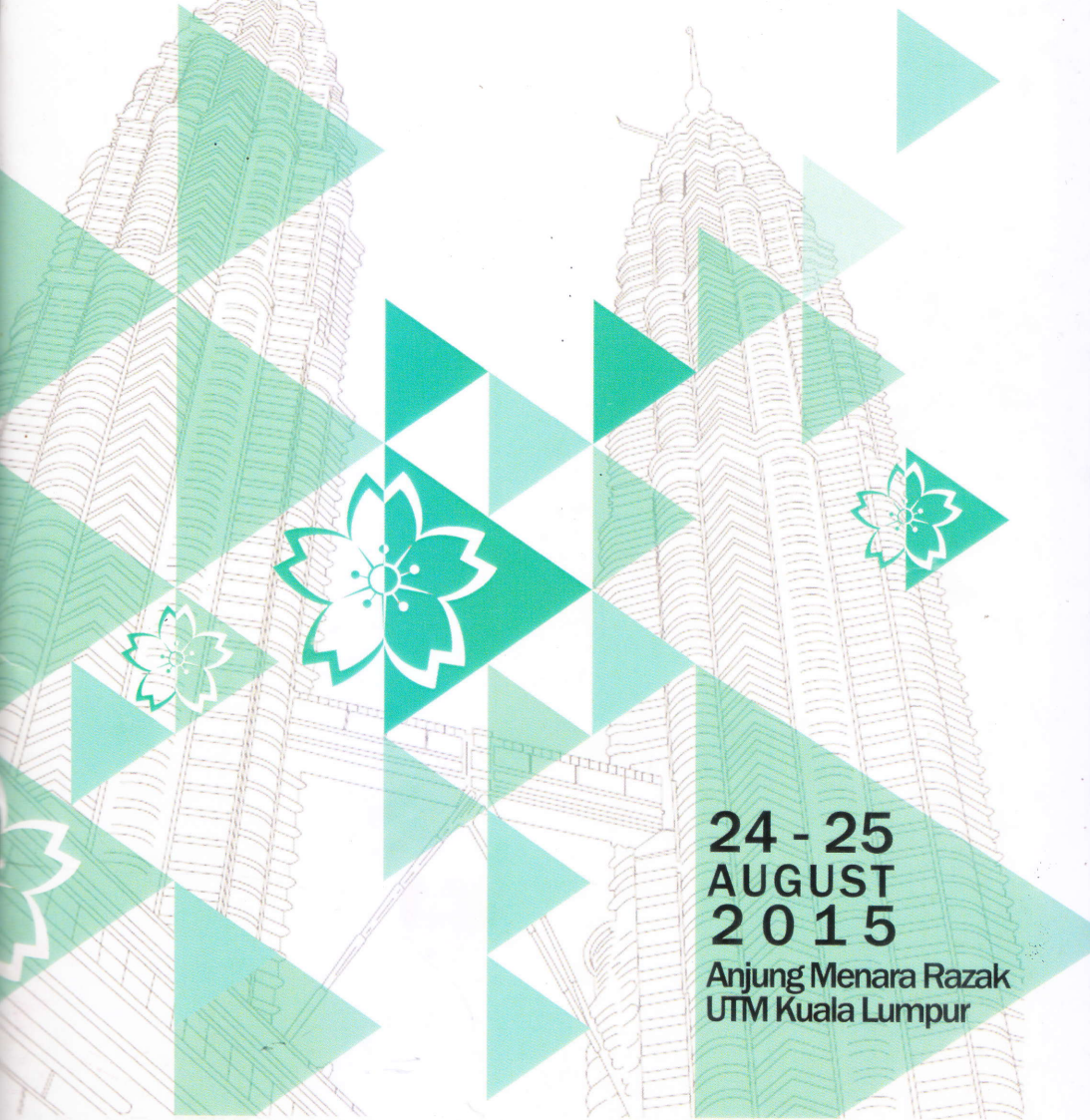
INTERNATIONAL CONFERENCE ON SUSTAINABLE INITIATIVES (ICSI)

8th ASEAN ENVIRONMENTAL ENGINEERING CONFERENCE (AEEC)



24 - 25 AUGUST 2015

Anjung Menara Razak
UTM Kuala Lumpur

UTM UNIVERSITI TEKNOLOGI MALAYSIA

MJIIT MALAYSIA-JAPAN INTERNATIONAL INSTITUTE OF TECHNOLOGY

AUN/SEED-Net

JICA

INTERNATIONAL CONFERENCE ON SUSTAINABLE INITIATIVES (ICSI 2015)

in conjunction with

8th ASEAN ENVIRONMENTAL ENGINEERING CONFERENCE (AEEC)

1. Prof. Datuk Ir. Dr. Wahid Omar
2. Prof. Datin Dr. Zuriati Zakaria
3. Prof. Dr. Shigeo Fujii
4. Mr. Hiroshi Iwadate

Opening Ceremony & Welcoming Speech

24 August 2015 | Main Hall, Anjung Menara Razak

Plenary Lecture 24 August

YB Dato' Seri Ir. Dr.
Zaini Ujang
Secretary General
Ministry of Higher Education

Prof. Emeritus Dr.
Saburo Matsui
Kyoto University

Plenary Lecture 25 August

Mr.
Joseph Tek Choon Yee
CEO & Managing Director
IJM Plantations Berhad

Professor
Ian Jonathan Scowen
University of Lincoln

Keynote Lecture 24 August

Professor Dr.
Satoshi Takizawa
Tokyo University

Professor Dr.
Shiro Saka
Kyoto University

Keynote Lecture 25 August

Professor Dr.
Yoshihiro Shiraiwa
University of Tsukuba

Professor Dr.
Zainuddin Abd Manan
Universiti Teknologi Malaysia

UTM Universiti Teknologi Malaysia | MJIIT | AUN/SEED-Net | JICA

Program Book

International Conference on Sustainable Initiatives (ICSI 2015)
in conjunction with
8th ASEAN Environmental Engineering Conference (AEEC)
August 24-25, 2015
Anjung Menara Razak, UTM Kuala Lumpur

Hosted by
Malaysia-Japan International Institute of Technology (MJIIT),
Universiti Teknologi Malaysia (UTM), Kuala Lumpur

Funded by
ASEAN University Network Southeast Asia Engineering Education Development Network (AUN/SEED-Net)

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FOREWORD BY THEVICE-CHANCELLOR UNIVERSITI TEKNOLOGIMALAYSIA

السلام عليكم ورحمة الله وبركاته and SincereGreetingstoAll,

I would like to congratulate the Malaysia-Japan International Institute of Technologyfor organising the International Conference on Sustainable Initiatives 2015 in conjunctionwith the 8th ASEAN Environmental Engineering Conference 2015. To all participants ofthe conference, I welcome you to our UTM Kuala Lumpurcampus.

UTMishighlycommittedtosustainabilityasreflectedinourUTMCampusSustainability Policy.UTMstressestheimportanceofasustainablecampusbyembodyingresponsible consumption of materials, energy, food and water. UTM also emphasises researchinitiatives focusing on sustainability, achieved by integrating available expertise in various disciplinesto comprehendandprovidesolutionsinmattersrelatingtolocal,nationalandglobal sustainabilityissues.

By embracing the culture of conservation, creativity and innovation, UTM has managedto achieve more than 10 % reduction in its energy efficiency index for three years from 2012to 2014incomparisontothebaselineyearof2009.UTMwasofficiallyawardedthe3-Star ASEAN Energy Management Scheme (AEMAS) Energy Management GoldStandard (EMGS)ratingon1st October,2014.Thisisthefirstever3-StarAEMASEMGSrecognition awarded to an organization in ASEAN on energy management andsustainability.

Locatedin1,145hectareofgreensplendourinSkudaiJohor,themainUTMJohorBahru campus prides itself on its ecotourism campus initiative. Its traditionally designedMalay architectureacademicbuildingsaresituatedinthemidstoflushgreenery,surroundedby stretchesofcreeks,streamsandlakes.Aspartofitskeencommitmenttoasustainable environment, UTM ecotourism campus offers a myriad of opportunities for outdoorrecreation andenjoymenttoactive,adventurousvisitorsaswellastothosewhosimplywishtoenjoy the solitude of nature. Various tourism packages promoting conservation efforts ofthe university,suchastheUTMrecreationalforest,andUTMTropicalParkcanbeenjoyednot only by the UTM community, but also by the public atlarge.

UTM will continue in its efforts to integrate and balance the economic, socialand environmentalspherestomeettheneedsofthepresentgenerationwithoutcompromising the ability of future generations to sustain the environment and resourceseffectively.

I believe all participants will benefit from the discussion and deliberations at thisInternational Conference on Sustainable Initiatives 2015 in conjunction with the 8th ASEANEnvironmental EngineeringConference.Havearewardingandfruitfulconference,anddoenjoythe company of your peers as well as our beautiful campus andcountry.

Bestwishes,

PROF. DATUK IR. DR. WAHID BINOMAR
Vice-Chancellor

MESSAGE FROM ACTING EXECUTIVE DIRECTOR AND CHIEF ADVISOR OF AUN/SEED-NET

On behalf of AUN/SEED-Net, I would like to welcome all participants to Kuala Lumpur, Malaysia, and to express my sincere gratitude to Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM) Kuala Lumpur as the dedicated host of the International Conference on Sustainable Initiatives (ICSI 2015) in conjunction with 8th ASEAN Environmental Engineering Conference (AEEC) this year. This conference provides a valuable platform for all participants to share research outputs and discuss the way forward which will further enhance the research and network of Environmental Engineering and sustainable initiatives in this region.

In recent years, people in many parts of the world are working on entrepreneurship innovations for sustainable economic reconstruction to create new types of cities and communities. However to create this communities, effective collaboration is necessary among academia, industry and community. It has been so far evidenced by the increasing number of proposed and also awarded projects under Collaborative Research with Industry under SEED-Net, and we are looking at this momentum to be applied to all SEED-Net programs by researchers in Environmental Engineering. Linkage with industry is extremely important for universities to improve the quality of engineering education and research.

I hope this conference provides an opportunity for a productive exchange of knowledge and lessons learned among participants that leads to successful collaboration with a wider range of network, and resulting in human resources development in the region for the future prosperity of ASEAN.

PROF. DR. UEDA TAMON

MESSAGE FROM DEAN OF MALAYSIA JAPAN INTERNATIONAL INSTITUTE OF TECHNOLOGY

I extend my most sincere welcome to all attendees of International Conference on Sustainable Initiatives (ICSI2015) in conjunction with the 8th ASEAN Environmental Engineering Conference (AEEC2015) hosted at Malaysia Japan International Institute of Technology (MJIIT), UTM, Kuala Lumpur funded by ASEAN University Network Southeast Asia Engineering Education Development Network(AUN/SEED-Net). We are very honored to be given this trust by AUN/SEED-Net for the fourth time where we hosted the International Conference on Electrical & Electronics Engineering 2014 and Workshop on Management of Technology for two consecutive years of 2014 and 2015.

MJIIT is a young institution which is established in 2010 as a result of cooperation between the government of Malaysia and Japan and intended to be the engineering education hub for ASEAN. It has three engineering departments' namely Mechanical Precision Engineering (MPE), Electronic Systems Engineering (ESE) and Environmental Engineering and Green Technology (EGT), and a department of Management of Technology (MOT) with a blend of Malaysian, Japanese and International staff. Besides this, we have a unique research laboratory system known as *i*Kohza which is set up with the collaborations with Japanese Universities Consortium (JUC) members, Japanese industries and government to initiate the transfer of knowledge and technology to our researches with some *i*Kohzas' focusing on Environmental issues.

Furthermore, Ministry of Education of Malaysia also supports sustainable initiatives by providing funding to waste management projects, led by MJIIT which involve collaboration between Japanese industry and local researchers. MJIIT is also privileged to receive continuous 5 years financial support from a renowned industry from Japan, Takasago Thermal Engineering Company Limited to set up a new *i*Kohza on energy research.

This conference is a platform to share the contemporary research trends and experiences in regional common issues as well as to expose research work of AUN/SEED-Net members and others. I hope you take advantage of this opportunity and contribute, through presentations, discussion and interaction, to the development of new ideas and new directions in research and applied technology on sustainability initiatives.

PROF. DATIN DR. RUBIYAH YUSOF

MESSAGE FROM ORGANISING CHAIRPERSON OF ICSI-AEEC 2015

Malaysia-Japan International Institute of Technology (MJIIT) is honoured to host the International Conference on Sustainable Initiatives (ICSI2015) in conjunction with the 8th ASEAN Environmental Engineering Conference (AEEC 2015).

This conference is of special significance to the scientists, academics and the professionals. This is the time that the world is faced with major problems such as climate change, energy and water and efforts to find solutions will involve various field of study such as engineering, chemistry, economy and social studies. I am happy to note that participants from various disciplines are contributing to this conference where sessions on Science and Technology, Policy and Education will be held. There will be a special session on conservation efforts at the Royal Belum Forest, a pristine area in the state of Perak. More than 80 papers will be presented from more than 10 countries. There will also be an exhibition to showcase the research activities relevant to sustainability studies at MJIIT, and also some instrumentation and research products pertaining to sustainability. MJIIT is a young Institution and ICSI 2015 will provide an opportunity for our staff and students to interact , network and collaborate with established scientists.

On behalf of MJIIT, I would like to thank the Vice Chancellor of Universiti Teknologi Malaysia, Prof Datuk Ir. Dr Wahid Omar for officiating the opening ceremony of ICSI2015 and also for his staunch support. I would like to thank our coorganiser, the AUN/Seed Net for the funding and support . I would like to record my appreciation to the organising committee members for their hard work in the preparation of the conference

To the Plenary speakers, keynote speakers , participants and exhibitors, we would like to express our gratitude for your contribution to make this conference a success. For the overseas participants, we would like to invite you to various places of interest in Malaysia. I wish that you have a fruitful and rewarding deliberation at ICSI 2015.

PROF DATIN DR. ZURIATI ZAKARIA

ORGANIZING COMMITTEE

Programme Advisor

Prof. Datin Dr. Rubiyah Yusof

Organizing Chair

Prof. Datin Dr. Zuriati Zakaria

Organizing Co-chair

Prof. Dr. Masafumi Goto

Prof. Ir. Megat Johari Megat Mohd Noor

Secretariat

Dr. Pramila Tamunaidu

Ms. Sharifah Radhiah Syed Azman

Mrs. Noridah Borhan

Mrs. Nor Najibah Khalid

Ms. Siti Juliana Mohd Imam

Ms. A-Ain ZubaidahMustafa Kamal

Technical Committee (Papers)

Prof. Dr. Norio Sugiura

Prof Dr. Mohd Rashid Mohd Yusof

Assoc. Prof. Dr. Hirofumi Hara

Assoc. Prof. Dr. Koji Iwamoto

Assoc. Prof Dr. Naoki Umemiya

Dr. Rory Padfield

Dr. Sune Balle Hansen

Technical Committee (IT)

Dr. Mohammad Ali Tareq

Ms. Norhafizah Kamarudin

Mr. Megat Farizul Auzan Zuhairi

Facilities and Logistic

Mr. Ahmad Redzuan Mohd Hanapiah

Ms. Nor Ashikin Hussein

Publicity, Exhibition& Sponsorship

Dr. Mariam Firdaus Mad Nordin

Dr. Shaza Eva Mohamad

Hospitality and Banquet

Assoc. Prof. Dr. Sabariah Baharun

Mrs. Nurulhaslinda Muhd. Sidek

Finance

Mrs. Effie Papargyropoulou

Mrs. Mazliza Aini Abdul Majid

Mrs. Nasuhah Che Abd Rahman

Student Committee

Ahmad Kamil Hakimien Nor Aslan

Analhuda Abdullah Tahir

Farah Syafiqah Ismail

Khadijah Mohamad Syayuti

Komathy Selvaraj

Mok Kar Mun

Muhamad Ezral Ghazali

Nadia Farhana Azman

Nur Syamimi Selamat

Nurtasbiyah Yusof

Nuurul Nadrah Mohd. Said

Ruthiraan Manimaran

Syamimi Mohd Zul

Tham Mun Hou

Thines Raj Kogiladas

Yuvaneswaran Krishnan

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Assoc.Prof Dr. Hirofumi Hara	H/P: +60 176400891

KEYNOTE AND INVITED SPEAKERS

Professor Dr Shigeo Fujii
Kyoto University

Title: Kyoto University's Challenge for international education and research collaboration with Southeast Asian Universities towards sustainable development for Environment

Biography: ProfessorShigeo Fujii, born in 1955, is a professor of Graduate School (GS) of Global Environmental Studies, Kyoto University (KU), Japan. He received B. Eng. in 1978, M. Eng. in 1980, and D. Eng. in 1990 from the Department of Sanitary and Environmental Engineering, Faculty of Engineering, KU.

His professional carrier started as a research associate at Faculty of Engineering, KU in 1980. In 1991, he was seconded to Asian Institute of Technology (AIT), and worked as an assistant professor and an associate professor in Environmental Division. Immediately after he came back to Japan, he moved to Ritsumeikan University as an associate professor. In 1998, he came back to KU as an associate professor in GS of Engineering, and then was promoted to a professor at Research Center for Environmental Quality Control in 2002. From 2007, he is working at GS of Global Environmental Studies. In 2012, he was elected as the dean of the GS, and he is working up to now (2015).

His research field is environmental engineering such as sanitation studies in Asian developing countries, behavior analysis of PFCs (perfluorinated compounds) in environment and development of their treatment methods, restoration of littoral areas by macrophytes, water pollution mechanism analysis of lakes and their management design, water quantity and quality management in river watersheds

Since 1987, he is a member of IWA (International Water Association), and working not only by attending conferences, but also by board members of specialist groups, and coordinating several conferences. By these activities, he was awarded an IWA fellow at its first selection in 2010. He was also given as a title of Distinguished Adjunct Professor in AIT in 2014.

YBhg. Dato' Seri Ir.Dr. Zaini Ujang
Secretary-General, Ministry of Higher Education, Malaysia

Title: Eco-Strategy: Policy Management and Business Tools for Environmental Sustainability

Biography:YBhg. Dato' Seri Ir. Dr. Zaini Ujang is currently the Secretary-General of Ministry of Higher Education, Malaysia since early August 2015. He obtained his Bachelor of Chemical Engineering (Hons.) from Universiti Teknologi Malaysia, Master of Science (Environmental Engineering) from University of Newcastle, United Kingdom, Doctor of Philosophy (Environmental Engineering) from University of Newcastle, United Kingdom and Advanced Management Program, Harvard Business School, Harvard University.

YBhg. Dato' Seri Ir. Dr. Zaini Ujang is a Professional Environmental Engineer cum Scientist and integrates studies on water ecology with engineering systems towards pollution control and sustainability, especially with reference to river rehabilitation in developing countries. His academic contributions are in the field of environmental management and technology, particularly water and wastewater treatment, sustainable resource strategies, and industrial ecology.

He also sits on the councils of various public agencies, and is a former member of the National Water Services Commission. He has written more than 250 scientific papers published in leading academic journals and proceedings, and 33 books on environmental engineering, water sustainability, higher education, and learning innovation.

ProfessorEmeritus Saburo Matsui
Kyoto University

Title: The BISTRO Plan of Japanese Sewage Works for Global Climate Change

Biography: Prof Emeritus Saburo Matsui obtained his Ph.D. at Univ. of Texas at Austin in year 1972 and Emeritus Professor from Kyoto University in year 2007. His research field is very wide in water pollution control, including waste-water treatment, ecological sanitation, eutrophication control of lakes, and micro-pollutant control. His recent research includes probiotics environmental farming. He organized a national research project of endocrine disruptors (2001-2005).

He is a Distinguish Fellow and Honorable Member of International Water Association, a Fellow of Japan Society of Civil Engineers, and members of many international and Japanese scientific societies. He was a member of Scientific and Technical Panel of Global Environmental Facility, United Nations (2004-2008) and a member of Scientific and Program Committee of Stockholm World Water Weeks (1996-2008). He is a member of Ad hoc Committee for Japanese Prime Ministers, Yasuo Fukuda and Taro Aso, for Global Warming Measures (2008-9).

He was given many awards including Kyoto Human Grand Prize 2015, Distinguished Achievement Award, Society of Environmental Science, Japan 2012, Distinguished Services Award of Japan Sewage Works 2011, Academy of Distinguished Alumni of Civil, Architectural and Environmental Engineering, The University of Texas at Austin(2008), Academic Prize, Japan Society on Water Environment(2002), Vollenweider Lectureship in Aquatic Sciences, Canadian National Water Research Institute, Environment Canada (1995), Distinguished Lecture Prize, Association of Environmental Engineering Professors, North America(1993),etc.

Professor Dr. Satoshi Takizawa
University of Tokyo

Title: The Future Perspective of Environmental Engineering in Asian Countries.

Biography: Professor Takizawa graduated from Department of Urban Engineering, Graduate School of Engineering, the University of Tokyo.

After graduation, he held several positions in a national university and a government research institute. He was assign to be an assistant professor in 1992 at the University of Tokyo. After experiencing the secondment to Asian Institute of Technology in Bangkok between 1997 and 1999, he was promoted to be a full professor at Department of Urban Engineering, Graduate School of Engineering, the University of Tokyo.

Professor Takizawa was the chairperson of the committee for the New Water Supply Vision, the Ministry of Health, Labor and Welfare in 2013 and also was a chairperson of the working group under the study group for International Development of the Water Business with the Ministry of Economy, Trade and Industry in 2010.

Professor Takizawa's research interests are Advanced Water Treatment Technologies, Planning and Management of Urban Water System, and Effects of Global Warming on Urban Water Systems.

Professor Dr. Shiro Saka
Kyoto University

Title: Advanced Bioethanol Production with Acetic Acid Fermentation from Lignocellulosics

Biography: Professor Shiro Saka, a biomass chemist, graduated from Department of Wood Science and Technology, Faculty of Agriculture, Kyoto University, Japan, in 1975 and moved to the USA, having studied in Department of Wood and Paper Science, North Carolina State University, Raleigh, N.C. for MS fulfilled in 1977 and PhD in 1980.

He worked as a Post-Doctoral Fellow for Pulp and Paper Research Institute of Canada/Department of Chemistry, McGill University, Montreal, Canada in 1980-1983, then as a senior Chemist in Research Center, Daicel Chemical Industries, Ltd., Himeji, Japan in 1983-1988. Since 1988, he became Associate Professor in Department of Wood Science & Technology, Kyoto University, and Professor in 1996 of Graduate School of Energy Science, Kyoto University.

Current projects include research on biofuels through thermochemical conversions of lignocellulosics to bioethanol by acetic acid fermentation and oils/fats to biodiesel by supercritical fluid technologies, and related research on biofuels and biochemicals.

He had been the Editor of the Journals of Wood Science and Mokuzai Gakkaishi, The Japan Wood Research Society. Additionally, he had been the former President of Biomass Division, Japan Institute of Energy, Japan, and elected as Fellow of the International Academy of Wood Science in 2008, and currently, the country representative of Japan for the International Energy Agency (IEA), Task 39 (Liquid Biofuels).

Representative awards he received are Wood Award 1980 in USA, 2008 Japan Prize of Agricultural Science, 2008 Yomiuri Prize of Agricultural Science, 2008 Japan Institute of Energy Award, 2009 Best Technology Award of Japan Society of Energy and Resources, and 2012 Special Technical Achievement Award of Suga Weathering Technology Foundation, .

In his academic career, he has produced 217 research papers, about 392 international conference proceedings, 109 books and 82 patent applications including 53 patents granted, as of August 18, 2015.

Professor Dr. Ian Jonathan Scowen
University of Lincoln

Title: Sustainability: Front Fundamental Research to Professional Practise – Integrating An Agenda for Change

Biography: Professor Ian Jonathan Scowen received a Ph.D from the University of North London, United Kingdom (UK) in 1993 on the topic of "Synthesis, structure and stability of metal complexes of nitrogen-based ligands". Since 2014 Professor Scowen has served as the Founding Head of Chemistry at the University of Lincoln, UK.

His achievements include becoming the Founding Director of University Analytical Centre – a central University resource housing the major capital instrumentation for the University. He established a sustainable business plan, including commercial exploitation, and provided a supported high quality research environment for PG research and UG/PG teaching. Prof Scowen managed a team of research technicians and commercial projects / business development group of post-doctoral scientists. The Centre has operated a financial surplus for 10 years.

Prof Scowen led the re-launch of UG Chemistry at University of Bradford. He invented Chemistry4 suite of programmes – innovative MChem programmes focussing UG training to key employment sectors (pharma, forensic/analytical, fine chems) - and led curriculum development programme across School of Life Sciences to develop/integrate specialist MSc programmes in Analytical Sciences, Pharmaceutical Technology, Drug Discovery and Forensic Archaeology and Crime Scene Science. He has worked closely with RSC for course accreditation (on-going programme).

Previously, Prof Scowen was the Head of Division for Chemical and Forensic Sciences, University of Bradford. He led the Division's chemistry programmes to the highest overall student satisfaction in England and second in UK; ranked 4th in North East of England (Sunday Times Good University Guide, Subject Tables for Chemistry, September 2013). The re-launch of Chemistry has doubled UG numbers in CFS to 420+ FTE.

Prof Cowen has authored/co-authored over 100 peer-reviewed articles in Chemistry [H-index (ISI Web of Science) = 24] and supervised 18 post-graduate research programmes to completion. RAE-submitted 1996, 2001 and 2008, and anticipate REF submission in 2014.

He is a research grant holder for RCUK awards in synthetic pre-biotic chemistry and analysis (EPSRC - EP/F042418/1) and remote instrument development for inter-planetary exploration (STFC - ST/F005415/1, ST/G003602/1, ST/F005687/1).

Mr. Joseph Tek Choon Yee
IJM Plantations Berhad

Title: IJM's Mantra of Nurturing Sustainability in Oil Palm Agribusiness

Biography: Mr Joseph Tek Choon Yee, born in January 1966, was appointed the Chief Executive Officer & Managing Director ("CEO&MD") of IJM Plantations Berhad ("IJMP") on 23 May 2010.

He graduated with a Bachelor of Science (First Class Honours) degree from Universiti Kebangsaan Malaysia. He was a Commonwealth ODASS/Sime Darby scholar and obtained his Master's in Philosophy (Plant Breeding) from Cambridge University, England. He also attended the ASEAN Senior Management Development Programme organised by Harvard Business School Alumni Club of Malaysia.

He joined IJMP in September 2004 to head the research, training and development activities of the Group, and was appointed an Alternate Director on 22 May 2008 and Executive Director on 19 October 2008 besides being the General Manager – Plantations (Sabah). He was then redesignated to the position of Chief Operating Officer & Executive Director on 18 May 2009, prior to his appointment as CEO&MD of IJMP.

Prior to joining IJMP, he was with Sime Darby Plantations Sdn Bhd as Plant Breeder in Ebor Research (1991-1997), R&D Manager (1997-2000) and later Manager-Agritech Business (2000-2001) with Sime Aerogreen Sdn Bhd and Sime Gardentech Sdn Bhd. His last position was Head of R&D with Malaysian Palm Oil Association ("MPOA") (2001-2004).

He is currently the President of the Malaysian Estate Owners' Association (MEOA). He was a member of the Programme Advisory Committee (PAC) of the Malaysian Palm Oil Board (MPOB) (2011-2013), a Council Member of the Malaysian Oil Scientists' and Technologists' Association (MOSTA) (2006-2007), a member of the Criteria Working Group for the Roundtable on Sustainable Palm Oil (RSPO) (2005-2006) and Vice-Chairman of the MPOA Environment Working Committee (2004-2005).

Professor Dr. Yoshihiro Shiraiwa
University of Tsukuba

Title: Algal Biofuel Production Biotechnology and Bioengineering

Biography: Professor Yoshihiro Shiraiwa, plant and algal physiologist and phycologist, is a professor of Faculty of Life and Environmental Sciences, University of Tsukuba. He is also the Aide of the President of University of Tsukuba for the Special Mission for Environmental Issues.

Dr. Yoshihiro Shiraiwa received the Bachelor degree in Science from Niigata University, Japan in 1973. He received the Master degree in Science from Tokyo Kyoiku University in 1975 and the Ph. D from University of Tokyo in 1979.

After Post-doctoral Research Fellow of Japanese Science Promotion of Science (JSPS) in 1979, he joined Niigata University, Japan as Assistant Professor at the Faculty of Science in 1979. From 1989 to 1997, he was the Associate Professor of the same faculty. In 1997, he became the Professor at the Institute of Biological Sciences, University of Tsukuba, Japan. From 2011 he is belonging to present affiliation via the Graduate School of Life and Environmental Sciences by reorganization in University of Tsukuba.

He is actively engaging in the research on the plant physiology using microalgae about 40 years, and within this recent five years he published 36 Original ISI papers, 1 Proceedings of International Meeting, 5 Review & Books and 12 Japanese Book Chapters. Within this recent five years, he also acquired two patents and a big research funds as 300 million JPY from CREST supported Japan Science and Technology Agency as project leader from 2010 -2015.

He is a member of the Society of Marin Biotechnology and was the president of the society from 2008 to 2010, the board of trustees from 1994 and Vice president from 2006 t- 2008. He also the member of the Botanical Society of Japan, Japanese Society of Phycology, American Society of Plant Physiologist, Japanese Society for Photosynthesis and contributed the societies as the board of trustees.

He is a recipient of Marine Biotechnology Editorial Board-Recognition Award by Springer New York in 2006, the Japanese Society for Marine Biotechnology Award for Best Paper of the Year 2009 Published in Marine Biotechnology in 2010 and the Japanese Society for Marine Biotechnology Award in 2015. He also awarded Alexander von Humboldt Foundation Fellow from 1984 to 1986, 1987 and 1993, and Visiting Scientist for Japan-US Exchange Program of Ministry of Education, Culture, Sports, Science and Technology in 1989 and 1990.

Professor Dr. Zainuddin Abd. Manan
Universiti Teknologi Malaysia

Title: Energy Supply and Demand Management towards Low Carbon Emission

Biography: Professor Dr Zainuddin Abd. Manan is the Dean of the Faculty of Chemical Engineering, Universiti Teknologi Malaysia (UTM) and was the Founding Director of UTM-Process Systems Engineering Centre.

He received his BSc from the University of Houston, USA, MSc from UMIST, UK, and PhD from the University of Edinburgh, Scotland, all in Chemical Engineering. Zain began his career as an engineer in PETRONAS and Hume Industries and has been a researcher, consultant and trainer for over 20 years.

He has completed over 70 R & D & consultancy projects, filed for fifteen patents and has over 300 publications that include 15 books/chapters, 130 refereed journals and 180 conference papers on sustainable planning and engineering of resources (energy, power, water, emissions & materials). He is the author of the 2014 Book on Process Integration and Intensification – Saving Energy, Water and Resources.

Zain was the winner of Saudi Arabia's 2008 Prince Sultan International Prize for Water. In 2013, he was awarded as one of the Top Research Scientists of Malaysia. In 2014, he received the UTM Top Researcher Award, UTM Top Academician Award and the Pannonia Award for his distinguished collaboration contributions with the University of Pannonia of Hungary. He was also sponsored by Imperial College of London to deliver the Imperial College Distinguished Chemical Engineering Lecture in May of 2014.

Zain is a Fellow IChemE, a chartered engineer, a certified energy manager, a registered electrical energy manager and the certified lead trainer for Malaysia energy managers. He has delivered over 400 professional workshops, seminars and invited lectures, and coached professionals from more than 500 companies. He was the vice-chairman of the Board of Judges for the South East Asia Energy Awards program.

He spearheaded the UTM Sustainable Energy Management initiative that led UTM to achieve USD 3 million energy savings between 2011 and 2014, and to win the ASEAN Energy Award in 2012.

PROGRAM SCHEDULE

Day 1 (Monday, August 24, 2015)

Time	Event	
08:00-09:00	Registration and Arrival of UTM Officials & Guests (Venue: Anjung Menara Razak)	
09:00-09:15	Welcoming Speechby Organizing Chair, Prof Datin Dr Zuriati Welcoming Speech by AUN/SEED-Net Representative, Mr Hiroshi Iwadate	
09:15-10:00	Opening Ceremony by Prof Datuk Ir. Dr. Wahid Omar Opening Address by Prof Dr Shigeo Fujii	
10:00-10:30	Tea Break (Venue: Bilik Ilmuan 4, Level 1, Menara Razak)	
10:30-11:15	Plenary Lecture by YB Dato' Seri Ir. Dr. Zaini Ujang (Venue: Dewan Utama, Menara Razak)	
11:15-12:00	Plenary Lecture by Prof Saburo Matsui (Venue: Dewan Utama, Anjung Menara Razak)	
12:00-13:00	Poster Session& Exhibition (Venue: Bilik Ilmuan 2, Level 1, Anjung Menara Razak)	
13:00-14:00	Lunch (Venue: Bilik Ilmuan 4, Level 1, Anjung Menara Razak)	
14:00-15:15	Keynote Lecture by Prof. Dr. Satashi Takizawa (Venue: Dewan Utama, Anjung Menara Razak)	
	Keynote Lecture by Prof. Dr. Shiro Saka (Venue: Dewan Utama, Anjung Menara Razak)	
	Royal Belum 1 (Venue: Bilik Kuliah 14)	
	Policy and Governance 1 (Venue: Bilik Kuliah 11)	
15:15-15:30	Tea Break (Venue: Bilik Ilmuan 4, Level 1, Menara Razak)	
15:30-17:30	Field Management Meeting (Bilik Kuliah 11)	
15:30-18:00	15:30 18:00	Water Treatment 1 (Venue: Dewan Utama)
		Reuse Materials / Waste (Venue: Bilik Kuliah 6)
		Microbes (Venue: Bilik Kuliah 14)
	16:00 17:30	Palm Oil (Venue: Bilik Kuliah 5)
		Education (Venue: Bilik Kuliah 12)
		Air Pollution (Venue: Bilik Kuliah 4)
		Chemical Analysis 1 (Venue:Bilik Kuliah 10)
18:30-21:00	MJIIT Dinner (Felda D'Saji)	

PROGRAM SCHEDULE

Day 2 (Tuesday, August 25, 2015)

Time	Event
08:30 – 10:30	Water Treatment 2 (Venue: Dewan Seminar, Menara Razak)
	Chemical Analysis 2 (Venue: Bilik Kuliah 6)
	Royal Belum2 (Venue: Bilik Ilmuan 1, Level 1, Anjung Menara Razak)
	Energy (Venue: Bilik Kuliah 14)
10:30 – 11:00	Coffee Break (Venue: Bilik Ilmuan 4, Level 1, Anjung Menara Razak)
11:00 – 11.45	Plenary Lecture by Mr. Joseph Tek Choon Yee (Venue: Dewan Utama, Anjung Menara Razak)
11:45-12:30	Plenary Lecture by Prof Ian Jonathan Scowen (Venue: Dewan Utama, Anjung Menara Razak)
12:30 – 14:00	Lunch (Venue: Bilik Ilmuan 4, Level 1, Menara Razak)
14:00 - 15:30	Policy and Governance 2 (Venue: Bilik Kuliah 14)
	Keynote Lecture byProfessor Dr Yoshihiro Shiraiwa (Venue: Dewan Utama, Anjung Menara Razak)
	Keynote lecture by Professor Dr Zainuddin Abd. Manan (Venue: Dewan Utama, Anjung Menara Razak)
15:30 - 15:45	Souvenir presentation and Group Photography
15:45 –16:45	AUN/SEED- Net General Info Presentation (Venue: Bilik Kuliah 14)
15:45 – 16.30	Tea (Venue: Bilik Ilmuan 4, Level 1, Menara Razak)

SCIENCES AND TECHNOLOGY SESSION 3

Track: Microbes
Time: 15:30-18:00
Date: August 24, 2015
Venue: Bilik Kuliah 14 (01.31.01), Anjung Menara Razak

Paper ID ST 38 Induction Condition of Secondary Metabolites Production in Soil Actinomycetes, *Rhodococcus jostii* RHA1

Syamimi Bt Mohd Zul, Nurul Syazwani Bt Sajari, Nor'azizi Othman, Koji Iwamoto, Masafumi Goto, Shaza Eva Mohamad, Mariam Firdhaus Bt Mad Nordin, Norio Sugiura, Zuriati Zakaria and Hirofumi Hara
Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM), MALAYSIA.

Paper ID ST 45 Azoreductase and NADH Peroxidase in Biodegradation of Acid Orange 7 Using Enterococcus faecalis Strain ZL

Ainur Adliana Salleh, Wong Huey Xuan and Shaza Eva Mohamad
Faculty of Biosciences and Medical Engineering, Faculty of Biosciences and Medical Engineering, Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM), MALAYSIA.

Paper ID ST 50 Identification of Multidrug-Resistant *Escherichia coli* Isolated from River in Kuala Lumpur

Yus Amira Yusaimi, Hirofumi Hara, Nor'Azizi Othman, Zuriati Zakaria, Norio Sugiura and Motoo Utsumi
Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM), MALAYSIA, University of Tsukuba, JAPAN.

Paper ID ST 56 Microcystin Degradation in *Sphingopyxis* Sp. C-1

Norio Sugiura, Hideaki Maseda, Maki Uwata, Kazuya Shimizu, Kunihiro Okano, Motoo Utsumi, Koji Iwamoto, Masafumi Goto and Tomoaki Itayama
Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM), MALAYSIA, Tokushima University, Toyo University, Akita Prefectural University, University of Tsukuba, Nagasaki University, JAPAN.

Paper ID ST 63 Population Dynamics of Bacteria in an Anoxic-Aerobic Membrane Bioreactor in the Biodegradation of Azo Dyes

Agus Jatnika Effendi, Puti Sri Komala, Dini Adyasari, I Gede Wenten and Wisjnuprapto

Institut Teknologi Bandung (ITB), INDONESIA, Universitas Andalas, INDONESIA.

Paper ID ST 42 Optimization Of Biodiesel Production from Marine Microalgae *Tetraselmis Chuii*

Natasha Nabila bt Ibrahim, Haruna A/P Magalingam, Madihah bt Md Salleh, Shaza Eva bt Mohamad

Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM), MALAYSIA.

Paper ID ST 43 The Potential of Marine Microalgae *Tetraselmis chuii* for Palm Oil Mill Effluent Treatment

Hilzaiti Ahmad Shaari Ameerah Tharek, Madihah Md Salleh and Shaza Eva Mohamad

Faculty of Biosciences and Medical Engineering, Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM), MALAYSIA.

POPULATION DYNAMICS OF BACTERIA IN AN ANOXIC-AEROBIC MEMBRANE BIOREACTOR IN THE BIODEGRADATION OF AZO DYES

Agus Jatnika Effendi[1], Puti Sri Komala[2], Dini Adyasari[3], I Gede Wenten[4], Wisjnuprapto[5]
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[2]Environmental Engineering Department, Universitas Andalas
[4] Chemical Engineering Study Program, Faculty of Industrial Engineering, ITB
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SUMMARY: In this study the population dynamics of microbes observed in membrane bioreactor process (MBR) where the contact stabilization combined with anoxic tank and connected with an external ultrafiltration membrane for biodegradation of azo dye Remazol Black 5. Feed consisted of a mixture of azo dye Remazol Black-5 and tempeh waste as co-substrates and was given continuously to mixed microorganisms. Tempeh wastewater concentration was varied in the range of 2%, 4%, 6%, 8% and 10% (v / v) with azo dye Remazol Black 5 in a fixed concentration is 120 mg / L at SRT 2 days. Nine (9) species of bacteria were successfully isolated from each tank and the membrane; They were *Klebsiella ozaenae* BK, *Staphylococcus auricularis* BTP2, *Pseudomonas pseudomallei* BTP1, *Staphylococcus hominis* BTM, *Kocuria kristinae* BO, *Brevibacillus laterosporus* TG, *Citrobacter freundii* B2, *Bacillus pumilus* R and *Paenibacillus macerans* GB1. Species of *K.ozaenae* BK, *S. hominis* BTM, *S. auricularis* BTP2, and *P. pseudomallei* BTP1 as the most occurence bacteria, besides acting as color degraders in anoxic tank, also served to eliminate COD and metabolism product of organic compounds in the contact and stabilization tanks. Species of *Citrobacter freundii* B2 was the predominant microorganisms occurred in the membrane surface, in addition to *S. auricularis* BTP2 and *K.ozaenae* BK. These bacteria were attached growth bacteria that have the ability to degrade azo dye and organic compounds.
***Keywords*:** azo dye compound, MBR, population dynamics

INTRODUCTION

One important factor affecting the performance of a bioreactor is the ability of microorganisms involved in the process to adapt to changes in environmental conditions. In addition to be able to withstand the toxic compounds and recalcitrant to be treated, the continuous system with multiple tanks, microorganisms must also be able to deal with different environmental conditions due to the displacement of one reactor to another. Azo dye is a toxic compound, wherein the biological treatment can be done with a combination of anaerobic-aerobic process. In this study developed a modified activated sludge process is contact-stabilization process which is the process of aerobic combined with anoxic reactor is placed at the beginning of the series, as well as the ultrafiltration membrane unit in lieu of the sedimentation basin which is placed between the contact tank and stabilization for biodegradation of azo dye Remazol Black 5.

Performance of a bioreactor depends on the ability of microorganisms to adapt to the changing of environmental conditions. In addition to be able to withstand the toxic compounds and recalcitrant to be treated, in a continuous system with multiple tanks, microorganisms should also be able to deal with different environmental conditions due to the displacement of one reactor to another. Azo dye is one of the toxic compounds, wherein the biological treatment can be treated with a combination of anaerobic-aerobic process. In this study, a modified activated sludge process is is developed. A contact-stabilization process, the aerobic process combined with anoxic reactor, is placed at the beginning of the series. An ultrafiltration membrane to replace the sedimentation basin is configured between the contact tank and stabilization tank to allow the biodegradation of azo dyes Remazol Black 5 occured.

In the process of color removal, the addition of an external carbon source as co-substrate is necessary to support the growth of microorganisms in the process. Yeast extract is one of the most effective supplements to get higher color removal efficiency [1]. However, the cost of yeast extract is very expensive especially if it is going to be used in a continuous system and applied on an industrial scale. It is necessary to substitute less expensive co-substrate that has similar characteristics to yeast extract. Some studies had used industrial tempeh wastewater as co-substrates to the

treatment of azo dyes and proved to have high color removal efficiency [2] [3]. In addition, industrial wastewater tempeh is easily available and contains high concentration of organic compounds, proteins, vitamins and trace minerals that required for the growth of microorganisms in the biological treatment. With the addition of co-substrates derived from soybean waste, then the source of carbon and nutrients for the growth of microorganisms not only from azo dyes as the main substrate. Thus, the presence of different carbon sources with various environmental conditions in each reactor will result in the case of population dynamics of microorganisms that presence in each reactor. The purpose of this research is to study the population dynamics due to displacement from one tank to another in membrane bioreactor in the biodegradation of azo dye RB5 at various substrate concentrations.

2. METHODOLOGY

Microorganisms

Mixed microorganisms that were inoculated in this study, were derived from industrial wastewater treatment plant of textile and dye industry. Microorganisms were enriched and grown under aerobic condition in a mixture of industrial wastewater tempeh as co-substrate and azo dye as the main substrate.

Co-substrate and Azo-dye Used

Tempeh waste as co-substrate was used as a source of organic carbon and nutrients in this study originated from the waste of boiling tempeh process. Tempeh waste was used in this study as a co-substrate, because it has sufficient organic carbon and nutrient for the growth of microorganisms [4]. Tempeh waste compared with yeast extract containing several organic and inorganic parameters such as COD, BOD, nitrate, K, Na, Mg, Ca, Fe and Al in higher concentration [4]. Thus tempeh waste is feasible to replace yeast extract as a source of carbon and nutrients in the biodegradation of azo dyes. Dye used in thi study was reactive azo dye Remazol Black-5 that has a wavelength of 609 nm. The feeding concentration of azo dye was ranging between 110-120 mg /L. The mixture of co-substrate and dye subsequently was fed on a continuous experiment.

Membrane Bioreactor (MBR) Configuration

MBR laboratory scale with a capacity of 2 L/h was installed and operated continuously. Bioreactors consist of anoxic tank, contact tank and stabilization tank with a constant hydraulic retention time (HRT) respectively 4, 2 and 4 hours during the operation. External membrane ultrafiltration hollow fiber type made of polysulfone was placed between the contact tank and stabilization tank. Feeding in the form of a mixture of dyes and tempeh waste was flowed into the anoxic tank equipped with a mechanical stirrer with a speed of around 40-60 rpm. NaOH is added to the feed to make the pH of the solution reached neutral (pH 7). From the anoxic tank, solution was then pumped into the contact tank. The mixture was then aerated in the contact tank to allow biomass to grow with the dissolved oxygen (DO) concentration about 5 mg /L. The aeration was performed by equipped at the bottom of the tanks with diffuser to distribute the air flow coming from the compressor. From the contact tank, the mixture was pumped into the membrane using a diaphragm pump with a certain pressure. Operating membrane pressure was obtained by membrane permeability experiment of optimum flux was achieved. The retentate in the form of concentrated biomass was flowed into the stabilization tank. Like in contact tank, in this tank, biomass was also aerated to reach DO of about 5 mg/L. Finally, the biomass was recirculated from stabilization tank back to the anoxic tank by gravity, and so on continuously. Disposal of biomass was done everyday in accordance with the sludge retention time (SRT) of stabilization tank. MBR configuration as decribed above can be seen in Figure 1.

Co-substrate & Tempeh Waste Variation

The changes in co-substrate (tempeh waste) concentration tempe with fixed color concentration of 120 mg / L and constant hydraulic retention time (HRT) and constant solid retention time (SRT) were studied. Feed concentration of co-substrate in the form of tempeh waste mixture was varied in the range of 2%, 4%, 6%, 8% and 10% (v/v) to obtain the COD concentration of about 2,400 mg/L, 2,533 mg/L, 2,933 mg/L, 3,867 mg/L and 6,000 mg/L, respectively. MBR was operated at a fixed SRT of 2 days. Of every variation of feed concentration, MBR's performance in color removal and provision for organic compounds were observed. The optimum feed concentration was determined by the biomass growth rate in the reactor that produced the highest

level of color removal and optimum COD. MBR performance was observed through parameter of mixed liqour volatile suspended solid (MLVSS), co-substrate concentration, azo-dyes concentration, flux and pressure of the external membrane. Changes in environmental conditions such as displacement from one tank to other tank, DO, pH and concentration of co-substrate on the number and type of microbial population were determined.

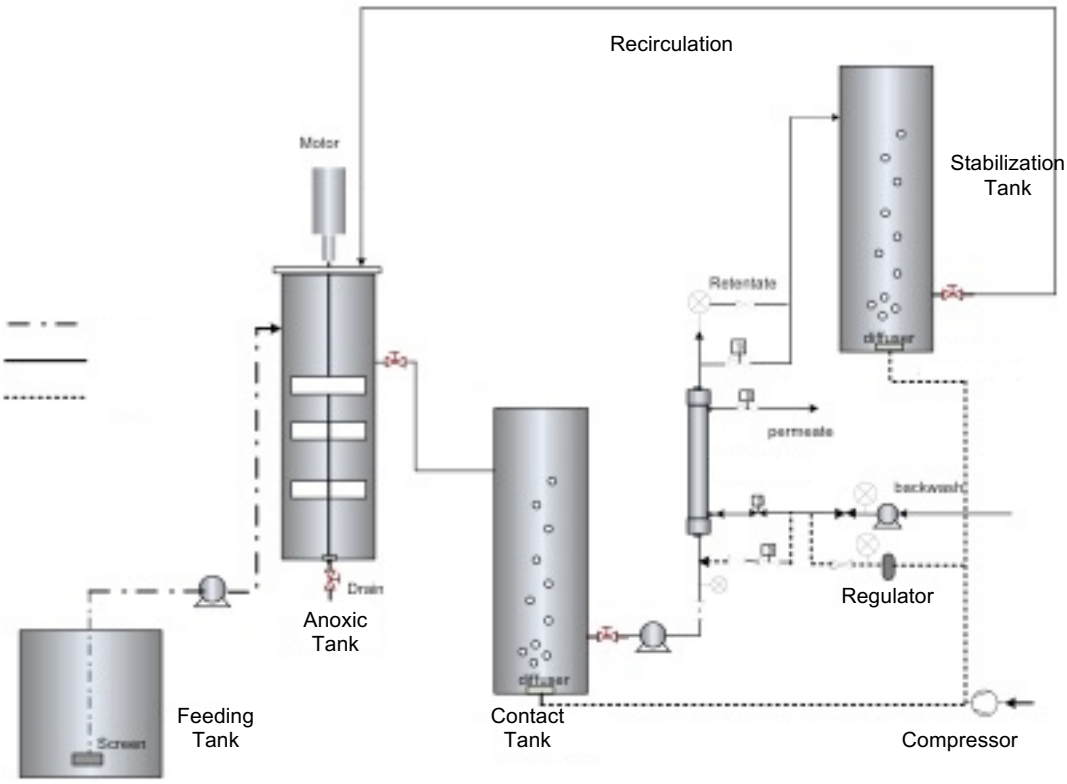

Figure 1. MBR Configuration

Analytical Methods

COD measurement was done by closed reflux method; MLVSS was determined gravimetrically; color wwas detected with UV-vis spectrophotometer; both were according to Standard Methods for the Examination of Water and Wastewater [5].

Bacteria Isolation & Identification

Biomass samples in the form of a mixed solution from each tank were taken everyday in every diffrent concentration of co-substrate. Biomass samples from membrane were taken only once at the end of the experiment. Bacterial enumeration was conducted using Total Plate Count (TPC) and calculated using colony counter. For the purposes of identification, a series of biochemical tests were performed to include hydrolysis of starch, citric test, gelatin hydrolysis, oxidation test/fermentation of glucose, oxidation /fermentation of sucrose test, oxidation/fermentation of lactose test, H_2S production test, Methyl Red Vogus Proskauer reaction test (MRVP), catalase reaction, hydrolysis of casein, nitrate test, test indole, and urease reaction test. Results from a series of biochemical tests mentioned above are used to determine the species of bacteria by the method of Bergey's Manual of Determinative Bacteriology [6].

3. RESULT & DISCUSSION

MBR Performance

The increase of feed concentration, followed by the increase in the number of microorganisms in both the anoxic, contact and stabilization tanks as shown in Figure 2a. The highest VSS concentration in all the tank was reached at the concentration of co-substrate was about 10% or 2,533 mg COD/L. The smallest

number of biomass population in the bioreactor was found in the anoxic tank of about $3x10^6$ colony/ml compared to the population in the contact tank and stabilization tank ($4{,}1x10^6$ colony/ml and $5x10^6$ colony/ml). Changes in the amount of biomass was related to the increase a given substrate concentration and was accompanied by an increase in DO concentration in aerobic tanks with an average of 5.57 mg/L and 3.31 mg/L in the contact tank and stabilization tanks respectively. These conditions allow for aerobic and facultative anaerobic bacteria grew in highest rate. The increased of tempeh waste concentration as co-substrate in feed, although it increased the concentration of biomass in the bioreactor as a whole, improved color removal and organic compound degradation but not in a linear manner (Figure 2b and 2c). In accordance with the functions of the processes that occurred in each tank, showed that the largest color removal occurred in the anoxic tank, while highest organic matter removal was found in the stabilization tank as shown in Figure 2d. Color removal and organic substances mechanisms in the membrane, described in more detail in other publications, is a combination of process straining, sorption and biodegradation by microorganisms attached on surface of the membrane.

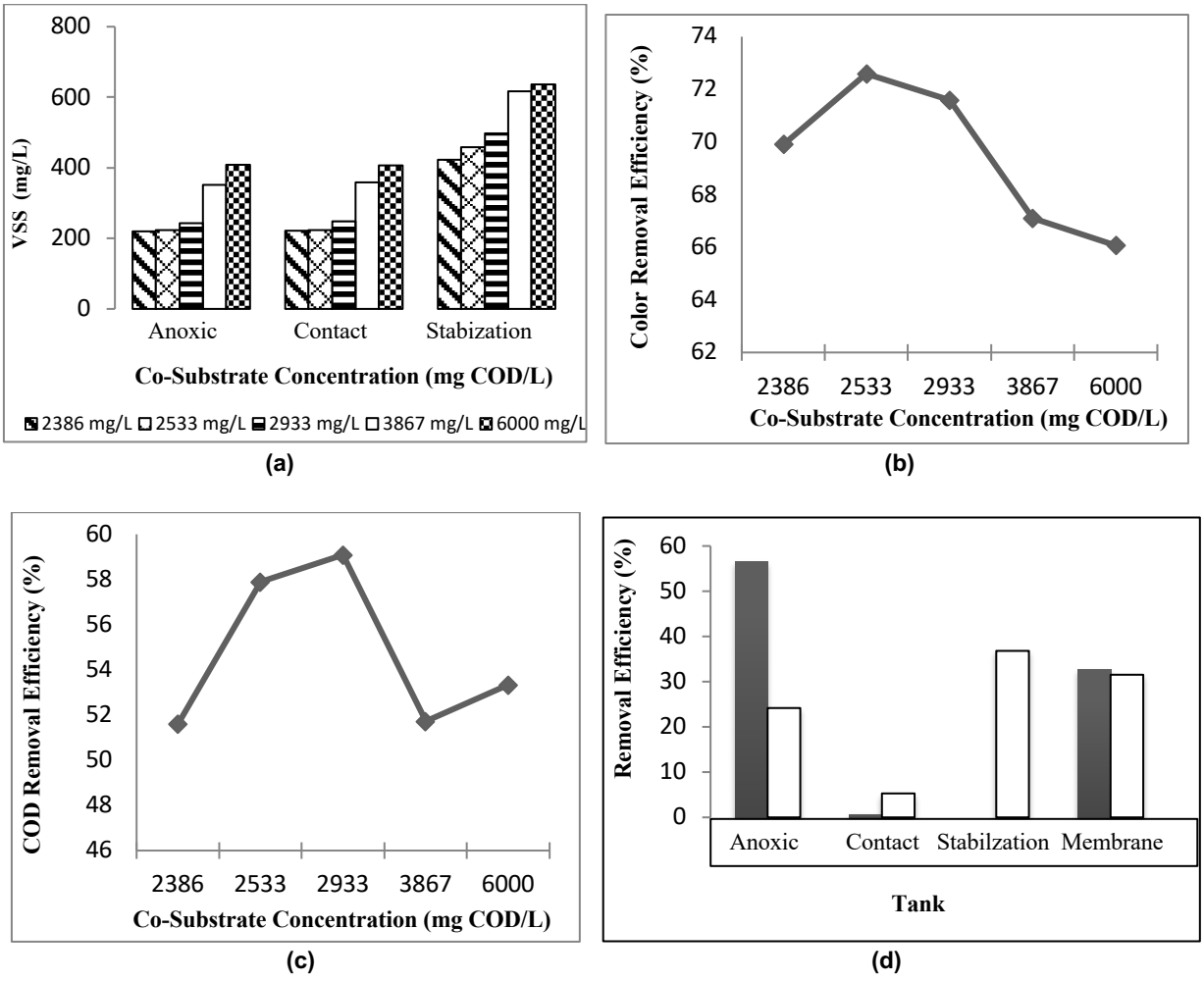

Figure 2. Biomass Concentration and MBR Performance (HRT of Anoxic, Contact and Stabilization tanks were 4, 2 dan 4 hours respectively) a). VSS concentration; b) color removal; c) COD removal d) Color and COD in every tank at feed concentration 2.533 mg COD/L (■color □ COD)

Bacteria Identification

Isolation and biochemical tests obtained nine dominant species of bacteria that were always found in every tank. These nine species were *Klebsiella ozaenae BK*, *Staphylococcus auricular* BTP2, *Pseudomonas pseudomallei* BTP1, *Staphylococcus hominis* BTM, *Kocuria kristinae* BO, *Brevibacillus laterosporus* TG, *Citrobacter freundii* B2, *Bacillus pumilus* and *Paenibacillus macerans* GB1. Of those

species, it was found that *S. auricularis* BTP2 and *P. pseudomallei* BTP1 formed a consortium in nutrient agar petri dish. *Pseudomonas*, *Bacillus*, *Brevibacillus*, *Paenibacillus* and *Kocuria* are classified as aerobic bacteria, whereas *Klebsiella*, *Staphylococcus* and *Citrobacter* belong to facultative anaerobes. They are are also able to live in aerobic conditions. Of the nine bacteria, it was found that *K. ozaenae* BK, *S. auricular* BTP2, *P. pseudomallei* BTP1, *K. kristinae* BO, *C. freundii* B2 are Gram-negative, while four other species of *S. hominis* BTM, *B. laterosporus* TG, *B. pumilus*, and *P. macerans* GB1 are Gram-positive bacteria. Majority of bacteria present in an activated sludge reactor is a Gram negative [7]. However, in this study revealed that Gram-positive bacteria also grew significantly in the activated sludge reactor. There is a close relationship between microorganisms with degradation of color [8]. Higher growth rate of microorganisms twill improve color removal. *K. Ozaenae*, *S. hominis*, *S. auricular* and *K. kristinae* were found to the bacteria group that responsible for the color removal because they produced azoreductase enzyme; The enzyme responsible for the degradation of azo dye. *K. ozaenae* was proven to perform decolorization and biodegradation of azo dyes from textile industry waste [9]. *Staphylococcus* genus has ability to produce azoreductase enzyme [10]. It was found that *K. kristinae* species managed to degrade azo dyes [11].

Population Dynamics in Anoxic Tank

I an MBR reactor, the N double bond breakage will occur in the anoxic tank that lead to the reduction of color intensity. The number of dominant bacterial populations found in the anoxic tank is shown in Figure 3. It was found that the dominant species in this tank were *K.ozaenae* BK, *S. hominis* BTM, *S. auricular* BTP2 and *P. pseudomallei* BTP1. These bacteria were responsible for breaking of N double bond in azo dye compound where mostly occurred in this tank. *K.ozaenae* was proven to have ability to perform decolorization and biodegradation of azo dyes in textile industry wastewater under microaerophilic-aerobic conditions [9]. It was found that the degradation of azo bond reached an efficiency of more than 94% in microaerophilic conditions. Another study involving *K.ozaenae* in azo dye removal showed that this species was responsible for the degradation of two types of azo dyes, namely Basic Blue 41 and Reactive Black-5 in facultative anaerobic conditions [12]. *Staphylococcus* genus has the ability to synthesize the azoreductase enzyme that is responsibility in azo dye degradation [10]. In addition to the above dominant bacteria, in this tank also grew some species with a small amount [10]. They were *B. pumilus* R, *K. kristinae* BO, *C. freundii* B2, *P. macerans* GB1, and *B. laterosporus* TG. Tempeh waste as co-substrate is containing complex carbon source. Therefore, some species of bacteria in the tank must be responsible for hydrolyzing these complex carbons into more simple carbon sources. Species of bacteria that can hydrolyze starch including *S. auricular* BTP2 [13], *K. kristinae* and *P. macerans* GB1. The presence of these bacteria in the anoxic tank converted complex carbon from Tempeh waste to a more simple carbon sources such as glucose and sucrose.

The increase of feed concentrations might increase the number of some types of microorganism population, but at the same time some other microorganisms will be eliminated because they are unable to compete for substrate. In addition, the presence toxic compounds to microorganisms as a result of an increase in the concentration of co-substrate tempeh waste also affected the gowth of some species. Tempeh waste contains ammonium, nitrates and nitrites where in certain level have negative consequences for the growth of certain microorganisms. Species presence with small amounts such as *B. pumilus* R, *K. kristinae* BO, *C. freundii* B2, *P. macerans* GB1, and *B. laterosporus* TG played significant role in degradation of organic compounds and color in the anoxic tank. *B. laterosporus* TG has a multi-functional role of which this aerobic bacteria is not only able to hydrolyze casein, gelatin, fermentation of glucose, sucrose, and citrate, but also to produce indole and catalase and reduce nitrate. *K. kristinae* BO can hydrolyze starch, glucose and sucrose fermentation, as well as producing catalase. *P.macerans* GB1 is capable of hydrolyzing starch, glucose and sucrose fermentation and also reducing nitrate. *C. freundii* B2 uses citrate, glucose, and carbohydrates to be catabolized into acid and gas, and also reduces nitrate and sulfate as well. Therefore, the decrease number of those microorganisms resulted in the decrease of MBR overall performance.

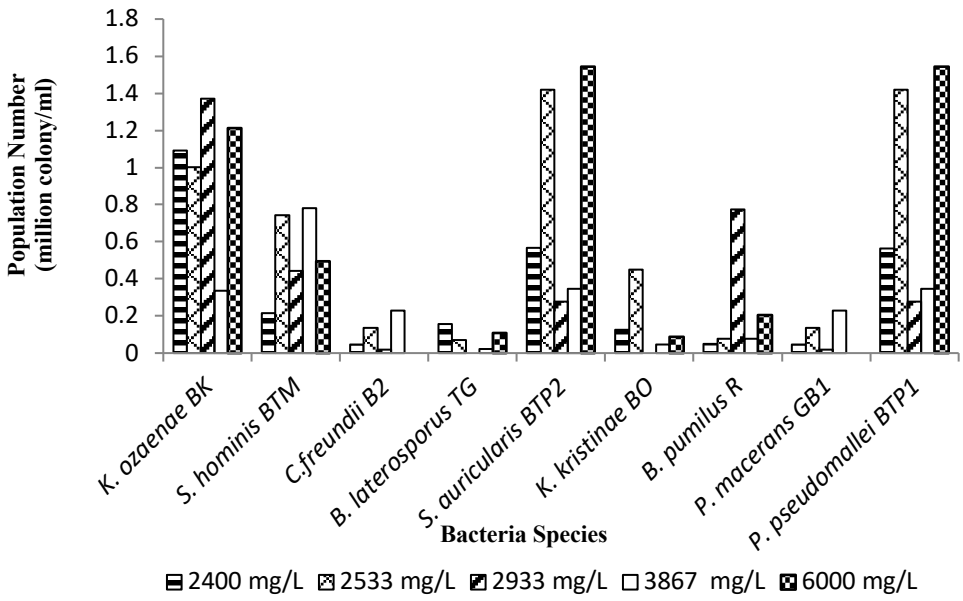

Figure 3. Bacteria Dynamic Population in Anoxic Tank under Different Feed Concentration (HRT of Anoxic, Contact and Stabilization tanks were 4, 2 dan 4 hours respectively)

Population Dynamics in Contact Tank

The process that occurs in the contact tank is substrates and nutrients sorbtion process by microorganisms. Thus, the presence of a population of microorganisms in the tank would be similar to the dominant bacteria that grew in the anoxic tank. The dominant bacteria presence in anoxic tank such as *K.ozaenae* BK, *S. hominis* BTM, *S. auricular* BTP2, and *P. pseudomallei* BTP1 also grew well in the contact tank (Figure 4). *K.ozaenae* BK, *S. auricularis* BTP2 and *S. hominis* BTM are facultative anaerobic bacteria, so they are also capable of performing respiratory metabolism under aerobic conditions. It could be seen from the number of these facultative anaerobic bacteria increased in the contact tank. Since *P. pseudomallei* BTP1 and *B. pumilus* R are aerobic bacteria, the environmental condition in the contact tank was appropriate environment for their growth. The increase on feed concentration generally increased the number of dominant populations like *K.ozaenae* BK, *S. hominis* BTM, *S. auricular* BTP2, and *P. pseudomallei* BTP1. At the highest feed concentration, that was 6,000 mg COD/L, the number of the dominant population reaches the highest number. The presence of *B. pumilus* R detected in high number when the feed concentration less than 2,933 mg COD/L. Species such as *K. kristinae* BO found in small numbers and even *C. freundii* B2 and *P.macerans* GB1 were almost completely undetectable. These bacteria were found to grow better in anoxic conditions which environmental condition was more complex than this tank.

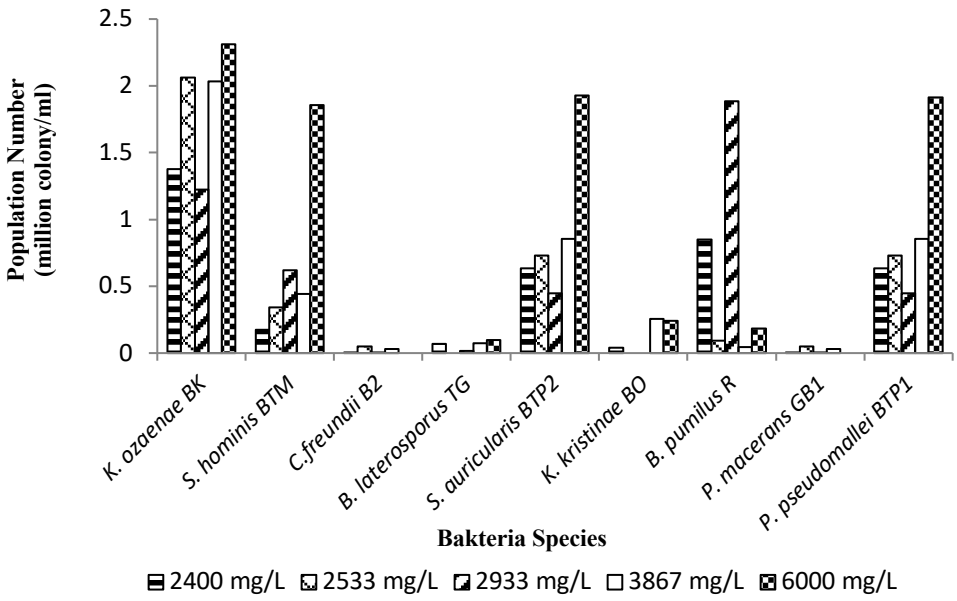

Figure 4. Bacteria Dynamic Population in Contact Tank under Different Feed Concentration (HRT of Anoxic, Contact and Stabilization tanks were 4, 2 dan 4 hours respectively)

Population Dynamics in Stabilization Tank

In stabilization tank, bacteria like *K. ozaenae* BK. *S. auricular* BTP2, *P. pseudomallei* BTP1 and *S. hominis* BTM remained the dominant population with a higher number than in the contact tank (Figure 5). In addition, species with a small number in contact tank such as *B. pumilus* R, *B. laterosporus* TG, *C. freundii* B2 and *P.macerans* GB1 grew with higher numbers in this tank. As in the case of anoxic tank and contact tank, increasing feed concentration generally increased the number of dominant population of *K.ozaenae* BK, *S. hominis* BTM, *S. auricular* BTP2 and *P. pseudomallei* BTP1. Interestingly, *B. pumilus* R was presence in high number until the feed concentration of about 3,867 mg COD/L, which was then going down at higher feed concentration. Instead, *B. laterosporus* TG was only able to grow at high organic concentration. At feed concentration below 3,867 mg COD/L, this species had never been detected. The population pattern of microorganisms in the stabilization tank was similar to the pattern of microorganisms in the anoxic tank. The presence of microorganisms in stabilization tanks was more varied than in the contact tank. In stabilization tank, it is expected the mineralization process to occur. Thus, the presence of various types of bacteria that are able to degrade such complex metabolite products, is required. In addition to the dominant bacteria like *K. ozaenae* BK, *S. auricular* BTP2, *P. pseudomallei* BTP1 and *S. hominis* BTM which acted as color- degrading bacteria in the anoxic tank, bacteria such as *B. pumilus* R, *B. laterosporus* TG, *C. freundii* B2 and *P. macerans* GB1 played an important role in the stabilization process. These bacteria had ability to help the improvement of the degradation of specific compounds that were resulted from the previous tank.

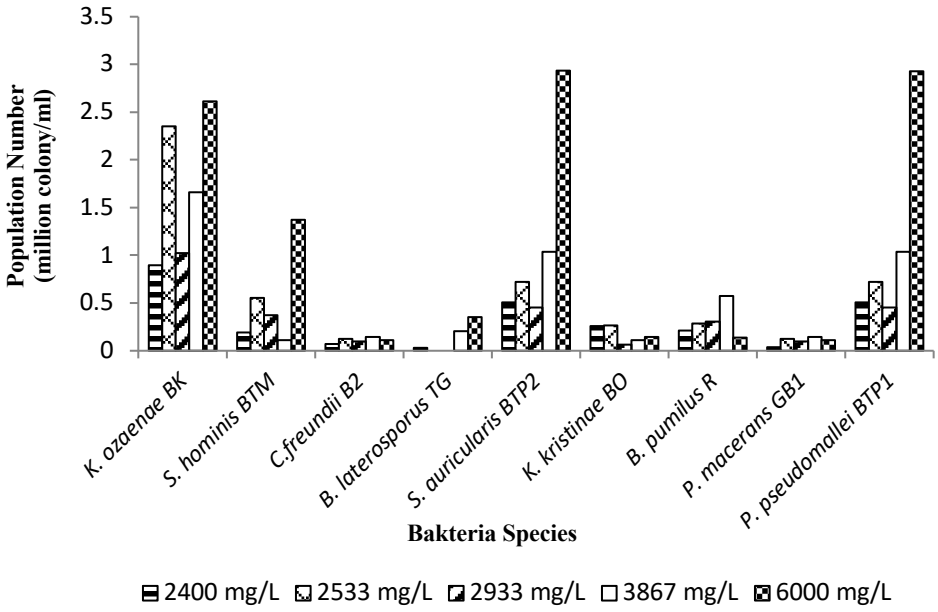

Figure 5. Bacteria Dynamic Population in Stabilization Tank under Different Feed Concentration (HRT of Anoxic, Contact and Stabilization tanks were 4, 2 dan 4 hours respectively)

Stabilization tank receives retentate flow from the membrane, so that the population goes into the tank is very much affected by the conditions that exist in the membrane. Many mechanisms happened in the membrane such fouling, sloughing of biofilms, feed pressure, permeate and retentate flow distribution and shear stress due to aeration of the membrane, will affect the biomass that goes into the tank stabilization. Therefore, a decrease number of biomass in the tank might occur if conditions change in the lumen of the membrane. Moreover, the changes that occurred in the anoxic and contacts tanks would affect the performance of the stabilization process, which in turn would affect the overall performance of MBR.

Attached-Growth Bacteria on the Membrane Surface

A change in the composition of the dominant microorganisms was found when biomass flowed through the membrane. Interestingly, *Citrobacter freundii* B2 population was normally found in very small number in both anoxic, contact and stabilization tanks, increased sharply to be the dominant bacteria gowth on the membrane surface. Of about 51% of the population on the membrane surface was detected as *Citrobacter freundii* B2. The others bacteria found on ther membrane surface were commonly the most highest bacteria grew in other tanks; they were *K.ozaenae* BK (16%) and *S.auricular* BTP2 (33%) (Figure 6). This indicated that pump pressure and turbulence due to aeration on the membrane affected the life of microorganisms that grew on the surface of the membrane. Attached growth bacteria that are resistant to extreme conditions in the membrane environment, become the dominant bacteria and play a significant role in the membrane. Although *S.auricularis* BTP2 and *K. ozaenae* BK were more likely classified as suspended growth bacteria, they were were still able to grow attached to the membrane surface. *C. freundii* B2 is an facultative anaerobic bacteria that is able to maximize the ability to use citrate, glucose, and carbohydrates, as well as reduce nitrate and sulfate together in anoxic conditions. These three types of bacteria that lived on the membrane surface, was detected to be able in producing EPS (extracelullar polimeric subtances) to form a biofilm on the surface of the membrane. The formation of biofilm on the membrane surface can contribute to membrane fouling. However, the presence of this bacteria also contributed to color removal and organic compounds in the membrane. This was due to the anoxic conditions occurred in the biofilm layer allowing the color removal took place on the membrane surface.

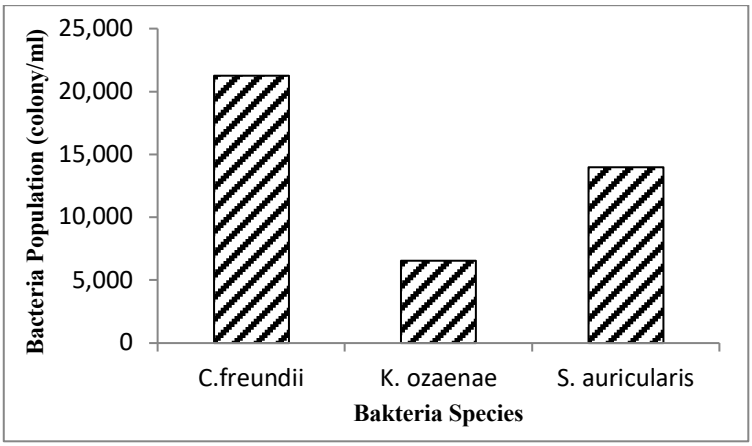

Figure 6. Occurance of Spesies Population on Membrane Surface

Further Discussion

At the optimum feed concentration showed that the bacteria *K. ozaenae* BK, *S. auricular* BTP2, *P. pseudomallei BTP1* and *K. kristinae* BO played an important role in color removal eventhough their population was smaller than when it entered into the contact tank (Table 1). Color removal process occurred mostly in the anoxic tank eventhough the population of bacteria in this tank was smaller than in the contact and stabilization tanks. Azo dyes are compounds that are recalcitrant and resistant to the indigenous aerobic microorganisms [14] [15] [16]. At aerobic conditions, microorganisms use free oxygen as the electron acceptor than electron acceptor from azo compounds. So, color removal in aerobic tanks (contact and stabilization tanks) occurred insignificantly. The dominant bacteria in the contact tank such as *Staphylococcus hominis* BTM, *Klebsiella ozaenae* BK, *Staphylococcus auricular* BTP2 and *Pseudomonas pseudomallei* only adsorbed organic compounds, whereas the metabolism process azo dye and organic compounds occurred in the stabilization tank. Azo dye and COD removal happened in membrane was fairly significant as a result of attached growth bacteria activity on the membrane surface. Despite the growth of these bacteria resulted in the case of membrane fouling, but it appeared that this bacterium group contributed substantially to the azo dye and COD removal.

Table 1. Bacteria Percentage Occurred in MBR under Optimum Co-Substrate Concentration

Anoksik	Kontak	Stabilisasi	Membran
K. ozaenae BK (30%)	*K ozaenae* (33%)	*K. ozaenae BK* (36%)	*K ozaenae (16%)*
S. auricularis BTP2 (23%)	*S. auricularis BTP2* (23%)	*S. auricularis BTP2* (28%)	*S. auricularis BTP2 (33%)*
P. pseudomallei BTP1 (23%)	*P. pseudomallei BTP1* (23%)	*P. pseudomallei BTP1* (28%)	
S. hominis BTM (5%)	*S. hominis BTM* (18%)	*S. hominis BTM* (4%)	
K. kristinae BO (17%)	*K. kristinae BO* (1%)	*K. kristinae BO* (1%)	
B. laterosporus TG (2%)	*B. laterosporus TG* (2%)	*B. laterosporus TG* (1%)	
		C. freundii B2 (1%)	*C. freundii B2 (51%)*
		P. macerans GB1 (1%)	

Dominant bacteria that played important role in the degradation of organic compounds (COD), should be capable of hydrolyzing complex carbon sources containing in the Tempeh waste such as starch. The bacteria that was capable of doing so, was found to be *S. auricular* BTP2. These bacteria grew dominantly in each tank and membrane. In addition, there was also found a minority group of bacteria that were able to hydrolyze starch, among others were *K. kristinae* BO and *P.macerans* GB1. The rest was bacteria that fermented glucose and sucrose as simple organic substances and were used as a carbon source for the growth of bacteria. In the anoxic conditions or in a state of low DO, bacteria are able to use glucose and sucrose as an electron donor, whereas electron acceptor was either from nitrate or sulfate. Tempeh waste contains carbohydrates, protein, nitrates,

sulfate, cations and vitamins that can be utilized by microorganisms in the reactor [4].

4. CONCLUSION

Azo dye color removal of Remazol Black 5 using combination of aerobic-anoxic in MBR with SRT 2 days by using Tempeh waste as Yeast extract substitute under concentration variation in the range of 2400-6000 mg COD/L, and azo dyes Remazol Black 5 at a fixed concentration of 120 mg/L, obtained that the optimum co-subsrate concentration (Tempeh waste) was equal to 2533 mg COD/L resulting in color and COD removal efficiency by 73% and 58% respectively. Bacteria isolated from anoxic tank, contact-stabilization tanks and on the membrane surface shows the presence of a few dominant bacterial species as well as its role in the process of color and COD removal. Based on biochemical tests, this study was able to identify some of those dominant bacteria. They were *K.ozaenae* BK, *S. hominis* BTM, *S. auricular* BTP2, and *P. pseudomallei* BTP1. In addition to act as color removal bacteria in anoxic tank, these bacteria also served to eliminate COD and degrade organic compounds in stabilization tank. On the surface of the membrane, species *Citrobacter freundii* B2 was found to be the dominant microorganism in addition to *S. auricular* BTP2 and *K.ozaenae* BK. These bacteria were classified as attached growth bacteria that had the ability to remove azo dye color and organic compounds. Bacterial population dynamic involved in the removal and degradation of azo dye and COD, was strongly influenced by the concentration of co-substrate and environmental conditions in the MBR.

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LIST OF ABBREVIATION

MBR: Membrane Bioreactor, VSS: Volatile Suspended Solid, COD: Chemical Oxygen Demand, DO: Dissolved Oxygen, SRT: Sludge Retention Time, HRT: Hydraulic Retention Time

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