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5th REGIONAL CONFERENCE ON GLOBAL ENVIRONMENT

"TOWARD A SUSTAINABLE ASEAN"

21 - 22 November 2012 | Aston Tropicana Hotel, Bandung, Indonesia

PROCEEDINGS

ORGANIZED BY:

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Proceedings of
The 5th AUN/SEED-Net Regional Conference on Global Environment

"Toward a Sustainable ASEAN"

21-22 November 2012
Aston Tropicana Hotel
Bandung, Indonesia

Centre for Environmental Studies – Institut Teknologi Bandung
Jalan Sangkuriang No. 42 A
Bandung 40135
Jawa Barat - Indonesia

FOREWORD

The seminar is strategic and prospective efforts to publish scholarly experimental works produced by researchers from universities, research institutions, industries, and other institutions. As part of the cutting edge research activities, seminar has been proven to play an important role in giving significant contribution to the researchers, creating discussion and providing an exchange of experience, as well as bridging the further collaboration among participants. The seminar is also an instrument in guiding the development of science and technology from the continuously research activities. In the international community windows, the seminar also reflects human dignity that demonstrates knowledge and technology.

Realizing the importance and benefits of the seminar, the Center for Environmental Studies (PSLH) Institut Teknologi Bandung (ITB) in collaboration with the College of Engineering University of the Phillippines-Diliman, which is also supported by AUN / SEED-Net, will host 5th Regional Conference on Global Environment (RCGE) on the theme "Toward a Sustainable ASEAN". The seminar will be held for two days from 21 to 22 November 2012, consisting of RCGE seminars and meetings of delegates of AUN/SEED-Net. In this conference, four plenary lectures will be given by eminent professor: Prof. Mitsuru Osaki, Director, Sustainability Governance Project (SGP), Hokkaido University; Prof. Yasushi Kiyoki, Faculty of Environment and Information Studies, Keio University; Prof. Naoyuki Funamizu, Graduate School of Engineering, Hokaido University; and Assoc. Prof. Shinjiro Kanae, Env. and Water Res. Eng. Group, Tokyo Institute of Technology, which will be continued by presentation of five invited speakers and parallel sessions. In total, we present 94 papers, which come from various countries in ASEAN. This book is a result of scientific and communicative papers compilation, which is presented in 5th Regional Conference on Global Environment (RCGE) on November 21-22, 2012, in Bandung, Indonesia.

Hopefully this conference would become a means of intensive communication between the community in pursuing the global environment in Indonesia and abroad, as well as industry and government, and could open up opportunities for cooperation for mutual benefit.

Last but not least, we gratefully acknowledge all participants, AUN/SEED-Net, and sponsors for their valuable contribution.

Bandung, 15 November 2012

Tjandra Setiadi
Head
Centre for Environmental Studies, Institut Teknologi Bandung

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CONFERENCE PROGRAM

20 November 2012	
18.00 - 20.00	Early Registration (at Hotel Aston Tropicana)

Day 1, 21 November 2012					
07.00 - 08.30	**Registration**				
08.30 - 09.00	**Opening Ceremonies and Performance** Assoc. Prof. Dr. Yogi Wibisono Budhi Chairman of The 5th AUN/SEED-Net Regional Conference on Global Environment Organizing Committee Mr. Toshiyuki Okui AUN/SEED-Net Representative Prof. Dr. Wawan Gunawan A. Kadir, MS Vice Rector for Research and Innovation Institut Teknologi Bandung, Indonesia				
09.00 - 09.30	**Plenary Lecture 1** Prof. Mitsuru Osaki Director of Sustainability Governance Project, Hokkaido University, Japan Theme: Carbon Management in Peat Forest				
09.30 - 10.00	**Plenary Lecture 2** Assoc. Prof. Shinjiro Kanae Env. And Water Res. Eng. Group, Tokyo Institute of Technology, Japan Theme: Global Hydrology and Climate Change				
10.00 - 10.30	**Photo Session and Coffee Break**				
10.30 - 12.05	**Parallel Session I**				
	Room 1	**Room 2**	**Room 3**	**Room 4**	**Room 5**
10.30 - 10.50	WP-1	PW-1	SC-1	AP*	CC-1
10.50 - 11.05	WP-2	PW-2	SC-2	AP-1	CC-2
11.05 - 11.20	WP-3	WP-6	SC-3	AP-2	CC-3
11.20 - 11.35	WP-4	WP-7	SC-4	AP-3	CC-4
11.35 - 11.50	WP-5	WP-8	SC-5	AP-4	CC-5
11.50 - 12.05	Question & Answer Session				
12.05 - 13.05	**Lunch**				
13.05 - 14.20	**Parallel Session II**				
	Room 1	**Room 2**	**Room 3**	**Room 4**	**Room 5**
13.05 - 13.20	WP-9	PW-3	SC-6	AP-5	CC-6
13.20 - 13.35	WP-10	PW-4	SW-1	AP-6	CC-7
13.35 - 13.50	WP-11	WP-14	SW-2	WP-17	CC-8
13.50 - 14.05	WP-12	WP-15	SW-3	WP-18	GT-1
14.05 - 14.20	WP-13	WP-16	SW-4	WP-19	GT-2
14.20 - 14.35	Question & Answer Session				

14.35 - 15.05	**Coffee Break**				
15.05 - 16.50	**Parallel Session III**				
	Room 1	**Room 2**	**Room 3**	**Room 4**	**Room 5**
15.05 - 15.20	CC-9	SW-5	SS-1	GT-3	CE-1
15.20 - 15.35	CC-10	SW-6	SS-2	GT-4	CE-2
15.35 - 15.50	CC-11	SW-7	WP-20	EE-1	CE-3
15.50 - 16.05	CC-12		WP-21	EE-2	CE-4
16.05 - 16.20				SW-8	CE-5
16.20 - 16.35				SW-9	CE-6
16.35 - 16.50				SW-10	CE-7
19.00 - 22.00	**Welcome Party (Gala Dinner)**				

Day 2, 22 November 2012					
08.00- 09.00	**Parallel Session IV**				
	Room 1	**Room 2**	**Room 3**	**Room 4**	**Room 5**
08.00 - 08.15	EE*	WP-22	WP-26	WP-30	WP-34
08.15 - 08.30	EE-3	WP-23	WP-27	WP-31	WP-35
08.30 - 08.45	EE-4	WP-24	WP-28	WP-32	WP-36
08.45 - 09.00	EE-5	WP-25	WP-29	WP-33	WP-37
09.00 – 09.30	**Coffee Break**				
09.30 - 10.30	AUN/SEED-Net update and discussion on collaborative research				
10.30 - 11.00	**Plenary Lecture 3** Prof. Yasushi Kiyoki Faculty of Environment and Information Studies, Keio University, Japan Theme: A Multimedia Data Mining System for Environmental and Cross-Cultural Computing				
11.00 - 11.30	**Plenary Lecture 4** Prof. Naoyuki Funamizu - Graduate School of Engineering, Hokkaido University, Japan Theme: Sustainable Sanitation				
11.30 - 12.00	**Closing Ceremony**				
12.00 - 13.30	**Farewell Lunch**				

LIST OF PAPER

Water Pollution Control				
Code	**Writers**	**Abstract title**	**Affiliation**	**Country**
WP 1	Guanglei Qiu & Yen-Peng Ting	Osmotic Membrane Bioreactor for Municipal Wastewater Treatment: System Performance, Flux Stability and Membrane Fouling	NUS	Singapore
WP 2	Mohd Nordin Adlan, Puganeshwary Palaniandy, Hamidi Abdul Aziz, & Helen Jong Wan Ting	The Effect of Media Configurations on the Treatment of Landfill Leachate Using Horizontal Roughing Filter	USM	Malaysia
WP 3	Florencio Ballesteros Jr., Trina Listanco & Manny A.M. Taguba	Concocting local "BMP's" in Agriculture for Non Point Pollution Reduction in Laguna de Bai, Philippines	UP	Phillipines
WP 4	Junel B. Borbo, Mark Daniel G. de Luna	Adsorption studies on The Removal of Reactive Blue 19 and Reactive Yellow 145 using Putsan(tiwi) Clay	UP	Philippines
WP 5	Oeurng Chantha, Ly Sarann, Mok Sokun Vichet, Keo Soksamnang	Sediment Load Assessment in a Tropical Monsoon Catchment of Tonle Sap Lake Basin, Cambodia: Monitoring and Modelling	ITC	Cambodia
WP 6	Wawan Budianta	Soil Cadmium Remediation by Yogyakarta Natural Zeolite	UGM	Indonesia
WP 7	Ratchanan Chamnanmor, Pisut Painmanakul, Chaiyaporn	Study of In-line Coagulation and Flocculation Processes for Turbidity Removal: Experimental Approaches	CU	Thailand
WP 8	Thanakorn Ermukdakul, Benjaporn Boonchayaanant, Wiboonluk Pungrasmil & Pisut Painmanakul	Treatment of Wastewater from Aquacultural Pond by Two Step Processes (Rapid Sand and Slow Sand Filter)	CU	Thailand
WP 9	Siska Widya Dewi Kusumah & Heto Dwi Ariesyady	Identification of Microbiological Pollution Source in Upper Citarum River by Antibiotic Resistance Analysis of Escherichia coli	ITB	Indonesia
WP 10	Barti Setiani Muntalif, Indah Rahmatia S.S., Arwin, Lieza Corsita	Analysis of Phytoplankton Diversity and Water Quality in Aquatic Ecosystems of the Jatiluhur Reservoir	ITB	Indonesia

Water Pollution Control				
Code	**Writers**	**Abstract title**	**Affiliation**	**Country**
WP 11	Fadjari Lucia Nugroho, Setiati, Anni Rohaeni, Sri Wahjuni, Dwi Sobirachman, Adhita Abdillah, Siti Maryam Khoirunnisa	Removal of Colour Index Reactive Blue 5 (CIRB5) Anthraquinone Dye by Live Trichoderma asperellum TNC52 Isolated from the Soil of a Cacao Plantation in Riau	Universitas Pasundan	Indonesia
WP 12	Witawat Jangiam & Sarayut Petra	Biodegradation of Linear Alkylbenzene Sulfonate by AOS-15 Microorganism	BUU	Thailand
WP 13	Phong Nguyen Tan, Luan Mai Thanh	Study on Fish Processing Wastewater Treatment by Swim-bed and Stick-bed Processes	HCMUT	Vietnam
WP 14	Krittita Lertpocasombut & Maruay Kiewsa-ard	The Properties of the Ash if the Vetiver Grass Roots as a Filter Material	Thammasat University	Thailand
WP 15	Sri Puji Saraswati, Bambang Agus Kironoto, Suwarno Hadisusanto	Comparison of Some Water Quality Indices in Determining A River Quality Status (A Case Study of Gadjah Wong Stream)	UGM	Indonesia
WP 16	Mohd Suffian Yusoff, Ming Rui Lo, Hamidi Abdul Aziz	Semi-aerobic Landfill Leachate Treatment Using Oil Palm Trunk Waste-Derived Coagulant	USM	Malaysia
WP 17	Ahmad Shukri Yahaya, Nor Azam Ramli, Ahmad Zia Ul-Saufie, Hazrul Abdul Hamid, Fauziah Ahmad	Prediction of Daily Average PM10 Concentration 3 Days in Advance for Melaka, Malaysia	USM	Malaysia
WP 18	Bambang Hari P. and Hendriyana	Batch and Continuous Processes of Electrocoagulation on Industrial Wastewater	Universitas Jendral Ahmad Yani	Indonesia
WP 19	Doni Sugiyana, Marisa Handajani & Suprihanto Notodarmojo	Degradation of Textile Dyeing Wastewater Through Photocatalytic Treatment by Using Immobilized TiO2 Nanofibers Composite Catalyst	ITB	Indonesia
WP 20	Nguyen Duy Hung, Herman D. Mendoza, Nghiem Trung Dung	A Proposed Establishment of Lam River Basin's Water Monitoring System Using Passive Sampling Techniques	UP	Philippines
WP 21	Bui Xuan Thanh & Nguyen Phuoc Dan	Performance of Membrane Bioreactor Coupling With Ozonation at Different Recirculation Rate for Dyeing and Textile Wastewater Treatment	HCMUT	Vietnam
WP 22	Thipaporn Sirinukulwattana, Wiboonluk Pungrasmi & Chaiyaporn Puprasert	Treatment of Low Strength Wastewater by Rubber Granules Media AFB Reactors Without Internal Recirculation	CU	Thailand

Water Pollution Control				
Code	**Writers**	**Abstract title**	**Affiliation**	**Country**
WP 23	Inneke F.M. Rumengan	Quantitative Assessment of Benthic Community in Buyat Bay, North Sulawesi	Sam Ratulangi University	Indonesia
WP 24	Yonik Meilawati Yustiani	Study on BOD Decay Rate of Urban Rivers in Bandung City, Indonesia	Universitas Pasundan	Indonesia
WP 25	Misri Gozan, Fita Sefriana, Stephan Stauder, Jutta Eggers	Challenges in Treatment of Ciliwung River Waters	Universitas Indonesia	Indonesia
WP 26	Nontiya Chothong & Petchporn Chawakitchareon	Adsorption of Methylene Blue By Spent Coffee Grounds	CU	Thailand
WP 27	Narapong Hongprasith, Tawan Chareonpittaya, Daiki Fusamae, Jin Tanaka, Yuta Hikiji, Maliwan Kutako, Tsuyoshi Imai & Pisut Painmanakul	Study of Alternative Aeration System Applied in Aquaculture Ponds	CU	Thailand
WP 28	Desiana Prilia, Herto Dwi Arisyady & Katharina Oginawati	Analysis of Mercury in Water and Sediment Distribution and Its Bioaccumulation Potential in Fish in the Small Scale Gold Mining Area (Case study: Ciberang River, Lebak, Banten)	ITB	Indonesia
WP 29	Qomarudin Helmy, Syarif Hidayat, Luhur A. Devianto, Mochammad Chaerul	Municipal Landfill Leachate Treatment: Common Practices in Indonesia	ITB	Indonesia
WP 30	David Andrio, Marisa Handajani & Mindriany Syafila	The Potential of Ethanol Production from High Strength Organic Wastewater on Acidogenic Phase: A Preliminary Study	ITB	Indonesia
WP 31	Dita Amalia, Indah Rachmatiah S. Salami & Dwina Roosmini	Improving Water Quality of Rivers Receiving Landfill Waste Through Utilization of Pistia stratiotes L. Plants	ITB	Indonesia
WP 32	Rudy L. Widiyatno, Munawar Ali, Bambang Wahyudi, Qomarudin Helmy	Degradation of Textile Industry's Effluent Using Integrated Chemical-Biological Process	UPN-Veteran Surabaya	Indonesia
WP 33	Tazkiaturrizki, Prayatni Soewondo, Marisa Handajani	Removal Nitrogen and Phosphate in Effluent of Bojongsoang Wastewater Treatment Using Subsurface Horizontal Wetland with Continuous Feed	ITB	Indonesia

Water Pollution Control				
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WP 34	Prismita Nursetyowati, Prayatni Soewondo and Marisa Handajani	Influence of the Influent Organic Loading on Organic Removal of Liquid Phase Biowaste in an Upflow Anaerobic Fixed Bed Reactor with Pumice Supporting Media	ITB	Indonesia
WP 35	Jaber M.A. Alkasseh, Mohd Nordin Adlan, Hj. Ismail Abustan, and Abu Bakar Mohamad Hanif	Minimum Night Flow Analysis to Estimate Water Loss: A Case Study in Kinta Valley, Malaysia	USM	Malaysia
WP 36	Irawan Sugoro, Dwiwahju Sasongko, D. Indriani, P. Aditiawati	Biosolubilization of Gamma Irradiation Lignite by Penicillium sp	ITB	Indonesia
WP 37	Syarif Hidayat and Edwan Kardena	Removal of Organic Compounds from Oilfield Produced Water in Batch Suspended Growth Bioreactor Using Endogenous Bacteria	ITB	Indonesia

Air Pollution Control				
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AP*	Driejana	Science and Policy in Air Quality Management in Indonesia	ITB	Indonesia
AP 1	Tran Thi Thu Huong, Nguyen Duc Khanh, Pham Hoang Luong, Le Anh Tuan	A Computational Study of The Effects of Injection Strategies on Performance and Emissions of A Syngas/Diesel Dual-Fuel Engine	HUST	Vietnam
AP 2	Kania Mayang Lestari & Driejana	Performance of Alternate Absorbents in the Application of Ambient-NO2 Passive Tube Sampler in Indonesia	ITB	Indonesia
AP 3	Endah Saptutyningsih	Impact of Air Pollution on Property Values: A Hedonic Price Study for Daerah Istimewa Yogyakarta	Universitas Muhammadiyah Yogyakarta	Indonesia
AP 4	Vita Wonoputri, Mohammad Effendy, Yogi Wibisono Budhi, Subagjo	Abatement of Fugitive Methane Emission by Catalytic Oxidation: Study on Rate Parameter Estimation	ITB	Indonesia
AP 5	Saripah Sobah, Hary Sulistyo, Siti Syamsiah	Romoval of CO2 from Ammonia Industry through Coal Gasification as an Effort for Minimizing Global Warming	UGM	Indonesia

Air Pollution Control				
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AP 6	Esrom Hamonangan, Jetro Situmorang	Monitoring of Ambient Air Quality in 288 Locations of Province, City and Regency to Support National Air Quality Management Indonesia	Pusat Sarana Pengendalian Dampak Lingkungan (Pusarpedal)-Kementrian Lingkungan Hidup	Indonesia

Climate Change				
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CC 1	Udin Hasanudin, Amalia Julfi R., Rahmawati Nurmalasari, Agus Haryanto	Greenhouse Gases Emission Reduction Potential through Bioethanol Industry Wastewater Utilization	University of Lampung	Indonesia
CC 2	Deni Bram	The Paradox of National Climate Justice (Indonesia Emission Quota as Case Study)	Universitas Indonesia	Indonesia
CC 3	Watt Botkosal, Chhuon Kong, Chea Chanthou	The State of Climate Change in Cambodia	UGM	Indonesia
CC 4	FX. Hermawan Kusumartonoirst	Women Role on Adaptation to Face Water Crisis Impact of Climates Change: Study Case in Palue Island	Research and Development Center for Social, Economic, Environment, Board of Research and Development, Ministry of Public Works	Indonesia
CC 5	Inna Marlina, Puji Lestari, Juli Soemirat	The Impact of Global Warming to the Incidence of Dengue Hemorrhagic Fever (DHF) and The estimation of Its Burden of Disease Using Daly Parameter in Bandung City From 2005-2010	ITB	Indonesia
CC 6	Mohd Syarif Hidayat	The Thermal Environment of Urban Open Spaces in Jakarta	Universitas Mercu Buana	Indonesia
CC 7	Haryanto Wardoyo	Risk Versus Potency of the Natural Anaerobic Methane Emission	Papua Sagosia PT, Molindo Raya Industrial PT	Indonesia
CC 8	Jeark A. Principe, Ariel C. Blanco	Climate Change Impact Assessment on Soil Loss Rate in a Large River Basin Using SWAT Model, RS and GIS	UP	Philippines

Climate Change				
Code	**Writers**	**Abstract title**	**Affiliation**	**Country**
CC 9	Djoko Suwarno, Budi Widianarko, Ansje Lohr, Carolien Kroeze	Climate Change and Nutrient Export, A Scenario for Bengawan Solo River, Java	Soegijapranata Catholic University	Indonesia
CC 10	Ishak Tan	Forest Governance in Autonomy Era: A Study of Administration of Controlling at West Java Province, Indonesia	Bitari Institution, Cimahi	Indonesia
CC 11	Yeni Rahmawati, Sanggono Adisasmito, Tjandra Setiadi, I G Wenten	CO2 Removal Using Membrane Contactor in Transversal Modul	ITB	Indonesia
CC-12	Budi Kamulyan, Johan Syafri Mahathir Ahmad, Rachmad Jayadi	Adapting Climate Change by Using Roof Garden with Closed Cycle Water Utilization for Creating Micro Climate Improvement	UGM	Indonesia

Coastal Environments and Vulnerability				
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CE 1	Aung Kyaw	Geographical Analysis on the Vulnerability of Myanmar Coastal Area to Natural Disaster	Dagon University	Myanmar
CE 2	Irwan Gumilar, H.Z. Abidin, T.P. Sidiq, H. Andreas, R. Maiyudi, M. Gamal, Y. Fukuda	Mapping and Evaluating the Impact of Land Subsidence in Semarang (Indonesia)	ITB	Indonesia
CE 3	Bryan Clark B. Hernandez, Tolentino B. Moya, Ariel C. Blanco, Maria Antonia N. Tanchuling, Kazuo Nadaoka	Investigation of Saltwater Intrusion into the Coast of Guimaras Island, Philippines Using Geophysical and Geochemical Methods	UP	Philippines
CE 4	Arni Rahmawati Fahmi Sholihah, Achmad Sjarmidi	Environmental Analysis of Post Sand and Andesite Mining Land in Cimalaka and Paseh, Sumedang, West Java	ITB	Indonesia
CE 5	Tan Lay Hui Ivy	Understanding the Risk and Impact of Natural Disasters Along a Shipping Network	NTU	Singapore
CE 6	Achmad Sjarmidi, Anzilni Fathia Amasya, Lerry Martina, Sarah Saqina	Coral Reef Condition in Pangandaran Marine Nature Reserve and Tourism Park in Relation with Human Activities and Tsunami in 2006	ITB	Indonesia
CE 7	Eka Wardhani	Damage Analysis of Lake Bulakan Tangerang Municipal	Itenas	Indonesia

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Code	**Writers**	**Abstract title**	**Affiliation**	**Country**
EE 1	Yogi Wibisono Budhi, Hari Rionaldo, Allan Abraham B. Padama, Hideaki Kasai, Irwan Noezar	The Challenge of Process Intensification for Improved Hydrogen Production as Clean and Sustainable Energy Carrier in the Future	ITB	Indonesia
EE 2	Edi Iswanto Wiloso, Reinont Heijungs	Key Issues in Conducting Life Cycle Assessment of Bioenergy Systems	Research Center for Chemistry, Indonesian Institute of Sciences (LIPI)	Indonesia
EE 3	Conrad Allan Jay R. Pantua	Life Cycle Assessment of Fiber Reinforced Composite Materials in A Solar Powered Racing Car	DSLU	Philippines
EE 4	Jefry A. Torhis Simanjuntak, Muhammad Alfalah Fauzi	Turbine Application Analysis Based on Ocean Current Characteristics under Suramadu Bridge	ITB	Indonesia
EE 5	Erna Subroto, R. Manurung, H.J. Heeres, A.A. Broekhuis	Solvent Assisted Hydraulic Pressing of Jatropha curcas Kernel	Rijks Universiteit Groningen	The Netherlands

Green Technology				
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GT 1	Aviasti	Efforts of Industrial Estate in Indonesia to Create the Eco Industrial Park (Case Study: Industrial Zone in District of Karawang and Bekasi	Bandung Islamic University	Indonesia
GT 2	Sarah Balfas, Arief Sudradjat	Rainfall Depth Determination for Green Infrastructure Development in the Context of Water Resources Sustainability (Case Study: Cikapundung, Cisangkuy, and Ciwidey Sub Watershed)	ITB	Indonesia
GT 3	Yanita Hanastasia Sinaga, Arief Sudradjat	Initial Study on Determination of Low Impact Development Technology/Green Infrastructure for Managing Stormwater using Geographic Information System (Case Study: Upstream Citarum River Basin Non Urban)	ITB	Indonesia
GT 4	Rachman Setiawan, Adi Ekaputra, Nanang Ali Sutisna	Study on Noise Behaviour of Passenger Car Tyre for "Green Tyre" Design	ITB	Indonesia

Sustainable Consumption and Production				
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SC 1	Petchporn Chawakitchareon, Titima Wongaree	Ethanol Production from Cellulosic Materials by Simultaneous Saccharification and Fermentation	CU	Thailand
SC 2	Vilandri Astarini, Pingkan Aditiawati, Achmad Sjarmidi	Sustainable Production and Consumption Response Healthy Sugar Isomaltulose Fermented by Protaminobacter rubrum in Bandung, West Java	ITB	Indonesia
SC 3	Martha Aznury, Azis Trianto, Adi Pancoro, Tjandra Setiadi	Effect of Feeding Time of Volatile Fatty Acids from Palm Oil Mill Effluent on Production Polyhydroxyalkanoates by Ralstonia eutropha JMP 134 in Batch Fermentation	ITB	Indonesia
SC 4	Ying-Wen Chang, Ching-Hwa Lee, Ching-Hua Liao, Xiang-Ren Lin, Wan-Chi Chang, Li-Jie Yu, Shih-Zong Syu, Jain-Jhong Wong	Leaching of Scrap Silicon Wafer by Nitric Acid	Da-Yeh University	Taiwan
SC 5	Silvi Octavia, I.D.G. Arsa P., Ronny Purwadi, Tatang H. Soerawidjaja	Determining the Enzyme Accessibility of Pretreated Lignocellulosic Substrates by Simon's Stain Method Compared to Enzymatic Hydrolysis	ITB	Indonesia
SC 6	Supaknapar Rattanagumpol and Thidarat Bunsri	Development of Light Fermentative Biohydrogen Process for Treatment of Starch Wastewater	KMITL	Thailand

Sustainable Sanitation				
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SS 1	Dwipayanti N.M.U, Suandi I.K.R, Akbar, S., Zonni, H.	The Implementation of Community Led Total Sanitation in Muntigunung, Tianyar Barat Village, Karangasem-Bali	Udayana University	Indonesia
SS 2	Adithyanti Febriana, Prayatni Soewondo, Marisa Handajani, Mayrina Firdayati	Effect of Glucose Addition on Lactofermentation Process in Faeces Treatement Based on Terra Preta Sanitation System Concept	ITB	Indonesia

Sustainable Waste Management				
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SW 1	Vu Duc Thao, Cao Xuan Mai, Vu Kiem Thuy, Ta Quang Tuyen Hung	Testing Adsorption Capacity of Rice Husk Carbon Produced by a New Method	HUST	Vietnam
SW 2	Aye Aye Thant	Analysis of Solid Waste Composition and Disposal Systems for Mandalay City, Myanmar	Mandalay Technological University	Myanmar
SW 3	Jonathan Rivera Dungca, Faustino J., Misa J. F., Napa R. D., Ramos D.J.R	Triaxial Shear Strength of Fly Ash and Bottom Ash as Structural Fill	DSLU	Philippines
SW 4	Maria Antonia Tanchuling, Augustus Resurreccion, Leah Diola, Camille Morales, Adrian Patacsil, Manuel Sy, Christine Razon, Stephanie Bundoc	Assessing the Solid Waste Management System of the University of the Philippines Diliman	UP	Philippines
SW 5	Le Van Khoa, Tran Minh Chi, Pham Minh Chi	Assessment of E-Waste Collection Model in Ho Chi Minh City	HCMUT	Vietnam
SW 6	El Khobar M. Nazech, Irma Gusniani S., Aisha Sean J.	Study on Soil-Compost Mixture to Cover Landfill	Universitas Indonesia	Indonesia
SW 7	Dissayapong Hoksuwan, Nattawin Chawaloesphonsiya, Patiparn Panyapalakul, Pisut Painmanakul	Effect of Various Operating Conditions on Preliminary Treatment of Waste Containing Aluminium Dross	CU	Philippines
SW 8	Reo Audi & Emenda Sembiring	Effect of Provision of Shopping Bag and Information on Plastic Bag Waste Reduction in Bandung City	ITB	Indonesia
SW 9	Emenda Sembiring, Listra Endenta Sitorus	The Effect of Compost Application on Soil Organic Carbon and CO2 emission	ITB	Indonesia
SW 10	Vivi Novianti, Devi N. Choesin, Didik Suprayogo, Djoko T. Iskandar, Huzen Suryawardana	Accelerating Primary Succession on Coal Mine Overburden Dumping Sites in Satui, South Kalimantan, Indonesia: Plants Species Selection and Growth Performance	ITB	Indonesia

Green House Gases Emission Reduction Potential through Wastewater Utilization in Bioethanol Industry

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Abstract. Bioethanol industry was developed to support renewable energy development. In other side, bioethanol industry has also potential to emit green house gases from their wastewater. Wastewater treatment in bioethanol industry used a conventional biological anaerobic process in an open lagoon that emitted methane to the atmosphere. Methane capturing and utilization as a renewable energy reduced green house gases emission. The objective of this study was to calculate the green house gasses emission reduction from wastewater treatment in bioethanol industries using cassava and molasses as raw materials. Complete Mixed Stirrer Tank Reactors with 50-litre working volume were used to evaluate the COD removal and biogas production potential from vinasse (wastewater from molasses based bioethanol) and thinslop (wastewater from cassava-based bioethanol). The averages of COD removal were 84,55% and 74,11%, respectively for vinasse and thinslop. Biogas production potentials from vinasse and thinslop were 542,12 m^3/kL ethanol and 105,86 m^3/kL ethanol, respectively. Methane concentration in the biogas was practically same for both wastewaters, namely 57,34% for vinasse and 57,0% for thinslop. The biogas from vinasse and thinslop treatment potentially reduces green house gases emission about 4,19 ton CO_2e/kL etanol and 0,82 ton CO_2e/kL etanol, respectively. Biogas utilization to replace coal in ethanol industry reduced GHG emission into 0,213 ton CO_2e/kL ethanol and minus 0,81 ton CO_2e/kL ethanol for cassava-based and molasses-based, respectively.

Keywords: *bioethanol wastewater, biogas,emission, methane, and green house gases.*

1 Introduction

According to UNFCCC (United Nations Framework Convention on Climate Change), there are six greenhouse gases (GHGs) important to be considered including carbon dioxide (CO_2), dinitro oxide (N_2O), methane (CH_4), sulphurhexafloride (SF6), perflourocarbons (PFCs), and hydroflourocarbons (HFCs) [1]. Main source of GHG emission is fossil fuels combustion. Recently, emission of these gases is of interest due to their relation to global warming effect. Accumulation of these gases in the atmosphere acts as a green house that is allowing short waves from solar radiation but becomes a barrier for long waves reflected from earth surfaces. As a consequence, temperature of the earth is increasing globally (just like interior temperature of a car parked in open yard at a sunny day). Therefore, emission of GHGs should be reduced.

As told by the Second National Communication [2], total GHG emission from Indonesia was 1,38 Gton CO_2e and 11% from it was released from waste. Indonesia has targeted to reduce the emission by 41% with increasing CO_2 absorption capacity by reforestation program, deforestation reduction, peat land management, mix energy program, and waste management. The last was performed with 3R (reuse, reduce, and recycle) principle. Waste becomes important source of GHG emission because it produces CH_4 during its anaerobic decomposition. Global Warming Potential (GWP) or global warming index of CH_4 is 21 meaning that every unit of CH_4 will affect 21 times as much effect of CO_2. Methane has contributed to GHG effect of around 15-20%. On the other side, CH_4 has a great economic value due to its energy value that can be used as a renewable fuel. One of important methane sources is wastewater from many agriculture-based industries, including bioethanol industry.

Bioethanol industry was developed to support renewable energy development. To produce ethanol, the industry used either cassava or molasses feedstock. Bioethanol industry has potential to emit GHG from their wastewater. Every liter of ethanol being produced, 17-25 liter of wastewater is released. Wastewater treatment using a conventional biological anaerobic process in open lagoons emits methane to the atmosphere. This becomes environment problem if wastewater is improperly treated [3]. Generally speaking, agro-based industries use a lot of water for production process and therefore they also release a lot of wastewater [4]

Wastewater from bioethanol industry has a great potential to lower environment quality and to hassle biological ecosystem. This is caused by high COD value of the wastewater. Thinslop, that is wastewater generated by cassava-based bioethanol industry, has a chemical oxygen demand (COD) of around 35.000-50.000 ppm [5]. Using molasses as raw material, bioethanol industry produces wastewater, called vinasse, having Biochemical Oxygen Demand (BOD) of around 35.000-50.000 mg/L and COD of around 100.000-150.000 mg/L [6]. High COD value of vinasse and thinslop implicate high content of organic matter in the wastewater which is good source of carbon. In the anaerobic pond, organic compound will be decomposed into CH_4 and CO_2 that can be recognized with the decrease in COD value of wastewater.

This research was point out to evaluate the GHG emission reduction potential of wastewater treatment while producing biogas in bioethanol industry. The research was also intended to investigate the possibility of using biogas digester as a mean to mitigate GHG emission in bioethanol industry.

2 Materials and Methods

Thinslop and vinasse were received from PT. Medco Ethanol Lampung, an ethanol producer operated at North Lampung. The wastewaters were characterized by their pH and COD (chemical oxygen demand) values. The COD measurement was based on the SNI number 06-6989.2-2004. A stainless steel vessel of 50 L capacity equipped with a stirrer was used as anaerobic reactor to study COD removal and biogas production using different substrates: thinslop and vinasse.

Sludge of wastewater as much of 14,5 L was introduced into the vessel. Adaptation stage was performed by removing 1 L of wastewater in the vessel and replacing it with a new one. This was performed daily till the pH has already stable at 6,5-7,5. Methane forming is initiated by organic acids production. The acids tend to increase acidity of the substrate (lower the pH value). Methanogenic bacteria are highly sensitive to the pH changes and the optimum pH for the growth of methanogenic bacteria is aroud 6-8 [7]. For experiment using vinasse substrate, COD load was 2,0 g/L per day. However, to avoid shocks, the addition of wastewater was started from COD load of 0,5 g/L per day for a week and increased by 0,5 increment each week till COD load was 2,0 g/L per day. From this time forward, new substrate was added at an equal quantity to the substrate removing from the reactor. Similar experiment was performed using thinslop substrate.

Temperature of anaerobic process was measured daily. The same was done for pH measurement of spent sludge. COD measurement of spent substrate was done every another day. Gas analysis was performed every week. Methane fraction in the biogas analyzed using gas chromatograph (GC Shimadzu 2014) with TCD detector and Shincarbon column (ST 50-80 D-1794). Biogas production was estimated from methane fraction [CH_4] using the following equation:

$$\text{Biogas} = \frac{0{,}35 \times \text{COD}_r}{[\text{CH}_4]} \tag{1}$$

where biogas production was presented in m^3, COD_r is COD removal; 0,35 is a conversion factor of CH_4 yield (m^3) per kg of COD removal [8].

Green house gas reduction potential (REP) of CH_4 was calculated as the following:

$$REP = BP - PE \qquad (2)$$

where BP is baseline emission, that is emission value without utilization, and PE is project emission, that is emission value with utilization. Baseline emission (in CO_2e) is equivalent to emission potential of CH_4. The value of PE was calculated assuming that emission during anaerobic digester project is 10% [1].

3 Results and Discussion

Table 1 showed wastewater characteristic using in our experiment. Even though there was no significant difference of pH value, a big different of COD value of the substrates was observed. Vinasse had a COD value of 105.000 mg/L, much higher as compared to 28.233 mg/L for thinslop. This implicated a high content of organic matter in the vinasse.

Table 1 Wastewater characteristic based on feedstock type used in bioethanol industry.

Feedstock (Wastewater)	pH	COD (mg/L)
Cassava (Thinslop)	4,30-4,80	28.233
Molasses (Vinasse)	4,99-5,00	105.000

During experiment it was observed that outlet temperature was 28,5 ^oC and outlet pH was 7,53 using thinslop substrate. Using vinasse substrate, outlet temperature was 27 ^oC and outlet pH was 7,60. This condition was favorable for methanogenic bacteria which grow up best in the range of 25-40 ^oC and pH of 7-8.

Figure 1 showed the COD value of inlet and outlet of wastewater, both for thinslop and vinasse. Whilst, Figure 2 revealed COD load and COD removal during experiment, both using thinslop and vinasse. Chemical oxygen demand is defined as a quantity of oxygen required in order organic matter in the wastewater is oxidized chemically. The main products of fermentation process (acetate, hydrogen, and carbon dioxide) are precursor for methane formation. Vinasse was thicker with COD value of much higher than thinslop and therefore is more difficult to decompose. The COD outlet vinasse substrate was relatively high, 36.883 mg/L. At COD load of 2 g/L.day, average COD removal for vinasse was 1,48 g/L.day or 74,11%. High content of organic matter decreased the effectiveness of microorganism to degrade organic compound in the wastewater. On the contrary, COD value for thinslop outlet was 4.362 mg/L.

Average COD removal for thinslop substrate was 0,596 g/L.day or 84,55% at COD load of 0,706 g/L.day. The different of COD removal was also influenced by COD load. High COD value combined with high COD load of vinasse has resulted in a slightly lower COD removal as compared to those of thinslop. In both cases, optimum condition for anaerobic fermentation was achieved.

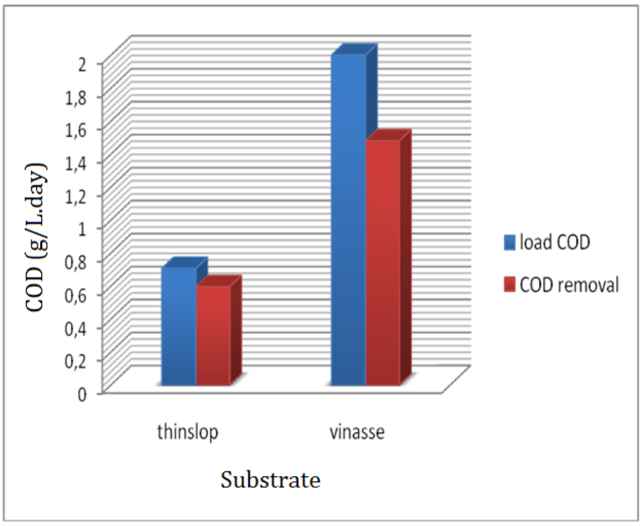

Figure 1 COD load and COD removal (g/L.day) for thinslop (0,706 and 0,596) and vinasse (2,00 and 1,48).

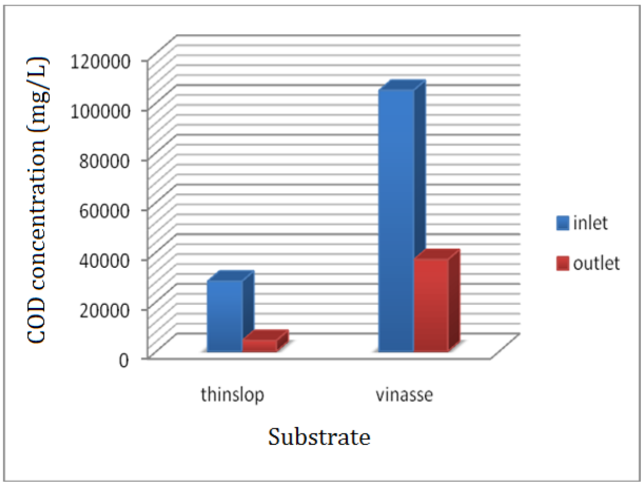

Figure 2 Average COD value (mg/L) of thinslop and vinasse at the inlet and outlet of wastewater treatment.

3.1 Emission Reduction Potential

Emission reduction potential was calculated based on bioethanol industry working at a capacity of 180 KLPD (kilo liter per day) of ethanol. This industry may use cassava tuber at a rate of 1.200 ton/day or molasses, by product from sugar industry, at a rate of 700 ton/day [5]. It was observed that producing 1 kL ethanol required 6,48 ton of cassava tuber with 7,22 m^3 thinslop, or 3,89 ton of molasses with 11,40 m^3 vinasse. Table 2 demonstrated emission potential at bioethanol industry based on feedstock used. The first choice will generate 1.300 m^3 thinslop daily with COD load of 36.703 kg/day. Using COD removal of 84,4% and a factor of 0,35 m^3 CH_4 per kg COD removal, this thinslop is possible to produce CH_4 at a rate of 10.861 m^3/day or 60,34 m^3/kL of ethanol. The second option generates 2.053 m^3 vinasse with COD load of 215.565 kg/day having potential to produce CH_4 at a rate of 55.914 m^3/day or 105,86 m^3/kL of ethanol.

Table 2 Calculation for emission potential from thinslop and vinasse treatment at a bioethanol industry with capacity of 180 KLPD.

Description	Unit	Type of wastewater	
		Thinslop	Vinasse
Raw material (feedstock)		Cassava	Molasses
Flow rate	m^3/day	1.300	2.053
COD input	g/L	28,23	105,00
COD load	kg/day	36.703	215.565
COD removal (COD_r)	%	84,55	74,11
	kg/day	31.032	159.755
Conversion factor of COD_r to CH_4 [d)]	m^3 CH_4/kg COD_r	0,35	0,35
CH_4 potential	m^3/day	10.861	55.914
	m^3/kL ethanol	60,34	310,63
CH_4 consentration	%	57,00	57,34
Biogas potential	Nm^3/day	19.055	97.582
	Nm^3/kL ethanol	105,86	542,12
CH_4 mass rate	ton/day	7,76	39,94
GWP CH_4 [e)]		21,00	21,00
Emission potential of CH_4 (BE)	ton CO_2e/day	162,96	838,74
	ton CO_2e/kL ethanol	0,91	4,66
Emission project (PE)	%	10	10
Reduction emission potential (REP)	ton CO_2e/day	146,63	759,95
	ton CO_2e/kL ethanol	0,82	4,19

It was observed that methane concentration was almost same for both substrates, specifically 57% using thinslop and 57,34% using vinasse. This meant that equivalent biogas potentially produced from thinslop and vinasse was respectively 19.055 and 97.582 m^3/day. Our calculation resulted that

GHG emission potential from thinslop and vinasse was 0,91 ton CO_2e/kL ethanol and 4,66 ton CO_2e/kL ethanol, respectively. It was surmised that producing bioethanol from molasses potentially emit GHG 5,14 times as much of those from cassava (Figure 3).

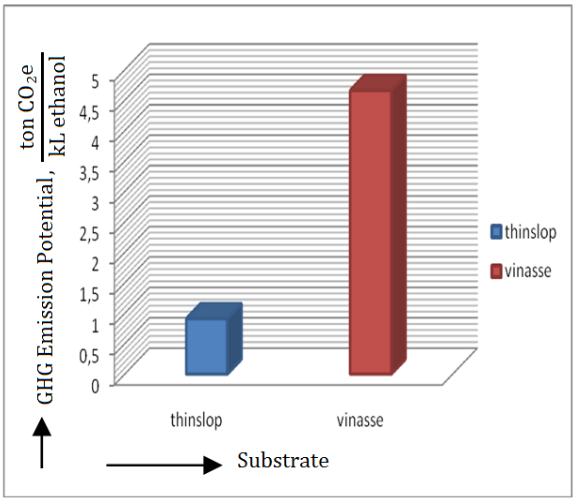

Figure 3 GHG potential emission (ton CO_2e/kL ethanol) from thinslop and vinasse treatment.

Project emission for anaerobic digester was assumed to be 10% [1]. Based on this assumption, proper thinslop treatment is capable to reduce GHG emission by 146,63 ton CO_2e/day or 0,82 ton CO_2e/kL ethanol in the cassava-based bioethanol industry with a capacity of 180 KLPD. Similarly, vinasse management is potentially reduce GHG emission by 759,95 ton CO_2e/day or 4,19 ton CO_2e/kL ethanol for molasses-based bioethanol industry. It is concluded that wastewater management is significant to reduce GHG emission.

3.2 GHG Emission Reduction in Bioethanol Industry

Generally, bioethanol industry uses coal to generate electricity required in production process. Our observation noted that cassava-based bioethanol industry with 180 KLPD capacity required 3,1 MW electricity power. According to West and Marland [9], emission factor for coal-bsed power plant was 0,282 kg C/kWh or 1,034 kg CO_2e/kWh. Thus, GHG from cassava-based ethanol industry was 76,93 ton CO_2e/day or 0,427 ton CO_2e/kL etanol. One way to reduce GHG emission is treating wastewater to produce biogas and subsequently utilize the biogas as fuel to generate electricity. Based on calculation presented in Table 2, biogas from thinslop treatment was expected to replace coal of about 50% at a conversion efficiency of 35%. This meant GHG emission can be reduced to 38,46 ton CO_2e/day or 0,213 ton CO_2e/kL ethanol.

Producing ethanol from molasses required little lower energy, that was 2,1 MW for the same capacity. Similar calculation was performed for molasses-based ethanol industry. The results revealed that GHG emission was 52,10 ton CO_2e/day or 0,289 ton CO_2e/kL ethanol. The biogas potential from vinase, however, was higher and able to excess power of 5,87 MW. Hence, the utilization of biogas in the industry can entirely replace coal. The excess power potentially reduce GHG emission into minus 145,70 ton CO_2e/day or minus 0,81 ton CO_2e/kL ethanol (Figure 4).

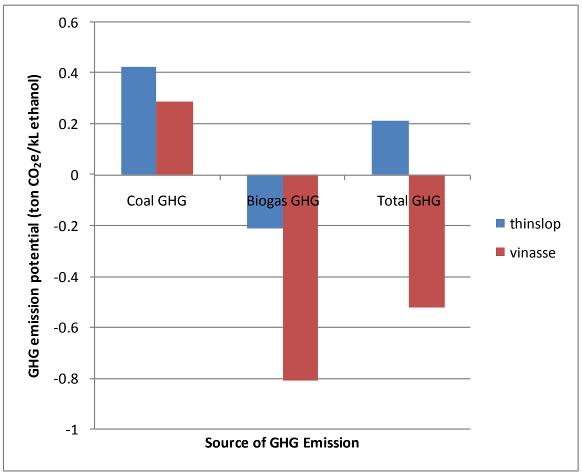

Figure 4 GHG emission comparison between cassava- and molasses-based ethanol industry.

Molasses-based ethanol industry required less power for production process than that of cassava-based one. Furthermore, utilization of vinasse to produce biogas had a great potential as renewable fuel and for reducing GHG emission. From this point of view, molasses-based ethanol industry was more attractive than cassava-based one.

4 Conclusion

1. GHG emission potential from wastewater treatment in bioethanol industry was 4,19 ton CO_2e/kL ethanol with molasses feedstock and 0,82 ton CO_2e/kL ethanol with cassava feedstock.

2. Wastewater utilization to produce biogas as renewable fuel to replace coal in ethanol industry reduced GHG emission into 0,213 ton CO_2e/kL ethanol and minus 0,81 ton CO_2e/kL ethanol for cassava-based and molasses-based, respectively.

5 Acknowledgements

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Peat Water Management				
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