bed reactor with hydrotalcite as a heterogeneous catalyst
10.45 – 11.00	CECR-10	M.F. Rabiah Nizah <sup>a,b</sup> , Y.H. Taufiq-Yap <sup>a,b,*</sup> , Z.A. Shajaratun Nur <sup>a,b</sup> , and Aminul Islam <sup>a,b</sup>	<sup>a</sup> Catalysis Science and Technology Research Centre, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia <sup>b</sup> Department of Chemistry, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia	Transesterification of non-edible Jatropha curcas oil to biodiesel using Bi <sub>2</sub> O <sub>3</sub> -La <sub>2</sub> O <sub>3</sub> catalyst
11.00 – 11.15	CECR-11	Rangga Budiawan, Zulfansyah, Z. Helwani <sup>*</sup>	Department of Chemical Engineering, Riau University Pekanbaru 28293, Indonesia.	Off-grade palm oil as a renewable raw material for biodiesel production by two-step processes
11.15 – 11.30	CECR-12	Novia <sup>1,3</sup> , Hermansyah <sup>2,3</sup> and Arif Nurrahman <sup>3</sup>	<sup>1</sup> Jurusan Teknik Kimia, Fakultas Teknik, Universitas Sriwijaya, Inderalaya, SUMSEL, Indonesia <sup>2</sup> Jurusan Kimia, Fakultas MIPA, Universitas Sriwijaya, Inderalaya, SUMSEL, Indonesia <sup>3</sup> Jurusan Teknik Kimia, BKU Teknologi Lingkungan Program Pascasarjana UNSRI	The Alkaline-Ozonolysis Pretreatment and Simultaneous Saccharification And Fermentation (SSF) For The Production of Bioethanol From Rice Straw
11.30– 11.45	PC-01	Sallehuddin Ibrahim*, Mohd Amri Md Yunus, Mohd Taufiq Mohd Khairi	Faculty of Electrical Engineering, University Teknologi Malaysia, Skudai, Johor 81310, Malaysia	Turbidity Measurement Using An Optical Tomography System
11.45– 12.00	PC-02	Hasan Eftekhari <sup>*1</sup> , Hamid Reza Rahbari <sup>2</sup> , Mahmood Farzaneh-Gord <sup>3</sup>	1 : National Iranian Gas Company, South Khorasan Gas Company, Iran 2,3 : Department of Mechanical Engineering, Shahrood University of Technology, Shahrood, Iran	The Effect of Important Parameter in Simulation of Natural Gas flow through Underground Transmission Pipeline
12.00 – 13.30	Lunch break			
14.00– 18.00	Conference Tour			

## Modified Carbon Composite Electrode with Zeolit in Degradation of Dissolved Chlorine

Yohandri Bow<sup>\*1</sup>, Ibnu Hajar<sup>2</sup>, Rusdianasari<sup>3</sup>

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### Abstract

Voltammetry is a electroanalytical method that can be used in the determination of dissolved chlorine without separation. In this research used voltammetry method based on Carbon Composite Electrode (SPCE) coated with zeolite with the aim to improve the sensitivity of the analyte. The composite carbon-zeolite electrode consists of platinum as working electrode, silver/silver chloride as reference electrode and the body electrode was made of polyester resin. The result of the study indicated that the composite carbon electrode was suitable for determining of dissolved chlorine at optimum operating characteristics with an applied voltage of +0.90 V. The steady state reduction current was achieved after 12 s. The standard calibration curve (concentration dissolved chlorine-reduction current) showed a linier relationship in the range of 2.9 – 30 ppm. The analytical performance characteristics of probe indicated: precision 0.6 – 13.04 %, sensitivity 0.1236 ppm/ $\mu$ A and detection limit 2.9 ppm. The t-test, F-test and Q-test at 95% confidence levels showed that there were no significant differences between using composite carbon-zeolite electrodes with titrimetric methods.

**Key words:** voltammetry, carbon composite electrode, zeolite

### Introduction

Many industries are located on the edge of the river are using chlorine as textile and paper industry where it functions as a bleaching agent and sanitary waste are drained to the river so it causes pollution to the environment. Losses that can be caused by, among others, if the chlorine reacts with the amine there will produce components of cancer-causing, chlorine-organic amines such as mono chloro [1].

Until now chlorine analysis is difficult, especially in the field so we need a procedure that is easy and simple analysis for dissolved chlorine analysis to be determined quickly. With existing instrument method there are difficulties in determining the levels of dissolved chlorine because chlorine levels of dissolved naturally changing due to changes in temperature, pressure and dissociated. Ideally determination of dissolved chlorine is done in situ or on-site measurements. For the measurement of dissolved chlorine levels in situ portable measuring instruments required a much simpler, cheaper but selectively and accurately, for example by using electrochemical electrodes [2].

Some of the advantages electrode [3]:

- The use of tools is very practical, simple and easy to carry making it suitable for in situ analysis purposes.
- Measurements can be done directly without sample preparation.
- Has a fast response time so that the measurement requires only a short time in the order of seconds.
- Has a wide measuring range.

The basic concept of determining the electrochemical chlorine levels using membranous electrode is on the current reduction is proportional to the chlorine concentration of dissolved chlorine. Electrodes for electrochemical determination of dissolved gas levels are based on

design model LC Clark (Clark electrode) consisting of a metal cathode lead (Pb) as the working electrode (working electrode), Ag wire as the anode electrode comparator as well as auxiliary electrode (auxiliary electrode), solution of potassium chloride and the tip of the tube is coated with a membrane [4].

The materials used for the working electrode must be inert in the provision applied voltage and has high electrical conductivity; this type of material is usually made of precious metals. Clark electrode characteristics use a semipermeable membrane and resistant to samples containing electrolytes, water solvents, inorganic solvents and organic solvents [5]. Clark electrode is based on design model in this research is made of membranous electrode electrochemical synthetic polyethylene which is a transparent thermoplastic that is resistant to oxidation of chemicals that are acidic, alkaline, alkaline and resistance to electric current [6].

Voltammetry is a category of electroanalytical methods used in analytical chemistry and various industrial processes. In voltammetry, information about an analyte is obtained by measuring the current as the potential is varied [7-8]. Voltammetry experiments investigate the half-cell reactivity of an analyte. Voltammetry is the study of current as a function of applied potential. These curves  $I = f(E)$  are called voltammograms. The potential is varied arbitrarily both step by step or continuously, and the actual current value is measured as the dependent variable. The shape of the curves depends on the speed of potential variation (nature of driving force) and on whether the solution is stirred or quiescent (mass transfer). Most experiments control the potential (volts) of an electrode in contact with the analyte while measuring the resulting current (amperes) [9].

To conduct such an experiment requires at least two electrodes. The working electrode, which makes contact with the analyte, must apply the desired potential in a controlled way and facilitate the transfer of charge to and from the analyte. A second electrode acts as the other half of the cell. This second electrode must have a known potential with which to gauge the potential of the working electrode, furthermore it must balance the charge added or removed by the working electrode. While this is a viable setup, it has a number of shortcomings. Most significantly, it is extremely difficult for an electrode to maintain a constant potential while passing current to counter redox events at the working electrode.

To solve this problem, the roles of supplying electrons and providing a reference potential are divided between two separate electrodes. The reference electrode is a half cell with a known reduction potential. Its only role is to act as reference in measuring and controlling the working electrodes potential and at no point does it pass any current. The auxiliary electrode passes all the current needed to balance the current observed at the working electrode. To achieve this current, the auxiliary will often swing to extreme potentials at the edges of the solvent window, where it oxidizes or reduces the solvent or supporting electrolyte. These electrodes, the working, reference, and auxiliary make up the modern three electrode system [10].

There are many systems which have more electrodes, but their design principles are generally the same as the three electrode system. For example, the rotating ring-disk electrode has two distinct and separate working electrodes, a disk and a ring, which can be used to scan or hold potentials independently of each other. Both of these electrodes are balanced by a single reference and auxiliary combination for an overall four electrode design. More complicated



experiments may add working electrodes as required and at times reference or auxiliary electrodes.

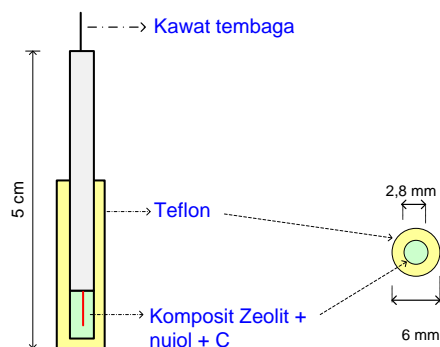
### Materials and Methods

The tools used in this research are modification voltammeter AD instruments, electrode Ag/AgCl as the comparison electrode, a platinum electrode as the auxiliary electrode, zeolite composite electrode as the working electrode.

#### *Making Body of the Working Electrode and the Electrode Composite Zeolite*

Electrode body is made of carbon-zeolite composite is made up the tubes 5 cm long, with an outer diameter of 6 mm. Diameter as the active substance in 2.8 mm. For copper wire is used to connect the composite mixture with modified equipment potentiostat.

Carbon-zeolite composite electrode was prepared by mixing a number of the weight in grams of carbon with a resin, paraffin or nujol and a number of zeolite to obtain the required mass proportions. Then the mixture is stirred to mix well to form a homogenous paste. A small amount of paste is used to fill the holes from the working electrode by using a small spatula, and then smoothed the surface of the electrode. After each measurement the electrode surface was washed and rubbed with paper to clean it. The design of the zeolite composite electrode body as is shown in Figure 1.



**Figure 1.** The design of the zeolite composite electrode body

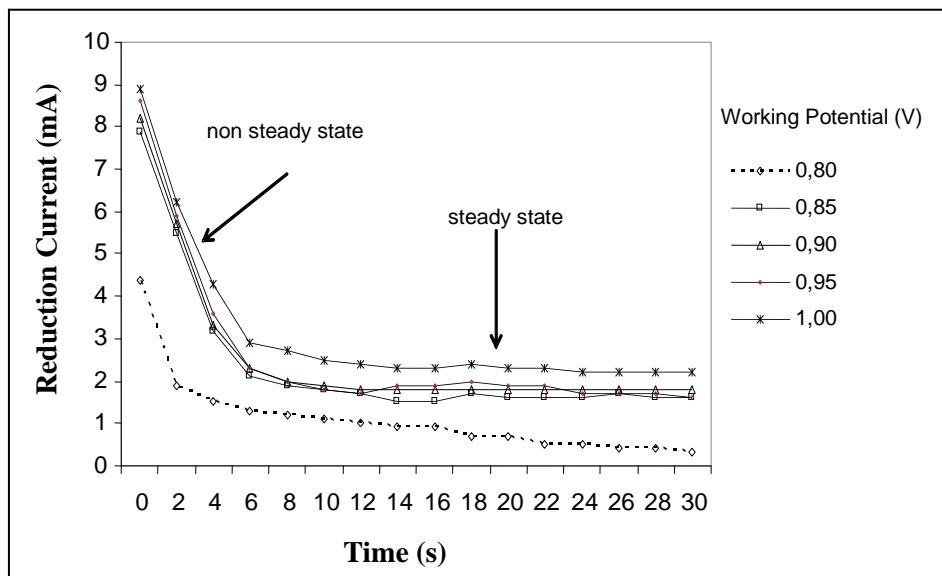
### Results and Discussion

#### *Determination of Steady and Unsteady State Profile*

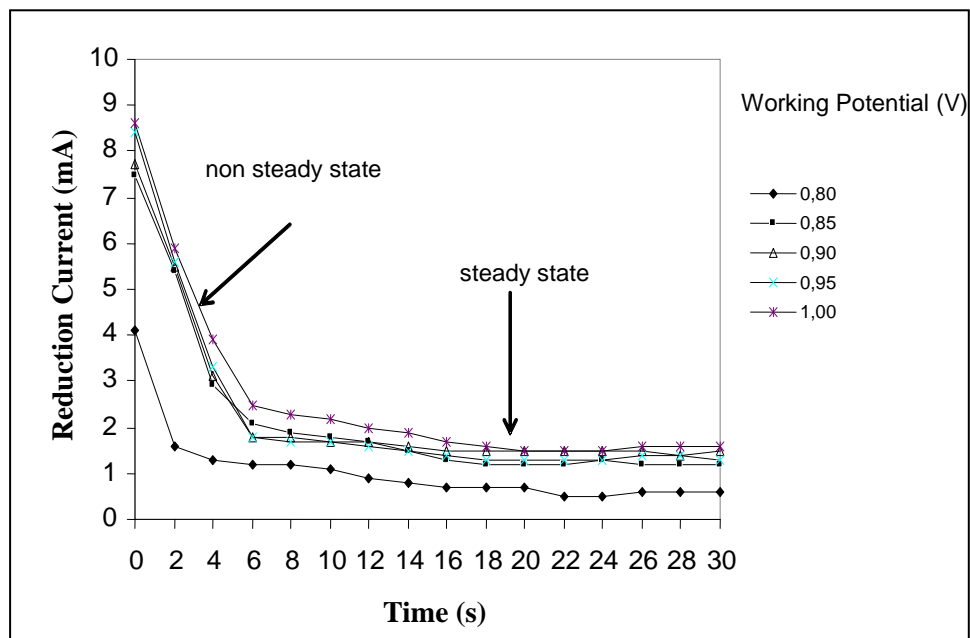
Determination of steady and unsteady state profile performed to determine the price of a constant current at the time of measurement that will be used as the measurement area. This profile determination was done by measuring one of the chlorine standard solutions (20 ppm) on the potential provision of a variety of work, namely: 0.80, 0.85, 0.90; 0.95 and 1.0 V, using a variety of concentration electrolyte 0.1 M, 0.5 M and saturated. Current measurement at each of the potential price of the work performed with three repetitions and recording currents conducted every 2 seconds interval that starts from time 0 seconds to show the values stable flow (steady state).

Based on the profile curve measurements were showed 0.80 to 0.10 V at a potential of generating local employment steady and unsteady state. Based on the curves in Figure 2 and 3 it can be seen that the unsteady state conditions are in seconds 0-11 seconds, in these conditions chlorine degradation occurs very quickly seen reduction of the current changes that

occur in 0-11 seconds with the current 9 mA to 2 mA. It can be explained that in the initial state (before giving employment potential) occurs only in regions equilibrium chlorine electrode-electrolyte solution interface.



**Figure 2.** Profile curve steady and unsteady state at the current time working with different potential (0.80 to 0.10 V), membrane thickness 32  $\mu\text{m}$  working electrode with an area of 1x1mm

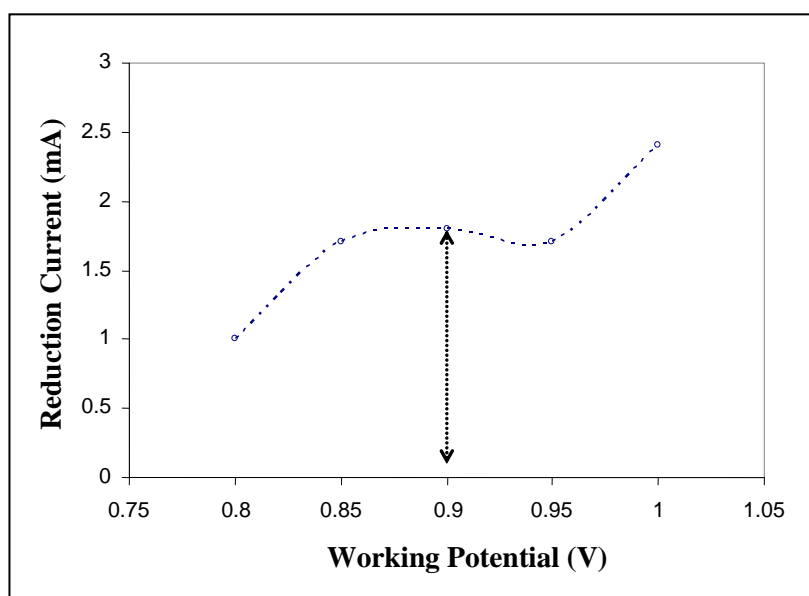


**Figure 3.** Profile curve steady and unsteady state at the current time working with different potential (0.80 to 1.00 V), for saturated electrolyte concentration, membrane thickness 32  $\mu\text{m}$  working electrode with an area of 1x2 mm

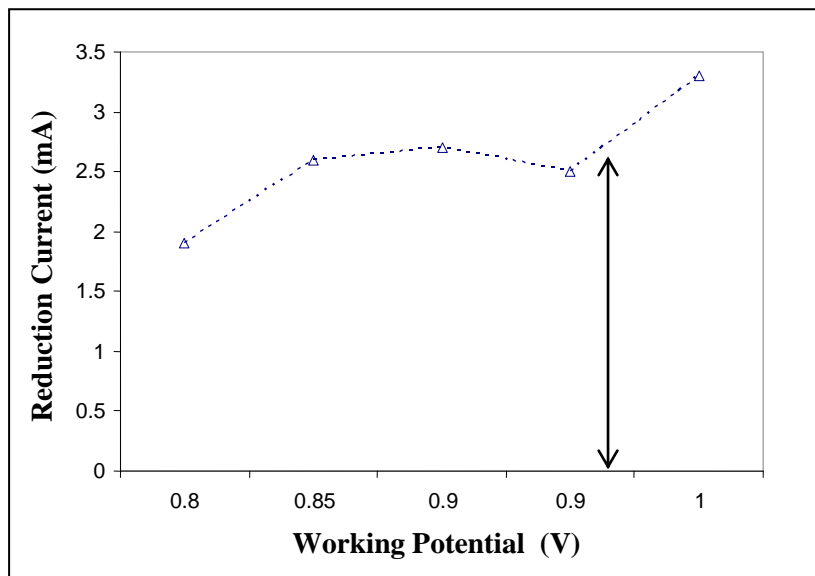
At the time of giving the first seconds of work on the electrode potential occurs currents that flow double layer that is formed when an electrode immersed in an electrolyte solution, so that it will form a local electrode-electrolyte solution interface and have different physical

properties to the physical properties of the electrode as well as the physical properties of the electrolyte solution. After experiencing double layer currents will flow a steady decline, the curve is between 12-30 seconds and then the curve will decrease with the increase of time so that the resulting current would drop to zero. From Figure 2 and 3 shows that the starting point of the steady-state condition occurs when the 12 seconds that this time is used as the observation time for the measurement.

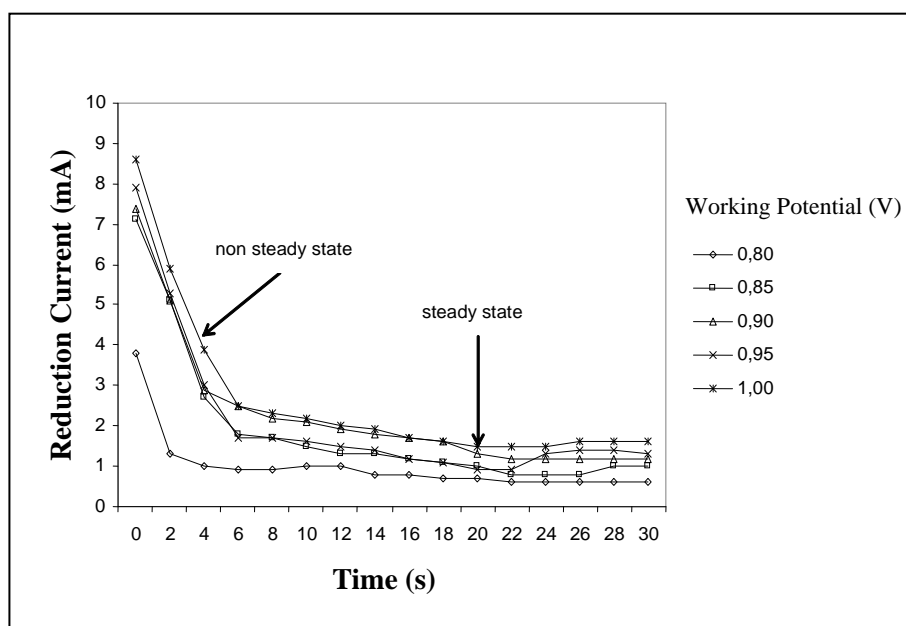
Next on the observation time-30 seconds to set the optimum working conditions are potentially used in a way to make the curve between the current reduction obtained by the employment potential as shown in Figure 4 and 5 for different broad working electrode. From Figure 4 and 5 shows that the employment potential ranging from 0.8 V and reaches a maximum at 0.9 V and then decreases again after a potential 0.9 V. Estimated reduction of chlorine takes place so that the optimum working potential 0.9 V is used as a measure of potential work, It is appropriate with the existing literature that chlorine reduction occurs between the range 0.8 V to 0.9 V. At 1 V working potential flow reduction resulting increased again, this may have been a reduction of H<sub>2</sub>O.



**Figure 4.** Potential profile curves work in the area of the current steady state for the concentration of electrolyte saturated with an area of 1x1 mm working electrode



**Figure 5.** Potential profile curves work in the area of the current steady state for the concentration of electrolyte saturated with an area of 1x2 mm working electrode



**Figure 6.** Curve is steady and unsteady state at the current time working with different potential (0.80 to 1.0 V) to the electrodes with a thickness of 64 mm membrane with an area of 1x2 mm working electrode

On an area variety of working electrodes and membrane thickness 64  $\mu\text{m}$  (Figure 6) shows that the measured current is lower when compared to the membrane thickness 32  $\mu\text{m}$ . This could be caused to the inhibition of the rate of diffusion of chlorine due to the thickness of the membrane electrode although widely used larger electrode is 1x2 mm. Subsequently selected for the membrane with a thickness of 32  $\mu\text{m}$ , saturated electrolyte solution, 1x1 mm an area electrode and the measurement time of 12 seconds.



### ***Performance Characteristics of Electrodes***

**Accuracy.** Accuracy of determination of chlorine dissolved procedures using platinum electrodes with an area of 1x1 mm polyethylene membranous determined using standard deviation and average price levels of dissolved chlorine standard solution measurements performed. Accuracy of the calculation results of dissolved chlorine concentration determination procedure using platinum electrodes with an area of 1x1 mm obtained 10%.

**Sensitivity.** Sensitivity is the ability of a device to differentiate smallest differences in the levels of analytes. Sensitivity is the coefficient or the slope of the curve direction relations between the response (y) with the analyte (x). From the standard curve equation measurement sensitivity is 0.1236 ppm/ $\mu$ A. This number indicates that 1 ppm chlorine levels can provide a response (flow reduction) of 0.1236  $\mu$  A.

**Detection Limits (Low Limit).** Detection limit is the analyte concentration that gives a response for the blank response ( $Y_{\text{blk}}$ ) plus three blank deviations ( $3S_{\text{blk}}$ ) with a detection limit of the response equation:  $Y_{\text{db}} = Y_{\text{blk}} + 3 S_{\text{blk}}$ , its value can be calculated from the standard curve regression equation.  $Y_{\text{blk}}$  is blank response by assuming  $Y_{\text{blk}} = a$ , while  $S_{\text{blk}} = S_{y/x}$ . Results of this calculation to get the lowest detection limit of price determination procedure dissolved chlorine levels using platinum electrodes with an area of 1x1 mm membranous polyethylene is 2.9 ppm.

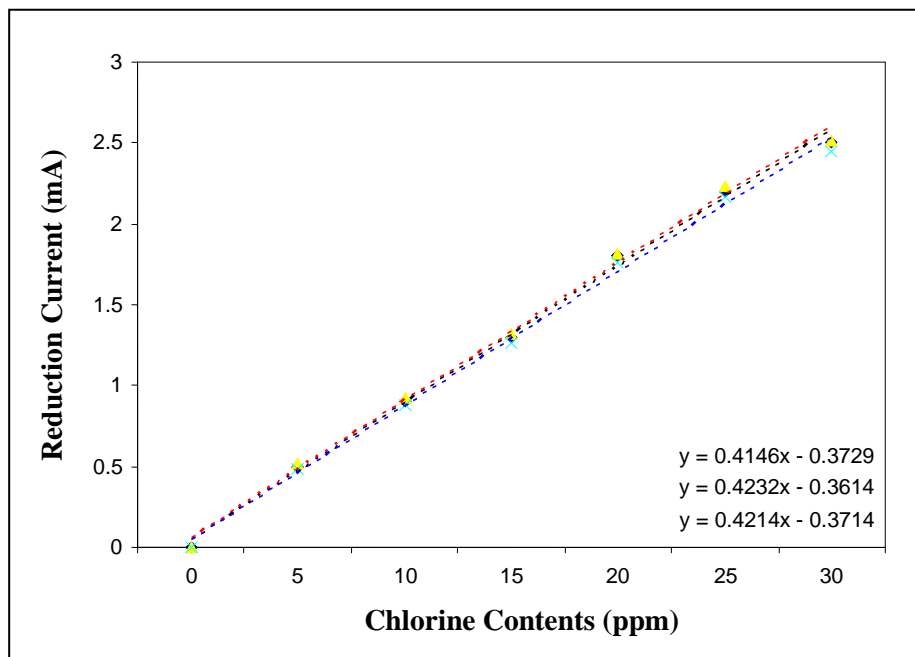
### **The effect of chlorine measurement to the interference**

To determine whether measurement of dissolved chlorine is influenced by interference from other gases dissolved in the water that participated, conducted experiments with saturated  $O_2$  and  $SO_2$  dissolve in a solution of chlorine separately. Concentration of chlorine is used as the concentration standard curve. The measurement results are illustrated in Figure 7. To determine the effect of these gases is calculated based on the slope of the standard curve was made and compared statistically with chlorine standard curve without interference [11].

Regression equation for the standard curve without interference,  $ip = 0.4214 x - 0.3714$ .

Regression equation for the standard curve with  $O_2$ ,  $ip = 0.4146 x + 0.3614$ .

Regression equation for the standard curve with  $SO_2$ ,  $ip = 0.4232 x + 0.3714$



**Figure 7.** Comparison of standard curves chlorine to the interference

From the calculation of the t test for the slope (slope) with the interference  $O_2$  saturation and concentration of 5 ppm  $SO_2$  obtained data on the level of 95%, where  $t_{cal} O_2$  was 2.13 and the tables are so  $t_{cal} O_2$   $2.306 < t$  table and the calculation of the interference  $t_{cal}$  obtained  $SO_2$  is 1.32 and  $2.306 t_{table}$  is so  $t_{cal} < t$  table, from both the calculation shows that the interference measurements with  $O_2$  and  $SO_2$  was no significant difference in mean with the dissolved  $O_2$  and  $SO_2$  at 5 ppm dissolved chlorine concentration measurements can still be performed.

### Conclusions

Composite electrode made of carbon-zeolite can be used as a tool for the determination of chlorine dissolved by generating current price reduction is relatively stable from this point on the 12th giving optimum working potential of 0.90 V. The resulting reduction of flow gives a linear relationship to the concentration of dissolved chlorine in the range of 2.9 ppm of dissolved chlorine concentration to 30 ppm.

The test results analysis procedure of determining the performance characteristics of dissolved chlorine levels using carbon-zeolite composite electrodes obtained accuracy ranged from 0.6% to 13.04%, so the carbon-zeolite composite electrodes can be used for measurement of chlorine compounds in situ.

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