CUSME 2020

2020 International Conference on Urban Sustainability, Environment, and Engineering

Urban Life and Technology

Program Book

20-21 January 2020,

Prime Plaza Hotel Sanur

Bali - Indonesia

Universitas Pembangunan Jaya

RISTEKDIKTI

UNIVERSITI TEKNOLOGI MARA

CONFERENCE BACKGROUND

The Institute of Research and Community Service (*Lembaga Penelitian dan Pengabdian Masyarakat – LP2M*), Universitas Pembangunan Jaya (UPJ) is proud to extend her promotion of research and education in the field of Urban Studies, Technology and Environment. The 2020 International Conference on Urban Sustainability, Environment, and Engineering (CUSME 2020) with the theme '**Urban Life and Technology**' will be the first series based on the conference involves the cooperation of Naresuan University Thailand, Universiti Teknologi MARA (UiTM) Perak Branch, Malaysia, and Udayana University, Indonesia.

CUSME 2020 aims to address the current issue of urban sustainability, environment and engineering, and will provide a forum for the exchange of latest technical information, the dissemination of the high-quality research, the presentation of the new developments in the area of urban studies and technology, and the discussion and shaping of future directions and priorities for better environment, sustainable development and sustainable technologies. The development of sustainable urban is a necessity where megatrends 2030 triggered by the Industrial Revolution 4.0 estimates urbanization will increase sharply, especially in Asia. City authorities must make appropriate policy choices to protect the provision of equitable housing, health, and transportation services in the future.

The conference outcome will support the government policy, stake holder, and scientists by bringing together researchers in the fields of sciences, technology and related fields internationally to present their research findings as well as create opportunities for more research collaborations by joining this conference. We are soliciting original papers describing the state-of-the-art research and development inclusive (but are not limited to) of the following technical areas: *Green Technology, Sustainable Development, Urban Sustainability, Management and Tourism, and Others.*

In the context of academics, the above issue will be primarily devoted to urban studies and contain the papers presented at this particular meeting. To document research findings and ideas, we are very pleased to inform that the accepted papers of CUSME 2020 will be published to one of the following category.

1. Journal of *Geographia Technica (SCOPUS – Q3),* ISSN 2065-4421 (Online) and DOI: 10.21163 with a special issue "***Physical and Technical Geography Issues in Urbanism***".
2. Book Chapter by Nova Science Publishers, New York, USA. The book will be titled **"Urban Development and Lifestyle"**.

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FOREWORD BY CHAIRMAN OF CUSME 2020

Dear Distinguished Guests, Speakers and Participants,

On behalf of the *Lembaga Penelitian dan Pengabdian Masyarakat* (LP2M), Universitas Pembangunan Jaya (UPJ), and conference committee members, we cordially welcome you to the 2020 International Conference on Urban Sustainability, Environment, and Engineering (CUSME 2020). We are very pleased with the positive responses to our invitation from various local and international research institutions. Enthusiasm is shown by the increasing participation from inside and outside the country, giving us confirmation that what we started is a big step in the right direction.

This is the first series of conference organized by LP2M UPJ in collaboration with Naresuan University Thailand, Universiti Teknologi MARA (UiTM) Perak Branch, Malaysia and Udayana University, Indonesia. The conference with the theme **'Urban Life and Technology'** serves as a platform for academicians, researchers, practitioners and students to present their current findings and perform discussion on the recent advancement in addressing various issues faced by urban phenomena, climate change, man-made activities, and the political will run by the authorities along with the major role of scientist to contribute to the urban sustainable development as well as providing opportunities for more research collaborations. In addition, the conference will include five keynote speeches by leading expert.

Most of all, we wish to express our deepest gratitude and appreciation to the management and staff of UPJ, the organizing committee members, our three co-organizers, our keynote speakers and reviewers for their support and relentless effort in ensuring the success of this conference. We would also like to extend our heartwarming gratitude to all authors and participants for participating in CUSME 2020. Without you and your support, this conference would not be possible.

Through this conference, it became our greatest wish that we all be inspired to keep striving for the better and to continue improving ourselves in the journey towards success. With this, we hope you have an exciting time and we wish you a fruitful conference.

Wayan Suparta, Ph.D.
General Chair of CUSME 2020
Universitas Pembangunan Jaya
Tangerang Selatan, Indonesia

ORGANIZING COMMITTEE

Advisor	Ir. Edmund Sutisna, MBA (*President of Universitas Pembangunan Jaya*) Leenawaty Limantara, Ph.D. (*Rector of Universitas Pembangunan Jaya*)
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IT/Webmaster	Hendi Hermawan

KEYNOTE 1

Prof. Ir. Frederik Josep Putuhena M.Sc., Ph.D.
Center for Urban Studies – Universitas Pembangunan Jaya

With his background education in Civil Engineering from Indonesia, UK, and USA, he has been working for Urban and Rural Development Programmes in Indonesia, as well as in Malaysia. His entire working experienced has been gained through the capacity development activities, either as academician or professional. His early contribution was as a trainer in the field of Hydrological Survey and Analysis, for Provincial Irrigation Planners in Indonesia. This rural irrigation development was designed to achieve the self food sufficiency of rice, which was successfully achieved by Indonesia in the 1980s. These activities brought him to become the Coordinator of Central Project Office for Capacity Building in Water Resources Sector Development in Indonesia in the late 1990s, and early 2000s. In Malaysia, he gave lectures in Civil Engineering undergraduate studies, as well as supervising graduate research for Master and Doctoral degree programmes. His research and public service contributions in Malaysia covered the following: The Capacity Building in newly established Rural Water Supply Department in Sarawak; Integrated River Basin Development, which include Hydraulic Modeling, and Participatory Approach for people in rural areas to participate in Hydropower, and other Water Infrastructure projects; and River System Modeling for Flood Control Projects in Urban areas. His tract records could be traced in all articles in the Indexed Journals, which were authored by himself, or together with his graduate students.

URBAN WATER DEMAND MANAGEMENT FOR SUSTAINABLE ALLOCATION OF THE AVAILABLE WATER AMONGST THE WATER USERS

Abstract

The amount of available water is finite, including its distribution along the year. As Indonesia is located at the equator, it has two seasons, dry and wet season. Due to the water demand that almost constant throughout the year, the available water during dry season would be critical. Dry season would be the time where Water Demand Management would be justified. Justification amongst the water users would be verified through the implementation of Integrated Water Resources Management. The challenge for IWRM is to maintain the delicate balance between water for livelihood, and water as a resource. In which, the overall objective of WDM is to increase the efficiency of water consumption to serve a larger part of water users, and to encourage sustainable economic production. The urban water users would include domestic, industrial, urban farming, and commercial uses. And the sustainable Service Provision would be reached if water continues to be available for the design period of a scheme, programme, or initiative in the quantity, quality, time, and location that was originally design. Series of the performance indicators are discussed, and the progress of implementing WDM in the cities in Indonesia would be presented.

KEYNOTE 2

Associate Prof. Dr. Dinesh Manandhar
Center for Spatial Information Science (CSIS), The University of Tokyo, Japan

He is an Associate Professor (Project) at The University of Tokyo, Japan and Adjunct Associate Professor at AIT, Thailand. Currently, he is developing GPS/GNSS signal authentication based on Japanese GPS satellites. He is also developing systems based on GPS signal authentication for traffic congestion management and illegal fishing management. His research fields are GPS/GNSS signal design, signal analysis, spoofing studies, anti-spoofing, and signal authentication solutions. He also conducting of trainings, seminars, and workshops in many countries to promote GNSS technologies and its applications.

GATE-LESS GATES: SOLUTION FOR TOLLING AND TRAFFIC CONGESTION MANAGEMENT

Abstract

We are proposing a tolling and traffic congestion management system called "Gate-Less Gates" based on a GPS device fixed to a vehicle. Since, a GPS device is used to monitor a vehicle's road-usage information, a physical toll gate is not required. Thus, it can be implemented on any road. The system will monitor vehicle traffic in real time for traffic congestion management. The traffic congestion management includes dynamic road pricing and rewarding system. This system will advise the drivers to take alternate routes or use alternate mode of public transports by rewarding them if they opt to these solutions. The system will charge the drivers for using congested roads during the peak hours. The charging is based on dynamic road pricing that calculates the fees based on traffic congestion, time, distance, vehicle type and number of persons on a vehicle. Since, the system is based on a GPS device, a lane-based charging or rewarding system can also be implemented. GPS devices with special signals like MADOCA or other signal processing techniques (RTK, PPP/AR etc.) are capable of providing about 30cm accuracy that is required for lane-level positioning. The use of this system will also assist in parking management, driving behavior monitoring, data for analyzing accidents, MaaS (mobility as a service) and as a back-bone towards intelligent transport system (ITS). Thus, this system will be the most practical solution for tolling and traffic congestion management for cities that are marred by traffic congestions.

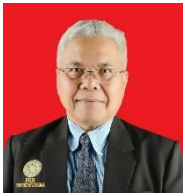
KEYNOTE 3

Dr. Md Firoz Khan
Senior Lecturer in the Department of Chemistry, University of Malaya, Malaysia

During his academic career, he has been working as a post-doctoral research at the University of Tokyo, Japan from 2010-2011. Then, he joined the Centre for Tropical Climate Change System at the Universiti Kebangsaan Malaysia, as a senior lecturer and attained the position till November 2018. He has been serving as an Associate Editor to two Web of Science indexed journals, Elementa: Science of the Anthropocene and Arabian Journal of Geosciences (Springer). His research interests cover a wide variety of topics in air pollution, source apportionment and human health impact of the pollutants. He is an author of more than 70 high impact peer-reviewed journal papers and book chapters. Currently, he leads a research group focusing on air pollution with a number of students at undergraduate, postgraduate and Ph.D. level.

A DECADAL TREND OF URBAN POLLUTION: CHALLENGES TOWARDS SUSTAINABLE SMART CITIES IN MALAYSIA

KEYNOTE 4



Prof. Dr. Wayan Gede Supartha, SE., SU.
Coordinator of Doctor Programme Study in Management Science, Udayana University

His Bachelor of Management education was completed in 1979 at the Faculty of Economics and Business, Udayana University. In 1984, he graduated with a Masters in Management from Gadjah Mada University. He earned a Doctorate in Management in 2006 from the Airlangga University Postgraduate Program. He has experience as a lecturer since 1980 until now. In addition, he has experience as a Consultant in Regional Water Supply Company, Bali Urban Infrastructure Program (BUIP) 1992-1995, Revenue Action Plan (RIAP) for District Government in Bali, in 1995-1998, Research on General Investment Development Plan in Bali Province in 2005, Research on Investment Potential in East Bali in 2007, Expert Team of Jembrana DPRD in 2010 - 2019, Chairperson of the Additional Assessment Team, employee based on performance E-performance 2017 - 2019, Author of Organizational Culture Book in 2008 and Organizational Behavior Book 2016.

CULTURE, TOURISM MANAGEMENT, AND SUSTAINABILITY

Abstract

This paper discussed cultural, tourism management and sustainable development. Organizational culture is the essence of community culture that is applied to an organization. Likewise, work culture is the essence of organizational culture in carrying out work. So that in tourism management, community culture is an important element that must be used as a basis for promoting tourism, especially for inclusive tourism. With the digital era, all tourism stakeholders should utilize digital technology to provide satisfaction and preserve resources, both natural and artificial resources.

KEYNOTE 5

Wendy Haryanto
CEO Jakarta Preoperty Institute, Indonesia

Having spent twenty over years in the Property industry, Wendy believes that this is just about the right time to giving back to her birthplace. Before assuming the position of Executive Director of Jakarta Property Institute (JPI) she was the Chief Operating Director of Mix-Use Development of apartment, office buildings and malls. Prior to her position as Chief Operating Director, Wendy Haryanto was the Director and Head of the Department of Procon/Savills Indonesia and the PIC of all development aspects including investor relations, market segmentation, and master planning.

PUBLIC AND PRIVATE PARTNERSHIPS FOR A BETTER JAKARTA

Abstract

Partnerships between the public sector and the property industry are more urgent than ever to overcome Jakarta's pressing issues. Beyond shaping Jakarta's urban environment, it is important to emphasize the industry's prominent role in the city's economy: it accounts for 19% of GDP; 42% of foreign direct investment; 14% of employment. Needless to say, the health of the industry depends upon the prosperity of the city and its residents. Housing affordability, traffic congestion, walkability and open green space are the concerns of the industry's players as much as policy makers. Key to finding solutions are active partnerships. In what forms do these partnerships take? Is it dialogue and policy consultation? Or business contracts such as PPP schemes to build infrastructure? Or private subsidies for public projects and their execution? And where does Jakarta stand now?

CONFERENCE SCHEDULE

Monday, 20 January 2020	
Time	**Event**
7.00 – 8.00	Registration
8.00 – 8.30	**Welcome Remarks** Wayan Suparta, Ph.D *General Chair of CUSME 2020* *Director of the Institute of Research and Community Service (LP2M) UPJ*
	Cultural performance (Denpasar room - Hall)
8.30 – 10.00	Prof. Ir. Frederik J. Putuhena M.Sc., Ph.D Associate Prof. Dr. Dinesh Manandhar Dr. Md. Firoz Khan Prof. Dr. Wayan Gede Supartha, SE., SU. Wendy Haryanto
10.00 – 10.15	**Coffee Break**
10.15– 12.00	Parallel Session 1A (Denpasar room - Hall) Parallel Session 1B (Kintamani room) Parallel Session 1C (Legian room) Parallel Session 1D (Bedugul room)
12.00 – 13.00	**Lunch (Sanur Harum Restaurant)**
13.00 – 13.45	Parallel Session 2A (Denpasar room - Hall) Parallel Session 2B (Kintamani room) Parallel Session 2C (Legian room) Parallel Session 2D (Bedugul room)
14.45 – 14.50	**Coffee Break**
14.50 – 16.30	Parallel Session 3A (Denpasar room - Hall) Parallel Session 3B (Kintamani room) Parallel Session 3C (Legian room) Parallel Session 3D (Bedugul room)
16.30 – 17.00	**Poster Session** (Denpasar room - Hall) **Closing & Awards** (Denpasar room - Hall)
Tuesday, 21 January 2020	
08.00 – 16.00	Excursion to Ubud
End of Conference	

TECHNICAL SESSION

Monday, 20 January 2020

Time	Event	
08.30-10.00	**Plenary (Denpasar room - Hall)**	
	1.	**Prof. Ir. Frederik Josep Putuhena M.Sc., Ph.D** Urban Water Demand Management for Sustainable Allocation of the Available Water amongs the Water Users
	2.	**Associate Prof. Dr. Dinesh Manandhar** Gate-less Gates: Solution for Tolling and Trafic Congestion Management
	3.	**Dr. Md Firoz Khan** A Decadal Trend of Urban Pollution: Challenges Towards Sustainable Smart Cities in Malaysia
	4.	**Prof. Dr. Wayan Gede Supartha, SE., SU.** Culture, Tourism Management, and Sustainability
	5.	**Wendy Haryanto** Public and private partnerships for a better Jakarta
10.00-10.15	**Coffee break**	
10.15-12.00	**Parallel Session 1A (Denpasar room - Hall)**	
	P013	**Kartina Alauddin, Halmi Zainol and Mohd Sabrizaa Abd Rashid** Integrating Of Knowledge Transfer Components In Decision Making Process For Adaptive Reuse Of Historical Buildings
	P033	**Fadhlizil Fariz Abdul Munir, Asniza Hamimi Abdul Tharim, Asmalia Che Ahmad, Nur'Ain Ismail and Noraidawati Jaafar** Association Between Thermal Comfort Condition And Worshippers' Satisfaction In Timber And Concrete Mosques
	P034	**Panu Putthawong and Suthat Yiemwattana** The Multi-Function Green Roof: A Case Study Of Uhi Mitigation From Usis Building, Phitsanulok, Thailand
	P036	**Adnin Syaza Jaafar, Yuhainis Abdul Talib and Muhammad Anas Othman** The Effect Of Green Elements On Means Of Escape In Green Building-Adapted Hospital
	P043	**Norhazlan Haron, Halmi Zainol and Wan Rabiah Wan Omar** The Neighborhood Effect On Cycling Behavior In Residential Areas
	P052	**Floriberta Binarti, Pranowo Pranowo and Soesilo Budi Leksono** Microclimate Models To Predict The Contribution Of Facade Materials To The Canopy Layer Heat Island In Hot-Humid Areas
	P056	**Harrini Mutiara Hapsari Wahyu, Rizka Drastiani, Sri Lilianti Komariah** Amphibious Architecture: An Alternative Floodproof Design For Urban Flood Mitigation In Palembang, Indonesia

Time	Event	
	P172	**Sarah Luziani and Beta Paramita** Sefaira And Autodesk Formit360 As Energy Based Building Simulation Applications For Architecture Student
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	P024	**Purnawan Purnawan and Widia Safira** The Important Factors For Sustainable Padang - Pariaman Train Operation
	P026	**Andy Malik, Roos Akbar, Sri Maryati and Petrus Indradjati** The Relationship Between Proximity And Security Perception In Encouragement Of Park Use: Case Study Of Kalbu Palem Park (Bandung, Indonesia)
	P050	**Hedista Rani Pranata, Dalhar Susanto and Toga H. Panjaitan** Towards Sustainable Food Landscape: Generating And Protecting Spatial Context
	P057	**Siti Akhtar Mahayuddin, Wan Akmal Zahri Wan Zaharuddin and Muhammad Redza Rosman** Documentation On The Construction Of The Traditional Orang Asli Houses
	P105	**Revy Safitri and Ririn Amelia** The Relation Pedestrian Age And Gender To Walkability In Commercial Area Of Pangkalpinang City
	P107	**Hetti Rahmawati, Siti Sendari and Yuni Rahmawati** Ecological Behavior Model : Explained By Rational And Moral Perspective
	P148	**Kushairi Rashid, Kamarul'Ain Kamal and Aizazi Lutfi Ahmad** Embracing Communicative Planning Through Technology Application By Malaysia Planning Agencies
	P171	**Munir, Beta Paramita, Robby Anggara and Lala Septem Riza** Geographic Information System On Mapping Dissemination And Prediction Of Population In Bandung City
10.15-12.00	**Parallel Session 1C (Legian room)**	
	P054	**Heti Herastuti and Siwi Hardiastuti Endang Kawuryan** The Effect Of Stem Cutting Type And Plastic-Covered On Bougainvillea Growth In The Green Open Space
	P061	**Endah Wahyurini** Propagation Of Arrowroot Plants In Vitro For The Agroforestry Environment Development
	P062	**Lelanti Peniwiratri and Dyah Arbiwati** Potential Of Kirinyuh (Chromolaenaodorata) And Cow Fertilizer To Increase The Nitrogen Uptake Of Tomato (Lycopersicumesculentum L.) On Sandy Beach Soil
	P080	**Tuti Setyaningrum and Dyah Arbiwati** The Role Of Guano Phosphate In Improving The Quality Of Compost From Waste Of Household And Mushroom Media In Supporting The Zero Waste Concept

Time	Event	
	P082	**Tutut Wirawati, Heti Herastuti and Husain Kasim** Increasing The Performance Of Bougainvillea With Top Grafting Model For The Green Line In Urban Environment
	P099	**Sumarwoto and Sugeng Priyanto** The Efforts To Improve The Quality Of Growing Bulbil Iles-Iles (Amorphophallus Muelleri Blume) With Oligo Chitosan Immersion
	P164	**I Made Diarta and Luh Komang Merawati** The Effect Of Efishery And Probiotic Dosage On Growth Rate And Survival Of Tilapia
	P165	**Ni Made Trigunasih and Putu Perdana Kusuma Wiguna** Land Suitability For Rice Field And Conservation Planning In Ho Watershed, Tabanan Regency, Bali Province, Indonesia
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	P014	**Khairina Natsir, Agus Zainul Arifin and Made Setini** The Influence Of Income And Financial Literacy On Financial Satisfaction Through Financial Behavior As Mediation Variable
	P022	**Syafieq Fahlevi Almassawa and Baharuddin Saga** Population Movement, Transportation Mode And Economic Relationship, South Tangerang City With Surrounding Areas
	P030	**Kartika Nuringsih and Nuryasman** Propensity For Sustainable Entrepreneurship: The Perceived Among Owners Of Mses At Small County In Yogyakarta, Indonesia
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12.00 - 13.00	**Lunch (Sanur Harum Restaurant)**	

Time	Event	
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	P041	**Nur'Ain Ismail, Tengku Nur Hazleen Tengku Abdul Aziz, Noraini Md Zain, Mohammad Nasharudine Shuib and Mohd Nasurudin Hasbullah** Consultant'S Roles In Minimizing The Occurrence Of Variation Order
	P043	**Chanrachna Nou and Sasima Charoenkit** The Potential Of Green Infrastructure (Gi) For Reducing Stormwater Runoff In A Phnom Penh Neighborhood
	P046	**Asniza Hamimi Abdul Tharim, Fadhlizil Fariz Abdul Munir, Farid Al Hakeem Yuserrie, Ahmad Faiz Hassan Naziri, Sayed Muhammad Aiman Sayed Abdul Khair and Zaiwannizar Zainal Abidin** Facade Influence On Indoor Environment Quality (Ieq) In Green Building Index (Gbi) Rated Office Buildings: A Correlation Analysis
	P060	**Syamim Jaafar, Nor Aini Salleh, Mohd Zaki Arif and Suwaibatul Islamiyah Abdullah Sani** An Empirical Investigation On The Relationship Between Property Manager'S Competencies And Property Management Performance In Green Certified Office Buildings
	P077	**Nur Ainaa Azmi, Haryati Isa, Siti Rasidah Sakip and Puteri Rohani** The Significance On The Compliances Of Person With Disabilities (Pwds) Facilities Towards Social Sustainability (Socsas)
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	P159	**Ayu Kurnia Permatasari, Teguh Hariyanto and Muhammad Taufik** Total Suspended Solid (Tss) Distribution Mapping Using Satellite Images And In Situ Data (Case Study : Porong River Estuary, Sidoarjo)
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	P002	**Wayan Suparta, Resdiansyah, Safitri Jaya** Application Of Anfis Technique For Prediction Of Rainfall In The South Tangerang City
	P020	**Ben Rahman** Prediction Text Mining For Market Segment Based On Twitter Data Using Method Time Series
	P023	**Bina Restituta Barus, Moch Zulfikar Eka Prayoga, Feri Karuana and Wardah Kaddihani** Evaluation Of Biodiesel Blends Properties During The Fuel Handling In Mining Sector
	P040	**Jeri Tangalajuk Siang, Jeremias Leda and Firdaus Chaeruddin** Physical Properties Analysis Of Environmentally Friendly Refrigerant On The Convective Heat Transfer Coefficient

Time	Event	
	P116	**Herawati Rubiana, Mochammad Chaeron and Apriani Soepardi** The Application Practice Of Solar Energy Generation In Indonesia'S Textile Industry
	P118	**Adi Surjosatyo, Muammar Muammar and Hafif Dafiqurrohman** Influence Of Co-Combustion Biomass Pellet Using Coconut Shell And Rice Husk On Bed Agglomeration And Temperature In Bubbling Fluidized Bed Furnace
	P167	**Jirawadee Polprasert, Sarawut Wattanawongpitak, Suchart Yammen and Titipong Samakpong** Study On Microgrid Technology And Development In Thailand
13.00 - 14.45	**Parallel Session 2C (Legian room)**	
	P001	**Pornnapa Sutawong, Det Wattanachaiyingcharoen, Norihiro Itsubo and Ksemson Suvannarat** The Risks To Human Health And Environmental Impacts From Community E-Waste Separation.
	P018	**Sylvan Odidi, Sarintip Tantanee, Korakod Nusit and Panu Buranajarukorn** Factors Influencing The Uptake Of Flood Mitigation Measured In Budalangi, Kenya
	P029	**Nur Amierah Harun, Asmalia Che Ahmad, Faridah Ismail and Siti Akhtar Mahayuddin** The Barriers In Implementing Construction Waste In Secondary Market
	P031	**Halmi Zainol, Kartina Alaudin, Marlyana Azyyati Marzukhi, Nur Huzeima Mohd Hussain, Shafa Marzidah Abdullah Ayeop, Mohd Sabri Mohd Arip and Norhazlan Haron** The Green Garden Contributory Components In Emerging Community Engagement For Dwelling Residents
	P063	**Norizan Mt Akhir, Siti Rasidah Md Sakip, Mohamed Yusoff Abbas and Noriah Othman** Determination Of Landscape Aesthetic Value In Developing Questionnaire Survey For Campus Planting Composition
	P076	**Aphantree Yuttaphan, Sombat Chuenchooklin and Somchai Baimoung** Meteorological Drought Index For The Northern Part Of Thailand
	P088	**Mohamad Haizam Mohamed Saraf, Sayed Muhammad Aiman Sayed Abul Khair, Thuraiya Mohd, Asniza Hamimi Abdul Tharim and Farid Al Hakeem Yuserrie** Grab Bag Flood Survival Kits For Flood Victims In Kuala Krai, Kelantan
	P160	**R.M. Rustamaji, Gusti Hardiansyah, Resdiansyah Resdiansyah, Nurhayati and Ivan Sujana** Preventing Disaster Climate Change: Utilization Of Bio-Waste For Canal Blocking In Peat Ecosystem
13.00 - 14.45	**Parallel Session 2D (Bedugul room)**	

Time	Event	
	P009	**Ismail Alif Siregar** Introducing Steam (Science Technology Engineering Arts And Math) Through Creative Exercise To Stimulate A Child'S Creativity And Motoric Senses In An Urban Environment
	P044	**Noraidawati Jaffar, Nur'Ain Ismail, Asniza Hamimi Abdul Tharim, Nurul Huda Muhammad, Norbaizura Abu Bakar and Siti Nurhayati Hussin** Students' Perception Towards Gamification Learning For Civil Engineering Works Measurement
	P048	**Puteri Rohani Megat-Abdul-Rahim, Sheema Liza Idris, Mahfuzah Rafek and Noraziah Azizan** The Pedagogical Challenges In Using Iot Among English Language Teaching Practitioners
	P081	**Dorjderem Buyantur, Phisut Apichayakul, Panu Buranajarukorn and Sarintip Tantanee** Disaster Mitigation For Urban School Using A Game-Based Approach
	P096	**Naurissa Biasini, Emma Rachmawati and Yosaphat Danis Murtiharso** Mapping The Digital Political Communication For Millenials
	P097	**Suci Marini Novianty and Emma Rachmawati** Case Study Of Urban Baby Boomer In Hoax Messages Distribution Through Whatsapp Aplication In Indonesia
	P139	**Reni Dyanasari, Fasya Syifa Mutma and Melisa Arisanty** Communication For Risk Reduction In Natural Disaster (Case Study: National Disaster Management Authority - Indonesia)
14.45 - 14.50	**Coffee Break**	
14.50 -16.30	**Parallel Session 3A (Denpasar room - Hall)**	
	P055	**Tamara F. Kamanga, Sarintip Tantanee, Faidess D. Mwale and Panu Buranajarukorn** A Multi Hazard Perspective In Flood And Drought
	P084	**Suon Tokla and Kumpon Subsomboon** Integration Of Building Information Model (Bim) And Thailand'S Governmental Cost Estimate
	P098	**Haris Prasanchum, Panuthat Sirisook and Worapong Lohpaisankrit** Flood Risk Areas Simulation Using Swat And Gumbel Distribution Method In Yang Catchment, Northeast Thailand
	P100	**Kusa Bill Noni Nope, Putu Alit Suthanaya, Dewa Made Priyantha Wedagama and I Nyoman Yudha Astana** The Jakarta Tod Model Application For Typology Of Middle Cities (Applied Research Design In Kupang City)
	P152	**Ani Hastuti Arthasari** Identification Of Transitional Space And Activity Space On Linear Urban Space (Case Study: Di. Panjaitan Street And Kh. Ali Maksum Street)

Time	Event	
	P163	**Marelianda Al Dianty, Rizka Arbaningrum and Frederik Putuhena** The Effect Of Climate Change In Determining Design Flood Of Tenggang River
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	P032	**Septiana Hariyani, Eddi Basuki Kurniawan, Fadly Usman and Fadhilatus Shoimah** Iot (Internet Of Things) For Participatory Planning And Sustainable Of City Planning
	P064	**Danang Yudhiantoro, Rifki Indra Perwira and Endah Wahyurini** Fuzzy Time Series To Predict The Volume Of Yield Of Arrowroot
	P085	**Nur Uddin** A Low Cost Wifi-Robot: Design And Implementation
	P102	**Johannes Siregar and Augury El Rayeb** Smartlab: Application Design For Supporting Studentsâ€™ Collaborative Work In Laboratory
	P110	**Linda Marlinda, Supriadi Rustad, Ruri Sukobasuki, Fikri Budiman and Muhamad Fatchan** Matching Images Using The Surf Method On The Face Of A Buddha Statue
	P132	**Ade Asmi, Aurino Djamaris and Mohammad Ihsan** Project Delay Factor Ranking Analysis Among Contractor, Client And Project Management Consultant In Construction Industry
	P161	**Resdiansyah Resdiansyah, Prio Handoko and Desi Dwi Kristanto** Speed Alert Mobile With Smart Message Sign: A Prototype Device For Speed Compliance
	P162	**Santi Widiastuti and Jennie Kusumaningrum** Modification Of Atrium Design To Improve Thermal Performance And As An Environment Noise Control
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	P012	**Putri Suryandari** Environmental Sensitive Design At Beleq Gumantar Village, Lombok East Nusatenggara, Indonesia
	P019	**Supawan Srirattana** Using Of Aermod Dispersion Model To Access The Influence Of Sulfur Dioxide Emitted From Hongsa Coal-Fired Power Plant Transboundary To Chaloem Phra Kiat District, Nan Province, Thailand
	P038	**Eseosa Ighile and Hiroaki Shirakawa** A Study On The Effects Of Land Use Change On Flooding Risks In Nigeria
	P058	**Siti Akhtar Mahayuddin, Noor Rizallinda Ishak, Wan Akmal Zahri Wan Zaharuddin and Jannatun Naemah Ismam** Methodology For Assessment Of Green Practices In Reuse And Recycling Of Domestic Solid Waste In Malaysia

Time	Event	
	P069	**Weerayuth Pratoomchai, Sarintip Tantanee and Chaiwat Ekkawatpanit** A Comprehensive Grid-Based Rainfall Characteristics In The Central Plain River Basin Of Thailand
	P094	**Charatdao Kongmuang, Sarintip Tantanee and Kamonchat Seejata** Urban Flood Hazard Map Using Gis Of Muang Sukhothai District, Thailand
	P130	**Ratnawati, Singgih Hartanto, Yuli Amalia Husnil and Christin Ratri** Synthesis Cds/Pt-Tio2 With Enhanced Its Performance For Photocatalytic Degradation Of Palm Wastewater Treatment
	P158	**Eidayu Rosli and Dr.Sapura Binti Mohamad** Landscape Typology Of Agriculture Terraces System On Slopeland In Cameron Highlands
14.50 -16.30	**Parallel Session 3D (Bedugul room)**	
	P066	**Antok Setiawan Jodi, Bagus Kusuma Putra and Surya Prayoga** Promotion And Brand Trust In Affecting Repurchase Intention On E-Commerce (Study On Go-Jek Application)
	P070	**Hastuti Naibaho and Yohanes Totok Suyoto** The Urgency Of Transforming Sales Strategy In Modern Markets Indonesia
	P073	**A.A Gde Satia Utama and Tjiptohadi Sawarjuwono** Agricultural Irrigation Information System (Subak 4.0): Creating Sustainable Culture In Bali Based On Tri Hita Karana
	P075	**Irma Paramita Sofia, Sila Ninin Wisnantiasri and Rizfy Aulia Putri** The Effect Of Environmental Accounting And Fundamental Factors On Company Value
	P124	**David Pangaribuan Pangaribuan and Fitriyah Nurhidayah Nurhidayah** Internal Control System And Coreporate Governance Functionality To Fraud Detection And Prevention
	P126	**Yanuar Yanuar and Eliza Phuanerys** Factors Affecting Indonesian General Sharia Bank Based On Its Performance
	P144	**Halmi Zainol, Abdul Malek A Tambi, Nor Eeda Ali, Kartina Alauddin and Hazirah Azami** Cross-Cultural Work Acclimation Of Malaysian Expatriates In Construction Industry: A Proposed Model
	P147	**Sanata Prayojana, Wibowo and R Madhakomala** The Effect Of Locus Of Control, Role Ambiguity, Leadership And Empowerment On The Performance Of Employee In The State Ministry For Cooperatives Small And Medium Enterprise (Smes), Indonesia
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	P025	**Rini Andari, I Wayan Gede Supartha, Gede Riana and Tjokorda Gde Raka Sukawati** Indigenious People, Culture, And Traditions: A Catalyst For Ecotourism Development In West Java
	P027	**Teddy Darajat** Bamboo Construction Strengthening Techniques With Metal Materials In The Furniture Industry
	P028	**Kwang Hwan Choi, Fatkhur Rokhman, Hwiung Choi, Jung In Yoon and Chang Hyo Son** Research On Thermal Performance Between Side And Water Side At New Dual-Source Flat Plate Solar Collector
	P049	**Fitrianty Wardhani and Samsul Bahri** Comparative Study Of The Patterns And Characteristics Urban Morphology In The Old City, Case Study Road And Block Patterns Bengkulu And Singapore
	P039	**Muhammad Tony Nawawi and Agus Zainul Arifin** The Impact Of Corporate Social Responsibility Implementation On Construction Firm Value In Indonesia
	P059	**Vivy Kristinae and I Made Wardana** Value Of Innovation: Creative Business Strategy Of Nyatu Rubber Tree In Central Kalimantan?
	P078	**Agnes Gantari, Teguh Hariyanto and Muhammad Taufik** Evaluation Of Distribution Total Suspended Solids (Tss) In East Surabaya Waters With Multitemporal Sentinel-2
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	P092	**Anita Pratiwi, Arie Dipareza Syafei, Abdu Fadli Assomadi, Rachmat Boedisantoso and Joni Hermana** Microplastic Characterization Based On The Number Of Occupants

Time	Event	
✓	P103	**Rurika Widya Ningrum Palureng, Arie Dipareza Syafei, Abdu Fadli Assomadi, Rachmad Boedisantoso and Joni Hermana** The Effect Of Air Quality On The Incidence Of Acute Respiratory Infection (Ari) In Pontianak City
	P106	**Agustira Rahman Ilhami and Evawani Ellisa** Banyuwangi Celebration: How Festival Create Place Making
	P108	**Sila Wisnantiasri, Hendi Hermawan and Reni Dyanasari** Analysis Of Twitter User Prediction Ability In Indonesia Capital Market
	P109	**Ayu Utami, Wibiana Nandari, Ekha Yogafanny, Kristiati E.A., Tedy Cahyadi and Nur Ali Amri** The Efficiency Of Produced Water Treatment Using Combine System Of Coagulation Process And Membrane Bioreactor
	P114	**Chaerul Anwar** Mobile Application Self Reporting Location Of Public Trash Can By Community Base On Geo Location Tag Photo
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	P119	**Mummayyiz Pramono, Hafif Dafiqurrohman, Kania Amelia Safitri, Iwan Setyawan and Adi Surjosatyo** Computational Fluid Simulation Of Self Bed Feedstock In Rice Husk Bubbling Fluidized Bed Gasification

	P119	**Mummayyiz Pramono, Hafif Dafiqurrohman, Kania Amelia Safitri, Iwan Setyawan and Adi Surjosatyo** Computational Fluid Simulation Of Self Bed Feedstock In Rice Husk Bubbling Fluidized Bed Gasification
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	P128	**Bambang Supriyanta, Danar Wicaksono, Oktavia Sarhesti Pratiwi and Muhamad Kundarto** The Screening Of Growth, Crop Component, And Resistance Of Sweet Corn Lines Of Downy Mildew On S-3 Generation
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	P168	**Fitriyah Nurhidayah, Johannes Siregar and Chaerul Anwar** The Sustainable Community Development In Learning Activities For Children At Suburban Area
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The Efficiency of Produced Water Treatment Using Combination of Coagulation Process and Membrane Bioreactor

Ayu UTAMI[1], Wibiana W. NANDARI[2], Ekha YOGAFANNY[1],Kristiati E.A[3], Tedy A. CAHYADI[4], Nur A. AMRI[4]

ABSTRACT:
The oil production was containing a very large amountof produced water, it was about 90% of fluids which brought up to the surface. Produced water contains several impurities which could affect the quality of surface water in the environment. This research was conducted in the conventional oil exploitation method at Wonocolo, Bojonegoro, Indonesia. At this oilfield, before the produced water discharge to the surface water, local people treat the produced water using gravity settling tank. Combine system was used for produced water treatment methodology in this research. The objective of this research was to obtain the efficiency of oilfield produced water treatment technology by conventional technology and membrane bioreactor. Nevertheless, from this research, we could determine how effective the treatment using chemical, physical, biological and ultrafiltration. In each unit operation of the treatment, removal efficiency was calculated. The methodology used in this study to attain the objectives were laboratory experiment using gravity separation, coagulation and flocculation, settling tank, aeration, and reverse osmosis. The total efficiency for the treatment with filter activated sand before ultrafiltration was 90,88% for Chemical Oxygen Demand (COD), 90,84 for Total Dissolved Solid (TDS), 93,33% for Total Suspended Solid (TSS), and 99,7% for turbidity. High removal efficiency result using this technology, it is possible to recycle the produced water as raw water for daily use.

Key-words: *oilfield produced water, produced water treatment, combine system, coagulation process, membrane bioreactor.*

1. INTRODUCTION

In the petroleum industry, produced water was considered as a waste stream and needs to be treated (Nasiri and Jafari, 2017). The oil production, both onshore and offshore, contains a very large amount of produced water. It was about 90% fluids which brought up to the surface (Yang, Zhang and Wang, 2002). Produced water contains several impurities which could affect the quality of surface water (Nadim, 2010). The impurities are oil and grease, salt content (salinity, conductivity, TDS) as primary contaminant and organic and inorganic compounds (J. Veil, M.G. Puder, D. Elcock, 2004). Thus, government has a regulation for produced water disposal and management (Kementrian Lingkungan Hidup, 2010).

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General petroleum industries have many ways to manage produced water, i.e., avoid produced water spill onto surface; injection to the reservoir; discharge into the surface water, reuse as process water or maintenance water; and consume in beneficial use (Arthur *et al.*, 2005). One of the technologies of produced water treatment (PWT) review said that to meet suitable characteristics of effluent, we cannot use single technology. Thus, two or more treatment system should be used in treatment unit series. To choose the best technologies, it depends on the water chemistry, cost effectiveness, space availability, disposal plans, durable operation, and byproducts (Fakhru'l-Razi *et al.*, 2009).

The old oilfield Wonocolo is extracted traditionally by local people. The activities of this traditional oil extraction, have not been equipped properly by produced water treatment process (Yogafanny, 2019). From the previous research, we knew that before the produced water discharge to the surface water, local people treat the produced water using gravity settling tank. Evaluation of gravity settling treatment unit revealed that the efficiency of TDS removal was only 61% while the requirement stated 74%, thus, the produced water would safely discharged (Utami, Sungkowo and Ali, 2017).

Several methods to treat PWT have been studied. Combine system using different technology for treatment such as physical, chemical, and biological methods (Fakhru'l-Razi *et al.*, 2009). Biodiesel wastewater, using coagulation and flocculation with chemical process remove more than 80% of oil and grease, more than 50% of Chemical Oxygen Demand (COD), and around 90% for Suspended Solid (SS) (Daud, Aziz and Latif, 2015). Other research treat artificial bilge water using electrocoagulation could remove around 95% of turbidity and above 95% of oil and grease (La and Rinc, 2014). Thus, one of the methods for this research to remove SS, COD, turbidity, and Total Dissolve Solid (TDS) in the produced water from oil production activity was coagulation and flocculation. The coaggulation in this research was used as pretreatment before membrane bioreactor. From the application of technology, we could compare the efficiency between the conventional and the advanced. If the conventional could highly reduce the contaminant from produced water, it is not required to use the advanced one and applied if the opposite condition appear.

Membrane technologies is one of technology for treating oil contaminated wastewater (Nasiri and Jafari, 2017). Membrane bioreactor is an activated sludge process combine with membrane filtration which can separate liquid and solid instead of settling process (Germany and Moustafa, 2011). One of the advantage using membrane as the treatment for produced water is in this process, the treated water allow to be recycled (Mondal and Wickramasinghe, 2008). The objective of this research was to obtain the efficiency of oilfield produced water treatment technology by conventional technology and membrane bioreactor. Nevertheless, from this research, we could determine how effective the treatment using chemical, physical, biological and an alternative suitable technology for the similar oilfield produced water characteristics with Wonocolo field.

2. MATERIAL AND METHODOLOGY

To conduct this research, it was required to develop several methodologies to get the existing condition of the field. Furthermore, oilfield produced water sample should be taken from the initial source. Thus, the treatment in this research was using fresh oilfield produced water. In order to take the suitable oilfield produced water sample, sampling method was required. The methodologies of taking sample and treat the oilfield produced water is explained below.

2.1. Oilfield Produced Water Sampling

This experiment needs a fresh sample of produced water to be treated. To take the sample of produced water, there were several methods such as field observation and sampling method. The first step of our research was to get the fresh sample of oilfield produced water. Direct observation in the field of oil well is one of the methods we used. The aims of using this method were to perceive the existing condition of the field and could analyze the environment condition because of the produced water discharge. Once the existing condition observed, sampling location was certain.

Purposive sampling method was used to take the sample of produced water. Purposive sampling method is one of the methodology of sampling which take the sample by divided the research area into several points that represent each population of the research area (Levy and Lemeshow, 2008). Six sampling points were chosen to indicate the oil well location which suitable for the experiment. The produced water from 6 locations was analyzed in the laboratory to specify the characteristics. We took the most suitable characteristics of produced water from one location to be treated on the experiment.

2.2. Experiment Procedure

The treatment experiment in the laboratory was started with gravity separation. After separated by gravity, coagulation follow with flocculation was used as a treatment method to separate the water and the colloids. Settling tank could separate the flock from flocculation process from the water. The clean water enters the aeration to get biological treatment. After biological treatment, the combine system uses ultrafiltration as the final treatment. The flow diagram of the experiment could be seen in the Figure 1. Each unit operation on the treatment experiment was explained below.

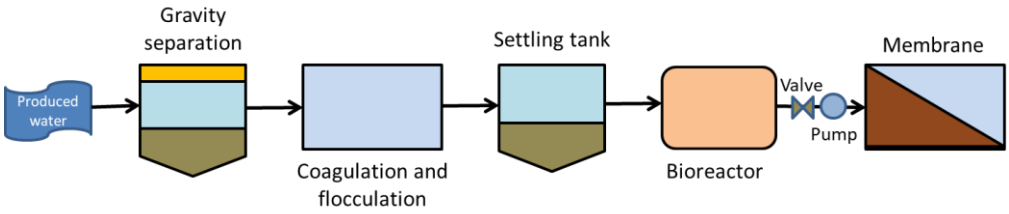

Figure 1 The Flow Diagram of Treatment Experiment

a. Gravity Separation

The basic separation on produced water treatment is using gravity. Gravity separation could separate between water, oil, and solid by the density. The objective of this treatment is to remove the oil and the first treatment for solid removal. The density of oil is less than water. Thus, using gravity separation technologies, oil will rise to the surface of the water where it can be skimmed (Atarah, 2011).

b. Coagulation and Flocculation

Coagulation is a process which destabilized the colloids. Generally, this treatment is followed by flocculation which the purpose to agglomerate the fine particles to reduce turbidity (Nazirah Wan Ikhsan *et al.*, 2017). To get the optimum coagulation and flocculation process, we varied the coagulant dosage

with different mixing times. Coagulation was using alum with rapid mixing on 5 minutes and flocculation with slow mixing on 30 minutes.

c. Settling Tank

This unit process objective is to make the flock from flocculation process settling. The retention time of settling tank was decided by trial and error experiment. The best retention time for this tank was decided by measure the turbidity. The less turbidity measured; it was the best retention time for the settling tank.

d. Bioreactor

Bioreactor in this experiment was using aerator to build the suitable environment for aerobic microorganism. The aerator infused the air into the produced water to supply oxygen for the microorganism. Microorganism in the bioreactor would reduce an organic contaminant from the produced water.

e. Reverse Osmosis

For this research experiment, reverse osmosis was used as chosen technology. The capacity of reverse osmosis membrane was 100 gallon per day (GPD). The membrane had spiral shaped with 6 sheet rolls. After the produced water treated by the conventional technologies, oilfield produced water would be treated by membrane technology. In the filtration process using reverse osmosis, there are 2 variations for the treatment experiment, including: produced water directly treated by reverse osmosis membrane without additional pre-treatment process; additional pre-treatment, activated sand filter, was added before it was treated by the membrane.

2.3. Treatment Efficiency Calculation

The calculation of efficiency was to evaluate the work of unit operation in each treatment. Laboratory analysis to characterize the produced water quality was conduct in each unit operation, both influent and effluent. This research calculates treatment removal efficiency of contaminant in produced water. The equation of efficiency calculation can be seen on Eq. (1).

$$\varepsilon = \frac{input - output}{input} \times 100\% \quad (1)$$

ε : Removal efficiency
Input : The characteristics of produced water before the treatment
Output : The characteristics of produced water after the treatment

3. RESULTS AND DISCUSSIONS

3.1. Initial Condition

In order to indicate the oilfield produced water characteristics, it was required water quality laboratory check. Parameters that analyzed to check the contaminants are Total Dissolved Solid (TDS), Total Suspended Solid (TSS), Chemical Oxygen Demand (COD), and turbidity. The result of laboratory analysis for oil-field produced water characteristics could be seen at 0.

Table 1. Oil-field Produced Water Characteristics

No	Parameter	Value	Maximum Value (PPRI No. 82 Tahun 2001, class III)
1	COD	77,9 mg/L	50 mg/L
2	Turbidity	105 NTU	-
3	TDS	1714 mg/L	1000 mg/L
4	TSS	90 mg/L	400 mg/L

Based on Peraturan Pemerintah No.82 Tahun 2001 about Water Quality Management and Water Pollution Control for water class III, the oilfield produced water characteristic above was exceeding the discharge limit. Thus, it is required to be treated. The removal efficiency of each contaminant's parameter would be explained below.

3.2. Treatment Efficiency

0 describe the efficiency of the treatment experiment. The pre-treatment of the reverse osmosis membrane was the conventional technology treatment. There is a variation of additional pre-treatment before the oilfield produced water treated by the reverse osmosis. The efficiency of each unit operation to treat the contaminant from oilfield produced water is explained below.

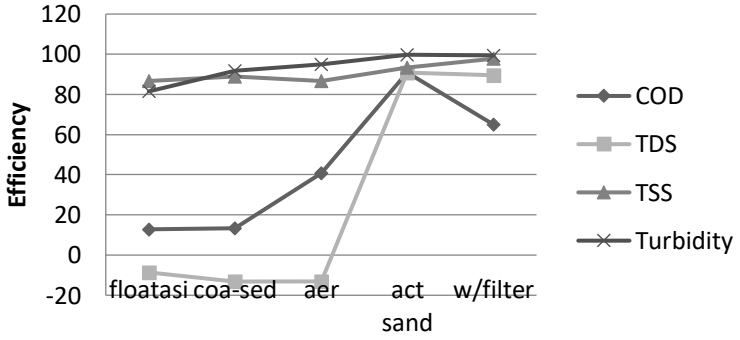

Fig 2. Removal Efficiency of Each Parameter by Combine System Treatment

a. Coagulation Process

The conventional treatment was beginning with gravity separation. Gravity separation removal efficiency for each parameter was 12.84% for COD, 86.67% for TSS, and 81.5% for turbidity. After gravity separation, the conventional treatment continues to coagulation and flocculation. This unit operation removal efficiency was calculated together with the settling tank process. The removal efficiency on this process was 13.22% for COD, 88.89% for TSS, and 91.67 % for turbidity. From the 0 we could saw that the removal efficiency for conventional technologies was increasing except for the TDS parameter.

The conventional treatment technology could remove the contaminant from oilfield produced water significantly from several parameters. Gravity separation, coagulation, and flocculation could not attain the high removal for TDS. It could be the dosage for

coagulation is not the optimum one. If the amount of coagulant is less than the required, the negative charge on particles does not get neutralized and the particles continue to repel each other. Moreover, if the coagulant is excess the optimum amount, the particles turn into positive charges and repel to each other again (Khajababu *et al.*, 2014). The condition when particles repel to each other, colloid could be increasing though the turbidity was reduced.

b. Bioreactor

The bioreactor in this experiment was operated by an aeration tank. The aeration in the tank could be accumulating the amount of aerobic microorganism. Microorganism in the wastewater parameter could be determined by the value of TSS. From the experiment result, removal efficiency from bioreactor was 40.82% for COD, 86.67% for TSS, and 95.02% for turbidity. It was an increasing value of COD and turbidity efficiency in this process. Otherwise, the TSS removal efficiency was decreasing. This could be happened because of the sedimentation needs a longer time to be settled the solid.

The ideal condition for bioreactor, especially aerobic bioreactor, it is required for the treatment to be followed by sedimentation tank with the longer settling time. The conventional technology and bioreactor still could not reduce TDS parameter from oilfield produced water. Thus, the TDS should be reduced significantly by the membrane technology.

c. Membrane Reverse Osmosis without Additional Pre-Treatment

To get the better result, the variation of experiment should be conducted. The first variation in this experiment was treating the oilfield produced water without additional pre-treatment before the produced water treated by reverse osmosis membrane. The result from this experiment would be compared with the treatment with the additional pre-treatment. The experiment without additional pre-treatment expected could be treating the water more efficient.

Based on the water quality analysis result, the removal efficiency for this treatment experiment was 65.08% for COD, 89.38% for TDS, 97.78% for TSS, and 99.53% for turbidity. The reverse osmosis membrane could reduce the TDS from oilfield produced water significantly. Without additional pre-treatment in the treatment technology, the parameters still could reduce significantly. The oilfield produced water safe to be discharged to the environment.

d. Membrane Reverse Osmosis with Activated Sand Pre-Treatment

Activated sand has the characteristics which could bond the iron (Fe), manganese (Mn), and sulfide in the water. Solids, microorganisms, and heavy metal could separate from the water when the water flowing through the filter media of activated sand (Nandari *et al.*, 2018). The application of additional pre-treatment could obtain the high removal efficiency for the treatment. From the 0 we could see that additional pre-treatment of activated sand has the highest removal efficiency.

The removal efficiency for this treatment was 90.89% for COD, 90.84% for TDS, 93.33% for TSS, and 99.74% for turbidity. Almost all the parameter could be removed above 90% using this treatment. The high efficiency removal of this treatment technology could make the oilfield produced water become raw water for daily consumed.

This treatment technology could reduce contaminant above 90%. The treatment that exist in the field could reduce around 61% contaminant. Thus, this treatment could conserve the water from this area. Furthermore, water from the treatment could be use as drinking water, raw water, irigation, or discharge to the environment. Local people could develop this technology and sell the clean water to the community.

5. CONCLUSIONS

The removal efficiency for primary treatment such as gravity separation, coagulation, flocculation, and settling tank were 13.22% for COD, 88.89% for TSS, and 91.67 % for turbidity. This primary treatment still could not remove the TDS from produced water. A bioreactor could reduce higher efficiency on COD. Moreover, TSS would be increased if the treatment does not have a sedimentation process. Before the membrane process, additional pre-treatment of activated sand filter highly effective reduce the contaminant above 90%. While without the additional pre-treatment also could remove 65.08% COD, 89.38% TDS, 97.78% TSS, and 99.53% turbidity. The application of the technology should be based on the necessity of the user.

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