E3S Web of Conferences • *Open Access* • Volume 148 • 5 February 2020 • Article number 01005 • 6th Environmental Technology and Management Conference, ETMC 2019 • Bali • 5 November 2019through 7 November 2019 • Code 115111

Document type
Conference Paper • *Gold Open Access*

Source type
Conference Proceedings

ISSN
25550403

DOI
10.1051/e3sconf/202014801005

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The potential of semi-permeable bentonite and zeolite composite on the reduction of Pb (II) concentration in landfill

Arief Budihardjo, Mochamad ; Zaman, Badrus; Bagus Priyambada, Ika; Ramadani, Dona; Rizky Rizaldianto, Alfian

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[a] Department of Environmental Engineering, Faculty of Engineering, Diponegoro University, Semarang, Indonesia

Abstract

An alternative material that could be used as a liner, which can avert the heavy metal migration from

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Title: The 6th Environmental Technology and Management Conference (ETMC) in conjunction with The 12th AUN/SEED-Net Regional Conference on Environmental Engineering (RC EnVE) 2019

Date: 5th-7th November 2019

Place of the Conference: Prime Plaza Hotel, Sanur, Bali, Indonesia

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Date and editor's signature 15 Jan 2020

Faculty of Civil and Environmental Engineering
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The 6th Environmental Technology and Management Conference

5th – 7th November 2019, Bali – Indonesia

"Towards a Smart and Green Innovations for a Safe, Resilient, and Sustainable Environment"

CONFERENCE SCHEDULE

The 6th Environmental Technology and Management Conference (ETMC 2019)

6th ETMC 2019 Program Schedule

DAY 1 **Tuesday, 5th November 2019**

08.00-09.00	Registration
09.00-09.15	Opening remark (Organizing Committee Chair)
09.15-09.30	Opening remarks from Rector/ Dean
09.30-10.00	Plenary Lecture 1: Minister of Public Work of Indonesia
10.00- 10.30	Plenary Lecture 2: Minister of Environment and Forestry of Indonesia
10.30- 11.00	Coffee break
11.00 – 11.30	Plenary Lecture 3: Prof. S Vigneswaran, UT Sydney, Australia *"Advances in water recycle plants: Our Research on Zero Discharge and Case Studies"*
11.30-12.00	AUN/SEED-Net promotional session
12.00-12.30	ASEAN Engineering Journal promotional session
12.30 -13.30	Lunch and prayer break
13.30-15.30	Parallel paper presentation
15.30-16.00	Coffee Break
16.00-17.00	Parallel paper presentation
19.00-21.00	Welcome Dinner and Cultural Night

DAY 2 **Wednesday, 6th November 2019**

08.30-09.00	Registration
09.00 - 09.30	Plenary Lecture 4: Minister of Energy and Mineral

	Resources
09.30 - 10.00	Plenary Lecture 5: Prof. Yasushi Kiyoki, Keio University, Japan *"5-Dimensional World Map System" For Global Knowledge-Sharing, Integration, Analysis and Visualization Towards Environmental Artificial Intelligence"*
10.00-10.30	Coffee Break
10.30-12.00	Parallel paper presentation
12.00-13.30	Lunch and prayer break
13.30-15.30	Parallel paper presentation
15.30-16.00	Coffee Break
16.00-17.00	Parallel paper presentation
17.00-17.15	Closing remarks

DAY 3 **Thursday, 7th November 2019**

08.00-16.00	Technical Tour

Parallel Session Schedule

DAY 1 **Tuesday, 5th November 2019**

Environment Restoration and Rehabilitation

Time	Kintamani Room
13.30 - 13.50	**Dr. Toshifumi Igarashi** *How Do We Remediate Abandoned Mine Sites?*
13.50 - 14.05	ID289: Nugroho, Fadjari Lucia
14.05 - 14.20	ID301: Iqbal, Rofiq
14.20 - 14.35	ID304: Ho, Gia Duc
14.35 - 14.50	Q & A for session 1
14.50 -15.05	ID309: Ueno, Akio
15.05 - 15.20	ID320: Budiman, Ibnu
15.20 -15.35	ID323: Mentari, Okti Dinasakti Nurul
15.35 - 15.50	Q & A for session 2
15.50 - 16.05	*Coffee Break*
16.05 - 16.20	ID376: Effendi, Agus Jatnika
16.20 - 16.35	ID337: Budianta, Wawan

Time	Kintamani Room
16.35 - 16.50	Q & A for session 3

Disaster Preparedness and Mitigation

Time	Singaraja Room
13.30 – 13.45	ID293: Rahmatika, Nur Ikhsani
13.45 – 14.00	ID312: Nur Azhar, Hanif
14.o0 - 14.15	Q & A for session 1
14.15 - 14.30	ID315: Siev, Sokly
14.3o - 14.45	ID318: Nandar Soe, May Ei
14.45 -15.00	ID372: Ho, Duc-Duy
15.00 - 15.15	Q & A for session 2
15.15 - 15.30	*Coffee Break*

Waste to Energy and Resources

Time	Tabanan Room
13.30 - 13.50	**Prof. Dr. Chart Chiemchaisri** *Mitigation of Fugitive Greenhouse Gas Emission from Municipal Solid Waste Disposal Using Biological Filters with Different Media*
13.50 - 14.05	ID294: Guerrero, Rodel
14.05 - 14.20	ID295: Lukman, Kevin Muhamad
14.20 - 14.35	ID303: Chiemchaisri, Wilai
14.35 - 14.50	Q & A for session 1
14.50 - 15.05	ID308: Caram, Rosabelle Louise Abad
15.05 - 15.20	ID322: Aghnia, Dini Widyani
15.20 - 15.35	ID331: Noor, Rifka
15.35 - 15.50	Q & A for session 2
15.50 - 16.05	*Coffee Break*
16.05 - 16.20	ID433: Dwipayanti, Ni Made Utami
16.20 - 16.35	ID436: Gumilar, Andri
16.35 - 16.50	ID437: Gustiani, Rr Srie
16.50 - 17.05	Q & A for session 7

Climate Change and Global Warming

Time	Amlapura Room
13.30 - 13.50	**Keitaro Tsuji** *Japan's Experience and Solution to Tackle Waste Issue and Climate Change for Indonesia*
13.50 - 14.05	ID291: Huboyo, Haryono Setiyo
14.05 - 14.20	ID317: Arrohman, Maulana Khafid
14.20 - 14.35	ID335: Kadir, Andi Iin Nindy Karlinda
14.35 - 14.50	Q & A for session 1
14.50 -15.05	*Coffee Break*
15.05 - 15.20	ID343: Sipayung, Sinta Berliana
15.20 -15.35	ID344: Susanti, Indah
15.35 - 15.50	ID351: Imami, Ahmad Daudsyah

Time	Amlapura Room
15.50 - 16.05	Q & A for session 2

Green Cities, Eco-Industries, and Sustainable Infrastructure

Time	Bangli Room
13.30 - 13.50	**Dr. Tresna Dermawan Kunaefi**
13.50 - 14.05	ID288: Huy, Nguyen Nhat
14.05 - 14.20	ID298: Putri, Eryanti Utami
14.20 - 14.35	Q & A for session 1
14.35 - 14.50	ID345: Muhammad, Fadel Iqbal
14.50 -15.05	ID352: Kushaflyki, Nabilah
15.05 - 15.20	ID356: Rizaldianto, Alfian Rizky
15.20-15.35	Q & A for session 2
15.35 -15.50	*Coffee Break*
15.50 -16.05	ID358: Wilujeng, Susi A
16.05 - 16.20	ID363: Va, Vandith
16.20- 16.35	ID364: Nguyen, Tan Phong
16.35 - 16.50	Q & A for session 2

Water Resource Conservation

Time	Legian Room
13.30 - 13.50	**Prof. Dr. Hiroyuki Katayama** ***Microbial Safety in Water Reuse***
13.50 - 14.05	ID292: Wiguna Sudiartha, Gede Adi
14.05 - 14.20	ID314: Chawakitchareon, Petchporn
14.20 - 14.35	ID321: Fareza, Achmad Agustian
14.35 - 14.45	Q & A for session 1
14.45 - 15.00	ID326: Ramadan, Attar Hikmahtiar
15.00 - 15.15	ID348: Qadafi, Muammar
15.15 - 15.30	ID426: Jayanti, Merri
15.30 - 15.45	Q & A for session 2
15.45 - 16.00	*Coffee Break*
16.00 - 16.15	ID366: Nurhayati, Siti Ai
16.15 -16.30	ID355: Hendrawan, Diana Irvindiaty
16.30 - 16.45	ID418: Roosmini, Dwina
16.45 - 17.00	Q & A for session 3

Kurita Session

Time	Mangapura Room
13.30 - 13.50	**Prof. Fujie Koichi** *Fundamental Research for the Sustainable Water Use in Development of Southeast Asian Countries*
13.50 - 14.10	**Prof. Dr. Yulinah Trihadiningrum M.App.Sc** *Plastic Pollution in Indonesian Rivers and it's Relevance to Current Solid Waste Management Status*
14.10 - 14.30	**Prof. Dr. Ir. Setijo Bismo, DEA**
14.30 - 14.45	Q & A for session 1

Time	Mangapura Room
14.45 - 15.00	ID 297: Kurniawan Setyo Budi
15.00 - 15.15	ID316: Riani Ayu Lestari
15.15 - 15.30	ID350: Rimba, Andi Beese
15.30 - 15.45	Q & A for session 2
15.45 - 16.00	*Coffee Break*
16.00 - 16.15	ID349: Mase, Lindung Zalbuin
16.15 - 16.30	ID386: Yuliasni, Rustiana
16.30 - 16.45	ID391: Riani Ayu Lestari
16.45-17.00	Q & A for session 3

DAY 2 Wednesday, 6th November 2019

Environment Restoration and Rehabilitation

Time	Kintamani Room
10.30 - 10.50	**Chevron Representative** *Phytoremediation Technology*
10.50 - 11.05	ID338: Darmasetiawan, Martin
11.05 - 11.20	ID339: YOS, Panha
11.20 - 11.35	Q & A for session 1
11.35 - 11.50	ID346: Lussa, Mala Oktaviyana
11.50 - 12.05	ID365: Mastroiani, Lalu Joaqim
12.05 - 12.20	ID327: Prabowo, Himawan Ganjar
12.20 - 12.35	Q & A for session 2
12.35 - 13.30	*Lunch Break + Prayer*
13.30 - 13.50	**Judy Libra** *Closing The Nutrient Loop- Current Trends in Challenges, Policies and Technologies in Agriculture*
13.50 - 14.05	ID390: Ayu Putri, Pradwi Sukma
14.05 - 14.20	ID403: Widyarsana, I Made Wahyu
14.20 - 14.35	ID438: Aminudin, Cecep
14.35 - 14.50	Q & A for session 2
14.50 - 15.05	ID408: Inthaboon, Phonethip
15.05 - 15.20	ID410: Win, Zar Che
15.20 - 15.35	ID419: Elprida, Agustina
15.35 - 15.50	Q & A for session 3
15.50 - 16.05	*Coffee Break*
16.05 - 16.20	ID423: Effendi, Agus Jatnika
16.20 - 16.35	ID428: Crispino, Marwin Giron
16.35 - 17.00	ID429 : Salami, Indah Rachmatiah Siti
17.00 - 17.05	Q & A for session 4

Climate Change and Global Warming

Time	Amlapura Room
10.30 - 10.50	**Prof. Puji Lestari**
10.50 - 11.05	ID422: Tomo, Haryo Satriyo
11.05 - 11.20	ID362: Triani, Meiri

Time	Amlapura Room
11.20 - 11.35	Q & A for session 1
11.35 - 11.50	ID412: Yudison, Adyati P
11.50 - 12.05	ID414: Wasi'ah, Nadiyatur Rahmatikal
12.05-12.20	ID383: Chung Nguyen Thuy
12.20-13.20	*Lunch Break + Prayer*
13.20-13.35	ID416: Seny Damayanti
13.35-13.50	ID351: Sudradjat, Arief
13.50-14.05	Q & A for session 2
14.05-14.20	*Coffee Break*

Disaster Preparedness and Mitigation

Time	Singaraja Room
10.30 - 10.45	ID374: Hendrawan, Vempi Satriya Adi
10.45 - 11.00	ID319: Budiman, Ibnu
11.00 - 11.15	ID360: Sudradjat, Arief
11.15 - 11.30	Q & A for session 1
11.30 - 11.45	ID347: Parura, Tezario Chandra Putra
11.45 - 12.00	ID381: Baldovino, Renann Grandecilla
12.00 – 12.15	Q & A for session 2

Waste to Energy and Resources

Time	Tabanan Room
10.30 - 10.50	**Prof. Enri Damanhuri**
10.50 - 11.05	ID332: Osorio, Ezra Daasin
11.05 - 11.20	ID334: Rakhmadumila, Deby Hajjar
11.20 - 11.35	ID340: Amalia, Rizki
11.35 - 11.50	Q & A for session 1
11.50 - 12.05	ID341:Kamny, Ekanzha R
12.05 - 12.20	ID357: Wirasenjaya, Farah
12.20 - 12.35	ID367: Abarca, Ralf Ruffel Mercado
12.35 - 12.50	Q & A for session 2
12.50 – 13.30	*Lunch Break + Prayer*
13.30 – 13.50	**Chevron Representative** *Hazardous Waste Capping*
13.50 - 14.05	ID370: Wattanachai, Piyachat
14.05 - 14.20	ID380: Bisara, Daniya
14.20 - 14.35	ID 382: Ismail, Guntur Adisurya
14.35 - 14.50	Q & A for session 3
14.50 - 15.05	ID387: Gumilar, Andri
15.05 - 15.20	ID396: Chaerul, Mochammad
15.20 - 15.35	ID421: Yulina, Rizka
15.35 - 15.50	Q & A for session 4
15.50 - 16.05	*Coffee Break*

Green Cities, Eco-Industries, and Sustainable Infrastructure

Time	Bangli Room
10.30 - 10.50	**Astra Representative** *Achieving Environmental Performance Excellence trough Implementation of Astra Green Company System*
10.50 - 11.05	ID368: Gultom, Marchella Christcelia
11.05 - 11.20	ID369: Merliana, Merliana
11.20 - 11.35	Q & A for session 1
11.35 - 11.50	ID378: del Rosario, Jay Robert
11.50 - 12.05	ID385: Zakiyya, Maisa Nida
12.05 - 12.20	ID402: Mayanda, Mentari Rizki
12.20 - 12.35	Q & A for session 2
12.35 - 13.35	*Lunch Break + Prayer*
13.35 - 13.50	ID404: Kusuma, Tetty Andriani
13.50 - 14.05	ID430: Maryati, Sri
14.05 - 14.20	ID413: Macasieb, Reygie
14.20 - 14.35	Q & A for session 3
14.35 - 14.50	*Coffee Break*
14.50 - 15.05	ID415: BUI, Xuan-Thanh
14.50 - 15.05	ID424: Antono, Fajar Eko
15.05 – 15.20	ID406: Zakiyya, Maisa Nida
15.20 – 15.35	Q & A for session 5
15.35 – 15.50	*Coffee Break*

Water Resource Conservation

Time	Legian Room
10.30 - 10.50	**Dr. Maazuza Othman**
10.50 - 11.05	ID354: Hendrawan, Diana Irvindiaty
11.05 - 11.20	ID371: Mori Chiho
11.20 - 11.30	Q & A for session 1
11.30 - 11.45	ID441: Arifianingsih, Nur Novilina
11.45 - 12.05	ID373 : Marselina, Mariana
12.05 – 12.20	ID375: Mushfiroh, Arini
12.20 - 12.35	Q & A for session 2
12.35 - 13.35	*Lunch Break + Prayer*
13.35 - 13.50	ID439: Yani, Sarah Dewi
13.50 - 14.05	ID377: Osae, Kasumi
14.05 - 14.20	ID388: Fahimah, Nurul
14.20 - 14.45	ID392: Hendrawan, Diana Irvindiaty
14.35 - 14.50	Q & A for session 3
14.50 - 15.05	ID409: Hatmoko, Waluyo
15.05 - 15.20	ID359: Clemente, Eligia de la Paz
15.20 - 15.35	ID353: Hendrawan, Diana Irvindiaty
15.35 - 15.50	Q & A for session 4
15.50-16.05	*Coffee Break*

Healthy and Safe Communities

Time	Mangapura Room
10.30 - 10.50	**Dr. Dwina Roosmini**
10.50 - 11.05	ID384: Saptarini, Dian
11.05 - 11.20	ID405: Firdayati, Mayrina
11.20 - 11.30	Q & A for session 1
11.30 - 11.45	ID401: Purba, Indah Yusliga Sari
11.45 - 12.00	ID400: Nastiti, Anindrya
12.00 - 12.15	ID417: Widya Dewi Kusumah, Siska
12.15 - 12.30	Q & A for session 2
12.05 - 12.20	*Lunch Break + Prayer*
12.30 - 13.30	**Dr. Mohan Amarasiri** *Quantification oif Human Health Risks Caused by Antibiotic Resistant Bacteria (ARB) and Antibiotic Resistance Genes (ARG) n Water Environments: Future Research Directions*
13.30 - 13.45	ID425: Oginawati, Katharina
13.45 - 14.00	ID427: Firdayati, Mayrina
14.00 - 14.15	ID440: Kania Dewi
14.15 - 14.30	Q & A for session 3
14.30 - 14.45	*Coffee Break*

PHOTO GALERY

1. Participant Registration.

2. Plenary Session

3. Paralel Session

4. Technical Tour.





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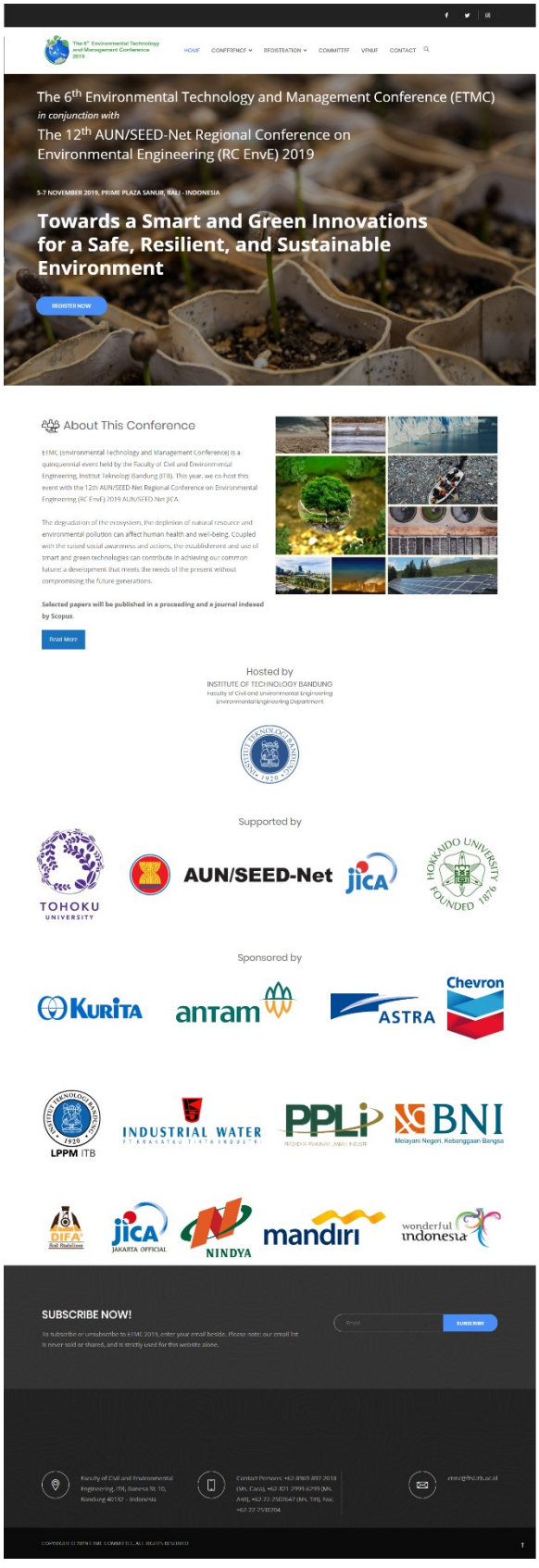

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THE 6TH ENVIRONMENTAL TECHNOLOGY AND MANAGEMENT CONFERENCE (ETMC)

5 – 7 NOVEMBER 2019, PRIME PLAZA SANUR, BALI – INDONESIA

"Towards a Smart and Green Innovations for a Safe, Resilient, and Sustainable Environment"

ETMC is a quinquennial event held by the Faculty of Civil and Environmental Engineering, Institut Teknologi Bandung (ITB). The degradation of the ecosystem, the depletion of natural resource and environmental pollution can affect human health and well-being. Coupled with the raised social awareness and actions, the establishment and use of smart and green technologies can contribute in achieving our common future: a development that meets the needs of the present without compromising the future generations. Selected papers will be published in a proceeding and a journal indexed by Scopus.

Topics

- Green Cities, Eco-Industries, and Sustainable Infrastructure
- Water Resource Conservation
- Waste to Energy and Resources
- Climate Change and Global Warming
- Healthy and Safe Communities
- Environment Restoration and Rehabilitation
- Disaster Preparedness and Mitigation

Important Dates

Deadline for abstract submission	16 June, 2019
Notification of acceptance	25 July, 2019
Deadline for full paper submission	31 August, 2019
Deadline for registration payment (for presenters)	31 August, 2019
Deadline for final full paper submission	27 October, 2019
Conference dates	5-6 November, 2019
Welcome and cultural dinner	5 November, 2019
Technical tour	7 November, 2019

Registration Fee

UNTIL 1 AUGUST, 2019

Local Participants	IDR 1,500,000
Foreign Participants	USD 450

AFTER 1 AUGUST, 2019

Local Participants	IDR 2,000,000
Foreign Participants	USD 500

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Faculty of Civil and Environmental Engineering
Institut Teknologi Bandung

The 6th ETMC

INSTITUTE OF TECHNOLOGY BANDUNG
Faculty of Civil and Environmental Engineering
Environmental Engineering Department

Environmental Technology and Management Conference

in conjunction with The 12th AUN/SEED-Net Regional Conference on Environmental Engineering (RC EnvE) 2019

5 - 7 November 2019, Prime Plaza Hotel, Sanur - Bali, Indonesia

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Volume 148 (2020)

The 6th Environmental Technology and Management Conference (ETMC) in conjunction with The 12th AUN/SEED-Net Regional Conference on Environmental Engineering (RC EnvE) 2019

Bali, Indonesia, November 5-7, 2019

A. Soleh Setiyawan, H. Dwi Ariesyady, A. Nastiti, D. Roosmini and M. Sonny Abfertiawan (Eds.)

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Preface from the Dean 00001

Ir. Ade Sjafruddin

Published online: 05 February 2020

DOI: https://doi.org/10.1051/e3sconf/202014800001

PDF (115.0 KB) | NASA ADS Abstract Service

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Opening Address from the Chairman 00002

Ir. Mindriany Syafila MS

Published online: 05 February 2020

DOI: https://doi.org/10.1051/e3sconf/202014800002

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- Green Cities, Eco Industries, and Sustainable Infrastructure

OK

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Effect of recirculation ratio on the performance of modified septic tank in treating office building wastewater 01001

Vandith Va, Ahmad Soleh Setiyawan, Prayatni Soewondo and Dyah Wulandari Putri

Published online: 05 February 2020

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PDF (1.541 MB) | References | NASA ADS Abstract Service

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The diversity of active microbial groups in an activated sludge process treating painting process wastewater 01002

Herto Dwi Ariesyady, Mentari Rizki Mayanda and Tsukasa Ito

Published online: 05 February 2020

DOI: https://doi.org/10.1051/e3sconf/202014801002

Open Access

The effect of artificial support material existence on removal of organic and nutrient in laboratory scale using plug flow reactor (PFR) 01003

Sarah Aphirta, Prayatni Soewondo, Nida Maisa Zakiyya, Dyah Wulandari Putri and Barti Setiani Muntalif

Published online: 05 February 2020

DOI: https://doi.org/10.1051/e3sconf/202014801003

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Published online: 05 February 2020

DOI: https://doi.org/10.1051/e3sconf/202014801004

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The potential of semi-permeable bentonite and zeolite composite on the reduction of Pb (II) concentration in landfill 01005

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Published online: 05 February 2020

DOI: https://doi.org/10.1051/e3sconf/202014801005

PDF (1.458 MB) | References | NASA ADS Abstract Service

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DOI: https://doi.org/10.1051/e3sconf/202014805005

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Published online: 05 February 2020

DOI: https://doi.org/10.1051/e3sconf/202014805006

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Zar Che Win, Leslie Joy L. Diaz, Teresita R. Perez and Kiyohiko Nakasaki

Published online: 05 February 2020

DOI: https://doi.org/10.1051/e3sconf/202014805007

OK

PDF (1.674 MB) | References | NASA ADS Abstract Service

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Okti Dinasakti Nurul Mentari, Qomarudin Helmy and Edwan Kardena

Published online: 05 February 2020

DOI: https://doi.org/10.1051/e3sconf/202014805008

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Initial study of the *Coix lachryma-jobi* application in reducing algal growth in eutrophic lake 05009

Rofiq Iqbal, Teddy Tedjakusuma and Dhimas Dwinandha

The potential of semi-permeable bentonite and zeolite composite on the reduction of Pb (II) concentration in landfill

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Abstract. An alternative material that could be used as a liner, which can avert the heavy metal migration from landfill to soil, is the combination between bentonite and zeolite. This study aims to analyze the Pb^{2+} adsorption capacity of the liner and permeability of bentonite with the addition of zeolite in several percentages. There were four different types of composite in the experiment, such as pure bentonite (BZ0), bentonite + zeolite 2% (BZ2), bentonite + zeolite 5% (BZ5), and bentonite + zeolite 8% (BZ8). Bentonite and zeolite composite was inserted into a cylindrical reactor, which was compacted to adjust the condition of the study to be similar with existing condition in the landfill. This study was conducted until the leachate produced and lead concentration was tested using samples from the liner and leachate in the outlet. The results showed that the highest efficiency of lead reduction was obtained from BZ8 with the percentage of 95.2%, while the highest permeability coefficient was found in BZ8 with the value of 7.76 x 10^{-11} cm/s. The addition of zeolite has been proven to be able to reduce the lead concentration of leachate, but it increased the possibility of leakage.

1 Introduction

In urban waste management, landfilling is a method that is commonly used as a place for the final processing of waste. However, there is a very important environmental problem to consider, namely the presence of leachate. Leachate is formed due to the process of decomposition of waste, which is supported by the presence percolation and infiltration of rainwater through the waste [1]. Landfill leachate is a complex pollutant that has a high concentration of dissolved organic matter [2]. In the leachate, there are various materials that are harmful to the environment, such as phenols, aromatic compounds, ammonium, and heavy metals [3].

Heavy metal contamination illustrates that serious environmental pollution is happening. One of heavy metal that its negative impact on the environment has been well known is lead, which has a high toxicity level and is difficult to process [4], [5]. In addition, lead also causes impacts on humans, such as internal organ damage, behavioral disorders, mental disorders, cancer, and nerve damage [6]–[8]. Therefore, it is necessary to have a semi-permeable layer that is able to hold the leachate so that it cannot escape and prevent environmental pollution [9].

There are various materials that can be used as landfill liners which have a function as barriers to hold leachate out of landfill cells into the surrounding environment. One of commonly used material as a landfill liner is compacted clay, because of its abundant availability and low price [10]–[12]. Compacted clay is able to remove lead (Pb^{2+}) in an adsorption process due to the presence of negative ions contained in it [13]. Bentonite, which is included in compacted clay, is often chosen because it has high porosity, high cation exchange capacity, large surface area, and small particle size so that it can adsorb more pollutants [14]–[17]. Bentonite can be found in both natural and sedimentary soils [18]. Bentonite mainly consists of montmorillonite, with an arrangement of two tetrahedral sheets from SiO4 which coincide with an octahedral sheet of Al^{3+} (Fe^{2+}/Mg^{2+}) [10], [19]. However, there are some problems with the use of pure bentonite as a liner, such as shrinkage and low shear stability [20], [21].

Zeolite is a material that can be used to improve the shear stability of a liner due to the nature of zeolite as a soil stabilizer. In its use, zeolite is widely used in construction activities. The presence of crystalline in zeolite is able to adsorb various particles that have smaller size than its diameter [21]. Zeolite can also increase the adsorption capacity of the liner because zeolite has a cation exchange capacity of 200 to 400 meq/100 grams, which is almost the same as the capacity possessed by bentonite [22]–[24]. Removal of various heavy metal compounds such as lead, cadmium, zinc, and manganese can be accommodated by using adsorbents from zeolite. However, zeolite has disadvantages because it can increase the permeability of

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The diversity of active microbial groups in an activated sludge process treating painting process wastewater

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Abstract. Activated sludge process is one of the wastewater treatment method that is applied for many wastewater types including painting process wastewater of automotive industry. This wastewater is well-known to have high heavy metals concentration which could deteriorate water environment if appropriate performance of the wastewater treatment could not be achieved. In this study, we monitored microbial community diversity in a Painting Biological Treatment (PBT) system. We applied a combination of cultivation and genotypic biological methods based on 16S rRNA gene sequence analysis to identify the diversity of active microbial community. The results showed that active microbes that could grow in this activated sludge system were dominated by Gram-negative bacteria. Based on 16S rRNA gene sequencing analysis, it was revealed that their microbial diversity has close association with Bacterium strain E286, *Isosphaera pallida*, *Lycinibacillus fusiformis*, *Microbacterium* sp., *Orchobactrum* sp., *Pseudomonas guariconensis*, *Pseudomonas* sp. strain MR84, *Pseudomonas* sp. MC 54, *Serpens* sp., *Stenotrophomonas acidaminiphila*, and *Xylella fastidiosa* with similarity of 86 – 99%. This findings reflects that microbial community in a Painting Biological Treatment (PBT) system using activated sludge process could adapt with xenobiotics in the wastewater and has a wide range of diversity indicating a complex metabolism mechanism in the treatment process.

1 INTRODUCTION

Every production process carried out by industry produces wastes that require further processing thus they cannot be directly discharged into the environment. These wastes were resulted from the production process as well as waste treatment process. The industrial waste must be treated before being discharged into the environment to prevent environmental pollution, one of which can be due to the presence of heavy metal content. The heavy metal is not biodegradable and tends to accumulate in the environment and cause diseases and other disorders, even though it could be treated by microalgae absorption [1, 2].

One of the wastewater treatment is biological treatment by indigenous bacteria that are environmentally friendly. This treatment configuration will be more effective, inexpensive and sustainable compared to conventional (physico-chemical) methods [3]. In addition, biological methods can also be an attractive choice for conserving water usage through treatment of water produced from wastewater [4].

The activated sludge method is an aerobic biological treatment by taking advantage of a suspended microbial ecosystem. Simphiwe *et al*. (2012) showed that the use of bacteria in the processing of industrial wastewater can be an alternative waste treatment that is more economical and effective in removing dyes, but the efficiency of removing dyes also depends on the type of dye, pH, temperature, and flocculant concentration [5]. This is in line with Mahmood *et al*. (2012) mentioned that the effectiveness of processing using this treatment method depends on three variables, namely: the substrate contained in the waste, the bacterial species, and the environment in which the bacteria live [3].

The object of this study was a biological wastewater treatment system of a metal painting facility owned by a shock-absorber manufacturing industry that generates wastewater consisting paint residues containing heavy metals. This biological wastewater treatment system consists of a Painting Biological Treatment (PBT) unit operating activated sludge treatment process. This PBT unit was constructed not only to treat wastewater, but also to conserve water use by reusing treated wastewater for water curtain system in capturing excess of paint during the painting process.

The PBT unit uses bacteria consortium as biodegraders. This bacteria consortium originated from five seeding tanks. Each of the tanks consists of specific bacteria which has been isolated and cultivated previously [6, 7, 8]. This specific bacteria is augmented to the PBT unit occasionally based on its performance. Another study showed the best composition of that bacteria consortium that needs to be augmented to the PBT unit based on different types of paint used which contains different pigments, binders, extenders, solvents and additives [8].

According to those studies, it could be recognized

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Estimating Energy Consumption and Cost for the Electrocoagulation of Arsenic-laden Water (ECAR) Using Iron Electrodes

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Abstract. In some areas in Pampanga, arsenic concentration from handpumps reaches up to 300 µg/L, 10 times higher than the safe limit for drinking water. An efficient way of reducing elevated arsenic concentration is through electrocoagulation (EC) process with the use of iron electrodes. However due to several factors, the efficiency of the technique is decreased. This study focuses on determining the energy consumption and cost through time. The cost per cycle was estimated through the power consumption and projecting its growth with time. One 600 L cycle costs around $0.60 to $1.10 which is approximately $0.001 to $0.002 per liter of water. This value increases through each cycle until half of the electrode is consumed (500 cycles) and is to be replaced. The current processing time was set at 30 mins, charge dosage of 150 C/L, applied current of 16.67 mA, and an electrode area of 6.6 cm2. One factor examined which may have caused the increase is the formation of passivation layer on the electrode surface. It was described using linear sweep voltammetry (LSV) and Tafel extrapolation method. The resistance due to charge transfer was determined to be increasing per cycle.

1 Introduction

In 2014 the Department of Health, in coordination with the Dutch Risk Reduction team, reported that Pampanga groundwater has elevated arsenic concentrations. The problem seems to be rampant particularly in certain areas in Lubao, with arsenic concentration reaching up to 300 µg/L–30 times higher than the Philippine National Standards for Drinking Water for arsenic [1].

Arsenic is a naturally occurring element and can contaminate water and soil and one possible reason for the contamination in Pampanga area is due to the Mt. Pinatubo eruption in 1991. Arsenic is a carcinogenic chemical and chronic exposure can eventually damage one's internal organs and cause skin diseases [2,3].

Seven out of nine drinking water samples from households of index cases have elevated arsenic concentrations between 10-600 µg/L from drinking water tests conducted in December 2014. Half the population of Lubao still uses handpump wells. From 2010 to 2014, 215 residents from 5 barangays in Lubao had consulted with similar dermatological symptoms, due to chronic exposure to. the contaminated water. Some dermatologic symptoms are skin discoloration, skin rashes, lesions, etc [1].

Rural Bangladesh experiences the same situation, but arsenic levels were effectively reduced in the area using electrocoagulation process, from 100- 500 µg/L arsenic to below the maximum limit of 10 µg/L recommended by the World Health Organization [4,5]. Electrocoagulation is an electricity-based treatment method wherein a sacrificial iron electrode is slowly electrochemically dissolved in arsenic-laden water [6]. Electrolytic dissolution of Iron (Fe-ED) is driven by applied current to the sacrificial iron anode as shown in Figure 1. The amount of electrons taking part in the process can be controlled based on the Faraday's Law, enabling the calculation of the iron dose from the applied current [7]. It is feasible due to its low treatment costs that offsets the maintenance, operation, and capital costs of an electricity source (usually small scale such as photovoltaics or battery packs).

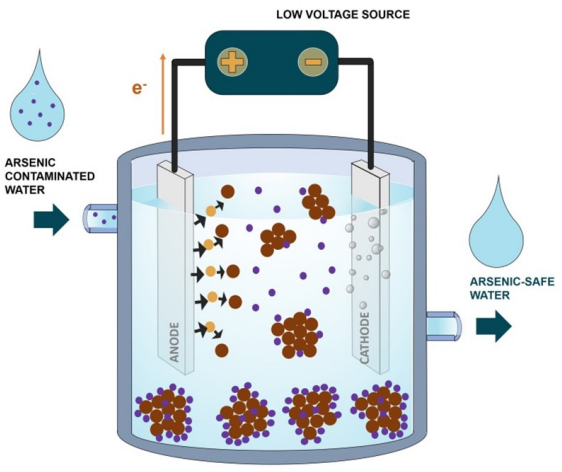

Fig. 1. Electrocoagulation process of arsenic-laden water

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Phytoremediation of Heavy metal Contaminated Wastes from Small-scale Gold Mining Using *Pityrogramma calomelanos*

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Abstract. In this study, viability of employing the waste treatment technique for industrial application was conducted by setting up a phytoremediation protocol for field application where heavy metal (Arsenic and Copper) contaminated adsorbents, i.e. coco peat and nanofiber membrane, used for the treatment of wastewater were also included. An arsenic hyperaccumulator, *Pityrogramma calomelanos* was used for the treatment of mine wastes- tailings, coco peat and nanofiber membrane. Phytoremediation procedure was established by investigating planting parameters namely ; plot height - (9 cm and 15 cm) and planting distance- (15 cm and 20 cm) for a period of five months. Translocation factor and % uptake of As and Cu by ferns were measured. According to the results, % uptake of As and Cu by *P. Calomelanos* was 0.16 % and 0.01 % and translocation factor of As and Cu was 6.78 and 0.04, respectively. Plant growth factors (root length, frond height and dry weight) in tailings mixture plant boxes and control soil were also determined. Accordingly, *P. calomelanos* grew well in tailings mixture without the symptom of phytotoxicity. Therefore, *P. calomelanos* can be used for the phytoremediation of the said heavy metal contaminated mine wastes. Based on this study, 15 cm plot height and 20 cm plant distance were suitable for field experiment although long term research data is required. The overall protocol for the treatment of mine wastes as field experiment was proposed based on the results.

1.Introduction

Mining for valuable metals, coal, and different wares shapes a significant piece of the economies of numerous nations [1]. The major environmental impact from waste transfer at mine site can be separated into two classes: the loss of productive land following its change to a waste stockpiling zone, and the presentation of silt, corrosiveness, and different contaminants into surrounding surface and groundwater from water running over uncovered dangerous or chemically reactive wastes [2]. The Philippines is considered as one of the profoundly mineralized nations per unit area of land. Mining activities are collected in Baguio Mining District, Benguet, Luzon where metallic reserves, for example, gold, silver, and copper are the biggest in the country [3]. Gold is the third most significant product in the Philippine export trade done by both small scale or large scale industry. Comparison of the mining technology of large-scale miners to small-scale miners, small- scale mining technologies leaves undeveloped and inefficient for the production and minimizing the environmental and health impacts because of lack of capital cost [4]. The small-scale gold processing place for this research released mining wastes (solid wastes-tailings and liquid waste-effluents). Mine tailings were stabilized in the tailings pond. Coco peat and polycaprolactone montmorillonite (PCL-MMT) nanofiber composite were utilized as adsorbents for the treatment of mining wastewater [5]. At a certain point, the spent adsorbent- coco peat and nanofiber membrane with heavy metals have to be properly disposed to minimize impacts on the surrounding environment. The estimated amount of mine tailing, coco-peat and nanofiber membrane produced per treatment are 3-4 tons, 25 kg and 20 g respectively.

Mining, producing, and the utilization of synthetic products (for example pesticides, paints, batteries, industrial waste, and land application of industrial or domestic sludge) can bring about heavy metal

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