Himpunan Kimia Indonesia

6th ICICS South Sumatera 2017

The 6th International Conference of the Indonesian Chemical Society 2017

PROGRAMME AND ABSTRACTS BOOK

Palembang, Indonesia October 15 – 20, 2017

http://icics.kimiawan.org

The 6th International Conference of the Indonesian Chemical Society 2017

Hotel Horison Ultima, Palembang, Indonesia

October 15 - 20, 2017

The 6th Himpunan Kimia Indonesia (HKI) annual conference on Tue-Wed, 17-18 October 2017, is organized by South Sumatera Branch of HKI in collaboration with Sriwijaya University (Unsri) and South Sumatera Province. South Sumatera was selected as the location for 2017 HKI annual conference in HKI National Meeting 2014, 3 years ago, in Ambon, Maluku. This is a bilingual conference (Indonesian and English), which means that the paper can be written in English or Indonesian language (Bahasa Indonesia), and the presentation can be delivered in English or Bahasa Indonesia.

Before, parallel to, or after the conference, there will be several satellite activities (workshop, etc.), including a meeting of the Forum of Head of Chemistry Departments in Indonesia (Temu Forum Ketua Jurusan/Prodi Kimia dan Pendidikan Kimia se-Indonesia 2017, Temu FKJKI-2017), contact: fkjki-2017@kimiawan.org) that will be started in the evening (19.00) of 17 October 2017. Any chemistry-related communities/institutions could register other satellite activities (one-day workshop, symposium, training, etc.) to icics-2017-satellite@kimiawan.org, to be offered to conference attendees. Satellite activities could be held in any date between 3 October to 31 October 2017.

One day before the conference, on Monday, 16 October 2017, HKI Congress will be held to find the next President-Elect of HKI. The elected person will be the next President-Elect of the Indonesian Chemical Society from 1 January 2018 to 31 December 2018, while Dr. Tatas Brotosudarmo will be the President of HKI.

Speach by Chairman

Assalamualaikum waromatullahi wabarakatu,

Dear Distinguished Guests and Participant,

We cordially welcome you to the 6th International Conference of Indonesian Chemical Society in Palembang South Sumatera. This conference is organized by the Indonesian Chemical Society (HKI) and Chemistry Department Faculty of Mathematics and Natural Sciences Sriwijaya University (Unsri) supported by LPPM Unsri.

I would like to inform some formal information related to this conference. The conference's theme is "Stimulating of Advanced Perspective and Current Concepts on Chemistry field". The goals of conference are to provide a vehicle the state of the art in research results and trends in chemistry field, to offer interaction, discussion and possible collaboration among chemist and the public about chemistry, to increase awareness of policy makers and public on chemistry's rule in national development.

This conference consists of 4 keynotes speakers from USA, Japan, Solomon Island, 8 invited speakers, and 229 participants who deliver as oral or poster presenters. Accompanying this conference, there are some activities: Indonesia high level meeting on chemical security by Sandia USA (15-16 October), Congress of PNHKI (16-17 October), FKJKI meeting (18 October), and Palembang city tour (19 October).

We are sincerely grateful to welcome honorable keynote speakers, distinguished invited speakers and excellent of participants for sharing their knowledge in this conference.

The keynote speakers in this conference are :

1. Dr. Andrew W. Nielson (Sandia National Laboratories, USA)
2. Prof. Hisao Yoshida (Kyoto University, Japan)
3. Prof. Dr. Basil Shelton Marasinghe (Solomon Island National University, PNG)
4. Drs. Muhammad Abdulkadir Martoprawiro, Ph.D (ITB, Indonesia)

The Invited Speakers are :

1. Prof. Dr. Subandi (UM, Indonesia)
2. Prof. Dr. Suyanta (UNY, Indonesia)
3. Prof. Aldes Lesbani, PhD (Unsri, Indonesia)
4. Dr. Jarnuzi Gunlazuardi (UI, Indonesia)
5. Dr.rer.nat. Didin Mujahidin (ITB, Indonesia)
6. Dr. Muktiningsih Nurjayadi (UNJ, Indonesia)
7. Dr. Sal Prima Yudha S. (Unib, Indonesia)
8. Prof. Dr. Muhammad Bachri Amran (ITB, Indonesia)
9. Dr.rer.nat. Ria Armunanto (UGM, Indonesia)

I would like also to express thanks and appreciation to the organizing committee for their cooperative work and efforts to make our conference a success.

Finally, I would like to thank to all participants and their respective institutions that have made this conference possible and I wish you all have a pleasant meeting.

Waalaikumsalam warohmatullahi wabarakatuh

Hermansyah, M.Si., Ph.D.

Chairman of Organizing Committee

The 6th International Conference of Indonesian Chemical Society

Forward by the Dean

In the Name of Allah, the Most Beneficent, the Most Merciful.

It gives me a great pleasure to welcome you to the 6th International Conferences of Indonesian Chemical Society (ICIC) 2017 organized by the Department of Chemistry Faculty of Mathematics and Natural Sciences University of Sriwijaya in collaboration with the Indonesian Chemical Society. The theme for this conference is "*Stimulating of Advanced Perspective and Current Concepts on Chemistry Field*".

I am very happy and grateful that many distinguished Academicians, Scientist, Researchers and practitioners of Chemistry have come from both home and abroad to share their knowledge and experience. On behalf of the Faculty of Mathematics and Natural Sciences University of Sriwijaya, I would like to take this opportunity to express our deep appreciation for all of national and international keynote speakers as well as invited speakers for their willingness to come to Palembang and honoring us a keynote speeches for this conference. I also wish to give special thanks to the Sandia America that has hold a special workshop on the "*Indonesia high level meeting on chemical security*" for the last two days. Last but not least, I would like to extend our appreciation to the Indonesian Chemical Society, government, university colleagues and companies for their continued and invaluable support to make this meeting a success.

I sincerely wish you would have most productive days of interesting and stimulating discussions. I believe that this conference is a great opportunity not only for sharing knowledge and experience in chemical research, but also for starting a long and fruitful cooperation and friendship among Academicians, Researchers and practitioners of Chemistry.

Finally, I would like to thank and congratulate the organizing committee for their dedication and tremendous efforts in organizing the conference. I wish you all an enjoyable meeting and fruitful discussion.

Prof. Dr. Iskhaq Iskandar, M.Sc.

Dean, Faculty of Mathematics and Natural Sciences
University of Sriwijaya

Speach by Rector of Sriwijaya University

Bismillahirrohmaanirrohim

Assalamualaikum warohmatullahi wabarakatuh,

In the name of Alllah SWT and all praise belongs to Him who is blessing us today to come and attend this important conference.

In accordance with the university status as a research university, it is important for the university to disseminate new research findings and discoveries in the community, the nation and the world. I am pleased that Chemistry Department Faculty of Mathematics and Natural Sciences Sriwijaya University (Unsri)supported by LPPM Unsri collaborate with the Indonesian Chemical Society (HKI) have organized the sixth international conference of Indonesian chemical society (ICICS) in Palembang.

With the theme of this conference, "Stimulating of Advanced Perspective and Current Concepts on Chemistry field". I believed that this conference served as platform for the discussion and dissemination of research findings information on research trends, and latest development in the area of chemistry. It is hoped that this meeting of academicians, researchers,and professionals from universities, government institutions, research institute, and private companies can lead to much bigger things in the future.

Therefore, I sincerely expect this conference generate more cooperation in research and education. Such cooperation can lead to progress in all areas of chemistry for the welfare of mankind.

By this conference also I hope that it facilitates Indonesian chemists to publish their research results in reputable journal/proceeding.

I am sincerely grateful to welcome honorable keynote speakers, distinguished invited speakers and excellent of participants for sharing their knowledge in this conference.

This conference will be able to meet our goals and objectives and provide a rewarding experience to all participants, from local and international. My appreciation also goes to the organizing committee for making this conference a success.

I take this opportunity to thank and to appreciate the Sandia and CRDF United State of America which have hold the workshop on 'Indonesia high level meeting on chemical security' on October 15-16, 2017.

Congratulation also address to Indonesian chemical society and head of chemistry department from Universities in Indonesia for their annual national meeting and congress during this conference.

Finally, in anticipation of successful conference, in the name of Allah, the beneficient, the merciful.

"Bismillahirrohmaanirrohim"

I hereby officially open the 6th International Conference of Indonesian Chemical Society 2017"

Good luck, I wish you all an enjoyable meeting and fruitful discussion.

Wassalamualaikum Warohmatullohi wabarakatuh.

Prof. Dr. Ir. AnisSaggaf, MSCE.
Rector of Sriwijaya University

Conference Activities

TIMELINE		ACTIVITIES
Sunday, Oct 15, 2017	09.00–16.00	High Level University Meeting on Chemical Security **(Sandia Laboratory, USA)**
Monday, Oct 16, 2017	09.00–16.00	High Level University Meeting on Chemical Security **(Sandia Laboratory, USA)**
	13.00 – 17.00	**Indonesian Chemical Society Forum Meeting**
Tuesday, Oct 17, 2017	08.00–16.00	ICICS Seminar
	19.00-21.00	Indonesian Chemical Society Congress
Wednesday, Oct 18, 2017	08.00–16.00	ICICS Seminar
	08.00–16.00	Department Chief of Chemistry Meeting
Thurday, Oct 19, 2017	08.00–16.00	**City/Musi Tour**
	13.00–17.00	**Computational Chemistry Workshop**
Friday, Oct 20, 2017	08.00–16.00	**Computational Chemistry Workshop**

keynote SPEAKERS

Prof. Hisao Yoshida,
Kyoto University, Japan

Andrew W. Nelson, Ph.D, MPH
Sandia Lab, USA

Prof. Dr. Basil Shelton Marasinghe,
Solomon Islands National University, PNG

Drs. Muhamad Abdul Kadir Martoprawiro, PhD
Chemical Society, Indonesia

invited SPEAKERS

Prof. Jarnuzi Gunlazuardi, Ph.D.
Universitas Indonesia

Prof. Aldes Lesbani, Ph.D.
Universitas Sriwijaya

Dr. rer.nat. Didin Mujahidin
Institut Teknologi Bandung

Dr. Multiningsih Nuryandi
Universitas Negeri Jakarta

Dr. Salprima Yudha S.

Universitas Bengkulu

Dr. Suyanta

Univ. Negeri Yogyakarta

Prof. Dr. Subandi

Univ. Negeri Malang

Prof. Dr. Muhammad Bachri Amran

Institut Teknologi Bandung

Dr.rer.nat. Ria Armunanto.

Universitas Gadjah Mada

keynote SPEAKS

Photocatalysis in various chemical reactions

Hisao Yoshida*

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Photocatalyst can catalyze various chemical reactions by using photoenergy. When the semiconductor photocatalyst absorbs a photon, an excited electron and a hole are generated at the conduction band and the valence band, which can promote reduction reaction and oxidation reaction, respectively, at the surface. This mechanism is quite different from that of the conventional catalysis, that is, the adsorption of the molecule makes the molecule be active. The application of photocatalysis can be classified into three: utilization for environmental application, energy conversion, and unique chemical reactions. The first is nowadays quite popular in literature: the photocatalysts can promote degradation of many kinds of organic compounds even in aqueous solutions, in air, or on the surface of materials to keep them pure and clean. This will contribute to the comfortable environment of our life. The second is the solar energy conversion to chemical potential, e.g., hydrogen production via water splitting, carbon dioxide conversion to useful chemicals and so on. This class is quite important for utilization of the sustainable solar energy and contribute to solving the energy and environmental issues. The last is also attractive: photocatalyst can realize new types of catalytic reactions that cannot proceed in the conventional methods. These kinds of photocatalyses will open a new field of chemistry. In the lecture, I will introduce several unique photocatalytic reactions by using some kinds of photocatalysts that we have developed so far, such as methane conversion, reduction of carbon dioxide, and organic synthesis.

Keywords: hydrogen, splitting, semiconductor, energy, conversion

Advancing Chemical Sciences in Indonesia by Attracting More Students to Chemistry

Basil Marasinghe*

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In order to advance chemical sciences in any country, it is important to get best students to study chemistry. To achieve this object, chemistry has to be made very attractive to students. 10-15 years ago, chemistry was not an attractive subject among undergraduates in Papua New Guinea. 12 years ago the author set about introducing several measures to make chemistry more popular among undergraduates. They included the use of information technology, introduction of weekly industrial visits and work experience programs in chemical industries, moving away from tests and examination being memory based to those based on understanding concepts and processing of knowledge, making learning more students centred than teacher centred, discussions on ethnochemistry and last but not least, addition of some humour to chemistry. This paper details some of these measures which most probably have led to a significant turnaround in students' attitude to the subject and its increased popularity among them.

Keywords: ethnochemistry, ethnomedicine

The Evolution of Chemical Risk Management

Andrew W. Nelson

International Biological and Chemical Treat Reduction Sandia National Laboratories, Albuquerque, USA

Abstract / presentation could be downloaded from:

docs.kimiawan.org/icics/andrew.pdf

If requested, fill in user: **icics** password: **2017**

Computational Chemistry in Indonesia

Muhamad Abdul Kadir Martoprawiro*

Department of Chemistry, Institut Teknologi Bandung

Abstract / presentation could be downloaded from:

docs.kimiawan.org/icics/muhamad.pdf

If requested, fill in user: **icics** password: **2017**

invited SPEAKS

Artificial Photosynthesis for Water Splitting: New Device Type Based on Modified Dyes Sensitized Solar Cell Having Catalysis Zone Extension.

Jarnuzi Gunlazuardi

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Water splitting induced by visible light is one of the interesting tasks to produce hydrogen (fuel). However to split water in to hydrogen and molecular oxygen by visible light induction is a difficult task. Titania (TiO_2 crystal) was reported being able to split water[), but need light with wave length less than 410 nm. Fortunately, titania can be composited with other small band gap semiconductor but has a conduction band level slightly higher (e.g. CdS). The visible light excites electron of CdS to its conduction band, that will flow down to the titania's conduction band. Hence the CdS/Titania system is considered as visible light active semiconductor composite. Having this system along with ability to morphologically control of highly ordered titania nanotubes array film[), we developed a system that have a potential to produce hydrogen from water under induction of visible light. A Highly Ordered Titania Nanotubes (HOTN) arrays have been successfully prepared by electrochemical oxidation of titanium metal sheet in a viscous electrolyte. The electrolyte comprises of ethylene glycol and water containing fluoride ion. By varying anodization voltage and time, at certain electrolyte composition, a typical tube length (2 - 7 µm) , inner tube diameter (40 – 80 nm), and thickness of the tube's wall (10 – 27 nm) can be controlled. The prepared HOTN then was sensitized by CdS nano particle by a SILAR (successive ionic layer adsorption and reaction) method[6)]. The resulting CdS/HOTN showed excellent response toward visible light. The obtained CdS/HOTN then was employed to construct a modified dyes sensitized solar cell (DSSC) having catalysis zone extension. To assembly the modified DSSC, the HOTN sheet was prepared carefully, in which half part of HOTN was sensitized by CdS (hence CdS/HOTN), dedicated as DSSC zone and another half part was leave it uncovered, managed as catalysis zone. The DSSC zone is a sandwich of CdS/HOTN, electrolyte (Na_2S/S; KCL in methanol water), and Pt/SnO_2-F Glass. Upon absorbing light, the CdS in the DSSC produce exited electron that flow to titania and subsequently migrate to the catalysis zone. The "hot" electron in the catalysis zone eventually reduce proton (water) in its adjacent to generate hydrogen. The deficit electron in CdS semiconductor (valence band) will be compensate by electrolyte in the DSSC zone, which will have uptake electron from the counter electrode in catalysis zone. So in the catalysis zone there will be reduction reaction of water (proton) to produce hydrogen (acceptor electron from the DSSC zone) and oxidation reaction of water to produce molecular oxygen or hydroxyl radical (donor electron to the DSSC zone). As long as light strike the DSSC zone the catalysis zone will eventually produce hydrogen.
The above modified DSSC which employing CdS/HOTN absorb visible light and convert it to energy which induce a chemical reaction in the catalysis zone to produce hydrogen from water. In our typical modified DSSC, when the active counter electrode (semiconductor) was being employed, the system can split water to hydrogen and molecular oxygen, by solely visible light, thus a kind of artificial photosynthesis. The proof of concept and features for further development will be discussed.

Keywords: Water Splitting; Hydrogen; Titania nanotubes; Cadmium Sulfide; Artificial photosynthesis

Supramolecular Ionic Crystals Based on Polyoxometalates-Organometallic Complexes

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Polyoxometalates are early transition metal oxygen anions clusters, which have various properties such as acid bases, redox potentials, shapes and structures, and solubility depending on counter ions. The researches of polyoxometalates are rapidly growing in this decade due to application not only in laboratory but also in industrial scales such as supramolecular building blocks, catalysis, membranes, adsorbents, and also sensors. In this report, polyoxometalates are used as anions in reaction with organometallic complexes as cations to form supramolecular ionic crystals. Several kinds of polyoxometalates and organometallic complexes are used in order to know the structural effect for formation of supramolecular ionic crystals. The applications of these

supramolecular ionic crystals are also addressed especially for separation and catalysis.

Keywords: ionic crystal, polyoxometalate, organometallic complexes

The Utilization of Palm Oil as Renewable Block Building Source in Chemical Industry

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Palm oil is one of the important national commodity and contributes significantly to the national income in Indonesia. Modern chemical reaction can modify the palm oil components into fatty acid derived high economic value materials, in addition to the palm oil utilization in food industry, traditional oleochemicals and fuels. Oleic acid is the major components in palm oil with a content of ca. 40%. Ethenolysis of methyl oleate successfully furnished methyl 9-decenoate and 1-decene via cross olefin metathesis reaction in the presents of Grubbs II catalyst. Valorization of methyl 9-decenoat as a new building block have an important role as renewable building block on further transformation to produce many high-value chemicals. In this presentation, we will show the transformation of methyl 9-decenoate in the synthesis of several potential monomers and the synthesis of civeton. The well-defined strategy on a target-oriented transformation could be a great contribution of organic chemical synthesis in improving the economic value of palm oil.

Keywords: palm oil, oleic acid, olefin metathesis, renewable building block.

Immunogenicity Evaluation of Recombinant Fim-C *S. Typhi* Protein as Typhoid Vaccine Candidate on Wistar Rat to Increase the Quality of Urban Health in Indonesia

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Typhoid fever is a world health problem and often occurs in developing countries, including Indonesia. The cause of typhoid fever in humans is *Salmonella typhi* bacteria. Transmission of the disease is generally through a pattern of life that is less healthy and hygienic. In a previous study, the UNJ Salmonella team had successfully isolated, cloned, expressed, and purified recombinant protein Fim-C *S. typhi* inclusion bodies sized 31 Kilo Dalton (KDa). Furthermore, these proteins have been used as antigen in immunogenicity test with ddY mice as test animals and give excellent results. This study aims to determine the immune response of rodent test animals with higher levels against recombinant protein Fim-C *S. typhi* inclusion bodies as antigen. Immunogenicity test was performed using male Wistar rats. That were divided into five test groups: Normal group (control, without injection), Control Group 1 (injected with PBS), Control Group 2 (injected with Adjuvant FCA/FIA), Samples Group 1 (injected with Fim-C Inclusion Bodies S. typhi protein), Samples Group 2 (Injected with Fim-C Inclusion Bodies S. typhi plus Adjuvant FCA/FIA protein). The results of the ELISA (Enzyme-Linked Immunosorbent Assay) analysis showed an increase in antibody titers produced by Wistar rats after subcutaneous injection with Fim-C protein emulsified adjuvant or without adjuvant. The result of analysis by Western Blot method showed the specific interaction between Fim-C *S. typhi* antigen with anti-Fim-C *S. typhi* antibodies. Data obtained from both methods confirm that the antigen has a high immunogenicity. It can be concluded that recombinant protein Fim-C *S. typhi* inclusion bodies can be used as a potential vaccine candidate for typhoid disease. These results are expected to be an alternative in the discovery of new vaccines that can improve the quality of life of Indonesian society.

Keywords : Typhoid Fever, Fim-C S. Typhi, Recombinant Protein, immunogenicity test, Wistar Rat

Biomolecules-Mediated Synthesis of Gold and Silver Nanoparticles: Recent Developments

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An environmentally-friendly approach was developed to synthesize gold and silver nanoparticles using biomolecules. The biomolecules were extracted using demineralized water and the extracts were used to reduce silver or gold cations to form silver and/or nanoparticles. In general, the reactions were carried out under open air condition at room tempeature (without any elevated temperature). Their characterizations along with some applicationshave also been discussed.

Electrocoagulation Technic for Improvement Quality of Swimming Pool Water

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This study aims to improvement quality swimming pool water by electrocoagulation process. The condition electrocoagulation are find to make good process and determine the quality of the water pool based on the parameters of Ca^{2+} concentration, pH, and TDS, after electrocoagulation process is carried out according to Indonesian Ministry of Health Regulation No. 416 / Menkes / Per / IX / 1990. The object of this research was the optimum condition electrocoagulation efficiency to remove of Ca^{2+} metal ions, pH and TDS in the FIK's swimming pool water, Yogyakarta State University. Optimization of the electrical voltage was done on variation 2, 4, 6, 8, 10 and 12 volts and optimization of the time electrocoagulation process was done on variations of 2, 4, 8, 16 and 24 hours. Parameters used are concentration of Ca^{2+} in the water, TDS and pH. Effectiveness of the electrocoagulation based on the graph, the separation efficiency of Ca^{2+} metal ion, TDS and pH values. The samples were analyzed using Atomic Absorption Spectroscopy (AAS), TDS meter and pH meters. The results showed the optimum potential is 10 volt and the optimum time of electrocoagulation process is 24 hours. The quality of the water pool based on the pH parameter after electrocoagulation process according to Indonesian Ministry of Health Regulation No. 416 / Menkes / Per / IX / 1990 is well as water quality standard swimming pool is pH 6.7 and TDS 231,3.

Keywords: electrocoagulation, swimming pool water.

Exploration of Herbal Anti Gout Drug: A Case Study on Xanthin Oxydase Inhibitor

Subandi

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The gout prevalence was increase sharply in recent decade. On other hand, as a mega-biodiversity country, Indonesia is a home to 11 percent of the world's flowering plant species and potencial as resource of many bioactive metabolites, including herbal antigout drug. Therefore, the herbal antigout exploration by biochemical studies is important to do. In this paper we presented some results of our preliminary exploration on herbal juice and extract that have activity as xanthin oxydase inhibitor, so they have potency as anti gout drug. Among them are seed peel extract of: melinjo (Gnetum gnemon), mangoosten (Garcinia mangostana), peanut (Arachis hypogaea L.), extract of soursop (Annona muricata) and sugar apple (Annona reticulata) fruit.

Keywords: :xanthine oxidase inhibitor, herbal anti gout, soursop, sugar apple

Structural and Dynamical Properties of Solvated Be(II) Ion in liquid ammonia: A Quantum Mechanical Charge Field Molecular Dynamics Simulation Study

Priyagung Dhemi Widiakongko, Bambang Setiaji and Ria Armunanto

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A quantum mechanical charge field molecular dynamics simulation study of structural and dynamical properties of solvated Be(II) ion in liquid ammonia using was carried out. The first and second solvation shell were treated by quantum mechanics at Hartree-Fock level of theory, and the outer region of the system was described using coulombic potential. The structure was evaluated in terms of radial and angular distribution functions and coordination number distributions. Ligand exchange processes between coordination shells have been investigated and evaluated. A rigid structure was observed for the first solvation shell showing a tetrahedral coordinated $Be(NH_3)_4^{2+}$ complex with a Be-N averaged distance of 1.745 Å. The second solvation shell shows a labile structure with large number of successful ligand exchange. The simulation result has a good agreement with the experiments.

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Production Biomethane from Palm Oil Mill Effluent (POME) with Truncated Pyramid Digester in Fed Batch System

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Abstract. Palm oil mill effluent (POME) production in Indonesia is estimated around 63 million ton/year [1]. Therefore it is a potential source of contamination when it directly discharged into the river. Even though, POME will be as raw resource biogas production.The aims of this research were to know the effect of fermentation time toward biogas production in truncated pyramid digester. The study was done in three combinations of feedstock with POME concentrations of 90, 80, and 70% and activated sludge concentrations of 10, 20, and 30%. A mixture of POME and activated sludge at 6 L/minutes for 30 days were fed into the digester. The result showed the fermentation time gave significant effect toward biogas production in the truncated pyramid digester. All combinations showed the upward trend in the volume of biogas during fermentation. The highest quantity of biomethane in biogas was 25% mol that the active microbes were added to POME in the ratio 1: 9 in a fed-batch system.

Keywords: biomethane, fed-batch, palm oil mill effluent (POME), truncated pyramid digester.

1. Introduction

Palm oil mill effluent (POME) is wastewater generated by palm oil mill mainly from condensate stew, hydrocyclones water and sludge separator. Every ton of fresh fruit bunches (FFB) processed formed about 0.6 to 1 m3 POME. POME is rich in organic carbon with chemical oxygen demand (COD) of 40 g/L and total nitrogen of approximately 0.5 g/L.

The fermentation process takes place in an anaerobic digester with the aid of bacteria. This process can be done in batch or continuous. In a continuous process, the substrate is inserted every day at certain flow rate corresponding to the retention period. The substrate is derived from a material that is rich in organic matter and mixed by activated sludge derived from manure as an activator. Nutrient content in manure varies depending on the state level of production, the type and amount of feed, as well as individual animals themselves [2]. Nutrient content in manure, such as nitrogen (0.29%), P2O5 (0.17%), and K_2O (0.35%) [3].

Biogas digestion consists of four stages of reaction that requires optimum conditions at each stage, if there are no optimum conditions, often the formation of biogas becomes obstructed and sludge still has the potential to produce biogas. In an effort to optimize the production of biogas, the fermentation process is done in two steps with two digesters interconnected. One of them can be done by assembling the digester interconnected in two stages.

Based on this, the authors conducted a study of wastewater treatment process of POME into biogas used by microorganisms as the activator. This research is expected to represent the real situation as possible so that it can be used to produce an environmentally friendly alternative energy. These technologies include the tank (biogas reactor) truncated pyramid-shaped. Truncated pyramid shape was chosen due to avoid channeling occurs in the bottom of the pool for their deposition. At the top of the reactor by the cover is that the methane gas trapped above the surface and can be converted to produce energy.

This technology generally avoids greenhouse gases, especially methane escape into the atmosphere. The subsequent processing stages can also be done with a truncated pyramid-shaped digester to treat of POME more effectively and efficiently. Methane gas as one of the products from oil POME can be accommodated and utilized to energy as compared to released into the atmosphere and added to greenhouse gas emissions. The other products, Sludge, can be used as a liquid fertilizer which is applied to palm oil plantations. Industrial liquid waste processing palm oil at the stage of sedimentation by using this design tool is one way that is more effective and efficient in terms of place, time, and cost of processing.

The purposes of this study include:

- Determine the influence of starter volume percentages given in POME in the digester to the quantity of biogas produced.
- Determine the influence of fermentation time on POME to the quantity of biogas by using a truncated pyramid-shaped digester on fed-batch system

2. Methods

2.1 Fermentation anaerobic for activator microorganism
The active microbes were added to POME in the ratio 1:4 L in a batch bioreactor with a volume of 8 L. Temperature and pH on anaerobic fermentation were not regulated, whereas the sampling time, each day with as much volume of 1 L and 1 L of water was replaced with POME.

2.2 Fermentation anaerobic for biogas production
Main raw material substrates of POME are pumped into the first tank to the brim. This tank serves as shelter bait. Feed that has been entered into the first tank will undergo deposition (sedimentation). The substrate will be divided into two layers. The bottom layer will be a rich substrate in the form of the slurry and the top layer of substrate that has been separated from the slurry.

The top of layer flowed into the second tank after deposition for 24 hours. In the second tank of POME mixed with a starter. Digester used with a truncated pyramid-shaped fed-batch type with a capacity of 18 L. The mixture of POME and starter varied by comparison wastewater and starter 10:90, 20:80, and 30:70. POME from the tanks streamed every day and also continuously added a

starter. The fermented liquid in the tank to be also streamed every day two to three tanks to prevent in the second tank so on until the gas obtained in the variant designated day (Figure 1).

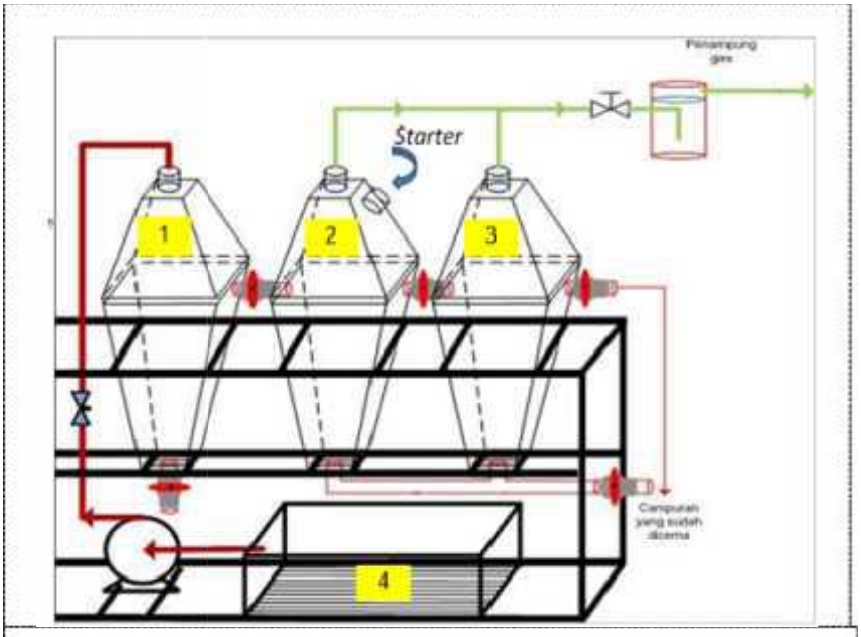

Figure 1. The design of the truncated pyramid-shaped measurement in processing of POME on biogas production

Note :

Tank 1 : Bioreactor for sedimentation

Tank 2 : Bioreactor for fermentation

Tank 3 : Bioreactor for collection

Tank 4 : Tank for collection of slurry

2.3 Analytical analysis

All the tests for the samples were analyzed according to the guidelines of the American Public Health Association [4] for the examination of POME and POME after fermentation. Biogas yield was measured with a wet gas meter (W-NK-O.SA, Shinagawa). Gas samples were obtained through an inverted funnel placed above baffles near the top of the reactor. Biogas composition was determined using a gas chromatograph (GC-8A, Shimadzu, Kyoto).

3. Results and Discussion

3.1 Raw materials analysis

POME is analyzed by nitrogen content, pH, COD, and BOD to get treatment in the sewage treatment pyramid-shaped anaerobic digester. POME as substrate was fermented to produce biogas. The results of the analysis of the substrate can be seen in Table 1

Table 1. Analysis Data from POME

Parameter	Result from this research	Kep Men LH 51
pH	4	6.0-9.0
BOD (mg/L)	1755	250
COD (mg/L)	26352	350
NH_3 Total (mg/L)	199,36	50

The results of the analysis of the chemical characteristics of POME from PT. Mitra Ogan (Table 1) shows that the waste has a pH of 4, BOD 1,755 mg/L, COD 26,352 mg/L, nitrogen 199.36 mg/L. The overall parameter is above the threshold value the quality standards set by Kep Men LH 51, 1995 (Table 1), so that POME which has a high organic matter content has the potential to be used as a substrate in the process of anaerobic fermentation. Biological treatment and in the process uses microorganisms to degrade organic pollutants [5] worthy recommended as the appropriate processing method. According to Davis and Cornell (1991) [6], the content of BOD in excess of 1,000 mg/L makes the anaerobic process to be applied as a pretreatment.
COD from POME is 26,352 mg/L. COD value is much lower when compared with studies Lang, (2007) [7] in the amount of 50,000 mg/L and is still smaller than research Hasanah, (2011) [8] is 47105.26 mg/L. COD is a measure of the quantity of organic material in the wastewater that showed high content in the form of lipids, carbohydrates, and proteins. According to Zhang et al (2008) [9], the processing potential of anaerobic fermentation is done for handling POME due to high organic material characteristics. Additionally, effluent BOD value of palm oil mill is 1755 mg/L is still the very high content of organic material so that the value of TDS and TSS is high anyway.

Based on the analysis, the total nitrogen content of POME is in the range approaching the total of nitrogen. According to Simamora et al. (2006) [10], C/N ratio that is optimum for the microorganisms is 20-25. Therefore, the liquid waste used as a substrate in the process of anaerobic fermentation. Sources C and N necessary microbes involved in the anaerobic process as a source of nutrients for growth and development of the microbes. If the N content in the substrate slightly, then the bacteria cannot produce the enzymes needed to synthesize the compound (substrate) containing carbon. Meanwhile, if the substrate is too much to contain N, bacterial growth is inhibited due to the ammonia contained in large quantities [11].

3.2 Aanalysis of Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD)
COD is used as a measure of the quantity of organic material in the wastewater industry-and the potential to produce biogas [12]. In the reform process of anaerobic, which is biodegradable COD present in the organic material and the resulting end product called methane and past the newly formed bacteria. Measurement of COD value in the wastewater end of the palm oil industry after the fermentation process in the digester is shown in Figure 2.

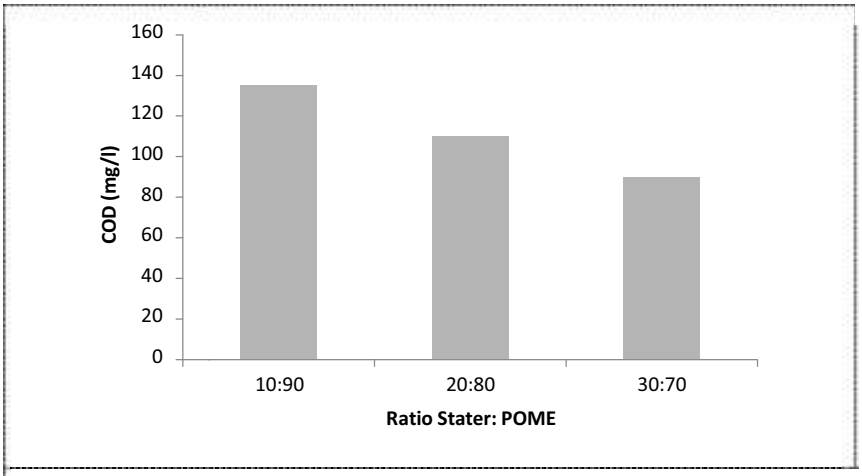

Figure 2. The value COD of POME in Fermentation Anaerobic Process

Based on the analysis, a combination of POME and starter has a significant influence on the COD value in the end. It can be seen that the value of COD in waste water mixture of palm oil and cow dung after undergoing a process of anaerobic fermentation decreased from 26,352 mg/liter before treatment to 135 mg/liter for the first sample and 110 mg/liter and 90 mg/liter for each of the second and third samples. This indicates that the POME waste containing high pollutant loads and can be dropped using the process of anaerobic fermentation processing.

The content of organic substances in the effluent POME has been degraded by microbes active from cow dung so that the organic material has been changed and its COD value decreases. According Nugrahini et al (2008) [13], COD is an important variable that indicates success or failure of the process of degradation. Overall COD measurement detects organic compounds, both organic as well as simple organic compound [14]. According Kresnawaty (2008) [15] due to impairment COD has become the hydrolysis process. At this stage of organic materials utilized by microorganisms as nutrients and convert it into a form simpler compounds.

As for the measurement BOD value in POME after the fermentation process in the digester is shown in Figure 3.

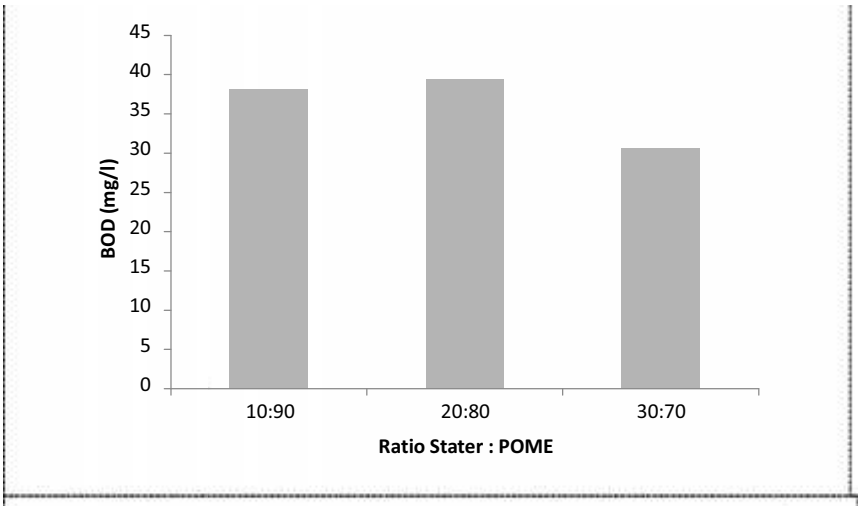

Figure 3. Concentration of BOD from Ratio of Stater and POME

The Figure 3, it can be observed that the reduction in BOD loadings occur in POME occurs due to the influence of the reduction in COD where the value of the initial BOD content before getting treatment in the digester pyramid. This reason is POME contains high pollutant loads and can be dropped using the process of anaerobic fermentation processing.

POME is dumped directly into the environment will cause environmental pollution, therefore, to reduce COD and BOD concentration required treatment in the form of waste treatment in the pyramid-shaped digester with a sedimentation process. The decrease of COD and BOD happens after treatment because some organic substances in the waste has been degraded into sludge and others have been degraded into other products such as methane [16]. Although at the sewage treatment of COD and BOD has decreased, but still need to do the processing for the reduction of COD as low as possible by regulations made by the government of Kep. MEN-LH No. Kep-51 / MENLH / 10/1995 dated October 23, 1995, where the quality of raw palm oil industry waste ready to be released into the receiving water body or the environment should have a maximum COD value of 500 mg / liter and maximum BOD of 250 mg/L.

POME has a high organic matter content and containing macro nutrients such as nitrogen (N), phosphorus (P) and potassium (K). Analysis of total nitrogen content before and after getting treatment by sedimentation processes in the pyramid-shaped digester is shown in Fig. 4.

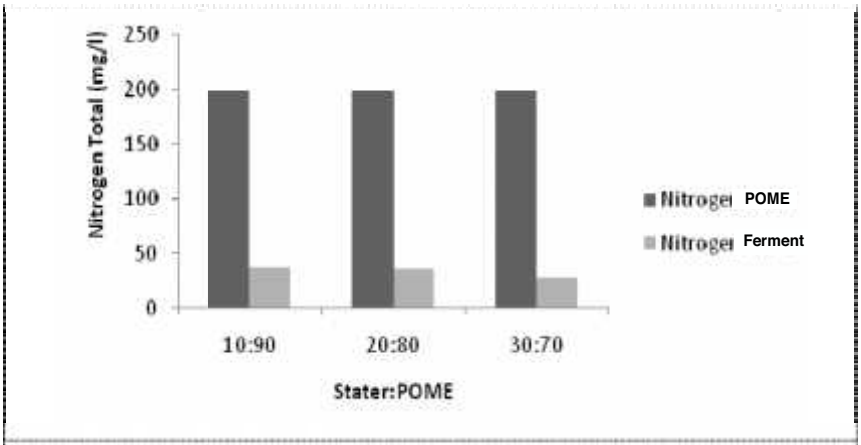

Figure 4. Total Nitrogen Levels Before and After Anaerobic Fermentation Process

After analysis of sludge produced, sludge wastewater treatment results of POME by means of sedimentation has a total nitrogen content of the previous 199.36 mg/L to Rp 38.08 mg/L for the first sample while samples in second and third respectively are 36.84 mg/L liter and 28 mg/L. This figure is already approaching the levels nitrogen of POME, so it could potentially be used as a liquid fertilizer

for palm oil plants, which can automatically replace the use of chemical fertilizers price is too expensive. In addition to reducing waste disposal to the environment and can save processing costs.

3.3 Effect of time and ratio on methane production

Gas production from POME and starter using truncated pyramid digester system result fed laboratory-scale batch volume of 18 litres shows the whole combination showed the trend of increasing volume of biogas fermentation. The highest quantity of CH_4 is 24.95865% mole in ratio 10:90, while the lowest quantity of CH_4 is 9.4782% in ratio 30:70. Each variation of the mixture composition shows fermentation time significantly affected the production of biogas. Wherein an increase in CH_4 composition during the 30 days of fermentation, as shown in Figure 5.

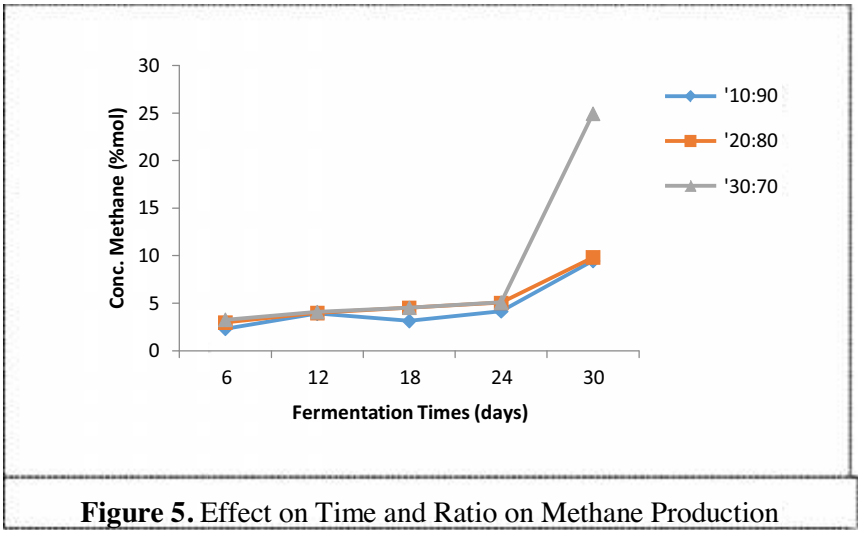

Figure 5. Effect on Time and Ratio on Methane Production

The optimumpercentage of methane concentration in optimum condition 30 days with a volume ratio of starter and liquid waste, 10:90, is 9.4782%. The percentage of gas in the ratio of 10:90 raw material are the compared with a ratio of 20:80 and 30:70 raw materials. However, the percentage of CH_4 always rises until the 30th day. The percentage of gas for 30 days of fermentation will experience enhancement with increasing fermentation time. According to research [17], the longer the fermentation time the increased activity of microorganisms to use a substrate so that it will affect the resulting product. On the 6th day of the first quantity produced was 2.9824%. The lower the percentage of CH_4 in this comparison due to the many factors that lead to microbial activity stops, such as pH and temperature factors so that microbes do not work optimally in overhauling the substrate. Such data has been shown in Table 1, the initial pH of POME that is 4. After the addition of the mixture to starter, the pH will increase. The reason is the pH value on anaerobic processes will decline with volatile acids produced and will increase with volatile acids consumed by methane forming bacteria [18]. If the pH drops below 6.5, the organic acid began to take shape with the help of hydrolytic bacteria and fermentation stage begin to stop. Methanogenic bacteria are very sensitive to changes in environmental pH. The pH value of 10 best in producing biogas ranged from 7.0. If the pH value below 6.5, the activity of methanogenic bacteria will decrease and pH below 5.0, the fermentation activity will stop [11].

The combination 20:80 of gas production in the digester produces truncated pyramid CH4 percentage is 9.8200%. Gas production on a combination was higher than 10:90 combination. It was explained earlier that the factors that influence differences in gas production in each treatment are the total N content of the substrate, the pH value and the content of nutrients and organic matter content in each mixture. The graph in Figure 5 above shows that in addition there is also the CH4 content of O2 and N2. The content of O2 and N2 looks quite higher than the content of CH4. This affects the fermentation process in the formation of biogas because microbes contained in the substrate cannot work properly if a lot of air contained within the digester. The presence of O2 and N2 content of that magnitude in the digester can occur due to the less closed digester, causing air can enter easily into the digester. The content of O_2 and N_2 causes a state in no aerobic digester while the methanogenic bacteria are living in anaerobic or minimal O_2.

In Figure 5, note that the content of CH_4 volume ratio of 30:70 starter and liquid waste is the highest, amounting to 24.95865%. This is the most appropriate composition of the three variations are done. This occurs because the starter, written more than 30% of the remaining mixture is POME with rich organic matter content so that the bacteria were able to remodel perfectly. The organic material will change the protein, cellulose, and fats into amino acids, glucose, and fatty acids. Level of methane in the biogas is affected by the ability of microorganisms to decompose organic substrate and the carbon and nitrogen in the digester.

The graph above shows the relationship quality of biogas against time to the comparison of the volume of each starter and POME. Quantities indicated a significant increase in the ratio of 30% and 70% starter liquid waste. This is because the ability of the bacterial hydrolysis of each comparison is different. Where the organic material from the starter ratio of 30% and 70% of POME is greater than the other resulting in the formation of methane by bacteria more leverage. Besides the comparison between batch and fed-batch systems are presented in Table 2.

Tabel 2. Comparison of percentage methane in batch and fed batch system

System	Stater:POME	Ferm. time (days)	Conc Methane (%mol)	Ref.
Batch	30:70	4	1.7972	Saputri (2015)
Fed Batch	30:70	30	24.9586	This research (2016)

4. Conclusions

Based on the results of research that has been done is the treatment of POME into biogas fed-batch system, it can be concluded of the three variations of combinations of substrates that starter and POME are 10:90, 20:80, 30:70 shows that the more volume starter is added to the liquid waste then the percentage of biogas produced will be higher. It can be observed in the percentage of methane generated is directly proportional to the volume of starter added.

Time of fermentation in each variation of the substrate, namely a combination of POME and starter 10:90, 20:80, 30:70 by fed-batch system provides real influence on the production of gas, with the

upward trend in gas production during the 30 days of fermentation. Fermentation time is long lead time live feed in digesters longer so that the bacteria can remodel more organic material into biogas.

In further research is necessary to add other nutrients to the substrate so that the result can be a maximum of biogas. In addition, variations in the other livestock manure activators could be in with a longer retention time again.

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