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The 5th *EnvironmentAsia*
International Conference

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The 5th *EnvironmentAsia* International Conference on Transboundary Environmental Nexus: From Local To Regional Perspectives

Chiang Mai University
TSHE

The 5th *EnvironmentAsia*
International Conference on
Transboundary Environmental Nexus: From Local To Regional Perspectives

PROGRAM AND ABSTRACTS

June 13-15, 2019

at Convention Center, The Empress Hotel,
Chiang Mai, Thailand

LIST OF CONTENTS

WELCOME MESSAGE

The Thai Society for Higher Education on Environment (TSHE) founded in 2005. Originally, TSHE was collaborated among universities and institutes in Thailand that concern solving environmental problems. We aim to enhance the quality and reference of educational and training in Environmental inter-discipline programs to apply in policy and leadership development in the area of natural resources and environment. TSHE has continuously organized the international conference every two year since 2011.

This year 2019, welcome to Chiang Mai, where TSHE is holding our 5th EnvironmentAsia International Conference "**Transboundary Environment Nexus from Local to Regional Perspectives**". This event is an extremely valuable opportunity to connect and share information with those in government, industry, consulting, environmental professionals and academia. I am proud to be part of this esteemed regional conference, providing a neutral forum for the discussion and debate on important environment issues. Everyone is encouraged to attend the meetings to participate or just observe. Check the program schedule for meeting date and times.

I would like to especially thank our Chair conference, Assistant Professor Dr. Somporn Chantra, Chiang Mai University, local host committee team, our dedicated TSHE staff, as well as our generous sponsors and exhibitors. Without their support and hard work this conference would not be possible.

On behalf of the Thai Society of Higher Education Institutes on Environment (TSHE), I am delighted to welcome all participants to learn, to meet and have fun exploring Chiang Mai. Thank you for joining us, and hope you enjoy your time at our conference.

Professor Dr. Wanida Jinsart
TSHE President

MESSAGE FROM CHIANG MAI UNIVERSITY

It is an honor for Chiang Mai University to co-organize this 5th Environment Asia International Conference together with the Thai Society of Higher Education Institute. The current Chiang Mai University Educational Development Plan considers "Environment and Energy" as one of its key strategies and is fully supportive of education and research relating to the environment including renewable energy, sustainable environment, and a green campus.

Even though Northern Thailand is blessed with magnificent natural surroundings, it is not without its environmental problems. However, there is cause for optimism. Various global movements are addressing these problems and this conference is a good example of one of them. I truly believe that events such as this in which new research findings are shared can lead to solutions to the ongoing problems. The conference's main theme of "Transboundary Environmental Nexus, from Local to Regional Perspectives" is very timely since many environmental issues are borderless. The recurring air pollution problem in Northern Thailand is an example of how local actions are needed to create regional impacts.

We therefore hope that this conference will highlight research results findings from both local and international researchers to tackle this and other environmental issues. It is also an opportunity to hear about exciting new areas of technology and innovations in the environmental field. In closing, I wish you all a fruitful and rewarding conference and I hope you can take the time to visit our campus and enjoy the many cultural attractions on offer in Chiang Mai.

Thank you.

N. Nantachit

Clinical Professor Niwes NANTACHIT, M.D.
President of Chiang Mai University, Chiang Mai, Thailand

MESSAGE FROM CONFERENCE CHAIR

It is a great honor for the Environmental Science Research Center (ESRC), Chiang Mai University to co-organize this important international conference in conjunction with the Thai Society of Higher Education Institutes of Environment (TSHE) here in the city of Chiang Mai.

This conference brings together scientists and environmentalists to address environmental issues and provide a forum for international cooperation for an environmentally sustainable world. The search for a global policy to cope with current and projected environmental dynamics requires international collaboration. There are 5 conference sessions covering all aspects of environmental sciences: 1) Environmental Science and Technology, 2) Natural Resources Management and Sustainability, 3) Environmental Engineering, 4) Environmental Management, and 5) Environmental Pollution and Health Impacts.

We are delighted to welcome guests from the US Consulate here in Chiang Mai and the Ministry of Natural Resources and the Environment. There are also numerous invited speakers from universities and organizations in Europe, North America, and Asia, including Thailand. Conference sessions will be chaired by experts in their respective fields.

The ESRC is particularly excited as a new international Bachelor's degree in Environmental Science (ES) will be offered for the first time starting this August. The new program has already attracted much interest both at home and abroad. The Faculty of Science has been offering international graduate degrees in Environmental Science for many years. This year is also an auspicious year for the Faculty as it is its 55th anniversary which is being celebrated with a series of events. Co-organizing this conference is one of the highlights. It should also be mentioned that Chiang Mai University has supported the ESRC in establishing a Center of Excellence in Environmental Science to conduct innovative research.

I would therefore like to thank most sincerely the Thai Society of Higher Education Institute on Environment for trusting us to co-organize this important conference. The various contributions of the national and international co-organizers as well as the financial support of the corporate sponsors are greatly appreciated.

On behalf of the ESRC, I hope that you will find the conference both informative and very rewarding and I wish you an enjoyable stay here in Chiang Mai.

Thank you.
Best wishes,

Assistant Prof. Dr. Somporn CHANTARA
Head of Environmental Science Research Center (ESRC)
Faculty of Science, Chiang Mai University, Chiang Mai, Thailand

OPENNING REMARK

On behalf of the Ministry of Natural Resources and Environment, the Royal Thai Government, I would like to express our sincere appreciation to the Thai Society of Higher Education Institutes on Environment (TSHE) and the Faculty of Science, Chiang Mai University, the organizer of the 5th EnvironmentAsia International Conference for inviting us to join the conference. It is timely and important event as we just celebrated the World Environment day last week under the theme of "Beat Air Pollution."

The World Environment Day takes place every year on June 5 . Since the first celebration in 1974 where the topic was "only one Earth," it has become the largest annual celebration of the environment, with millions of people joining in to leave a lasting legacy for the planet. The theme of this year is formulated by China as the host country, aiming to spur governments, industry and individuals to come together to explore renewable energy and green technologies and improve air quality across the world. According to the World Health Organization, every year, around 7 million people die prematurely from diseased caused by air pollution and approximately, 4 million of these deaths occur in the Asia Pacific region. It is apparently that this complex challenge demands immediate attention and action. We, thus, need to act now.

However, not only air pollution but also other environmental problems such as marine debris and wildlife trafficking are transboundary issues.

Ladies and Gentlemen, You may know very well that Thailand, as the Chair of ASEAN, is going to host the ASEAN SUMMIT during June 22-23. We highly anticipate that the outcomes of the SUMMIT will include the declarations and frameworks of action on the transboundary environmental issues, particularly on the issues of marine debris and wildlife trafficking. This will significantly advance our partnership for sustainability.

Thailand faces the same challenges on air pollution and other environmental problems as the other countries in the Region. Cities in the country including Bangkok and Chiang Mai were choked by high level of air pollution and have been struggling with tons of trash. In this regard, I am very please to inform you that we have already started a new pathway to deal with the environmental issues both at the national and international level under our long term national strategy or so call "20 years National Strategy," in which I will further elaborate during the panel discussion.

Having said that, I would like to conclude that the theme of our conference on "Transboundary Environmental Nexus, from Local to Regional Perspectives," is fully concurred with the current trend and situation.

I wish that all of us will have the productive deliberation during the conference and come up with the fruitful outcomes.

Last but not least, I hope that apart from heavy discussion in the conference room, you will have time to explore and enjoy the beautiful city of Chiang Mai.

With this, I would like to declare this 5th EnvironmentAsia International Conference open.

Thank you.

A Krairapanond

Dr. Asdaporn KRAIRAPANOND

COMMITTEE

Chair

Assistant Professor Dr. Somporn Chantara
Chiang Mai University

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Thammasat University
Dr. Wan Wiriya
Chiang Mai University

KEYNOTE SPEAKER, PANELISTS AND INVITED SPEAKERS

Keynote speaker

Mr. Mozaharul Alam	*Regional Coordinator for Climate Sub-Programme, United Nations on Environment Programme (UNEP)*

Panelists

Ms. Vi. L. Jacobs-Nhan	*Political, Economic, and Public Affairs Section Chief, U.S. Consulate Chiang Mai, Thailand*
Dr. Asdaporn Krairapanond	*Inspector General, Ministry of Natural Resources and Environment, Thailand*
Prof. Thares Srisatit	*President of Environmental Engineering Association of Thailand*
Assoc. Prof. Dr. Mark Morgan	*University of Missouri, Missouri, USA*
Prof. Dr. Chongrak Polpresert	*Thammasat University, Thailand*
Prof. Dr. Akira Kondo	*Osaka University*
Assoc. Prof. Dr. Sarawut Thepanondh	*Mahidol University, Thailand*

Invited speakers

Prof. Dr. Tamao Kasahara	*Kyushu University, Japan*
Dr. Thanapong Duangmanee	*Mae Fah luang Foundation, Thailand*
Prof. Dr. Akira Kondo	*Osaka University, Japan*
Prof. Dr. Kunio Kawamura	*Hiroshima Shudo University, Japan*
Prof. Dr. Eiji Yano MD	*Teikyo University, Japan*
Prof. Dr. Warren Y. Brockelman	*Mahidol University, Thailand*
Prof. Dr. Akihiko Terada	*Tokyo University of Agriculture and Technology, Japan*
Dr. Alice Sharp	*Chiang Mai University, Thailand*
Dr. Tippawan Prapamontol	*Chiang Mai University, Thauland*
Assoc. Prof. Dr. Sarawut Thepanondh	*Mahidol University, Thailand*
Dr. Sarah Clement	*University of Liverpool, England*
Prof. Dr. Shin'ichi Okamoto	*Tokyo University of Information Sciences, Japan*
Asst. Prof. Dr. Yanyong Inmuong	*Mahasarakam University, Thailand*
Dr. Stephen D.Elliott	*Chiang Mai University, Thailand*
Assoc. Prof. Dr. Mark Morgan	*University of Missouri, Columbia*

PROGRAM

The 5th EnvironmentAsia International Conference on

"Transboundary Environmental Nexus: from the local to regional perspectives"

13-15 June 2019

The Empress Hotel, Chiang Mai, Thailand

June 13, 2019

09.00 – 09.30	**Opening Ceremony**
	• **Welcome remarks** **Clinical Professor Niwes Nantachit, M.D., FRCP(T)** *President of Chiang Mai University* **Professor Dr. Wanida Jinsart** *President of Thai Society of Higher Education Institutes on Environment (TSHE)* • **Opening remarks** **Dr. Asdaporn Krairapanond** *Inspector General, Ministry of Natural Resources and Environment, Thailand*
9.30 – 10.00	**Keynote speech "Transboundary Climate Risk and Seizing Opportunities"** **Mr.Mozaharul Alam** *Regional Coordinator for Climate Sub-Program, United Nations on Environment Programme (UNEP)*
10.00 – 10.30	**Refreshment**
10.30 – 12.00	**Panel Discussion "Environmental Policy : local to regional perspectives"** **Panelists** **Ms. Vi. L. Jacobs-Nhan** *Political, Economic, and Public Affairs Section Chief, U.S. Consulate Chiang Mai, Thailand* **Dr. Asdaporn Krairapanond** *Inspector General, Ministry of Natural Resources and Environment, Thailand* **Prof. Thares Srisatit** *President of Environmental Engineering Association of Thailand* **Assoc. Prof. Dr. Mark Morgan** *University of Missouri, Missouri, USA.* **Moderator: Prof. Dr. Siwatt Pongpiachan** *National Institute of Development Administration, Thailand*
12.00 – 13.00	**Lunch**
13.00 – 16 .55	**Oral Presentation**

June 13, 2019

17.00 - 18.00	**Poster Presentation (All posters from session I & II)**
18.30 – 20.30	**Welcome Dinner**

June 14, 2019

09.00 – 10.30	**Panel Discussion "Transboundary pollution management"** **Panelists:** **Prof. Dr. Chongrak Polpresert,** *Thammasat University* **Prof. Dr. Akira Kondo,** *Osaka University* **Assoc. Prof. Dr. Sarawut Thepanondh** Mahidol University, Thailand **Moderator: Prof. Dr. Steve Edwards,** *University of Liverpool,UK*
10.30 – 11.00	**Refreshment**
11.00 – 12.00	**Poster Presentation (All posters from session III-V)**
12.00 – 13.00	**Lunch**
13.00 – 16.30	**Oral Presentation**
16.30 - 17.30	**Closing Remarks by President of TSHE**

June 15, 2019

Excursion	Conference Excursion (Optional) 1. Chiang Mai History Tour 2. Touch of Nature Tour 3. 25 years of Forest Restoration Research Tour

June 13, 2019					
Session	**I** **Envi Sci Tech**	**II** **Nat Res Man**	**III** **Envi Eng**	**IV** **Envi Man**	**V** **Envi poll and Health**
Room	Chiang Mai 4-5	Chiang Mai 3	Board Room 4	Chiang Mai 2	Chiang Mai 1
Session Chair	Assoc. Prof. Dr. Jaroon Jakmunee Chiang Mai University	Dr. Mike le Duc University of Liverpool	Prof. Dr. Akihiko Terada Tokyo University of Agriculture and Technology	Asst. Prof. Dr. Yanyong Inmuong Mahasarakam University	Senior Asst.Prof. Dr. Yoko Tsuda *Teikyo University*
Co-chair	Dr.Chidsanupong Chart-asa Chulalongkorn University	Asst. Prof. Dr. Ratcha Chaichana Kasetsart University	Assoc. Prof. Dr.Pongsak Noopan Kasetsart University	Dr. Sumeth Wongkiew Chulalongkorn University	Asst. Prof. Dr. Uma Langkulsen Thammasat University
(Special Talk) 13.00 – 13.20	I-1-i Prof. Dr. Tamao Kasahara Kyushu University	II-1-i Dr. Thanapong Duangmanee Mae Fah luang Foundation	III-1-i Prof. Dr. Akira Kondo Osaka University	IV-1-i Prof. Dr. Kunio Kawamura Hiroshima Shudo University	V-1-i Prof. Dr. Eiji Yano MD Teikyo University
13.20 – 13.40	EST-O-01 (13.20-13.35)	II-2-i Prof. Dr. Warren Y. Brockelman Mahidol University	III-2-i Prof. Dr. Akihiko Terada Tokyo University of Agriculture and Technology	IV-2-i Assoc,Prof.Dr. Alice Sharp Chiang Mai University	V-2-i Dr. Tippawan Prapamontol Chiang Mai University
13.40-13.55	EST-O-02 (13.35-13.50)	NRMS-O-01	EE-O-01	EM-O-02	EPHI-O-02
13.55-14.10	EST-O-03 (13.50-14.05)	NRMS-O-02	EE-O-02	EM-O-03	EPHI-O-03
14.10-14.25	EST-O-04 (14.05-14.20)	NRMS-O-03	EE-O-03	EM-O-04	EPHI-O-04
14.25-14.40	EST-O-05 (14.20-14.35)	NRMS-O-04	EE-O-04	EM-O-05	EPHI-O-05
14.40-14.55		NRMS-O-05	EE-O-05		EPHI-O-06
14.55-15.20	Refreshment				
(Special Talk) 15.20 – 15.40	I-3-i Assoc. Prof. Dr. Sarawut Thepanondh Mahidol University	II-3-i Dr.Sarah Clement University of Liverpool	III-3-i Prof. Dr. Shin'ichi Okamoto Tokyo Uni. Information Sci.	IV-3-i Asst. Prof. Dr. Yanyong Inmuong Mahasarakam University	
15.40 – 15.55	EST-O-06	NRMS-O-06	EE-O-06	EM-O-06	EPHI-O-07
15.55 – 16.10	EST-O-07	NRMS-O-07	EE-O-07	EM-O-07	EPHI-O-08
16.10 - 16.25	EST-O-08	NRMS-O-08	EE-O-08	EM-O-08	EPHI-O-09
16.25 - 16.40	EST-O-10	NRMS-O-09	EE-O-09	EM-O-09	EPHI-O-10
16.40 - 16.55		NRMS-O-10	EE-O-10	EM-O-10	EPHI-O-11
17.00 - 18.00	Poster Presentation (All posters from session I & II				
18.30 – 20.30	Welcome Dinner				

June 14, 2019

Session	I Envi Sci Tech	II Nat Res Man	III Envi Eng	IV Envi Man	V Envi poll and Health
Room	Chiang Mai 3-5	Chiang Mai 2	Board Room 4	Board Room 3	Chiang Mai 1
Session Chair	Assit. Prof. Dr. Panwadee Suwattiga *King Mongkut's University of Technology North Bangkok*	Prof. Dr. Steve Edwards *University of Liverpool*	Prof. Dr. Chongrak Polpresert *Thammasat University*	Prof. Dr. Kunio Kawamura *Hiroshima Shudo University*	Prof. Dr. Eiji Yano MD. *Teikyo University*
Co-chair	Dr.Peerapong Pornwongthong *King Mongkut's University of Technology North Bangkok*	Assoc. Prof. Dr. Patana Anurakpongsatorn *Kasetsart University*	Assit. Prof. Dr.Vorapot kanokkantapong *Chulalongkorn University*	Assoc. Prof. Chuleemas Boonthai *Khon Kaen University*	Dr.Jatuwat Sangsanont *Chulalongkorn University*
(Special Talk) 13.00 – 13.20		II-4-i Dr. Stephen D.Elliott *Chiang Mai University*	III-4-i Prof. Dr. Shin'ichi Okamoto *Tokyo Uni. Information Sci.*	IV-4-i Assoc. Prof. Dr. Mark Morgan *University of Missouri*	V-4-i Senior Asst.Prof. Dr. Yoko Tsuda *Teikyo University*
13.20–13.35	EST-O-11	NRMS-O-11	EE-O-11	EM-O-11	EPHI-O-12
13.35-13.50	EST-O-12	NRMS-O-12	EE-O-12	EM-O-12	EPHI-O-14
13.50-14.05	EST-O-13	NRMS-O-13	EE-O-13	EM-O-13	EPHI-O-15
14.05-14.20	EST-O-14	NRMS-O-15		EM-O-14	EPHI-O-16
14.20-14.35	EST-O-15				
14.35-15.00	Refreshment				

Session	I Envi Sci Tech	I Envi Sci Tech	V Envi poll and Health	V Envi poll and Health
Room	Chiang Mai 3-5	Chiang Mai 2	Chiang Mai 1	Board Room 4
Session chair	Assist. Prof. Peerapong Pornwongthong *King Mongkut's University of Technology North Bangkok, Thailand*	Assoc. Prof. Dr. Prasit Wangpakapattanawong *Chiang Mai University*	Assoc,Prof.Dr. Alice Sharp *Chiang Mai University*	Asst. Prof. Dr. Somporn Chantara *Chiang Mai University*
Co-chair	Lt.Col.Assist.Prof.Dr. Kittiphop Promdee *Chulachomklao Royal Military Academy*	Dr. Sila Kittiwachana *Chiang Mai University*	Asst. Prof. Dr. Chayakorn Pumas *Chiang Mai University*	Dr. Wan Wiriya *Chiang Mai University*
15.00-15.15	EST-O-16	EST-O-21	EPHI-O-17	EPHI-O-21
15.15-15.30	EST-O-17	EST-O-22	EPHI-O-18	EPHI-O-22
15.30-15.45	EST-O-18	EST-O-23	EPHI-O-19	EPHI-O-23
15.45-16.00	EST-O-19	EST-O-24	EPHI-O-20	EPHI-O-25
16.00-16.15	EST-O-20			
16.30-17.30	Closing Remarks by President of TSHE			

Invited speakers

Code	Abstract title	Presenter
I-1-i	Stream-groundwater exchange and organic matter decomposition in headwater streams with different parent lithology in Kyushu, Japan	Prof. Dr. Tamao Kasahara Kyushu University
I-3-i	Atmospheric Dispersion of Polycyclic Aromatic Hydrocarbons from Open Burning of Agricultural Residues	Assoc. Prof. Dr. Sarawut Thepanondh Mahidol University
II-1-i	Natural Resource Management and Sustainable Development at Mae Fah Luang Foundation	Dr. Thanapong Duangmanee Mae Fah luang Foundation
II-2-i	Park protection in a changing landscape: case study of Khao Yai National Park	Prof. Dr. Warren Y. Brockelman Mahidol University
II-3-i	Nature-based solutions for resolving multiple social, economic and environmental challenges: promises and pitfalls	Dr.Sarah Clement University of Liverpool
II-4-i	The science and sociology of restoring Asia's tropical forest ecosystems	Dr. Stephen D.Elliott Chiang Mai University
III-1-i	Analysis of climate change impacts on water resources in the Yodo river basin, Japan	Prof. Dr. Akira Kondo Osaka University
III-2-i	A membrane-aerated biofilm reactor for cost-effective nitrogen removal with low greenhouse gas emissions: Insights from macro and micro scale observations	Prof. Dr. Akihiko Terada Tokyo University of Agriculture and Technology
III-3-i	The transition of air pollution and its countermeasure in Japan	Prof. Dr. Shin'ichi Okamoto Tokyo Uni. Information Sci.
III-4-i	A study on the distribution of Papilionidae in Thailand based on statistical analysis	Prof. Dr. Shin'ichi Okamoto Tokyo Uni. Information Sci.
IV-1-i	Education as a key social system for the global environmental protection on the basis of biosystematic view of civilizations	Prof. Dr. Kunio Kawamura Hiroshima Shudo University
IV-2-i	Climate Change Mitigation and Adaptation in the Local Context	Dr. Alice Sharp Chiang Mai University
IV-3-i	Adaptation to climate change: a new challenge for GMS sustainable development goals	Asst. Prof. Dr. Yanyong Inmuong Mahasarakam University
IV-4-i	Using Asian carp for humanitarian aid in Haiti	Assoc. Prof. Dr. Mark Morgan University of Missouri
V-1-i	Research fund by the tobacco industry	Prof. Dr. Eiji Yano MD Teikyo University
V-2-i	Health effect from exposure to environmental pollution: An insight from smoke-haze pollution study in upper northern Thailand	Dr. Tippawan Prapamontol Chiang Mai University
V-4-i	Biological monitoring for chemical substances	Senior Asst.Prof. Dr. Yoko Tsuda Teikyo University

Session 1 Environmental Science and Technology

Oral presentation

Code	Abstract Title	Presenter
EST-O-01	Decreasing of PM_{10} and $PM_{2.5}$ and PAHs exposures and health risk in urban parks of Bangkok	Ms. Panjamaporn Suwannapun
EST-O-02	Roadside $PM_{2.5}$, PM_{10} and heavy metal composition related to overcrowded traffic and road construction activities in Bangkok	Mr. Paphinwit Thammasaroj
EST-O-03	Long-Term Satellite Assessment of Particulate Matter in Thailand	Mr. Sakonwach Mongkolphew
EST-O-04	-Withdraw-	
EST-O-05	Evaluation of palm oils as hydraulic fluids	Asst. Prof. Anusan Permsuwan
EST-O-06	-Withdraw-	
EST-O-07	Environmental Analysis of Coal Fire Power Plants in Ultra Supercritical Technology Versus Integrated Gasification Combined Cycle	Ms. Dwi Ratna Mustafida
EST-O-08	Nono-Particle ZVI Inhibition Threshold in Cassava Pulp Bio-Methanation	Mr. Htay Aung Pyae
EST-O-10	-Withdraw-	
EST-O-11	Optimization of $Ca(OH)_2$ pretreatment to enhance methane production of rice straw using response surface methodology	Ms. Witthayaporn Kongyoo
EST-O-12	Electrospun Poly (lactic acid)/Polyvinylpyrrolidone Composite for Biodegradable Face Mask	Ms. Pattama Madaeng
EST-O-13	Optimization of microwave-assisted extraction for enhancing reducing sugar of water hyacinth pretreatment before organic fertilizer production at Klong Yong community in Phutthamonthon, Nakhon Pathom, Thailand	Mr. Hendri Rantau Silalahi
EST-O-14	Discrimination of Seismic Events in Lampang Province: A Complexity Approach	Dr. Sukrit Kirtsaen/ Santawat Sukrungsri
EST-O-15	Effect of silver nanoparticles on *Pseudomonas putida* and *Bacillus subtilis* biofilm formation	Ms. Rungnapa Takam
EST-O-16	Comparison of water quality and caddisfly (Trichoptera) communities between old and new reservoirs in Chiang Mai University	Ms. Miatta Kiawu
EST-O-17	Toxicity effects of copper and zinc on physiology of the green microalga, *Chlorella vulgaris* Beyerinck	Mr. Phruetthiphong Phetchuay
EST-O-18	Development of Energy Saving Illumination System for *Arthrospira (Spirulina) platensis* Cultivation in Raceway Pond	Mr. Krit Sirikulrat
EST-O-19	Assessing the effects of copper and zinc toxicity on physiological responses in *Ceratophyllum demersum* L.	Ms. Pornpailin Luengluetham
EST-O-20	Determination of profenofos and cypermethrin in Chinese kale using a modified quick, easy, cheap, effective, rugged and safe method with Fe_3O_4 magnetic nanoparticles	Ms. Nipawan Phosri
EST-O-21	Chlorpyrifos tolerance of *Pseudomonas pseudoalcaligenes* biofilms under water-limiting conditions	Mr. Suthi Rattanaprapha
EST-O-22	Photocatalytic Degradation and Mechanism of Glyphosate Herbicide Contaminated in Water by TiO_2 Pellet Photocatalyst	Ms. Kanokwan Yamsomphong
EST-O-23	Treatment of Highly Colored Wastewater from Commercial Biogas Reactor Discharge using Fenton Oxidation Process	Ms. Hatairut Samakkarn
EST-O-24	Manganese Remediation by Green Microalga in Synthetic and Natural Contaminated Wastewater	Mr. Jakkapong Thongpitak

Poster presentation

Code	Abstract Title	Presenter
EST-P-01	Effects of temperature on chronic toxicity of ZnO in *Daphnia magna*	Ms. Paweena Sanpradit
EST-P-02	Effect of Yeast Volatile Organic Compounds on Growth and Ochratoxin A Production of *Aspergillus carbonarius*	Ms. Pichamon Soma
EST-P-03	Microbial surfactant supplementation to improve the anaerobic digestion of palm oil mill wastewater	Ms. Chittapat Lertbussarakam
EST-P-04	Comparison of anaerobic sequencing batch reactor and anaerobic baffle reactor for biogas production from co-digestion of concentrated latex wastewater and palm oil decanter cake	Mr. Thongchai Wongsuvan
EST-P-05	Relationship Between Habitat Characteristics and Immature Mosquitoes and Their Natural Predators in Chiang Mai City	Ms. Panipak Saetan
EST-P-06	Isolation of crude oil-degrading bacteria and bioremediation of crude oil-contaminated soil microcosms	Ms. Wannarak Nopcharoenkul
EST-P-07	Co-digestion of rice straw with pig manure improves biogas production - effects of pretreatment	Dr. Nam Tran Sy
EST-P-08	Mixture of biogas and air to optimize burning and the evaluation of biogas stoves	Dr. Nam Tran Sy
EST-P-09	Effects of composting on the production of methane in solid-state anaerobic digestion of corncob	Mr. Methit Thammakhet
EST-P-10	Bioethanol from Cassava Starch Using *Amylomyces rouxii* TISTR 3182 and Immobilized *Saccharomyces cerevisiae* TISTR 5088	Ms. Wachiraya Janthachot
EST-P-11	The Water Footprint of Biogas Production Using Microalgal Biomass Cultured with Wastewater from Chicken-Manure Biogas Digester	Mr. Thoranit Moungmoon
EST-P-12	Biogas generated from corn waste by continuous stirred tank reactor using anaerobic bacteria from UASB system	Mr. Piyachet Jinsart
EST-P-13	Correlation between $PM_{2.5}$ levels and VIIRS hotspots during intensive biomass burning period in Nakhon Pathom	Mr. Siraphop Pinitkarn
EST-P-14	Arsenic in rice and paddy soil samples	Ms. Wannee Srinuttrakul
EST-P-15	Investigation of hydrogen-based denitrification performance on nitrite accumulation under various bicarbonate doses	Mr. Suphatchai Rujakom
EST-P-16	Isotopic mass balance approach for verification of shallow groundwater recharge, Phitsanulok	Mr. Wutthikrai Kulsawat
EST-P-17	Equilibrium and Kinetic Study of Adsorption of Lead from Aqueous Solution onto Polyvinyl Alcohol - Alginate Beads Immobilized with Spent Yeast	Asst. Prof. Mongkol Phensaijai
EST-P-18	Evaluation of using a cost-effective open tubular capillary ion chromatograph for some ions determination in environmental samples	Ms. Kanlayarat Tianrungarun
EST-P-19	The effects of heavy metals in sediment on benthic organisms at Pak Phanang river mouth, Nakhon Si Thammarat	Mr. Surasak Sichum/ Dr. Preecha Chuaybumrung
EST-P-20	Novel 3D lab on a chip for determination of phosphate in water samples	Assoc. Prof. Napaporn Youngvises
EST-P-21	Appropriate scenarios for mercury emission control from coal-fired power plant using the iPOG and CALPUFF model	Ms. Vasita Tunlathorntham
EST-P-22	Assessment of hydrogen sulfide concentration and dispersion in ambient air using AERMOD model from Saen Saeb canal in Bangkok, Thailand	Ms. Piyapat Saenpao
EST-P-23	Enhancing the predictive performance of colorimetric sensors using multivariate calibration models	Ms. Nutthatida Phuangsaijai
EST-P-24	Prediction of PM_{10} Concentrations over Upper Northern Thailand using Statistical Approach	Mr. Ammar Gaber

Code	Abstract Title	Presenter
EST-P-25	Lignin Separation from Bagasse and Precipitation by Organic Acid	Ms. Supattra Mataraj
EST-P-26	-Withdraw-	
EST-P-27	A new strategy for coproducing high-value commodity chemicals and liquid hydrocarbon fuels from lignocellulosic biomass	Mr. Kim Hyunwoo
EST-P-28	Volatile oil and extracts from leaves of *Seseli mairei*	Dr. Napapha Promsawan
EST-P-29	Adsorption of Basic Red 29 Using Magnetic Activated Carbon	Asst. Prof. Panjai Saueprasearsit
EST-P-30	Photocatalytic degradation of organic pollutants by monoclinic $BiVO_4$ photocatalyst synthesized by a microwave radiation method	Ms. Wimonnat Choklap
EST-P-31	The Study of Wastewater Treatment Efficiency Chiang Rai Rajabhat University	Ms. Pinatthinee Jitkham
EST-P-32	People and data: two factors for sustainable of water quality management in Pak Phanang river basin	Ms. Karanrat Thammarak

Session 2 Natural Resources Management and Sustainability

Oral presentation

Code	Abstract Title	Presenter
NRMS-O-01	Ecological Aspects of Dhole in Huai Kha Khaeng Wildlife Sanctuary, Uthai Thani Province	Assoc. Prof. Ronglarp Sukmasuang/Khwanrutai Charaspet
NRMS-O-02	Traditional Ecological Knowledge of Indonesian Sea Nomads "Orang Suku Laut" on Climate Change Adaptation	Mr. Wengki Ariando
NRMS-O-03	Valuing ecosystem services from organic agroecosystem as an approach for natural resource management at Gasa, Bhutan	Ms. Serki Wangmo
NRMS-O-04	Economic return of crop rotation and reduction of open-air rice straw burning in rice-based cropping system in Northern Thailand	Mr. Kamthorn Thambhitaks
NRMS-O-05	The Development of A Liveable Agricultural Community Through Community-Based Natural Resource Management: A Case Study of Salaengphan Sub-District, Lamplaimat District, Burirum Province, Thailand	Ms. Imporn Ardbutra
NRMS-O-06	Assessing of Water Balance Components in Dry Dipterocarp-Forested Watershed in Phayao, Thailand	Ms. Phenruedee Khamsorn
NRMS-O-07	Satellite Remote Sensing for Agricultural Mapping at Nang Lae Sub-district, Mueang Chiang Rai District, Chiang Rai Province	Dr. Krittawit Suk-ueng
NRMS-O-08	Water footprint of super absorbent polymer process	Mrs. Amonwan Choodonwai
NRMS-O-09	-Withdraw-	
NRMS-O-10	Identifying and locating trees of framework species using photography from an unmanned aerial vehicle (UAV)	Mr. Krishna Bahadur Rai
NRMS-O-11	Relationship between topographic wetness index and soil thickness in Nam Hia creek catchment, Phetchabun, Thailand	Mr. Rugkiet Chansorn
NRMS-O-12	Assessment of the Lower Ping Rivers bank erosion and accretion, Northern Thailand using geospatial technique; implication for river flow and sediment load management	Mr. Nikhom Chaiwongsaen
NRMS-O-13	-Withdraw-	
NRMS-O-15	-Withdraw-	

Poster presentation

NRMS-P-01	Soil and Water Quality Assessments for Agricultural Uses in Nang Lae Sub-district, Mueang District, Chiang Rai Province	Dr. Kittichai Chantima
NRMS-P-02	-Withdraw-	

Code	Abstract Title	Presenter
NRMS-P-03	Payment for ecosystem services of dry Dipterocarp forest at Phu Kao, Nongbua Lamphu, Thailand	Asst. Prof. Dr. Adcharaporn Pagdee
NRMS-P-04	Potential alternative to conventional fungicides to control fungal phytopathogen by biosurfactant-producing *Bacillus licheniformis* F2.2	Ms. Sirita Siammai
NRMS-P-05	Physical and Chemical Properties of Groundwater and Surface Water for Water Resource Management in Wiang Pa Pao Basin, Chiang Rai Province	Ms. Chirapa Tanya
NRMS-P-06	Biosurfactant from *Bacillus velezensis* B49 as an alternative to chemical fungicide to inhibit the growth of fungal plant pathogen	Mr. Siraphop Pumiputikul
NRMS-P-07	Valuing Benefits of Soil Conservation to Support Payment for Ecosystem Services in Mae Sa Watershed, Chiang Mai Province	Ms. Oraphan Pradit
NRMS-P-08	Aquatic insect diversity in non-disturbed and disturbed areas at Nong Kom Koh, Nong Khai province	Ms. Narumol Piwpuan
NRMS-P-09	Quality and production cost of seedlings grown with different root pruning techniques.	Ms. Preeyaphat Chaiklang
NRMS-P-10	-Withdraw-	
NRMS-P-11	-Withdraw-	
NRMS-P-12	Assessment of soil organic carbon and available micronutrients: A comparison between burning and non-burning paddy fields	Asst.Prof.Pasicha Chaikaew Ms. Boonyaporn Juethong, Mr.Phanupong Wongchan

Session 3 Environmental Engineering

Oral presentation

Code	Abstract Title	Presenter
EE-O-01	The Effect of the Solid Retention Time on Simultaneous COD, TKN, and TP Removal from Slaughterhouse Wastewater Using Sequencing Batch Reactor	Ms. Siriluck Pinvattanachai
EE-O-02	Full Scale of Trickling Filter Wastewater Treatment Systems: case study between Phuket, Thailand and Englewood/Littleton Colorado, USA	Assoc. Prof Dr. Pongsak (Lek) Noophan
EE-O-03	Start-up of aerobic granulation in sequencing batch reactors treating acetate synthetic wastewater	Ms. Saengjan Boonket
EE-O-04	-Withdraw-	
EE-O-05	-Withdraw-	
EE-O-06	Removal of 1,4-dioxane by cellulose acetate and polyvinylidene fluoride blend membrane with titanium dioxide additive	Asst. Prof. Peerapong Pornwongthong
EE-O-07	Fouling of PVDF Hollow-Fiber Microfiltration Membrane at Filtering Tannic Acid and Iron Oxide Containing Feed Water	Ms. Mariny Chheang
EE-O-08	Application of Modified Airlift Reactor for Ferrous Iron Oxidation-Precipitation: Kinetics and Influences of Process Conditions	Mr. Saret Bun
EE-O-09	Optimization of Factors Affecting the Biosynthesis of Silver Nanoparticles Using Orange Peel Extract	Ms. Cathleen Simatupang
EE-O-10	Inactivation of tetracycline-resistant bacteria by a combination of chlorine and UV irradiation	Ms. Narissara Chareewan
EE-O-11	The effect of bentonite on the properties of landfill liner from clay mixed with industrial wastes	Mr. Woottipong Prakongwittaya
EE-O-12	The effect of Na_2O/SiO_2 and SiO_2/Al_2O_3 ratios on engineering properties of alumino-silicious materials solidified plating sludge	Ms. Parichat Muensita
EE-O-13	Utilization of Bagasse Ash in Interlocking Block Production	Dr. Rungroj Piyaphanuwat

Poster presentation

Code	Abstract Title	Presenter
EE-P-01	The study on the effects of chemical coagulation and cost estimates throughout the water supply treatment cycle of Phichit provincial waterworks authority	Ms Somsamai Khamching
EE-P-02	PM_{10} and dust fall concentrations of mobile sources in Sukhothai Municipality	Mr. Nattaphong Moomuangsong
EE-P-03	-Withdraw-	
EE-P-04	COD and heavy metal of dry deposited particles on bituminous road shoulder in Tak province	Mr. Parinya Prasertsang
EE-P-05	Composition of dry deposition from roads construction and management	Mr. Thanadet Yiangyong
EE-P-06	-Withdraw-	
EE-P-07	Enhance nitrate removal by cation supplying: The role of plants in wastewater treatment	Assoc. Prof. Arunothai Jampeetong
EE-P-08	Arsenic adsorption mechanisms by iron oxide particles and iron oxide coated sands	Mr. Ramy Lun
EE-P-09	Scale-up factor of Cr-free Fe-Al-Cu catalyst for hydrogen production from waste-derived synthesis gas via the water gas shift reaction	Asst. Prof. Won-Jun Jang
EE-P-10	Investigation on the preparation method of Ni-Cu-CeO_2 oxide catalyst for hydrogen production from waste-derived synthesis gas	Ms. Min-Ju Park
EE-P-11	Performance of bimetallic NiCu-CeO_2 catalyst to produce hydrogen via high temperature water gas reaction using waste-derived syngas	Mr. Ju-Hwan Kim
EE-P-12	Methane Reforming of Highly Active and Stable Ni−Ce−ZrO_2 Catalyst for Gas to Liquids (GTL) in Combined H_2O and CO_2	Mr. Tae-Gwang Kim
EE-P-13	The comparison of catalyst activity according to Cu-$Ce_xZr_{1-x}O_2$ catalyst structure for low temperature water gas shift reaction	Ms. Yun-Jung Gu
EE-P-14	Evaluation of Loading of Masan Bay Streams using Load Duration Curve	Eun-Taek Bae
EE-P-15	Study on spectral characteristics and load calculation of compost based on UAV	Mr. Geon-Ung Park
EE-P-16	Bioconcentration of hazardous chemical in *Oryzias latipes*	Ms. Hyeonjeon Cha
EE-P-17	A study on lifetime characteristics of insoluble catalyst anode by interlayer formation method	Mrs. Mi-Jung Park

Session 4 Environmental Management

Oral presentation

Code	Abstract Title	Presenter
EM-O-02	Comparing the results of people participation implementation in environmental management from case of Bangpakong Combined Cycle Power Plant number 5 and case of crude oil leak crisis Samed island, Rayong Province	Mr. Danai Bawornkiattikul
EM-O-03	-Withdraw-	
EM-O-04	Walkability Indexes of Current Pedestrian Facilities nearby Universiti Putra Malaysia, Serdang Campus	Dr. Nazatul Syadia Zainordin
EM-O-05	Potential of *Sphingobium yanoikuyae* to eliminate H_2S in biogas	Ms. Saowaluck Haosagul
EM-O-06	-Withdraw-	
EM-O-07	Performance of Pitaya Production by Using Life Cycle Methods: A Case Study In Selangor, Malaysia.	Dr. Amir Hamzah Sharaai
EM-O-08	-Withdraw-	
EM-O-09	Length and Weight Relationship and Fish Condition of Non-Native Fish Species in Selected Recreational Lakes, Kuala Lumpur, Malaysia	Dr. Rohasliney Hashim

Code	Abstract Title	Presenter
EM-O-10	Microplastics in Asian green mussels (*Perna viridis*) cultured in Bacoor Bay, Philippines: Qualitative Assessment and a Closer Look on Local Management Practices	Mr. Cristian Ryan Argamino
EM-O-11	An investigation and environmental evaluation on rigid polyurethane foam waste disposal in Thailand	Ms. Soraya Suwannafon
EM-O-12	Assessment of the local government's solid waste management system in Carmona, Cavite: a 'Wasteaware' benchmark indicator approach customized to Philippine setting	Mr. Remsce Pasahol
EM-O-13	An investigation and Assessment of the Material and Pollutant Pathway from Dismantling of Refrigerator in Thailand	Ms. Thidapon Ketthong
EM-O-14	Development of rural water supply sustainability index and assessment	Dr. Jutamas Kaewsuk
Poster presentation		
EM-P-01	Infectious waste management among health personnel on sub-district health promoting hospital in Sukhothai province	Mr. Sane Saengngoen
EM-P-02	Life cycle assessment of Nanglae pineapple production	Mr. Phanuphat Oonkasem
EM-P-03	"One Health" concept towards environmental transboundary: a prospective wetland ASEAN network	Dr. Kamalaporn Kanongdate
EM-P-04	Identification sources of $PM_{2.5}$ in Thepha, Songkhla Province, Southern Thailand	Ms. Muanfun Inerb
EM-P-05	Estimating human blood cyanide concentration resulting from continuous inhalation of cyanide from a gold mine	Mr. Quoc Tran Ba

Session 5 Environmental Pollution and Health Impacts

Oral presentation

Code	Abstract Title	Presenter
EPHI-O-02	-Withdraw-	
EPHI-O-03	Adsorption of Nickel and Chromium from synthetic wastewater by activated carbon derived from waste rubber tires	Ms. Ketkanok Saeuang
EPHI-O-04	Transboundary Air Pollution in Relation to Open Burning in Upper Southeast Asia	Mr. Souninthone Choommanivong
EPHI-O-05	Modeling of particulate matter in the vicinity of Chatree gold mine in Thailand	Dr. Win Trivitayanurak
EPHI-O-06	Effects of the Chlordane residues on mortality, histology and proteome profile of *Crassostrea iredalei*	Ms. Juthamas Phothakwanpracha
EPHI-O-07	Effects of Organophosphate Insecticides on Acetycholinesterase Activity in Earthworms and Dragonfly Nymph from Highland Rose Cultivation Area in Chiang Mai Province	Mrs. Nout Kanyaphim
EPHI-O-08	-Withdraw-	
EPHI-O-09	Acute effects of diurnal temperature range on hospital admissions for cardiovascular disease in Bangkok, Thailand	Dr. Arthit Phosri
EPHI-O-10	The quantity and type of airborne and surface fungi at the child development center and the beauty salon in Phitsanulok Province	Dr. Sarunya Thiphom
EPHI-O-11	Noise exposure among flower garland sellers who work at the red light intersection of Warinchamrap to Ubon Ratchathani bypass road, Ubon Ratchathani Province	Dr. Laksanee Boonkhao
EPHI-O-12	The inhalation exposure and health effect of PM_{10} of population in faculty of engineering, Naresuan University and particle management	Mr. Theerapon Suksamran
EPHI-O-14	Microplastic pollution in surface water of the Chao Phraya River in Ang Thong area	Mr. Anh Tuan Ta

Code	Abstract Title	Presenter
EPHI-O-15	Microplastic contamination in a typical wastewater treatment plant	Ms. Katekanya Tadsuwan
EPHI-O-16	The spatial variations of water quality and sediment characteristics in the Ishikari Floodplain water body	Mr. Pongpet Pongsivapai
EPHI-O-17	Carbon footprint of Weatherstrip manufacturing	Ms. Methaporn Somsookcharoen
EPHI-O-18	The Phase of Transport Process During Loading from Certificate Oil Truck to Storage Tank	Ms. Kittiya Klaharn
EPHI-O-19	Emission Estimates during Landing/Take-off Activities from the Commercial Aircrafts at Large International Airports in Thailand	Mr. Weerapong Thanjangreed
EPHI-O-20	Determination of $PM_{2.5}$-bound PAHs in Northern Thailand for health risk assessment during open burning season	Ms. Nuttipon Yabueng
EPHI-O-21	Stable carbon isotope composition in $PM_{2.5}$ as a tracer of biomass burning in Chiang Mai City, Thailand	Mr. Sawaeng Kawichai
EPHI-O-22	-Withdraw-	
EPHI-O-23	Feasibility of Air Quality Standard compliance in Phnom Penh: case of PM_{10} and $PM_{2.5}$	Ms. Leakhena Hang
EPHI-O-25	Modeling and Monitoring of Transboundary Particulate Mercury Deposition in Chaloem Phra Kiat District, Nan Province	Asst. Prof. Tanapon Phenrat
Poster presentation		
EPHI-P-01	Monitor and Evaluation of Particle Matter in Police Fort at Thanyaburi Hospital Intersection, Pathum Thani Province	Asst. Prof. Dr. Nisa Pakvilai
EPHI-P-02	PM_{10} and dust fall concentrations of mobile sources in Kamphaeng Phet Municipality	Mr. Sekpinya Suban
EPHI-P-03	Heavy metals accumulation in fish species *Barbonymus gonionotus* and *Tenualosa toil* in an ex-mining lake at Tanjung Tualang, Perak, Malaysia and its potential human health risk	Dr. Zufarzaana Zulkeflee
EPHI-P-04	Using PRTR database to assess human toxicity and eco-toxicity: a case study on emission sources in Rayong province, Thailand	Mr. Krisda Chidsanit
EPHI-P-05	Ambient $PM_{2.5}$ and its ion composition in Chiang Mai Provinces during open burning season 2018	Miss Patcharee Saejiw
EPHI-P-06	Identification of micro-plastics in different brands of bottled water in Thailand	Ms. Dinuka Kankanige
EPHI-P-07	Levels of Saxitoxins Toxicity in Relation to Body Size of Green Mussel (*Perna viridis*)	Ms. Phatchad Nochit
EPHI-P-08	Determination of elemental composition of ambient PM_{10} and $PM_{2.5}$ during open burning season in Chiang Mai, Thailand	Ms. Tantaraporn Charoenporn
EPHI-P-09	-Withdraw-	
EPHI-P-10	-Withdraw-	
EPHI-P-12	A study of urinary metabolomic profiles in COPD patients during smoke haze pollution in Northern Thailand	Dr. Warangkana Naksen
EPHI-P-13	The heavy metal concentrations in *Panicum repens* L. and in soil at solid municipal waste landfill site, Nakhon Si Thammarat	Dr. Chuthamat Rattikansukha/Thanyalak Buctchamni
EPHI-P-14	Population structure and diversity of marine Gastropods along the shoreline of a nickel mining site in Carrascal, Surigao del Sur	Prof. Rizza May Canete, Cesar G. Demayo
EPHI-P-15	Heavy metals in Thai honey	Dr. Chuleeporn Saksangawong
EPHI-P-16	Evaluation of eutrophication state of Mae Kuang Reservoir, Chiang Mai, Thailand by using Calson's Trophic State Index	Mr. Songpon Saetang
EPHI-O-13	Nitrogen Dioxide Concentration and Health Risk Assessment in Tourist Attraction in Nakhon Si Thammarat, Thailand	Dr. Rungruang Janta

ABSTRACTS

INVITED SPEAKERS

I-1-i

Stream-groundwater exchange and organic matter decomposition in headwater streams with different parent lithology in Kyushu, Japan

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Abstract

Headwater streams in forested watersheds are dependent on allochthonous organic matter, and their storage and decomposition are of great importance. Streambed sediments are one of the crutial storage zones, and the zone close to the channel supports stream organisms and is influenced by stream-groundwater interaction. In this study, we examined the effects of stream-groundwater exchange on organic matter decomposition in headwater streams with 4 different types of parent lithology; granite, pelitic schist, andesite, and welded tuff. The standardized cotton-strip assay was used to evaluate organic matter decomposition rate in summer months of July and August in 2017. The results showed that the decomposition rates were highest in the streams with pelitic schist, which had high rate of stream-groundwater exchange, and lowest in streams with welded tuff, which had low stream-groundwater interaction. The streams with granite and andesite showed intermediate rates. The decomposition rate in the streambed sediments is lower than the one in channel, but the streams with high rate of stream-groundwater exchange showed similar decomposition rates both in the sediments and the channel. These suggest that stream-groundwater exchange influence organic matter decomposition, and because the exchange rate differ, the importance of the streambed sediments as a zone of decomposition differ among geologic types.

Keywords: headwater, organic matter decomposition, parent lithology

I-3-i

Atmospheric Dispersion of Polycyclic Aromatic Hydrocarbons from Open Burning of Agricultural Residues

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Abstract

CALPUFF (California Puff Mesoscale Dispersion Model) was applied to simulate concentrations and the spatial distributions of polycyclic aromatic hydrocarbons (PAHs) emitted from open burning of maize residues in Chiang Rai, Thailand. The model was simulated during the burning season. The 95th percentile values of 24-h average concentration of total PAHs at 117 specified ground level receptors were calculated. Spatial distribution of predicted concentration is also illustrated. The modeled results indicated that the open burning of maize residues contributed to high PAHs concentration in particularly at the receptors located near the burned areas. The cancer risk of carcinogenic PAHs was evaluated using the calculation of Benzo(a)Pyrene equivalent (BaPeq). The results show that the calculated BaPeq values on daily basis ranged from 0.1–18.6 ng m^{-3}. These concentrations exceeded the Chinese's standard of 2.5 ng m^{-3} at 26 receptors among 117 receptors. It was estimated that about 20% of the population living in Chiang Rai was exposed to PAHs at this level. This finding suggests that the open burning of maize residues could significantly contribute to high cancer risk to local population. It is expected that the outcome of this study can support the setting up an appropriate mitigation strategy for reducing their emissions and health impacts on population in the affected areas.

Keywords: Polycyclic aromatic hydrocarbons, CALPUFF, Agricultural waste burning, Risk assessment

II-1-i

Natural Resource Management and Sustainable Development at Mae Fah Luang Foundation

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Abstract

The Mae Fah Luang Foundation under Royal Patronage (MFLF) is a not-for-profit organization founded in 1972 by the Princess Mother (HRH Princess Srinagarindra, the late grandmother of King Rama X) of Thailand. MFLF is recognized for its sustainable development (SD) model, based on holistic approach to livelihood enhancement, environmental restoration and protection, education, health and cultural preservation, through the application of social entrepreneurship and community empowerment. As the MFLF flagship, the Doi Tung Development Project, helps communities who used to grow poppy for opium to transition to legitimate livelihood of growing premium quality coffee, macadamia nuts and pursuing opportunities in horticulture, high fashion textiles, home décor accessories and tourism. Profits from the DoiTung brand are invested back in development activities, making Doi Tung one of the first social enterprises in Thailand. “Cultivate Land, Cultivate People” is the Foundation principle to enable people and nature to co-exist in harmony. The Foundation believes that the root cause of deforestation is poverty as people expand cultivation area into the forest to increase more income. As a result, through food security and holistic livelihood development as well as sustainable land-use management which economic forestry and value adding activities are key factors, people earn stable and long-term income and no longer need to encroach the forest. In addition, people participation and empowerment throughout the development process allows the people to have community-based rules and regulations on sustainable natural resource management – a culture of lawfulness from grassroots. The speaker will also share about other Foundation’s environmental conservation activities, such as waste management, renewable energy utilization, energy conservation, water saving, and greenhouse gas reduction. This is to give the audience a more complete view of the Foundation’s natural resource management and sustainability development.

Keywords: Air quality, Monitoring, Aerosol formation, Transport, Climate

II-2-i

Park protection in a changing landscape: case study of Khao Yai National Park

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Abstract

The success of national park management depends greatly on the social and economic conditions of communities in the landscape surrounding the park. Communities around the park are the source of encroachment problems and poachers of wildlife. Having worked on projects in and around Khao Yai National Park since the 1970s, we have observed drastic changes that have occurred in the local landscape and in management success over a span of about 40 years. In the 1980s, poor farmers encroached on Forest Department land bordering the park and their fields of corn and other crops encroached up the mountainsides and into the park. The park boundary had not been surveyed and marked on the ground. In the village of Ban Sap Tai, several conservation projects were initiated by NGOs to provide economic help to villagers and stop them from poaching wildlife. Starting in the 1980s, park officials began marking the boundary and patrolling was increased. During the subsequent economic land booms in Thailand, scenic lands surrounding the park gradually fell into the hands of wealthy developers and Bangkok residents desiring weekend residences. Recent visits to Ban Sap Tai found few of the original poor residents, some of them working for wealthy land owners. The unpredicted economic transformation of the landscape around Khao Yai Park has completely changed the management problems and threats facing the park. The park boundary is now generally well-marked, but what should have been a buffer zone surrounding the park is now occupied by intensive development of resorts and homes for the wealthy.

Keywords: National park, Forest management, Economic development, Poverty

II-3-i

Nature-based solutions for resolving multiple social, economic and environmental challenges: promises and pitfalls

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Abstract

Nature-based solutions (NBS) have emerged as a 'new' concept driving environmental investment, particularly in European cities. NBS refers to a family of approaches inspired or supported by nature that target societal challenges whilst also providing a wide range of social and ecological benefits. They are presented as cost-effective, innovative and responsive interventions, with both policy and academic literature promising improved air quality, water management, climate change mitigation and adaptation, social justice, community cohesion, economic development, biodiversity conservation, and more. While there are data supporting some of the benefits proposed in the literature, many of the promises are based on hypothesised relationships and are not yet supported by robust evidence. Although the term itself is relatively new, it builds on older concepts from landscape planning, ecology, and natural resource management. Yet there are questions about whether it provides added value beyond existing approaches in environmental planning and management, or whether it is little more than a re-framing and re-badging of more established approaches. While there is a great deal of investment in NBS in Europe, including work to improve the evidence base for their use, there are questions over whether the practical implementation of NBS aligns with the principles established by researchers and environmental organisations. In particular, there is a focus on smaller-scale, 'innovative' NBS interventions in practice. Not only are these often much more expensive than conventional approaches (e.g. ecological restoration and green infrastructure interventions), they need to be part of a larger, landscape or ecosystem-based approach, if they are to deliver on the multiple promised benefits. This paper reviews both the promises and the pitfalls of using NBS to address challenges in urban areas and suggests ways in which this discussion could inform more robust, comprehensive approaches to creating more sustainable, just, and resilient cities.

Keywords: green infrastructure, nature-based solution, environmental planning, climate change

II-4-i

The science and sociology of restoring Asia's tropical forest ecosystems

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Abstract

Thirty years ago, reforestation meant monoculture plantations of economic trees. Tropical forests were considered too complex to be restored, and effective restoration techniques did not exist. Since then, ecologists have devised effective techniques to i) protect and encourage natural forest regeneration (e.g. ANR[1]), ii) plant the right trees in the right places (e.g. the framework species method) and iii) ameliorate soils on severely degraded sites. Such techniques maximize recovery of i) biomass (and carbon) and ii) structural complexity, which re-creates the niches that support iii) biodiversity recovery and consequently the species interactions that restore iv) ecological functioning. The 25-year research program of Chiang Mai University's Forest Restoration Research Unit is presented, as a case study.

Attitudes towards restoration have also undergone a paradigm shift. The UN has declared a "Decade of Ecosystem Restoration" (2021-2030) and the Bonn Challenge aims to restore 350 million ha of forests by 2030. However only 34% of the planned reforestation efforts involve natural forest regeneration. The rest are monoculture plantations (45%) and agroforests (21%), even though natural forests sequester 40 and 6 times more carbon, than the former, respectively[2] and they support far higher biodiversity. Whilst scientists have overcome the *technical barriers* to restoration, social/political "scientists" and economists have consistently failed to overcome the *socio-economic barriers*, such as poor governance, lack of funding, failure to motivate stakeholders and an ineffective science-policy interface. The result has been continued clearance of primary tropical forests, at the rate of about 3 million ha/y. Reducing that rate remains a priority, but complete prevention of primary forest clearance is unlikely, so restoration remains an essential counter measure. Even if forest ecosystem restoration contributes only 34% of 350-million-ha Bonn Challenge target, that would result in re-establishment of about 10 million ha/y of forests with carbon and biodiversity levels similar to those of primary forest – more than enough to reverse primary forest losses (by 2030). Scientists have delivered the technical tools to achieve this – now we need the social scientists, economists and politicians to deliver the socio-economic tools.

Keywords: deforestation, forest restoration, framework species method, forest restoration research unit

[1]Assisted natural regeneration
[2]Lewis, S. L. & C. E. Wheeler, 2019. Regenerate natural forests to store carbon. *Nature* 586:25-28

III-1-i

Analysis of climate change impacts on water resources in the Yodo river basin, Japan.

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Abstract

Forest vegetation is known as “Green Dam”, and plays important roles in water resources conservation. Therefore, change of forest vegetation induced by climate change may have significant impact on water resources. However, there is few studies about the future water resources considering both climate and vegetation changes. This research conducted the analysis of climate change impacts on water resources in the Yodo river basin using meteorological, vegetation and hydrological models. WRF of the meteorological model provides the meteorological parameters which are used in vegetation and hydrological model. CLM-CNDV of the vegetation model provides the distribution of forest type, LAI and soil carbon content. Hydrological model provides river discharge and evapotranspiration, which is associated with soil carbon content. In addition, the assessment of forest thinning effects on water resources was also performed. The difference of temperature, precipitation, evapotranspiration and river discharge between in the present (1971 - 2000) and in the future (2071 - 2100) was compared. The results showed that temperature (1.5 ^{o}C) and precipitation (8 mm/year) were increased by global warming and evapotranspiration (99 mm/year) were increased and river discharge (12.8 m^3/s) were decreased by global warming and greening. These effects may contribute to water shortages and enhance extreme drought risk in the future. On the other hand, thinning led to the decrease of evapotranspiration and the increase of river discharge and to the reduction of extreme drought risk. This suggested that thinning was a key factor for adaptation to the impacts of climate change.

Keywords: Water Shortages, Climate Change, River Discharge, Evapotranspiration, Forest Maintenance

III-2-i

A membrane-aerated biofilm reactor for cost-effective nitrogen removal with low greenhouse gas emissions: Insights from macro and micro scale observations

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Abstract

A membrane-aerated biofilm reactor (MABR), mounting a gas-permeable membrane as an oxygen-supplying material and bacterial carrier in a reactor vessel, provides efficient and bubbleless oxygen supply, bringing considerable attention to researchers and practitioners working on wastewater treatment. Notably, the direct and controllable oxygen supply to a biofilm grown onto a gas-permeable membrane allows high oxygen utilization efficiency (OUE) by targeted bacterial guilds, *e.g.*, ammonia-oxidizing microorganisms, and reduces operation cost by air supply. We implemented the operation of a membrane-aerated biofilm reactor for efficient oxygen supply for nitrification, achieving a high OUE (> 75%) by nitrifying bacteria present in a membrane-aerated biofilm. The high OUE by nitrifying bacteria provided a region in the biofilm where oxygen concentration is limited. Such an oxygen gradient in the biofilm resulted in the creation of oxic and anoxic zones in a biofilm, accelerating simultaneous nitrification and denitrification in a single reactor vessel. An MABR achieved a higher nitrogen removal performance for a long operation period than a conventional biofilm reactor. In addition to the superior nitrogen removal performance, an MABR contributed to the reduction of nitrous oxide (N_2O), known as a highly potent greenhouse gas and ozone-depleting substance. We unraveled a mechanism for the lower N_2O production by an MABR than by a conventional biofilm reactor. The application of N_2O, nitric oxide and O_2 microsensors to a membrane-aerated biofilm successfully revealed a hot spot for N_2O consumption appearing in the middle part of the biofilm. The presence of the hotspot is likely a driver to reduce N_2O emission from an MABR system. The macro- and micro-scale observations clarified the superiority of an MABR in terms of high performance of nitrogen removal from wastewater streams and low greenhouse gas emission, contributing to reductions of operation cost and CO_2 footprint.

Keywords: Membrane-aerated biofilm reactor, effective oxygen supply, nitrogen removal, nitrous oxide

III-3-i

The transition of air pollution and its countermeasure in Japan

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Abstract

After the World War II, the rapid industrial restoration caused serious pollution problems in Japan. In order to solve such pollution problems, the "Air Pollution Control Law", and other regulations have been enacted and strengthened several times. This paper focuses on the environmental problems in Japan, especially air pollution, and the transition of air pollution and its countermeasures to date are discussed here.

In the air quality administration, there are environmental standards and emission standards, and their efficacy varies from country to country. In Japan, environmental standards are considered administrative goals and there is no legal enforcement in itself. On the other hand, emissions standards are enforceable, penalties apply to people and companies that do not comply.

There are two ways to manage the environment. One is a mandatory system and the other is self-management. If voluntary activities can realize a good environment, total cost including social expense can be expected to be smaller than so called command-and-control system such as regulatory measures by the administration. Regarding the regulation of hazardous chemical substances announced in 2001, it was intended to achieve the environmental standards by voluntary activities in each company. As far as the recent trends of the Benzene concentrations are concerned, the effect of this policy seems to be satisfactory. However, in markets where price competition is intense, there is a serious hurdle to voluntarily adopt such measures. In other words, situations where such voluntary management is accepted may be limited. However, it seems desirable to see the attitude of actively working as an industry.

Keywords: Air quality, air pollution, regulation, air quality management

III-4-i

A study on the distribution of Papilionidae in Thailand based on statistical analysis

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Abstract

Many earlier studies on Thai flora and fauna showed that the richness of the ecosystem in this region arises from biogeographic situation. The distribution of Lepidoptera species is highly depended on the distribution of flora, especially food plants. Therefore, by analyzing their distribution data, we can get some insight into the flora and fauna of the ecosystem. Here, we believe that the easiest to identify is the most appropriate for adopting the Papilionidae family data. The raw data was composed by 0 or 1 in each cell of the spread sheet according to the presence or absence in a province. The column of the spread sheet corresponded to the province. The row was related with the species or subspecies. In this analysis, we could analyze the spatial differentiation or similarity of provinces from the view point of the butterfly's distribution. In order to clarify the distribution, a factor analysis with the principal component analysis mode was conducted. By conducting this analysis five factors were obtained, and the meanings of former four factors could be explained as follows: factor 1 represents the central eastern area; factor 2 is the northern; factor 3 is the southern or peninsular; factor 4 is western. This analytical result seems to support the classification of zoo-geographical sub-regions proposed by many researchers.

Keywords: Biogeography, Lepidoptera, Papilionidae, principal component analysis

IV-1-i

Education as a key social system for the global environmental protection on the basis of biosystematic view of civilizations

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Abstract

A systematic view on the basis of comparative analysis of life-like systems at different hierarchical levels, so call biosystems is a useful approach for analysing and organizing knowledge about the biosystems. We proposed an importance of biosystematic view of life-like systems and showed some applications to proposing mechanisms for the emergence of the most primitive life-like system from simple chemical networks and the historical behaviors of Western Europe and Japan around the time of the Industrial Revolution. Here, We will discuss the importance of education for the development and innovation in relation to science and technology to the global environmental protection from the biosystematic view of civilizations (BVC).

Prior to discuss the characteristics of civilizations on the basis of the BVC, the Ecological View of History (EVH) proposed by T. Umesao at 1957, which is not still popular in Western scholars, will be briefly introduced as a successful theory for the parallel behaviours of the Western Europe and Japan. Both the EVH and BVC theories involve the principle of systematic views for analysing the civilizations. According to the BVC, civilization is regarded as a biosystem. Thus, the inner mechanisms and interactions to outside are determining factors for the status in future. Our analysis of civilizations based on the BVC suggested that civilization possesses inherent controlling machinery for information, which support the characteristics of the civilization. Furthermore, civilization possesses inherent machinery for incorporating energy, materials, and information from outside, of which the corresponding information is stored in the civilization. Thus, the behaviours of civilization resemble the cell type organisms. Based on this fact, we deduced the importance of education and development of science and technology. In the present paper, a potentially useful approach will be proposed for the global environmental destruction.

Keywords: Civilization, Education, Science, technology, Biosystematic view

IV-2-i

Climate Change Mitigation and Adaptation in the Local Context

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Abstract

Climate change is one of the major global challenges that will continue to affect human society in the future. Countries around the world has responded to the challenges by implementing various kinds of action. As for Thailand, after the ratification to the United Nations Framework Convention on Climate Change (UNFCCC) the country has put tremendous effort to combat the climate change. Targets for greenhouse gas reduction were set and actions to be taken were announced. Policies related to climate change can be found in many sectors (e.g. energy, transport, and forestry). Cities as part of the interwoven context of the nation will also have to incorporate such policies into their management tasks. Gaps in policy implementation at the national and local government levels, unfortunately, exist. The paper aims to assess challenges and opportunities of climate change policy implementation in Bangkok. Information obtained can be used as lesson learnt for other cities in Thailand as well as cities in other developing countries.

Bangkok as a largest city and the centre for economic and social activities has emitted large amount of greenhouse gases. Therefore, in order to achieve targets set in the Thailand Nationally Appropriate Mitigation Actions (NAMAs), effort from Bangkok is undeniably playing crucial role. Additionally, Bangkok is also directly affected by climate change especially from flood, drought, and coastal erosion. As a result, Bangkok Master Plan on Climate Change (2013-2023) was developed and implemented. Activities implemented were aiming for both mitigation and adaptation. Although the results from implementation were outstanding, there are challenges that city has to overcome. One of the major challenges is to develop or adopt the verification system for greenhouse gas calculation that will ensure the smooth integration of data from Bangkok into the national system.

Keywords: Climate change, Policy implementation, Mitigation measures, Adaptation measures

IV-3-i

Adaptation to climate change: a new challenge for GMS sustainable development goals

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Abstract

The Mekong River is the 8th largest river in the world while it flows for almost 4,800 km from its source in Tibet through China, Myanmar, Lao PDR, Thailand, Cambodia, and Viet Nam into the sea, draining a basin area of 795,000 km^2. Across the Mekong landscape, the climatic change is also evident with rising temperatures, changing precipitation patterns and rising sea-levels over the historical record. Model projections indicate a fairly quick and drastic change in the spatial distribution of bioclimatic conditions across the northern and mountainous portions of the GMS region, with significant warming and modification of rainfall patterns predicted for 2030, increasing in this general trend and direction substantially by 2060. Many studies noted the most vulnerable communities to climate impact are those rural farmers who are planting rain fed crops while the extreme floods also cause extensive damages to urban infrastructures. Climate change is threating the GMS to the achievement of sustainable development goals. There is a need to initiate various aspects of climate change adaptation studies as well as policy and planning developments at local to regional levels to mainstreaming climate resilience.

Keywords: Climate change, Climate change adaptation, GMS climate change and SDGs

IV-4-i

Using Asian carp for humanitarian aid in Haiti

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Abstract

Asian carp were imported from China into the U.S. during the 1970s as a biological control mechanism to improve water quality. Subsequent flooding allowed this fish to escape confinement, resulting in unusually large concentrations in the Mississippi River and its tributaries. Invasive species are nearly impossible to eradicate after occupying a new niche. High densities of Asian carp pose many problems for aquatic ecosystems since they consume planktonic organisms and therefore compete with native species for available food sources. Asian carp threaten to enter Lake Michigan, despite efforts by the U.S. Army Corps of Engineers to electrify the waterways around Chicago. Although electric current is a good deterrent for Asian carp, it does nothing to reduce their expanding population. Asian carp are not caught using conventional fishing methods. Commercial harvest is a viable option, but the supply of fish is much larger than current demand. Americans tend to disdain carp, often referring to them as trash fish. Use of Asian carp as a potential food source for hunger relief is a promising, but overlooked strategy. According to the Food and Agriculture Organization, nearly 800 million people worldwide suffered from chronic undernourishment in 2014-2016. Most of them live in developing countries. The first and most important deficiency is protein-energy malnutrition. For example, Haiti is the poorest country in the Western hemisphere and about 30% of the population lives in extreme poverty. Nearly half of Haiti's population (about 5.35 million) are undernourished. About 30% of Haitian children are chronically malnourished, often stunting their growth. This study was designed to create an inexpensive food product using Asian carp for people in developing countries that is safe to eat and easy to transport without the need for refrigeration or freezing.

Keywords: Asian carp, invasive species, hunger relief, protein, Haiti

V-1-i

Research fund by the tobacco industry

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Abstract

Tobacco smoke is the worst environmental pollutant and despite its well-recognized health hazard, prevalence of smoking is still high in Asian countries. People who keep smoking are doing so not because of their unawareness of the harm but because they are made to smoke by the ingenious tactics of the tobacco industries (TI). Thus, we need to pay more attention to the vector role of TI which endeavour to maintain tobacco business. Among the tactics of TI, research fund provided from them is a controversial issue for scientists. It has been reported that, through the fund, TI have persuaded scientists to challenge the studies showing the adverse effects of tobacco and publish papers denying the hazardous effects of tobacco. A study showed that review papers funded by TI were 88 times more likely to deny the hazardous effects of second hand smoke. In 1995, American Thoracic Society (ATS) announced its policy to refuse papers funded by TI to publish. Whereas, the editorial board of British Medical Journal (BMJ) first criticized ATS saying that ATS's policy could jeopardize scientific freedom and thorough review process of academic journal should be used to guard academic dignity from the vicious intention of TI. However, in 2013, BMJ changed its policy learning from the mounting facts that even thorough review process cannot identify the distortion of science by TI, and BMJ decided to take the same policy as ATS. In Japan, the Consortium of Academic Societies for Smoking Cessation made a survey among member societies for their attitude toward research fund from TI. In 2016 the Japanese Society of Public Health solely refused to publish research papers funded by TI, but in 2019, eight medical societies of the Consortium do so. Because of its importance, I propose extensive discussion on this issue.

Keywords: Tobacco industry, Research fund, Academic journal, Scientific misconduct, Conflict of interest

V-2-i

Health effect from exposure to environmental pollution: An insight from smoke-haze pollution study in upper northern Thailand

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Abstract

It has been over a decade since the first episode of smoke-haze pollution occurred in upper northern Thailand. Multiple collaborative efforts on understanding upstream burning sources through downstream health effects from smoke-haze exposure produced substantial scientific reports. Though the pollution episodes occurred in dry season, it seems to be worsen and affecting on health as well as other economic issues. Health effect assessment depends on the exposure dose therefore both environmental and biological monitoring are essential performance. Ambient (or outdoor) pollution affects indoor air quality enormously especially in tropical open- housing styles. Health effects from air pollution have been worldwide reported with strong association between smoke- haze events and respiratory as well as cardiovascular diseases. Although fine particulate matter ($PM_{2.5}$) was shown to play a crucial role in the increased incidence of respiratory and cardiovascular events, the key underlying mechanisms are still not well understood. In recent year, the adverse health outcomes from $PM_{2.5}$ pollution are reportedly not just related to the mass/number of $PM_{2.5}$, but also its chemical composition and sources. Biomarkers of exposure and effects as well as study design i.e. in vitro, in vivo and epidemiologic study will provide understanding of mechanistic indicator of health effect. This presentation will cover the progress, some of the challenges and needs that have been encountered in health effect research from smoke-haze pollution in upper northern Thailand.

Keywords: Health effect, Smoke haze, $PM_{2.5}$, Exposure, Biomarkers

V-4-i

Biological monitoring for chemical substances

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Abstract

Exposure to chemical substance in discharged wastes is one of the most challenging problems for the Asian countries. It is necessary to measure the precise amount of the chemical substances taken into a human body to know the health effects by the chemical substances. Biological monitoring is a useful method to know the exposure to chemical substances. It is one of the ways to properly measure the amount of the chemical substances taken into a human body. Even if we use personal protective equipments (PPEs) such as respiratory protective equipments and chemical protective gloves and clothes, sometimes we are exposed to the chemical substances due to inappropriate selection or usage of PPEs.

I have been measuring metabolites of the chemical substances using biological monitoring methods for sulfuryl fluoride, formaldehyde, methanol and *N*,*N*-dimethylformamide (DMF). I will report the advantages and disadvantages of the biological monitoring. First, drinking green tea that contains a large amount of fluorine during fumigation with sulfuryl fluoride affects the urinary level of fluoride as a sulfuryl fluoride metabolite. Second, assessing urinary level of formaldehyde metabolites is difficult because the similar metabolites are originally present in a human body. Third, in an epidemiological survey with the male workers who use DMF, there is significant difference in the urinary level of DMF metabolites between in summer and in winter. We measured urinary levels of *N*-methylformamide (NMF) and *N*-acetyl S-(*N*-methylcarbamoyl)-systeine (AMCC) as DMF metabolite in the workers wearing gas masks. Even though DMF concentration of work environment was not significantly different between two seasons, urinary levels of NMF and AMCC in summer were higher than those in winter. The result showed that percutaneous absorption of DMF was increased in sweat in summer.

Keywords: Chemical substance, Biological monitoring, Health effects

ABSTRACTS

SESSION I
Environmental Science and Technology

Oral presentation

EST-O-01

Decreasing of PM_{10} and $PM_{2.5}$ and PAHs exposures and health risk in urban parks of Bangkok

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Abstract

Polycyclic aromatic hydrocarbons (PAHs) are group of chemicals that were produced during incomplete combustion of coal, oil, and gasoline. In congested traffic areas of Bangkok, PAHs emitted from vehicles were considered a serious problem of urban air quality. These compounds can cause serious health problems in human such as respiratory symptoms and lung cancer. In this study, PAHs bound PM_{10} and $PM_{2.5}$ were determined at three urban parks in Bangkok from January 2018 - March 2018 and January 2019 - March 2019 (dry season). Moreover, air samples were also collected at the roadside area (Victory Monument) to be compared as a reference site. Particulate matter samples were collected using personal modular impactor with filters pack attached and air pump sampler flow rate 3 L/min for 24 hours on both weekend and weekdays. PAHs were extracted from PM_{10} and $PM_{2.5}$ filters by ultrasonic extraction method and were analyzed by HPLC using Fluorescent and UV detector. The PM_{10} concentration in urban parks was ranged from 26.33 $\mu g/m^3$ to 109.14 $\mu g/m^3$. The $PM_{2.5}$ concentration in urban parks was ranged from 14.83 $\mu g/m^3$ to 84.03 $\mu g/m^3$. The highest concentration of PM_{10} and $PM_{2.5}$ were found in Chatuchak Park and Santiphap Park, respectively. The PM_{10} concentration in the roadside area (Victory Monument) was ranged from 77.60 $\mu g/m^3$ to 113.41 $\mu g/m^3$. The $PM_{2.5}$ concentration in the roadside area (Victory Monument) was ranged from 51.36 $\mu g/m^3$ to 82.33 $\mu g/m^3$. The results show that the concentration of PM_{10} and $PM_{2.5}$ in the reference area is much higher than in the urban parks and exceed Thailand pollution control standard for 24-hour average of ambient air. Hazard quotient for PAHs in the reference area is higher than the study area which means higher cancer risk for human who expose to these pollutants.

Keywords: PM_{10}, $PM_{2.5}$, PAHs, particulate matter, urban parks

EST-O-02

Roadside $PM_{2.5}$, PM_{10} and heavy metal composition related to overcrowded traffic and road construction activities in Bangkok

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Abstract

Bangkok, one of mega-cities which has faced environmental problems from high density of populations and traffic for many years. Several studies had reported that air pollution related traffic is the major cause of environmental issue. Recently, Thai government has launched a new project to improve Bangkok mass transit system including extend new road and new routes of Bangkok sky train and subway train. This study aims to quantify roadside fine particulate matters in term of $PM_{2.5}$ (diameter less than 2.5 μm) and PM_{10} (diameter less than 10 μm) in construction related area and traffic congested area. The eastern routes, Pattanakan and Srinakarin, those are located between inbound and outbound junction were selected as the studied sites. $PM_{2.5}$ was sampled using a mini-volume air sampler, while PM_{10} was sampled using a cyclone air sampler near the construction sites. Both $PM_{2.5}$ and PM_{10} were sampled for 12 hours a day, during November to December 2018. The samples are extracted using microwave digestion method to quantify the concentration of five hazard heavy metals (Fe, Cu, Zn, Cd, and Pb) by Graphite Furnace Atomic Absorption Spectrometry (GFAAS). The traffic conditions monitored from video-camera were found more crowded in construction related area than traffic related area. The 12 hr. average $PM_{2.5}$ and PM_{10} concentrations at construction related area (39.38 μg/m3 and 55.08 μg/m3, respectively) were higher than the control area without construction (36.15 μg/m3 and 48.87 μg/m3, respectively). The lowest concentration was 17.28 μg/m3 and 27.32 μg/m3 for the background site. However, it is the matter of the benefit to provide convenience in the future after the construction, whether the environmental problems could be solved in the long terms. This will be worth wide to monitor the trend of pollution changes and health impact in the future.

Keywords: Particulate matter, Heavy metals, Construction activity, Overcrowded traffic, Graphite Furnace Atomic Absorption Spectrometry (GFAAS)

EST-O-03

Long-Term Satellite Assessment of Particulate Matter in Thailand

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Abstract

Satellite data of aerosol optical depths (AOD) were retrieved from MODIS-Terra and -Aqua satellite over 20 years from 2000-2019 in northern and central parts of Thailand. Long-term (2000-2018) time series of AOD plotted with ground based PM_{10} and $PM_{2.5}$ concentrations showed good consistency in seasonal pattern, especially in the northern region. Both satellite and ground data presented high levels during February-April with the peak in March. In the central region, AOD presented similar pattern as the northern region whereas PM_{10} and $PM_{2.5}$ concentrations presented higher levels during November-March. The model results showed that the discrepancy was due to the dust aloft traveling from neighboring countries. The relationship of AOD and PM_{10}/$PM_{2.5}$ were also investigated during air pollution episode in Bangkok during January 2019. The results presented well correlated between the data when the AOD data were retrieved from Aqua. The levels of AOD, PM_{10} and $PM_{2.5}$ in January revealed increasing trends from 2016-2019. Moreover, the relationship of satellite and ground based data were analyzed with cloud fraction (CF) using the data from 2000-2016. Overall, the correlation in the northern region provided better results than in the central region with the correlation coefficients (r) of 0.68-0.82 and 0.30-0.36 in the northern and central regions, respectively. The analysis with CF=0.2 slightly improves the r values from CF=1. However, the number of the data reduces around 75%. The regression models of AOD-PM_{10}/$PM_{2.5}$ under CF=0.2 were developed with meteorological variables (relative humidity and temperature) using the data from 2000-2016 for based data to estimate PM_{10} and $PM_{2.5}$ concentrations in 2017 and 2018 in the northern part. The modeled outputs were validated with observed PM_{10} and $PM_{2.5}$ concentrations. The r values of modeled and observed data range from 0.41-0.79 in case of PM_{10} and from 0.72-0.82 in case of $PM_{2.5}$.

Keywords: AOD, MODIS, $PM_{2.5}$, PM_{10}, Thailand

EST-O-04

EST-O-05

Evaluation of palm oils as hydraulic fluids

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Abstract

Most hydraulic fluids nowadays are petroleum products, made from mineral oil. Its biodegradability is quite low which makes it a harmful to the environment as its composition is difficult to digest by micro-organisms. Palm oil being a vegetable oil has a high biodegradability. It can easily be digested by micro-organisms. Palm oil has similar characteristics to hydraulic fluid, such as a high viscosity index and high flash point. However, it suffers from oxidation when exposed to air. Once oxidized, the oil becomes corrosive and can damage metal surfaces. The aim of this project was to evaluate the wear effect of palm oil (PO) and palm oil with polyalphaolefin (PP) on a hydraulic pump. Both oils were tested for 100 hours in a modified version of a standard test method for indicating wear characteristics of non-petroleum and petroleum hydraulic fluids in a constant volume vane pump (Modified ASTM D7043-12). After testing, the pump was examined for any wear damage to the critical parts such as the vanes. The results revealed no excessive wear on the vanes. The total mass loss of the vanes after testing with PO, PL and mineral hydraulic fluid were 4.1 mg, 3.3 mg and 3.7 mg, respectively. This concluded that PO and PL had high potential to be substituted for hydraulic fluid.

Keywords: Vegetable oil, Vane pump, Wear, Polyalphaolefin

EST-O-06

EST-O-07

Environmental Analysis of Coal Fire Power Plants in Ultra Supercritical Technology Versus Integrated Gasification Combined Cycle

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Abstract

Combustion of fuel produced high exhaust emission especially CO_2 gases which increased pollutant concentration in air. Coal contributed 44% of total global CO_2 emissions and became the largest source of GHG (greenhouse gas) emissions, which trigger the acceleration of climate change. In 2017 the composition of Indonesia's electricity production was projected to be 55.6% using coal, and in 2026 coal use would still 50.4%, In addition Indonesia had signed a Paris Agreement in 2015 where Indonesia should reduce CO_2 emissions by 29% in 2030. The existing technology in electricity sector were Ultra Supercritical (USC) and Integrated Gasification Combined Cycle (IGCC). The study of this research is to compare the efficiency of both of these technologies to environmental analysis aspect using UNISIM and Promax Simulation Program. The coal data was obtained from Indramayu PLTU. The data of this research was compared to *Intergovernmental Panel on Climate Change Guidelines* to obtain the calculation. From report Huaneng Greengen Co the result shows that USC has higher exhaust emissions than IGCC in terms of SO_2, CO_2, NO_x, CO and slag. The hypothesis of this study is IGCC technology produce lower exhaust emissions.

Keywords: Clean Coal Technology, USC, IGCC, environmental analysis, sub-bituminous

EST-O-08

Micro-Particle ZVI Inhibition Threshold in Cassava Pulp Bio-Methanation

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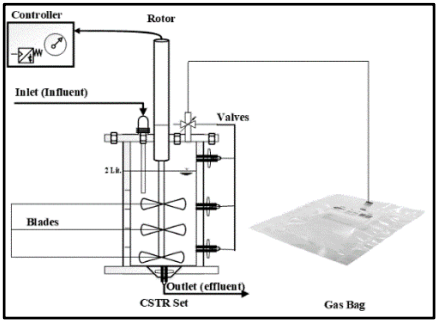
Abstract

One setback of mono-digestion for biogas production is low methane concentration, the core energy calorific value. Catalyst and nutrient supplementation are the option to improve biogas volume both in quantity and quality by reducing carbon dioxide (CO_2) back to methane (CH_4). Using CSTRs, this study attempted to enhance bio-methane from cassava pulp and its wastewater substrate by readily available reducing agent, Zero Valent Iron, Fe^0 (ZVI). M100 iron nanoparticle was verified and characterized by synchrotron lights (XAS and XPS) whether it is in state of valency 0 for optimum reactional kinetic. Introduced ZVI in 0-0.25-0.5-1-2 g/L dosage, it was discovered that 1 g/L ZVI nanoparticle concentration resulted maximized sCOD and VS removal (up to 95%) generating biogas for 800 ml/day/OLR with utmost 92% methane content. Although the presence of ZVI in biogas process is stimulatory, inhibition started when iron concentration exceeds 1 g/L ending digestion failure by iron toxicity after 5 days along comparative study for 30 days HRT. Meanwhile, the performance of CSTRs in remaining doses function stably among which ZVI nanoparticle in 1 g/L supplemented CSTR processed in ideal anaerobic digestion conditions. This study inspires the possibility of enriching more methane during bio-methanation to cut hefty cost and chemicals consumption in subsequent gas upgrading processes.



Keywords: biogas, cassava pulp, nanoparticle, ZVI, CSTR.

EST-O-10

EST-O-11

Optimization of $Ca(OH)_2$ pretreatment to enhance methane production of rice straw using response surface methodology

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Abstract

In this study, an alkaline pretreatment process with $Ca(OH)_2$ for rice straw at different conditions to enhance methane production was investigated through biochemical methane potential (BMP) tests. The pretreatment process factors including $Ca(OH)_2$ concentrations of 5 – 15% (by weight) and temperatures of 70 – 90°C with pretreatment time of 2 h were studied. A response surface methodology (RSM) combined with a face-centered composite design (FCCD) was employed in obtaining the optimized pretreatment conditions for the highest methane yield of rice straw. The BMP experimental results show that the methane yield for all pretreated rice straws was increased by 55.44 – 78.59%, compared to the untreated rice straw. The statistical analyses show that the maximum methane yield of 304.31 NmL/g VS was obtained at the desirable pretreatment conditions of 5% $Ca(OH)_2$ and 87.34°C with pretreatment time of 2 h. The ANOVA test also revealed that the model was considered statistically significant with a determination coefficient (R^2) of 81.65%. The model could be efficiently used to predict the methane yield from the anaerobic digestion process of the pretreated rice straw. Furthermore, $Ca(OH)_2$ concentration was a more significant factor affecting methane production than temperature.

Keywords: Rice straw, Alkaline pretreatment, Biochemical methane potential (BMP), Methane production, Response surface methodology

EST-O-12

Electrospun Poly(lactic acid)/Polyvinylpyrrolidone Composite for Biodegradable Face Mask

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Abstract

Recently, PM2.5 (particulate matter with a diameter of 2.5 microns or less) in polluted air has become a major health hazard in Thailand, especially in the northern region. Regular face masks are used to prevent inhaling hazardous particles; however, these are not able to filter out PM2.5, because of their large pore size. In addition, the majority of these masks are produced from petroleum-based plastics, e.g., polypropylene, which becomes non-degradable wastes after use. Rising environment concerns have forced many industries to seek more environmentally-friendly processing and safer materials alternatives. Poly(lactic acid) (PLA), a biodegradable polyester derived from renewable resources, e.g., corn, cassava, and sugarcane has been widely used in various applications. Herein, biodegradable face mask based on PLA nanofibers was developed by an electrospinning technique. To further improve the mask efficiency, polyvinylpyrrolidone and negatively-charged graphene oxide nanoparticles were introduced to the PLA nanofibers. The obtained composite nanofibers were characterized by scanning electron microscopy, air permeability tests, and PM2.5 trapping experiments. The results showed that the composite nanofibers can effectively filter out PM2.5 particles with 98% while that of regular face mask of 70% and simultaneously preserve a good breathability. We attribute such improvements to the nano-scaled inter-fiber space and the presence of negative charges on the fiber surface. Experiments on durability and degradability tests of the face masks after use are undergoing.

Keywords: Degradable polymer, electrospinning, dust capturing, face mask, filter

EST-O-13

Optimization of microwave-assisted extraction for enhancing reducing sugar of water hyacinth pretreatment before organic fertilizer production at Klong Yong community in Phutthamonthon, Nakhon Pathom, Thailand

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Abstract

Water hyacinth is an aquatic plant that has emerged as a major invasive weed and high reproduction rate at Soi Bon canal in Klong Yong, Phutthamonthon, Thailand. As a lignocellulosic plant material, it can be made into an organic fertilizer at 60-90 days. Microwave-assisted extraction was to investigate the effect of different solvents concentration, various sizes of material and the optimization model for hydrolyzed cellulose and hemicellulose from lignin structure disruption of water hyacinth. The result showed that calcium hydroxide solvent was the best solvent for total reducing sugar extraction from water hyacinth with size as 3-5 cm. Box-Behnken design was conducted for microwave-assisted pretreatment at 450 watts with using three parameters; the solid to liquid ratios as 1:10, 1:15, and 1:20 with volume of liquid at 30 ml, extraction times of 20, 30, and 40 minutes, and calcium hydroxide solvent at various concentrations as 0.1, 0.55, and 1 %wt. The optimum conditions of total reducing sugar from water hyacinth solution were 54 mg/g at the solid to liquid ratio as 1:10, concentration of calcium hydroxide at 0.55 %wt, and 30 minutes of extraction time. Microwave-assisted pretreatment was an alternative of organic fertilizer production at shorter times for fermentation.

Keywords: Water hyacinth, Total reducing sugar, Lignocellulosic, Microwave-assisted extraction, Box-Behnken.

EST-O-14

Discrimination of Seismic Events in Lampang Province :A Complexity Approach

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Abstract

This study aimed to distinguish microearthquakes from quarry blasts in order to clarify the seismic hazard situation in Lampang province. Complexity (C) technique is regarded as an effective statistical approach for seismic discrimination and strongly relies on p-wave energy in impulsive signal. Quarry blasts, in general, provide larger p-wave energy than that of earthquakes in specific time window. This technique carried out utilizing 30short period seismograms with the local magnitudes of -1.0 1.9, recorded in February 2019by Thai meteorological department (TMD). The events posed in vicinity of both coal mines and the fault rupture zone which associated with the M 4.9earthquake in Lampang province. The suitable Complexity parameters obtained from successive retrospective tests revealed the time windows of t3 = 1s and t6 = 2s were appropriate for classifying seismic events in the region. Consequently, implemented parameters could obviously separate two clusters from the independent seismic data. C-value would be only lower than) 1.0in the range of (0.95-0.23in mining areas, while it would be only higher than) 1.0varies from 1.12to (4.31in aftershock zone of M 4.9earthquake. The proposed criteria in this study were that the seismic events with the C-value being lower than 1.0were identified as quarry blast and the C-value being higher than 1.0were classified to be the earthquake, which will be useful for seismic discrimination, decontamination of the TMD earthquake catalogue, as well as further seismicity and seismic hazard investigations, in particular for Lampang province.

Keyword Discrimination, Microearthquake, Quarry blast, Lampang province, Complexity

EST-O-15

Effect of silver nanoparticles on *Pseudomonas putida* and *Bacillus subtilis* biofilm formation

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Abstract

Wide applications of silver nanoparticles (AgNPs) could possibly lead to the release into the environment. Environmental bacteria are normally living together in a protective layer of extracellular polymeric substances (EPS) called biofilms. The toxicity of AgNPs probably results in the unfavorable conditions for biofilm formation, causing the reduction of biofilm biomass and consequently the activities beneficial to the ecosystem. The objective of this research is to study the effect of various concentrations of AgNPs on the formation of gram-negative and gram-positive bacteria. By using soil bacteria, *Pseudomonas putida* KT2440 and *Bacillus subtilis*, as the representatives of environmental bacteria. The experiments were conducted in a 96-well plate with the presence of AgNPs (average size of 5-20 nm) at the concentrations of 0, 0.1, 0.5, 1, 10, 50, 100, 500 and 1000 mg/L. The plate was incubated at room temperature for 48 h, and biofilm formation was measured by crystal violet staining throughout the incubation period. The growth curve of biofilm formation under different AgNP concentrations was conducted. The results showed that AgNPs at 10 and 50 mg/L resulted in the formation of *P. putida* KT2440 biofilms similar to the control (0 mg/L) while the formation was inhibited completely at the AgNP concentrations of 100, 500 and 1,000 mg/L. Interestingly, AgNPs at low concentrations of 0.1, 0.5 and 1 mg/L could increase *P. putida* KT2440 biofilm formation compared with the control. Differently, AgNPs at the studied concentrations only inhibited *B. subtilis* biofilm formation, and no increased formation of biofilms was observed. The findings from this study can be used in the determination of AgNP impacts on environmental biofilms of both gram negative and positive bacteria.

Keywords: Silver nanoparticles, Biofilms, Extracellular polymeric substances

EST-O-16

Comparison of water quality and caddisfly (Trichoptera) communities between old and new reservoirs in Chiang Mai University

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Abstract

Some physicochemical parameters and adult caddisfly specimens were sampled using portable black light traps at Angkaew; the older reservoir, and Tart Chompoo; the newly created reservoir, Chiang Mai, Thailand during October 2018 to February 2019. Caddisflies were chosen for this study because they are academically recognized as a good indicator of water quality in aquatic ecosystem, and can be identified to species level which produces more accurate results than family level identification. A total of 5 study sites were monitored. 3 at Angkaew and 2 at Tart Chompoo reservoirs respectively. Parameters such as: air and water temperature, pH of water, total dissolved solids, electrical conductivity, biological oxygen demand, dissolved oxygen, and wind speed had 3 replications per site. Both reservoirs had the significant difference ($p< 0.05$) of air and water temperature, pH, electrical conductivity, total dissolved solids, and wind speed. Mean values of electrical conductivity and pH at Angkaew reservoir were 116, and 6.9; while at Tart Chompoo reservoir it was 204, and 7.6. Angkaew reservoir is approximately more than 50 years old, has more stable environmental conditions and serves as the controlled site; in contrast to Tart Chompoo which was created only 3 years ago and undergoing many changes. A total of 487 adult male caddisflies were collected from the sampling sites representing 2 species, *Dipseudopsis robustior* ULMER 1929 and *Amphipsyche meridiana* ULMER 1909. *D. robustior* contained the highest number of species at Angkaew reservoir (44.6%, 217 individuals); while Tart Chompoo consisted of (29.4%, 143 individuals). On the other hand, *A. meridiana* contained (14.7%, 72 individuals) at Angkaew; and (11.3%, 55 individuals) at Tart Chompoo reservoir. Both *A. meridiana* and *D. robustior* exhibited a strong correlation with dry humidity and orthophosphate, whereas *A. meridiana* showed a very strong correlation with air temperature.

Keywords: water quality, Trichoptera, newly created reservoir

EST-O-17

Toxicity effects of copper and zinc on physiology of the green microalga, *Chlorella vulgaris* Beyerinck

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Abstract

Microalgae are widely used as a model for ecotoxicological assays. The present study investigated the physiological responses of *Chlorella vulgaris* NES to five days-exposure to different concentrations of copper or zinc (control (JM medium), 125, 250, 500 and 1,000 µM). The heavy metals were introduced into the medium during the exponential phase of algal growth. Heavy metal contents in the cell was assessed at the end of the experiment. Photosynthetic parameters (maximum quantum yield; Fv/Fm and proline level) were measured on 0, 6, 12 h, 3 and 5 days after treatments. Chlorophyll *a* content and oxidative stress-related parameter indicated by reactive oxygen species (ROS) and malondialdehyde (MDA) content were measured on day 0 and 5. Both heavy metals showed dose-dependent cellular accumulation. Decreased maximum quantum efficiency of photosystem II (Fv/Fm) was influenced by both heavy metal concentration and time of exposure which the physiology of *C. vulgaris* was changed at 500 and 1,000 µM of copper and zinc treatments. A reduction in Fv/Fm indicates that photodamage occurred from day 3 after exposure. Other toxicity symptoms include chlorophyll degradation and an increase in reactive oxygen species (ROS). While exposure to both heavy metals resulted in a decrease in chlorophyll a content to a similar extent, an increase in ROS was detected only in 1,000 µM copper, suggesting stronger toxicity effects of copper compared to zinc. Nevertheless, an increase in lipid peroxidation was not detected, indicating that ROS produced in 1,000 µM copper was not sufficient to induce disintegration of membrane lipids via the oxidation process. Proline, an amino acid with various putative protective functions against stress, exhibited a rapid increase depending on heavy metal concentration and time of exposure. These results provide a set of effective biomarkers for heavy metal contamination using *C. vulgaris* as a bioindicator.

Keywords: *Chlorella vulgaris*, physiology, heavy metal, toxicology

EST-O-18

Development of Energy Saving Illumination System for *Arthrospira (Spirulina) platensis* Cultivation in Raceway Pond

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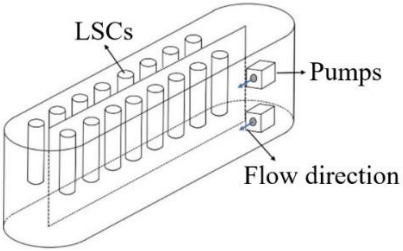
Abstract

One major problem found in the open ponds for algae cultivation is limitation of light penetrability which results in the pond depth should not exceed 25 cm. This study aimed to use low cost light scattering materials for enhancement of both the better light scattering and the light penetration in the deeper level of the high depth pond. Two similar pilot scale race way ponds were prepared with the length of 160 cm, the channel width of 20 cm and 50 cm in depth for outdoor cultivation. The light scattering materials were made from cylindrical shape transparent acrylic with the diameter of 6 cm, the length of 40 cm and filled with clear water called light scattering column (LSC). The maximum LSC of 16 columns were immersed vertically downward in the testing pond. Microalgae biomass productivity was observed in parallel with the control pond without LSC. The working volume of control raceway pond was about 303 liters and 289.4 liters for the LSC raceway pond. The culture in this study was *A. platensis* c005 with the initial concentration of 191 mg/l or the optical density (OD_{560}) of 0.1 and the culture period of 14 days. Results from the study found that the final culture concentration in the control raceway and the LSC race way ponds was 405 mg/l and 427 mg/l which equivalent to the growth rate of 15.3 mg/l-d and 16.9 mg/l-d respectively. From the study, cultivation in the pond with LSC can increase the growth rate by about 10.5%. For the net energy ratio (NER) analysis found that the NER can also increase up to 6.4% and water loss from evaporation during cultivation period decreased by about 13.8% in the LSC pond.



Keywords: Microalgae, Cultivation, Illumination improvement, Raceway pond, Net energy ratio

EST-O-19

Assessing the effects of copper and zinc toxicity on physiological responses in *Ceratophyllum demersum* L.

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Abstract

Copper and zinc are used in several agricultural practices and industries thus are among the common contaminants in the aquatic ecosystem. Although both elements are plant essential micronutrients, high concentration of these metals affects plant physiology especially photosynthetic activity and cellular redox status. In this study, the photosynthetic efficiency, the pigment content, the production of reactive oxygen species (ROS) and electrolyte leakage in *Ceratophyllum demersum* L. were investigated as a biomarker. The plants were treated with 2, 5, 10 and 50 µM of Cu or 50, 100, 500 and 1000 µM of Zn in 1/10 Hoagland's solution for 3 days. Cu-treated plants exhibited reduced photosynthetic activity with increasing concentrations of Cu. In addition, the content of chlorophyll a, chlorophyll a/b ratio and carotenoid were diminished. Cu also induced the production of reactive oxygen species causing an eventual membrane damage indicated by an increase in electrolyte leakage. In contrast, treatments with Zn did not lead to any significant difference in the photosynthetic activity and ROS. However, Zn at the concentrations above 500 µM induced degradation of pigments including chlorophyll a, chlorophyll b and carotenoid and an increase in electrolyze leakage. All the parameters were calculated as an index of integrated biomarker responses (IBR) and IBR was found responsive only to Cu dose. Therefore, physiological analysis and IBR index suggest that toxicity effect of Cu is more severe than Zn.

Keywords: Copper, Zinc, *Ceratophyllum demersum* L., Physiology, Biomarker

EST-O-20

Determination of profenofos and cypermethrin in Chinese kale using a modified quick, easy, cheap, effective, rugged and safe method with Fe_3O_4 magnetic nanoparticles

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Abstract

A modified quick, easy, cheap, effective, rugged and safe (QuEChERS) sample preparation with Fe_3O_4 magnetic nanoparticles (MNPs) was established to determine profenofos and cypermethrin in Chinese kale. The magnetic nanoparticles have excellent function as adsorbent and fast separated from the extract. Fe_3O_4 MNPs were synthesized by co-precipitation of $FeCl_3.6H_2O$ and $FeCl_2.4H_2O$. Then, sample extracts were analyzed by HPLC-UV with C18 column (25 mm× 4.6mm, 5.0µm) at 219 nm. Results showed that the extractions of profenofos and cypermethrin with MNPs 40 mg and without MPNs gave similar percent recoveries and RSDs. The amounts of Fe_3O_4 MNPs were investigated and found that the optimum amount of Fe_3O_4 MNPs was 20 mg. Moreover, the recoveries and precisions of profenofos and cypermethrin were evaluated by spiking to the concentrations of 0.5, 1.0 and 2.0 mg/kg and they were in the range 100.37-102.58% and 98.86-102.04%, respectively, with relative standard deviations less than 2.55 and 2.77, respectively. LOD and LOQ of profenofos were 0.04 and 0.12 mg/kg. LOD and LOQ of cypermethrin were 0.08 and 0.28 mg/kg. The matrix effects of profenofos and cypermethrin were not significant. This method was applied to the analysis of raw Chinese kale from local markets. Chinese kales were purchased from 5 markets in Suphan Buri and Nakhon Pathom (Thailand) and profenofos and cypermethrinin each sample were determined in triplicates. The concentrations of profenofos of 2 samples were higher than 0.5 mg/kg (EU maximum residue limit, MRL) but concentrations of cypermethrin were less than 1 mg/kg (EUMRL) Therefore, using Fe_3O_4 MNPs as adsorbent in QuEChERS method to analyze these insecticides provides similar efficiency as QuEChERS without Fe_3O_4 MNPs, but it is faster and more convenient.

Keywords: Fe_3O_4magnetic nanoparticles, QuEChERS, Profenofos, Cypermethrin

EST-O-21

Chlorpyrifos tolerance of *Pseudomonas pseudoalcaligenes* biofilms under water-limiting conditions

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Abstract

Chlorpyrifos (CP) is an insecticide widely used in agricultural area in northern Thailand. Due to its high toxicity, CP may have an adverse effect on the beneficial bacteria in soil. Bacteria normally develop biofilms to protect the cells from toxic substances. However, during a dry season, drought may induce more stress to the biofilms in soil by creating water-limiting conditions, which could affect the biofilm tolerance to CP, leading to a decrease in soil fertility. The objective of this study is to determine the CP tolerance of the biofilms of an indigenous bacterium from agricultural soil under water-limiting conditions. *Pseudomonas pseudoalcaligenes*, a biofilm-forming bacterium able to tolerate CP, was isolated from the tangerine-field soil in Nan province that had received continuous application of CP. The biofilm experiments were conducted in a 96-well plate at room temperature in media added with different CP concentrations. Water-limiting conditions were simulated using NaCl and polyethylene glycol (PEG) at the concentrations of NaCl (0, 20 and 40 mg/L) and PEG (0, 5 and 10%). Reduction in biofilm biomass after the exposure was determined by crystal violet staining. The results showed that *P. pseudoalcaligenes* biofilms showed high tolerance to CP up to 300 mg/L. Biofilms formed with highest biomass at 12 and 24 h at the CP concentrations of 5 to 300 mg/L. The biofilms at 24-h formation time was then selected for further experiments. When forming under water-limiting conditions (20 mg/L of NaCl and 10% of PEG), biofilms produced more biomass than those in the regular conditions. Our findings suggest that during drought season, soil bacteria could produce higher biomass as a stress response to provide the protection from CP residue in the field.

Keywords: Chlorpyrifos, Biofilms, Water-limiting conditions

EST-O-22

Photocatalytic Degradation and Mechanism of Glyphosate Herbicide Contaminated in Water by TiO_2 Pellet Photocatalyst

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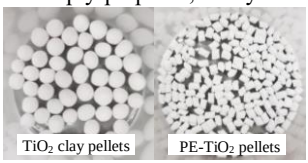
Abstract

In Thailand, glyphosate herbicide has been used intensively to prevent *food crops from weeds and grasses* in agriculture, contributing to the contamination in the environment especially in natural water resources. According to several researchers, the titanium dioxide (TiO_2) photocatalysis was considered as an effective water decontamination process. Evidently, TiO_2 powder photocatalyst has been widely studied in the photocatalytic degradation of pesticides. However, it is difficult to separate TiO_2 powder from water, resulting in its limitation for the practical application. The aim of this work is to study the feasibility of TiO_2 pellets for photocatalytic degradation of glyphosate in water. Two types of TiO_2 pellets: TiO_2 clay pellets (4-7 mm in size) and polyethylene (PE)-TiO_2 pellets (2.5 mm in size) were used in the experiment. The TiO_2 clay pellets were prepared in the laboratory by using TiO_2 powder (Degussa P-25) as raw material, whereas the PE-TiO_2 pellets were purchased from Shandong Longsheng Masterbatch Co., Ltd, China. Such TiO_2 pellets were characterized by X-ray diffraction (XRD), Brunauer-Emmett-Teller (BET) specific surface area and scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM/EDX). Meanwhile, the photocatalytic degradation of glyphosate as well as its possible *mechanisms* have been investigated. Results showed that glyphosate was slightly adsorbed by both TiO_2 pellets under dark condition. No observable degradation of glyphosate could be seen under UV_A illumination alone. Conversely, 99% of glyphosate degradation was reached by using TiO_2 clay pellets within 240 min under UV_A illumination, while the photocatalytic *degradation* of glyphosate by *using* PE-TiO_2 pellets was much lower. The present study showed that TiO_2 clay pellet was simply prepared, easily removed from water and highly photocatalytic activity.



Keywords: Glyphosate, TiO_2, Photocatalysis, Contamination

EST-O-23

Treatment of Highly Colored Wastewater from Commercial Biogas Reactor Discharge using Fenton Oxidation Process

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Abstract

Biogas generation utilize sugarcane molasses wastewater as one of its ingredients is gaining more interests in recent years due to its industrial by products. However, discharge from biogas reactors utilizing molasses wastewater is highly colored and difficult to be degraded further by conventional biological treatment. In this work, Fenton oxidation process has been employed to test for the color reduction of the discharge from a commercial biogas reactor using molasses wastewater as one of its ingredients. Operating variables, such as the pH and amounts of Fenton reagents are explored to determine their respective effects on the efficiency of the Fenton process. The operating ranges tested are the Fe^{2+} concentrations between 1.7-8.9 mM, the H_2O_2 concentrations between 6.5-13.1 M, and the pH between 3-6. The Fenton treatment of this wastewater showed a very high color removal efficiency of up to 90% color removal from the initial value of more than 200,000 ADMI (American Dye Manufacturers Institute) standard.

Keywords: Molasses wastewater, Decolorization, Fenton oxidation process

EST-O-24

Manganese Remediation by Green Microalga in Synthetic and Natural Contaminated Wastewater

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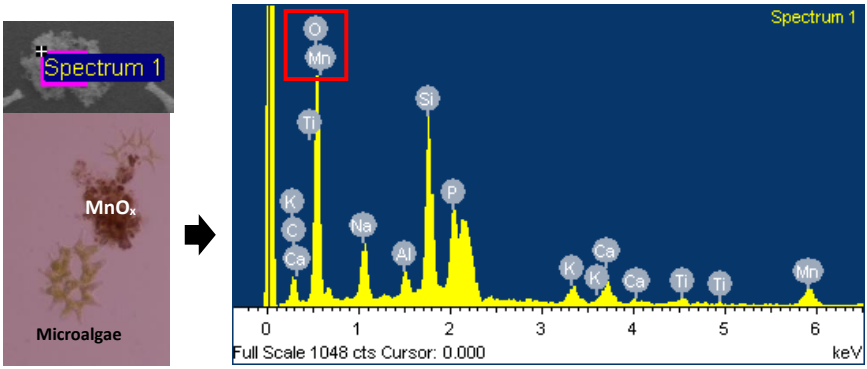
Abstract

Green microalgae represent an efficient method for the bioremediation of manganese in a process of adsorption and oxidation. One of the crucial factor to archive the manganese remediation is a medium cost. Thus, this research aims to optimize the cheap formation medium for algae cultivation, then evaluate microalgal manganese remediation from synthetic and natural contaminated wastewater. First microalga Pediastrum duplex AARLG060 was cultivated with modified medium (consist of N P C Mg) compared to JM, the standard medium, for remediate 20.00 mg/l Mn in synthetic wastewater. Second, the Mn remediation was confirmed using natural contaminated wastewater (BP-2 reservoir in Lamphun province, containing Mn as 9.00 mg/l, pH as 3.42). The remained Mn in solution was detected by Atomic Absorption spectroscopy and the manganese oxide precipitation was observed by scanning electron microscopy and confirm by energy-dispersive x-ray spectroscopy analysis. The result found that Mn was reduced up to 100% by this microalga after 12 hr of cultivation. The manganese was remediated by both of adsorption and oxidation. The result of algal oxidation as MnOx precipitation was confirmed by SEM-EDX analysis.



Keywords: Heavy metal, Adsorption, Microalgae, Cultivation, Synthetic wastewater

ABSTRACTS

SESSION I
Environmental Science and Technology

Poster presentation

EST-P-01

Effects of temperature on chronic toxicity of ZnO in *Daphnia magna*

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Abstract

Temperature is a physical factor that affects to physiological processes in organisms and toxicity of chemicals. ZnO is widely used as a catalyst in industry, which causes contamination in aquatic ecosystem. This study aimed to investigate chronic toxicity of ZnO under different temperatures and concentrations by using *Daphnia magna* as a model organism. The results showed that higher concentration of ZnO inhibited the growth, first clutch eggs and number of juveniles at both 23°C and 28°C. Moreover, higher temperature inhibited the growth and number of juveniles. The chemical resistant increased, since the activity of detoxification was increased at high temperature. We also observed the levels of malondialdehyde (MDA) in *D. magna* treated with ZnO. At higher concentration of ZnO, lipid peroxidation was induced to increase MDA level in *D. magna*. Higher temperature also increased MDA level due to temperature raises up oxidative stress and metabolic rate in *D. magna*. Our results suggested that both ZnO and higher temperature induced oxidative stress in *D. magna* leading to increase of MDA concentration and unbalance between oxidant and antioxidant. These led to affect the growth and reproduction of *D.magna.* This study might be useful for further studies and controlling of heavy metal contamination in freshwater ecosystem.

Keywords: Temperature, Chronic toxicity, ZnO, *Daphnia magna*

EST-P-02

Effect of Yeast Volatile Organic Compounds on Growth and Ochratoxin A Production of *Aspergillus carbonarius*

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Abstract

The objective of this study was to evaluate the *in vivo* effect of volatile organic compounds (VOCs) produced by two antagonistic yeast i.e. *Wickerharmomyces anomalus* MSCU 0652 and *Kluyveromyces marxianus* MSCU 0655 from corn silage on growth and ochratoxin A (OTA) production of *Aspergillus carbonarius* TK4.2. It was observed that *W. anomalus* MSCU 0652 and *K. marxianus* MSCU 0655 showed the inhibitory effect of 83.81% and 66.04%, respectively, on growth of *A. carbonarius* TK4.2. OTA production was also inhibited 99.77% by both antagonistic yeasts. GC-MS analysis showed that the major component of was ethyl acetate. Other minor VOCs compound were also found 1-butanol, 3-methyl, acetic acid, phenylethyl alcohol, 1-propanol, 2-methyl etc. produced by *W. anomalus* MSCU 0652 and *K. marxianus* MSCU 0655.

Keywords: Ochratoxin A, *Aspergillus carbonarius*, *Wickerharmomyces anomalus*, *Kluyveromyces marxianus*, Volatile organic compound

EST-P-03

Microbial surfactant supplementation to improve the anaerobic digestion of palm oil mill wastewater

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Abstract

Lipids and scum formation are the main problems in the hydrolysis of palm oil mill wastewater. The aim of this study was to investigate the effect of microbial supplement (MS) on the hydrolysis of palm oil mill wastewater under anaerobic condition. The strain TW-3 and TS-8 isolated from palm oil contaminated soil were cultivated in palm oil mill wastewater. After 72 h, TW-3 gave the better candidate MS than TS-8 and was selected to further study. Afterward, TW-3 culture broth with the surface tension of 30 mN/m and emulsification activity of 73.0% was supplemented in palm oil mill wastewater inoculated with anaerobic sludge. The ratio of TW-3 culture broth and wastewater at the different amount of 0-50 %v/v (TW-3/wastewater was investigated. The high hydrolysis with the maximum VFA generation (4,100 mg/L) was found in palm oil mill wastewater with the 20% of MS addition after 4 h. In addition, the soluble COD/total COD ratio increased with MS supplement. For anaerobic digestion in batch mode, the maximum methane yield of 0.31 L-CH4/g-$COD_{removed}$ and the maximum COD removal of 93.8 % were obtained. Moreover, the comparison of MS from TW-3 and TritonX-100 as commercial surfactants was studied. Although, the MS from TW-3 gave slightly lower the methane yield than TritonX-100, the MS from TW-3 was preferred in term of the economic and environmental aspects.

Keywords: palm oil mill wastewater, microbial surfactant, methane

EST-P-04

Comparison of anaerobic sequencing batch reactor and anaerobic baffle reactor for biogas production from co-digestion of concentrated latex wastewater and palm oil decanter cake

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Abstract

This study focused on the improvement of the anaerobic digestion of concentrated latex wastewater (CW) via co-digestion process. In general, the low methane content in biogas production from CW was obtained due to low COD/SO_4 ratio. In this study, the effect of co-digestion was investigated by the palm oil decanter cake (PDC) addition of 0.3, 0.6 and 0.9%TS with organic loading rate (OLR) of 0.89, 1.12 and 1.44 kgCOD/m^3·day. In addition, the performance of three different reactors; anaerobic sequencing batch reactor (ASBR) by propeller mixing (pASBR), ASBR with liquid recirculation (lASBR) and anaerobic baffled reactor (ABR) were compared. All experiment was operated at hydraulic retention time (HRT) of 10 day with semi-continuous mode at 28 ± 2 ºC. The result showed that pASBR gave the highest biogas production of 3,611 ml/day with the methane yield of 0.28 m^3 CH_4/kgCOD_{added} at OLR of 1.44 kgCOD/m^3·day. Biogas production from the co-digestion process was 2.65 fold higher than that from the mono digestion with only CW as substrate. The performance of lASBR and ABR systems was not stable. After 17 days, the biogas production gradually decreased probably due to the foaming on top of lASBR and the accumulation of solid in the bottom of ABR system. It should be noted that the pASBR system was the suitable reactor for the biogas production of co-digestion with PDC addition.

Keywords: Co-digestion, Palm oil decanter cake, Concentrated latex Wastewater, Biogas production

EST-P-05

Relationship Between Habitat Characteristics and Immature Mosquitoes and Their Natural Predators in Chiang Mai City

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Abstract

The study of mosquito's habitat is very important in order to predict risk associated to humans and to reduce the mosquito population by biological means. Biological control can be best applied at the larval stage of mosquito. In recent times, dengue fever has become one of the most serious health concerns in Thailand. Chiang Mai is one of the highest numbers of such cases. The aim of this study is to investigate the relationship between habitat, immature mosquitoes and predators. Eleven (11) sampling sites were selected in Chiang Mai City according to permanent habitats of immature mosquitoes and their predators. Mosquito larvae were collected each dipped 6 times using standard dipping method. The D-frame net was used to collect mosquito predators. Physico-chemical parameters including dissolved oxygen, temperature, pH, electric conductivity, salinity and turbidity were *in situ* measured. Whereas, nitrate, ammonia, *ortho*-phosphate, and biochemical oxygen demand were analyzed in laboratory. Almost all study sites were classified as polluted water according to standard water quality of Thailand. From biological data, 9,354 mosquito larvae were collected from 11 study sites belonging to 3 genera including *Culex*, *Lutzia*, and *Mimomyia*. The damselfly nymph (Odonata) was the most abundant macro-invertebrate predator (Protoneuridae, 71.7% and Coenagrionidae, 13.3%). Whilst, the mosquito fish, *Gambusia* spp. (15%) was one of abundant vertebrate predator in some habitats. The result showed that the mosquito larvae and their predators have high tolerance to survive in a highly polluted water. It is expected that, the findings from this research will help to predict the oviposition sites and accordingly design mosquito larval control programs.
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Keywords: mosquito larvae, predators, water quality, habitat characteristic, biocontrol

EST-P-06

Isolation of crude oil-degrading bacteria and bioremediation of crude oil-contaminated soil microcosms

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Abstract

The problem of crude oil contaminated environment is originated by accidental release of crude oil from production unit and distribution processes. Crude oil contains many toxic compounds which are impact all living organisms. Bioremediation is one option to clean up the environment by using microorganism. In this study, five mixed bacterial consortiums were isolated from five petroleum-contaminated sites by enrichment technique with crude oil. The results of crude oil degrading capability were obtained from five consortiums around 96, 70, 46, 79 and 76%, respectively, of 4,500 mg/L crude oil in liquid cultures was degraded within 9 days. The mixed bacterial consortiums #1 was the most effective in degrading crude oil. In addition, the consortiums #1 can produce biosurfactant which emulsifying activity index with crude oil was 39%. Moreover, the mixed bacterial consortiums #1 was applied in soil microcosms. The consortiums could also degrade crude oil about 87 % of the initial concentrations at 20,000 mg/kg soil within 4 weeks. The results showed that these consortiums could be used for environmental bioremediation.

Keywords: Crude oil-degrading bacteria, Bioremediation, Soil microcosms

EST-P-07

Co-digestion of rice straw with pig manure improves biogas production - effects of pretreatment

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Abstract

In the Mekong Delta of Vietnam, many household biogas digesters are temporarily limited on pig manure which constitutes the main substrate. Abundantly available waste biomasses such as rice straw has not been thoroughly investigated as a supplementary feedstock for small household digesters to secure a more steady production of biogas. In the present study anaerobic co-digestion of pig manure (PM) with rice straw (RS) were evaluated in 21 L batch digesters loaded with mixtures of PM/RS in a 1:1 ratio as based on VS at a total loading of 45 g VS/L. Additional experiments were conducted investigating the effect of different types of environmentally friendly pretreatments of RS on biogas production. Our study demonstrates that anaerobic co-digestion of RS with PM could enhance total biogas production by 79 - 85% as compared to control reactors digesting pure pig manure during 60 days of digestion. The use of simple pretreatment methods such as soaking the RS biomass in suspensions of anoxic river sediment or digester effluent also enhanced biogas production from RS slightly more as compared to pretreatment in tap water.

Keywords: rice straw, pig manure, anaerobic co-digestion, biogas yield, pretreatment

EST-P-08

Mixture of biogas and air to optimize burning and the evaluation of biogas stoves

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Abstract

An experiment was conducted to find the best mixture of biogas and air to optimize burning in infrared biogas stoves as well as to evaluate some biogas stoves that are popular in the Mekong delta of Vietnam. The burning experiment was carried out with mixtures of biogas and air that ranged from 5% to 10% methane. Three types of biogas stoves: (i) simple stove, (ii) normal gas stove, and (iii) improved biogas stove were evaluated using a water-boiling test at two levels of cooking (minimum and maximum). All experiments were conducted in replicates of five. The results showed that the gas mixture of 5% CH_4 was the lowest limitation for infrared burning, whereas the mixture of 10% CH_4 was the highest limitation. In terms of biogas consumption and boiling time, the mixture of biogas and air for optimized burning was 8–9% CH_4. At the minimum cooking level, the biogas consumptions of the simple stove, normal gas stove, and improved biogas stove were not significantly different ($p>0.05$). Whereas at the maximum cooking level, the improved biogas stove consumed 21 liters of CH_4 to boil 1 liter of water, which was lower than that of the normal gas stove at 23.9 liters of CH_4, and the simple stove consumed the highest level, at 37.2 liters of CH_4 ($p<0.05$). Improved biogas stove showed the highest burning efficiency due to air enhancing device which made a better burning mixture gas than other stoves. Applying improved biogas stoves to optimize burning is highly recommended as the best practice when using biogas for cooking.

Keywords: biogas, infrared burning, simple stove, normal gas stove, improved biogas stove

EST-P-09

Effects of composting on the production of methane in solid-state anaerobic digestion of corncob

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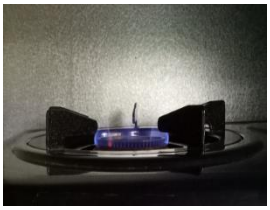
Abstract

The solid-state anaerobic digestion (SS-AD) is a simple and efficiency technology for waste management of lignocellulosic residue since it reduces the water footprint and produces higher volumetric methane productivity compared with the liquid anaerobic digestion. The effluent is solid waste which does not require the remediation of the remaining wastewater. The pretreatment is beneficial processes for improving the methane yield of the SS-AD. The composting is one of the pretreatments which is inexpensive and simple to treat lignocellulosic materials. The main goal of this research project was to investigate the effects of composting of corncob on the biogas production from SS-AD by using corncob as raw material. The 30 kg corncob was ground and composted in 200 L composting bin. The effects of composting inoculum, calcium oxide, urea and aeration on the methane yield of SS-AD were investigated. After 60 days of the SS-AD operation, the highest biogas and methane yield were 362.1 and 98.3 mL/g$VS_{corncob}$ respectively which was achieved by adding 1% CaO and 5% composting inoculum. The methane yield was decreased by the aeration of the compost ($P < 0.05$). The additions of CaO, urea and composting inoculum were not significant to increase the methane yield ($P \geq 0.05$).

Keywords: Pretreatment, Composting, Solid state anaerobic digestion, Methane

		
(i) simple stove	ii) normal gas stove: modified from a normal LPG cooking stove for biogas	(iii) improved biogas stove: improved from a normal LPG cooking stove with the ceramic burners and an air enhancing device which create a better burning mixture gas

(a) Min – simple stove



(b) Min – normal stove

(c) Min – Improved

(d) Max – simple stove

(e) Max – normal stove

(f) Max – Improved stove

Three types of biogas stoves at two levels of cooking (minimum and maximum)

EST-P-10

Bioethanol from Cassava Starch Using *Amylomyces rouxii* TISTR 3182 and Immobilized *Saccharomyces cerevisiae* TISTR 5088

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Abstract

The objective of this research was to saccharify cassava starch by *Amylomyces rouxii* TISTR 3182 and conversion sugar to ethanol by *Saccharomyces cerevisiae* TISTR 5088. The separate hydrolysis and fermentation (SHF) and simultaneous saccharification and fermentation (SSF) process were compared. The SHF process gave the higher ethanol concentration (22.84 ± 0.82 g/L) than the SSF process (14.46 ± 3.90 g/L) at 96 hr. Further study on ethanol production was carried out using the SHF process. The immobilization of *S.cerevisiae* TISTR 5088 by sodium alginate concentration of 2.0%, 3.0% and 4.0% (w/v) were studied. The result showed that the free cell of *S.cerevisiae* TISTR 5088 gave the highest ethanol concentration (19.65 ± 1.97 g/L, Q_p 0.20 ± 0.02g/L/h) and 4.0% of sodium alginate concentration gave higher ethanol concentration (11.73 ± 1.06 g/L, Q_p 0.09 ± 0.02g/L/h) than other sodium alginate concentrations at 120 hr. The bead diameters of immobilized cells at 0.4, 0.8 and 1.2 mm. were obtained at ethanol concentration of 15.78, 16.69 and 16.41 g/L at 120 hr., respectively, which didn't show statistically significant difference ($p > 0.05$).

Keywords: Immobilization, Bioethanol, Cassava starch, *Amylomyces rouxii*, *Saccharomyces cerevisiae.*

EST-P-11

The Water Footprint of Biogas Production Using Microalgal Biomass Cultured with Wastewater from Chicken-Manure Biogas Digester

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Abstract

Microalgae are interesting substrates for biogas production. Biogas from microalgae are possibly be a renewable energy source in the future. Many research have developed and improved biogas production with various implementations. However, water is an essential source for microalgal biomass production. The water consumption is calculated by the water footprint (WF). The water footprint from microalgae has two components: blue water footprint and grey water footprint. When all nutrients are recycled, the grey water footprint is zero. This research investigated the calculation of blue water footprint (four steps: water footprint of biomass production; WF_{produc}, water footprint of microagal harvesting; $WF_{harvest}$, the assessment of the biogas energy yield; E_{biogas} and water footprint of biogas; WF_{biogas}) using microlgal biomass cultured in wastewater from chicken-manure biogas digester for each season in northern Thailand. The cultivation capacity was 10L (surface area: 0.1058 m^2). The WF_{biogas} varies between 5.26±2.01 and 26.15±8.21 $m^3.GJ^{-1}$ depending on season. The microalgal consortium with 100% wastewater in rainy season (comprised of *Leptolyngbya* sp. 60.1%, *Chlamydomonas* sp. 24.2% and *Chlorella* sp. 15.7%) had the lowest WF_{biogas} value (p<0.05). The cultivation required 25.74±4.55 m^3 of water (WF_{produc}+$WF_{harvest}$) for 1 ton of microalgae (32 day of cultivation period). The water evaporation rate in rainy season was about 2.05 times lower than hot season. In conclusion, the microalgal cultivation with wastewater in rainy season is more effective than other seasons in the context of water footprint assessment.

Keywords: Water consumption, Biogas production, Microalgal consortium, Wastewater

EST-P-12

Biogas generated from corn waste by continuous stirred tank reactors using anaerobic bacteria from UASB system

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Abstract

Corn waste was collected from a corn farm (Insee Farm, Saraburee) in Central Thailand. To generate the biogas from corn waste containing high Lignocellulosic biomass, the samples were separate into three parts, silk corn, leaves and stalk. The biogas production from these three parts were compared and evaluated. Plant samples were grinded into small pieces 2 mm and dried with temperature at 180 ^{0}C for 30 min and pretreated with 2% NaOH for 2 days. The hydrolysis was done by using the Fibrolytic enzymes from fungi. The reaction was taken in the continuous stirred tank reactor (CSTR). The variation of pH, COD and VFA were measured at regular intervals. Volatile fatty acid (VFA) production from silk corn was found significantly higher than from leaves and stalks. The hydrolyzed solutions were taken to anaerobic digestion in laboratory scale Leach-bed reactor. The anaerobic bacteria from Upflow Anaerobic Sludge Blanket (UASB) from Beverage Factory were added into the reactor after 1 week activated with hydrolyzed solution. Biogas volumes of samples were measured each 3 days by a gas sensor probe. The biogas volume tended to increase gradually at the beginning of the first week and the emissions remained stable after four weeks. Silk corn substrate gave highest yield of biogas production.

Keywords: anaerobic digestion, batch fermentation, corn waste

EST-P-13

Correlation between $PM_{2.5}$ levels and VIIRS hotspots during intensive biomass burning period in Nakhon Pathom

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Abstract

A dry season is an agro-residue burning season for farmers in Thailand. After harvesting, agricultural wastes have been burned in order to clear the land for the next cultivation. Biomass burning emits several types of air pollutant especially, fine particles. In this study, ambient and indoor $PM_{2.5}$ as well as hotspot counts in Nakhon Pathom, Thailand and neighbouring countries were monitored for subsequent correlation analysis. Biomass burning data observed as hotspots obtained from NASA's archived data for 3 months. The burnings of biomass were monitored by the VIIRS aboard the Suomi-NPP satellite. The back trajectories of air masses were determined by the HYSPLIT model. Meteorological data about wind direction during sampling period were also collected in Nakhon Pathom. Indoor $PM_{2.5}$ was collected in Science, Silpakorn University. The results from HYSPLIT showed that the air masses were originated from the Northeast of Thailand and subsequently entered Nakhon Pathom. Levels of ambient and indoor $PM_{2.5}$ throughout sampling period were 31 and 56 $\mu g \cdot m^{-3}$, respectively. The levels of $PM_{2.5}$ were higher than Thailand's air quality standard for 1 year. Additionally, indoor levels were considerably higher than ambient levels approximately 2 times due to poor ventilation. It was obvious that the ambient and indoor levels were strongly correlated (r=0.8). During 3 months, the ambient $PM_{2.5}$ levels in Nakhon Pathom were moderately correlated with hotspot counts in Thailand (r=0.55) (42,476 hotspots) and Thailand combined with Cambodia (r=0.56) (59,229 hotspots) corresponding to the air mass direction acquired from HYSPLIT Model. For other countries the r was between -0.1 to 0.2. The degrees of correlation were not high since hotspot counts obtained from VIIRS reflect counts of burning rather than the sizes of burning area. In addition, levels of $PM_{2.5}$ were influenced by traffic which also plays an important role in the areas.

Keywords: $PM_{2.5}$, Opened burning, Air quality monitoring, Hotspots.

EST-P-14

Arsenic in rice and paddy soil samples

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Abstract

Arsenic (As) is a toxic element that is widely found naturally in the environment. In this study, the concentration of As in rice and paddy soil samples collected from the northeastern region of Thailand was determined by inductively coupled plasma mass spectrometry. The mean concentration of As in rice and soil samples were 0.140 □□0.059 and 1.82 □□1.37 mg kg^{-1}, respectively. All rice samples showed inorganic As lower than the limit data of Codex (0.2 mg kg^{-1}). As in paddy soil samples was less than the US EPA cancer soil screening level (22 mg kg^{-1}). The estimated daily intake (EDI) of inorganic As from rice consumption was 0.023 □ 0.010 mg day^{-1}. The percentage contribution to Provisional Tolerable Weekly Intake (PTWI) value of As for Thai male (body weight of 69 kg) was 15.5% and for Thai female (body weight of 57 kg) was 18.7%. The findings indicated that all studied rice samples are safe for consumption.

Keywords: Arsenic, Rice, Soil, Estimated daily intake, ICP-MS

EST-P-15

Investigation of hydrogen-based denitrification performance on nitrite accumulation under various bicarbonate doses

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Abstract

Nitrate-contaminated in groundwater sources has been globally taken as crucial issue effects of nitrate on human health, e.g., Methaemoglobinaemia. There are various processes, which have been applied for treatment of the contaminated nitrate. Hydrogen-based autotrophic denitrification (hydrogenotrophic denitrification) is an alternative process used for abatement of the nitrate-contaminated in groundwater. High efficiency on nitrate removal was achieved by former researchers. Still, nitrite accumulated inside the system was observed in those studies. This particular study found that inorganic carbon had no impact on the nitrate reduction rate whereas the nitrite reduction rate was improved when higher amount of inorganic carbon was supplied. Also, using bicarbonate as an inorganic carbon source had a positive effect on the growth and adaptation of *true denitrifiers* that can reduce the nitrite accumulation in hydrogen-based denitrification system.

Keywords: Hydrogenotrophic, Denitrification, Hydrogen, Bicarbonate, Nitrite

EST-P-16

Isotopic mass balance approach for verification of shallow groundwater recharge, Phitsanulok

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Abstract

This study employs a mass balance approach on stable isotopes to verify shallow groundwater recharge in Chumsaeng Songkhram district, Phitsanulok during 2016-2017. Precipitation, shallow groundwater and surface water samples were collected and analyzed for stable hydrogen and oxygen isotopic compositions. The study area had low humidity and high ambient temperature causing the observed Local Meteoric Water Line (LWML) shown smaller slope and intercept than in the Global Meteoric Water Line. The surface water was enriched in heavier stable isotopes of oxygen and hydrogen and offset from the LMWL indicating an evaporation of surface water. Overall, hydrogen and oxygen isotopic compositions of shallow groundwater were distributed along the LMWL implying that local rainfall was the main source of recharge for shallow groundwater. Using isotopic mass balance approach, the percentage recharge contribution of surface water and rainwater to groundwater was calculated. This study found that groundwater recharge during the monsoon season was consisted of approximately 90.17% rainwater. Similarly, the average contribution of surface water during the high flow period was about 9.83%.

Keywords: Water balance, Stable isotopes, Yom River, Groundwater, Phitsanulok

EST-P-17

Equilibrium and Kinetic Study of Adsorption of Lead from Aqueous Solution onto Polyvinyl Alcohol - Alginate Beads Immobilized with Spent Yeast

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Abstract

Spent yeast was immobilized with polyvinyl alcohol and sodium alginate and used in the study on adsorption of lead to determine the effect of initial lead concentration. A kinetic model has been developed using pseudo-first and pseudo-second order equations and fitted for the sorption of lead. The results showed that the sorption of lead can be described by a pseudo-second order model as shown from higher correlation coefficients (R2). The values of the rate constants (k2) and initial sorption rate (h) were calculated and tended to decrease with an increase in the initial concentration of lead. Langmuir, Freundlich, Temkin and Dubinin-Radushkevich (D-R) isotherms were used to fit the equilibrium sorption data. The results showed that the R2 value of Freundlich isotherm was the highest. The sorption intensity was 2.40 indicating a favorable sorption process. Langmuir isotherm is also favorable, the maximum monolayer coverage was 12.29 mg/g and the separation factor was 0.006-0.024. The heat of sorption process was estimated to be 791.86 J/mol from Temkin isotherm model and the mean free energy was 2.93 kJ/mol calculated from D-R isotherm model.

Keywords: Sorption isotherm, Spent yeast, Polyvinyl alcohol, Sodium alginate, Lead

EST-P-18

Evaluation of using a cost-effective open tubular capillary ion chromatograph for some ions determination in environmental samples

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Abstract

The ion chromatography is a powerful tool for ion separation and analysis for environmental science and technology investigation. However, the conventional ion chromatography is bulky and expensive equipment. In this work, a cost-effective lab-built open tubular capillary ion chromatography (OTIC) with 130 cm length of 50 µm ID fused silica capillary coated with poly(butadiene-maleic acid) (PBMA) copolymer has been developed for separation of some alkaline cations. With using a low-cost capacitance board as contactless conductivity detector, some alkaline cations can be separated and determined. The extremely low flow rate of the proposed system in the level of < 1 µL/min provides to be a versatile green analytical technique. In addition, the proposed system requires very low pressure at the level of 10-30 psi. Therefore, it shows a possibility to be fabricated as a compact instrument setup. As a result, it is a promising portable system for ion determination in the environmental samples. The procedure to fabricate a separation column and evaluation result with using the proposed system for some alkaline cations determination in selected water samples will be presented.

Keywords: Cations determination, Open tubular capillary ion chromatography, Cost-effective device

EST-P-19

The effects of heavy metals in sediment on benthic organisms at Pak Phanang river mouth, Nakhon Si Thammarat

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Abstract

Pak Phanang estuary, Nakhon Si Thammarat province is one of the most dynamic ecosystems in Thailand. Land uses of human activities have major effects on coastal resources. This study aimed to investigate diversity of benthic organisms in Pak Phanang river mouth in difference areas of human activities. Benthic organisms and sediments were sampled from dockyards, community and mangrove areas in September 2018 and April 2019. The Samples were collected in triplicates by 50× 50 centimeter quadrants at a depth of 0-15 centimeter. The benthic organisms were classified benthic species and applied for BIMP. The heavy metals in sediment samples were extracted with concentrated nitric acid and determined by Couple Plasma-Optical Emission Spectrometer (ICP-OES). Richness Index, Biodiversity Index and Evenness Index of sample areas were derived to classify dominant species, and distribution of benthic organisms. The Biological Monitoring Working Party (BMWP) score system was applied to identify an index of river water quality for Pak Panang river mouth based on benthic organisms. Finally, Principle Component Analysis (PCA) was used to analyst major pollutants of heavy metals that affected on benthic organisms. Results showed that benthic organisms in mangrove areas demonstrate the highest score of Biodiversity Index. This indicated that human activities impacted on coastal resources. PCA showed that lead was the major influence on benthic biodiversity of Pak Phanang river mouth.

Keywords: Benthic organisms, Heavy metal, Water Quality, Sediment

EST-P-20

Novel 3D lab on a chip for determination of phosphate in water samples

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Abstract

Novel 3D lab on a chip (LOC) used in the micro reverse flow injection analysis (µ-rFIA) system has been fabricated on polymethylmethacrylate (PMMA) by laser etching and applied for determination of phosphate in water samples. The assay is based on molybdenum blue reaction. The LOC components included a micro-reactor (250 µm i.d.) and a flow through cell (1-cm pathlength). The calibration curve was constructed between [phosphorus] vs. absorbance, and it was linear in the range of 0.1-5.0 mg L^{-1} with R^2 = 0.9989. The limit of detection was 0.065 mg L^{-1} and percentage relative standard deviation (%RSD, n=10) was 2.88. The percentage recoveries varied from 90.3 to 106.4 for spiked water samples. The outside dimension of lab-made LOC is the same as a typical flow through cell, therefore it can be applied to a common spectrophotometer.

Keywords: Water samples, Phosphate, Lab on a chip, Flow injection analysis, Spectrophotometry

EST-P-21

Appropriate scenarios for mercury emission control from coal-fired power plant using the iPOG and CALPUFF model

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Abstract

Combustion of coal in a power plant is one of the major anthropogenic sources that release mercury into the atmosphere. However, its emission is expected to be decreased by implementing several emission control strategies. This research evaluates the success of mitigation scenarios in controlling mercury emissions from coal-fired power plant. These measures include gas cleaning systems, coal properties, furnace conditions, specific mercury control technologies as well as the co-benefit of mercury reduction from existing air pollution control devices installed at the power plant. Emissions are estimated using an actual characteristic of the power plant as an input for the iPOG model. As for the best practice in controlling of mercury emission, it is found that the appropriate scenario in this study can be achieved by adding the brominated activated carbon injection to the air pollution control devices (electrostatic precipitator and wet flue gas desulfurization) currently be installed at the power plant which can reduce the amount of mercury emission by 9.15 times of the baseline emission and causes the change of mercury concentration in the atmosphere from the current situation up to 92.8%. In a presence of existing air pollution control devices, it was estimated that about 374 g/hr of mercury emission were controlled. This success was about 9.12 times in mercury emission reduction when comparing with no any air pollution control devices equipped at the power plant. These results revealed the co-benefit of air pollution control technologies used in controlling conventional air pollutants (dust, SO_2 and NOx) towards controlling of mercury emission. Improving of combustion characteristics such as controlling of the loss of ignition which has a direct benefit in energy conservation could also reduce up to 1 time of mercury emission from it baseline scenario.

Keywords: Co-benefit, Mercury emission, Coal combustion, iPOG

EST-P-22

Assessment of hydrogen sulfide concentration and dispersion in ambient air using AERMOD model from Saen Saeb canal in Bangkok, Thailand

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Abstract

Hydrogen sulfide (H_2S) released as by product of anaerobic process from the Saen Saeb canal in Bangkok is evaluated for its potential impact on odour nuisance to nearby residents and businesses. Emissions of H_2S were estimated by the US.EPA WATER 9 model by using actual concentrations of H_2S in the canal obtained from the direct measurements as one of the input data along with the physical characteristics of the canal. Calculated emission rates under 2 scenarios (with and without operations of the public-transportation boat) were further evaluated for spatial distribution of ambient H_2S concentrations using the AERMOD model. Predicted results revealed that with an operation of the public-transportation boat in the canal, H_2S concentrations were about 67% higher than those without canal-boat operation. Seventeen sensitive receptors in the study area were evaluated for their potential threat on odour nuisance problem. It was found that there were 9 and 4 receptors predicted to have H_2S concentrations greater than its odour annoyance threshold of 7 $\mu g/m^3$ under with and without the canal-boat operation scenarios, respectively. Predicted concentrations under the scenario with the canal-boat operation were ranging from 2.57 to 38.31 $\mu g/m^3$. On the other hand, without canal-boat operation, it was predicted that H_2S ambient air concentrations at those receptors will be varied from 0.83 to 12.35 $\mu g/m^3$.The study clearly indicated that the effort in controlling H_2S concentration in the canal taking into consideration the water quality standard is not enough to minimize the potential impact on an odour nuisance from this compound particularly when the canal is aerated from the operation of the public-transportation boat. Therefore, a concern on an odour impact should also be given when setting up a river water quality standard for those rivers which serve as a public transportation route in an urban area.

Keywords: Hydrogen sulfide, AERMOD model, Saen Saeb canal, Odour

EST-P-23

Enhancing the Predictive Performance of Colorimetric Sensors Using Multivariate Calibration Models.

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Abstract

Colorimetric sensors have become a more popular analytical technique because they allow chemical detection to be performed without or less complicated analytical instruments. The colorimetric detection can be done based on observation of color changes in chemical sensors and this could be simply by using naked eyes. However, the naked eye detection is often suitable for screening or semi-quantitative analysis purposes. This research aims to enhance the detection performance of colorimetric sensors by adopting some chemometric models. Eight commercially available colorimetric sensors including manganese (II) ion (Mn^{2+}), copper (II) ion (Cu^{2+}), iron (III) ion (Fe^{3+}), nitrate (NO_3^-), phosphate (PO_4^{3-}), sulfate (SO_4^{2-}), pH and total hardness test strips were used for the demonstration. The sensing colors were converted into RGB (red, green, blue) color coded values. Chemometric models such as univariate linear regression (ULR), multivariate linear regression (MLR) and partial least squares (PLS) were established based on the coded digital data. Model statistics, such as root mean square error of calibration (RMSEC), root mean square error of prediction (RMSEP), coefficients of determination for calibration (R^2) and prediction (Q^2) of the developed models were compared to envisage the predictive ability and robustness of the developed models. In this research, the optimal predictive performance was obtained from ULR and MLR for the determination of PO_4^{3-} and Fe^{3+}, respectively, whereas the remainder strips have found to provide the best predictive results with PLS modelling.

Keywords: Colorimetric sensor, Chemometrics, Multivariate calibration, Water quality monitoring, Color model

EST-P-24

Prediction of PM_{10} Concentrations over Upper Northern Thailand using Statistical Approach

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Abstract

This study aims to predict daily PM_{10} concentration and to investigate the effects of extreme meteorological variables and air pollutants over six provinces in Upper Northern Thailand (UNT) region. To this end, two models; Multiple Linear Regression (MLR) and Quantile Regression (QR) models with ten predictors each have been developed. Five meteorological variables (maximum temperature, rainfall, relative humidity, air pressure, and wind speed) and five air pollutants (CO, PM_{10}, O_3, NO_x and SO_2) observations from 2003 to 2015 were used to construct and verify the MLR model. The coefficient of determination and adjusted R^2 ($p < 0.01$) were 0.71 and 0.70, respectively. The model performance has been assessed over the period from 2012 to 2015 over UNT using three statistical performance indicators including Root Mean Square Error (RMSE), Mean Absolute Error (MAE), and Index of Agreement (IOA). Their value ranges were 20.35-40.00, 12.00-30.00, and 0.65-0.93, respectively. QR model reflected the sensitivity of predicted PM_{10} concentrations to the extreme covariate values (5 % and 95 % quantiles) over this region. The effects of extreme meteorological variables are found to be mixed. CO is found to be the most significant contributor to PM_{10} concentrations compared with the other air pollutants. In terms of air quality management in UNT, these models can be used effectively to aid air quality regulations and policies formulation to improve the air quality during the dry seasons, as they showed high performance in predicting PM_{10} concentrations and investigating the effect of extreme values on its concentrations.

Keywords: Air quality, Monitoring, Aerosol formation, Transport, Climate (maximum 5 keywords)

EST-P-25

Lignin Separation from Bagasse and Precipitation by Organic Acid

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Abstract

This research aimed to study the optimum conditions for separating the maximum amount of lignin from bagasse and comparing the precipitation between inorganic and organic acid. The experiments were divided into three procedures. The first procedure was to determine the lignocellulosic compositions in bagasse which were cellulose, hemicellulose, and lignin. Then, the second procedure was to study the optimum conditions which included temperature, time and the bagasse to solvent ratio in order to extract the lignin from bagasse using sodium hydroxide as solvent. The studied conditions were carried out at 60 and 120 ℃, dwell times of 30, 60 and 120 minutes and the ratio of bagasse (g) to sodium hydroxide solution (ml) at 1:10, 1:20, and 1:30. The final procedure was to separate lignin from sodium hydroxide solution by precipitation using sulfuric and formic acid at pH 1, 2, 3, 4, and 5. The experimental results showed that the bagasse consisted of 45% cellulose, 20% hemicellulose, 21% lignin, and 14% other compounds. The optimum condition for separating lignin was 60 minutes, 120 ℃, and the ratio was 1 g of bagasse to 10 ml of sodium hydroxide. The lignin was precipitated by sulfuric and formic acid at pH value of 3, and the precipitated lignin and their yield were 6.47 and 6.53g/l; 30.8 and 31.1%, respectively. In summary, the lignin from bagasse can be extracted by sodium hydroxide solution and separated by sulfuric and formic acid precipitation and the yield of lignin from formic similar to one of sulfuric acid at the same pH value. Therefore, the formic acid can use for precipitating lignin instead of sulfuric acid and it is also friendly and less toxic chemical for environment more than sulfuric acid.

Keywords: Bagasse; Lignin separation; Lignocellulose

EST-P-26

EST-P-27

A new strategy for coproducing high-value commodity chemicals and liquid hydrocarbon fuels from lignocellulosic biomass

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Abstract

A biorefinery strategy, for the coproduction of liquid hydrocarbon fuels and chemicals from lignocellulosic biomass, is proposed. In this strategy, all three primary components of biomass are converted into high-value products that can be commercialized: (1) cellulose, which is converted into butene oligomers for transportation; (2) hemicellulose, which is converted into 1,5-pentanediol, which can be used as polyester and polyurethane component; and (3) lignin, which is converted into carbon products (e.g., carbon fibers or batter anodes), thereby maximizing the biomass utilization (up to 48% of the biomass to useful products) and leading to an increase in economic feasibility. Technoeconomic analysis shows that the integrated strategy leads to a minimum selling price of $4.27 per gallon of gasoline equivalent for butene oligomers, which suggests that it is a promising alternative to current biofuels production approaches.

Keywords: Economics, Heat integration, Sensitivity, 1,5-Pentanediol, Butene oligomer

EST-P-28

Volatile oil and extracts from leaves of *Seseli mairei*

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Abstract

In this research, extraction and analysis of chemical composition of volatile oil and extracts from *Seseli mairei* have been performed. The volatile oil from leaves was isolated by steam distillation. The leaves were also extracted by maceration with hexane and dichloromethane to afford the extracts in 0.5% and 0.8%, respectively. The chemical constituents of the volatile oil and the plant extracts were mainly characterized by gas chromatography-mass spectrometry (GC-MS). The major chemical components of the leaf oil were 2,4,5-trimethyl benzaldehyde (51.7%), bis(2-ethylhexyl) sebacate (6.7%) andβ-sitosterol (2.1%). In addition,3-methyl-but-2-enoic acid, 2,2-dimethyl-8-oxo-3,4-dihydro-2*H*,8*H*-pyrano[3,2-g]chromen-3-ylester(7.7%) was found in maximum quantity in hexane extract, followed by hexadecanoic acid, methyl ester (6.2%) and 9,12-octadecadienoic acid, methyl ester (5.7%). The most abundant compound in dichloromethane extract was 9-octadecanamide (20.0%), followed byhexadecanoic acid (10.2%) and cyclooctacosane (9.1%). Moreover, biological activities (*eg*. antibacterial activity and antifugal activitiy) of these *Seseli mairei* oil and extracts will be further investigated.

Keywords: *Seseli mairei*, Volatile oil, Extraction, Biological activity

EST-P-29

Adsorption of Basic Red 29 Using Magnetic Activated Carbon

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Abstract

In this research, the mechanism of the adsorption of Basic Red 29 from aqueous solution using magnetic activated carbon (MAC) prepared by chemical co-precipitation ($FeCl_3.6H_2O$ and $FeSO_4.7H_2O$) was investigated. Adsorption parameters considered in this study included pH, contact time, initial Basic Red 29 concentration and temperature. Adsorption isotherms, kinetics, and thermodynamics were used to determine the maximum adsorption capacity and to explain the adsorption mechanisms.

The optimum conditions for the adsorption of Basic Red 29 color using MAC was pH, 8; contact time, 90 min; initial Basic Red 29 concentration, 200 mg/L; and temperature, 15°C. The maximum adsorption capacity was 256.41 mg of Basic Red 29 /g of MAC. The equilibrium data was fitted well with the Langmuir isotherm, so the adsorption was monolayer and site-specific. The kinetic results corresponded to the Pseudo second order model, indicating chemical sorption as the rate limiting step of adsorption mechanisms. The thermodynamics results revealed the dominant role of an exothermic reaction and a spontaneous reaction. Moreover, MAC had advantages as easy and rapid separation from aqueous solution. All results indicate that MAC is an effective adsorbent for adsorbing Basic Red 29 from aqueous solution.

Keywords: Magnetic Activated Carbon, Adsorption, Basic Red 29

EST-P-30

Photocatalytic degradation of organic pollutants by monoclinic $BiVO_4$ photocatalyst synthesized by a microwave radiation method

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Abstract

Monoclinic bismuth vanadate (m-$BiVO_4$) has been regarded as a promising visible-light-driven photocatalyst for degrading of organic pollutants in wastewater due to its narrow band gap energy, non-toxicity and high stability. In this work, m-$BiVO_4$ photocatalyst was successfully synthesized by a microwave radiation method aiming for fast chemical reaction which led to short reaction time, energy saving, and high efficiency for the material production. Effect of microwave power (300, 450, 600, and 700 W) on crystallinity, particle size and photocatalytic activity of the synthesized powders was investigated. The samples were characterized by X-ray powder diffraction (XRD), field emission scanning electron microscopy (FESEM), and UV-Vis diffuse reflectance spectroscopy (UV-Vis DRS). XRD and FESEM analyses showed that crystallinity and particle size of the synthesized m-$BiVO_4$ particles increased with increasing of the microwave powers. UV-vis DRS spectra indicated the absorption band edge in the region of 540-600 nm. The m-$BiVO_4$ photocatalyst synthesized using 700 W of microwave power exhibited the highest photodegradation efficiency where 99.11% of methylene blue was degraded within 270 min under visible light irradiation. This photocatalyst also showed higher photocatalytic selectivity on the cationic dye rather than the anionic dye.

Keywords: Monoclinic $BiVO_4$, Photocatalyst, Visible light, Photodegradation, Microwave radiation

EST-P-31

EST-P-32

People and data: two factors for sustainable of water quality management in Pak Phanang river basin

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Abstract

Pak Phanang river basin located in the south of Nakhon Si Thammarat province, Thailand. It covers 10 districts of Nakhon Si Thammarat province, 2 districts of Phatthalung province and 1 district of Songkhla province. In term of the water quality, it has more complex and diverse from population, resources and land use, and climate change. It has led to effects on the livelihood of the people in the basin. Therefore, water quality management is important to achieve sustainable development. This study focuses on two factors of sustainable development are people and data. In this study, researchers and communities are working together. Every month, communities will test and send a water quality data to researchers to analyze and collect. On the other hand, the communities have continuously used the information to plan and manage water quality problems in his area. Currently, the project has 19 water quality testing points by the community. There is also mobile and web application that helps facilitate the work between researchers and communities. For data factor, every water quality data can store and retrieve from database and represent in many format such as spreadsheet, PDF, graph and pine chart. In addition, this study has also created open data that human (spreadsheet) and machine (RESTFUL API) readable to links a local data to city and country data platform according to the Thailand's strategic plan.

Keywords: Water Quality Assessment, Mobile Application, Open Data, Pak Panang river basin.

ABSTRACTS

SESSION II
Natural Resources Management and Sustainability

Oral presentation

NRMS-O-01

Ecological Aspects of Dhole in Huai Kha Khaeng Wildlife Sanctuary, Uthai Thani Province

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Abstract

The dhole (*Cuon alpinus*) is an endangered species in the family Canidae of the world. The objectives were to investigate the spatial movement of dhole, prey abundance, prey selection and also to study the prey overlapping with other large carnivorous species in Huai Kha Khaeng Wildlife Sanctuary, Uthai Thani Province during November, 2017 and October, 2018. Two adult female dholes were captured and fitted with Global Position System (GPS)-collars. Fifteen camera trap sets were systematically used to survey over year round. The scat collection was done along forest roads and forest trails. Based on 2 collared dholes, home range size of the first dhole was 4,474.23 ha, 3,151.63 ha, 214.83 ha, and 6.05 ha at 100%, 95%, 75%, and 50% minimum convex polygon (MCP), respectively. The average distance from the center of home range of the first dhole was 1,442.84 m (median 450.00 m, range 0-8,312.60 m). The home range size of the second dhole was 157.71, 33.39, 13.24, and 3.38ha at 100, 95, 75, and 50% MCP respectively. The average distance was 331.56 m (median 209.11 m, range 0-3,476.56 m). Percent relative abundance (%RA), investigated using camera traps, found that sambar deer (*Rusa unicolor)* was the prey of highest abundance (30.93%). %RA of the dhole was 0.95% less than the leopard (*Panthera pardus*) (7.76%) and tiger (*Panthera tigris*) (3.25%). Prey species identification based on fecal analysis reflected that dhole consumed at least 6 prey species. The frequency of occurrence (FO) of prey species based on scat analysis found 57.1% of red muntjak, similar to the leopard (40%), while the prey species with the highest FO consumed by tiger was sambar deer,33.3%FO. The electivity index showed that dhole mostly preferred prey with small body size, such as the red muntjak, more than availability. Leopards preferred to consume primates and red muntjac at a rate greater than their availability. The carnivore with the largest body size in the area, the tiger, preferred to consume prey of larger body size, especially sambar deer, wild boar (*Sus scrofa*) and red muntjac based on their availability. Pianka's index showed a high degree of overlap between dhole and leopards (98%), indicative of a very high degree of prey competition between these two species. In comparison, there was 68% overlap between dhole and tiger.

Keywords: Dhole, Large predator, GPS-collar, Camera trap, Scat analysis

NRMS-O-02

Traditional Ecological Knowledge of Indonesian Sea Nomads "Orang Suku Laut" on Climate Change Adaptation

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Abstract

At the international community, the Traditional Ecological Knowledge (TEKs) of indigenous peoples has been acknowledged as an important role to tackle climate change. The concept of the TEKs as practices, cultural beliefs, and adaptive capacities could be integrated into climate change adaptation. The *Orang Suku Laut* (OSL) as Indonesian indigenous group who are living nomads in the sea possess the TEKs that would be considered as the key drivers to achieve the effectiveness of climate change adaptation. This research aimed to study the TEKs of the OSL on climate change adaptation. The semi-structured questionnaire was developed for field observation and in-depth interview by using the purposive sampling method in selecting the multilevel respondents (n= 77). The study found that 82.8% of the OSL have known about climate change and its impacts on their livelihood. The TEKs of the OSL on climate change adaptation include best practices by 53.3% cultural beliefs by 33.3%, and adaptive capacities by 13.4%. About 55% of them mentioned that the TEKs would be integrated with any modern technology in adapting to climate change. The study also found that the challenges of the OSL in using their TEKs for climate change adaptation consist of the degradation of their cultural belief and practice. In addition, climate variability, governmental policies, globalization, and socio-economic situation were observed as principle factors in declining their TEKs. Therefore, the Indonesian action plans on climate change adaptation would take consideration of the TEKs regarding their autonomous adaptation. The study would highly recommend the involvement of the OSL through the Free, Prior, and Informed Consent (FPIC) participation in the national strategic plans on climate change adaptation in a clear direction.

Keywords: Traditional Ecological Knowledge (TEK), Indonesian Sea Nomads, Orang Suku Laut (OSL), Climate Change Adaptation

NRMS-O-03

Valuing ecosystem services from organic agroecosystem as an approach for natural resource management at Gasa, Bhutan

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Abstract

Ecosystem services (ES) are the goods and services derived from the ecosystems, thus, linking the ecosystems to the human welfare. Organic agroecosystem (OA) proved to have potential to sustain supporting and regulating services stabilizing the provisioning and socio-cultural services which yield indirect use value. Valuing indirect use value would bring a scientifically sound approach to natural-resource management decision making. Thus, study was conducted to value ecosystem services from organic agroecosystem in providing ES as an approach for natural resource management. This study was carried out at Khatoed and Khamaed gewog (village block) growing certified crops under Gasa district in Bhutan. So far garlic, carrot and potato are organically certified. Value of the most prominent ES identified for study were primary nutrient (nitrogen, phosphorus, potassium), soil formation, carbon offset and soil moisture regulation. Monetary value was calculated from the total dryland cultivated area of 295.43 acres. The valuation method used was avoidance expenditure. The results show Khatoed and Khamaed could avoid the cost of $38.62 and 130.35 respectively for not having to buy organically garlic, carrot and potato. Moreover, farmers could avoid the expenditure of $ 669,436 per season from mentioned vegetables by going organic. This study revealed that OA has the potential to maintain ES reducing the expenditure on external inputs. The similar studies also showed that OA outweighs the conventional agriculture in terms of enhancing ES without compromising the yield. The recommendations for the future ventures are (1) to assess the provisioning and socio-cultural services and (2) do comparative assessment with conventional agriculture using life cycle assessment approach.

Keywords: Certified vegetables, Economic valuation, Regulating services, Supporting services

NRMS-O-04

Economic return of crop rotation and reduction of open-air rice straw burning in rice-based cropping system in Northern Thailand

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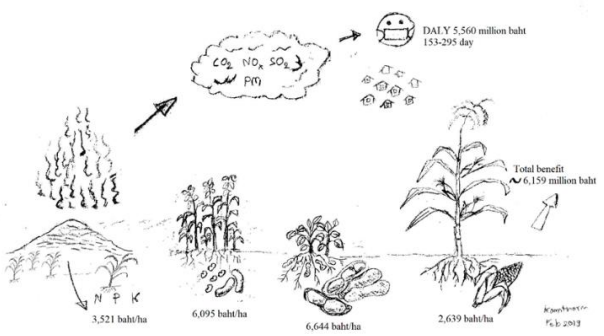
Abstract

Open-air burning of crop residues (OBRS) has been widely practiced before the next cultivation while seriously affecting the human health and the environmental quality. The benefits of crop's residue management in term of economic evaluation are useful guideline to the post-harvesting time. This study shows the economic return of three crop rotation and the reduction of OBRS in the upper Northern Thailand. The external costs were evaluated base on the environmental impacts to the greenhouse gases and the human health damage with climate change and the particulate matter (PM), to estimate the value of disability-adjusted life year (DALY). The results show the farmers lose a quality of good health 153-295 day per ha that it is the external cost 5,560 million baht of total burning area. However, after rice harvesting, the incorporation of the rice straw into the soil returns most of the nutrients, show the benefit are 3,521 baht per ha. For the crop rotation, legume is the crop with most value of nutrients (6,644 baht per ha) follow by crotalaria (6,094 baht per ha) and maize (2,639 baht per ha)



Keywords: Economic valuation, Open-air rice straw burning, value of DALY, value of social benefits

NRMS-O-05

The Development of A Liveable Agricultural Community Through Community-Based Natural Resource Management: A Case Study of Salaengphan Sub-District, Lamplaimat District, Burirum Province, Thailand

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Abstract

The objective of this research is to analyse the guidelines for community-based natural resource management (CBNRM) for the agricultural sector in Salaengphan community. The quantitative and qualitative data were collected from representatives of governmental and private sector, community leaders, and consumers. A total of 146 farmers were randomly selected from four villages of Salaengphan sub-district. Data were collected using questionnaires, in-depth interviews, and focus group discussion. Rice and vegetables are the main agricultural productions in this community. Some farmers have been certified by Good Agricultural Practices (GAP). However, most of the farmers are still utilising chemicals in their agricultural practice. They normally grow, harvest, and sell to middlemen. Some of the vegetables are delivered to a local supermarket as a part of a CSR programme. In the past, before the pilot groundwater project was implemented, the community suffered from water scarcity. Currently, farmers are facing problems of plant disease and insects. Farmers do not have sufficient income to purchase seeds and machinery. To achieve a liveable agricultural community, the community members have set the vision "Farmers will work together in order to cultivate organic vegetables". CBNRM guidelines have been developed through the focus group discussion as follows: to implement zoning for organic agriculture, to create and strengthen the farmer leaders in organic agriculture, to support farmers in capacity building in the organic agricultural sector, to cultivate medicinal plants and to raise awareness of organic agriculture.

Keywords: Community-based natural resource management (CBNRM), liveable agricultural community

NRMS-O-06

Assessing of Water Balance Components in Dry Dipterocarp-Forested Watershed in Phayao, Thailand

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Abstract

Water dynamics in dry dipterocarp-forested (DDF) watershed ecosystem plays an important role for hydrological cycle. Phayao province has a large surface water storage as in Phayao lake and upper Ing river. Changes in water bodies impact on ecosystem service and water consumption for stakeholders. Accurate estimation of water balance components is needed for good decision-making in water resources policy and management. This study aims to understand variations of water balance components in DDF watershed including rainfall (P), evapotranspiration (ET), runoff (Q) and soil water storage change (ΔS). P and ΔS were measured by micro-meteorological equipment, while ET was estimated by eddy covariance technique. These parameters were collected for four years between 2014 to 2017. The results showed annual P, ET, Q and ΔS were 985±52.2, 854±59.6, 131±35.4 and 0.1±0.3 mm, respectively. Noteworthy, the annual P and ET were slightly different, but the seasonal P and ET in dry season 2015/2016 (November 2015 to April of the following year) significantly declined 36% to 20% compared with its average for four dry seasons. In addition, runoff in 2015 was a decrease of 28% compared with the averaged four years. The severe drought in dry season 2015/2016 was consistent with the El Niño event in 2015/2016. Thus, this study could detect the impact of El Niño on water balance in DDF watershed. However, there was a distributed runoff for 5 months per year according to post-rainfall event that exhibited the importance of DDF for water conservation.

Keywords: Dry dipterocarp forest, Eddy covariance, Water balance components, Forested watershed

NRMS-O-07

Satellite Remote Sensing for Agricultural Mapping at Nang Lae Sub-district, Mueang Chiang Rai District, Chiang Rai Province

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Abstract

Agricultural areas in Nang Lae Sub-district have changed dramatically over the past 10 years (2006-2016), which requires sustainable land-use planning. Satellite remote sensing has been used for agricultural management. Nang Lae sub-district, Mueang Chiang Rai district, Chiang Rai province, is considered in this study because of its importance for economic agricultural production from the paddy fields, and field crops (e.g. pineapple) and orchards (e.g. lychee, longan and pomelo). Systematic stratified sampling was applied on the study site for ground truth observations. Three plots of each agricultural area were surveyed and identified. Thaichote imageries were digitally classified into three agricultural classes, namely paddy field, field crop (pineapple) and orchard (lychee/longan/lemon/pomelo). Both underestimation (omission errors) and overestimation (commission errors) occurred due to mixed reflectance of field crop and orchard in this study area which led to less classification accuracy. Thaichote sensors specification may not be appropriate for agricultural land classification. Using high spatial resolution images with environmental information concerning may help to improve agricultural mapping. However, the result suggested that there is an immediate need to monitor current landuse across the reserve forest to assist the municipal and government policies concerning agriculture and forestry.

Keywords: Remote sensing, Thaichote satellite, Agricultural land classification, Chiang Rai province

NRMS-O-08

Water footprint of super absorbent polymer process

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Abstract

The water footprint (WF) is an indicator of water consumption both direct and indirect water use in manufacturing. WF concept can be applied to companies to evaluate the sustainability of product and production process. This paper aims to evaluate the existing water footprint of super absorbent polymer (SAP) process per ton of SAP following the global water footprint standard. The evaluation scope is cradle-to-gate that covers both supply chain and production process. Blue and gray water were focused in this evaluation excepted green water due to its has not been consumed in process. SAP has been developed for over 20 years in the world. These polymers have the ability to absorb and retain a large volume of liquid without water soluble. They are made from partially neutralized, lightly cross-linked polyacrylic acid that is low solids levels, and are dried and milled into white granular solids. SAP is extremely swelled to a soft gel in water that in some cases can be up to 99wt% water. The major of SAP consumption is for hygiene application, e.g. baby diapers, adult incontinence, and napkin. Calculation data is based on actual yearly consumption. Simplified flow diagram was calculated, raw material which is small consumption values are grouped and evaluated under others. Total utility consumption is calculated that complies with a financial report. Calculated values were already deducted administrative activities. Accord to the limitation of emission factor, the equivalent factors are implemented for calculation. The results show total water consumption of SAP process requires 181.91 m^3H_2O per ton, which 99.96% and 0.04% of blue and gray water. Total WF is divided into 5 sectors which supply chain 80.58%, material 19.17%, the manufacturing process 0.19%, packing and transferring 0.03% and disposal 0.03%. The studied results can support the water management program of manufacturing.

Keywords: Super absorbent polymer, water footprint, supply chain, sustainability

NRMS-O-10

Identifying and locating trees of framework species using photography from an unmanned aerial vehicle (UAV)

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Abstract

The need to locate and identify potential seed trees has become crucial, if we are to meet ambitious global reforestation targets of UN New York Declaration on Forests, 2014, which aims to restore forest in 350 million ha of degraded land by the year 2030. Tree species identification in tropical forests is hindered by low visibility from the ground. The possibility of viewing trees from above, using remote sensing platforms (planes and satellites) and imaging technologies such as hyperspectral imagery and lidar are being investigated. However, such technologies are very expensive and not readily accessible. In contrast, Unmanned Aerial Vehicle (UAV's), with high-resolution cameras, have become a lot more affordable in recent years. Therefore, the research presented here determined if an off-the-shelf UAV could be used to easily identify 9 target tree species in dense regenerating forest from above. The study site was at Ban Mae Sa Mai (BMSM), Doi Suthep-Pui National Park, Northern Thailand, where forest had been restored in two plots (0.64 ha), by planting framework tree species 20 years previously, by Chiang Mai University's Forest Restoration Research Unit (FORRU-CMU). Digital photographs (20 megapixels) of tree crowns of nine framework tree species (*Artocarpus gomezianus, Castanopsis calathiformis, Castanopsis tribuloides, Choerospondias axillaris, Ficus altissima, Magnolia garrettii, Pinus kesiya, Prunus cerasoides* and *Toona ciliata)* were taken monthly over 8 months, using a DJI Phantom 4 Pro, flown at 50 m above the ground, along an identical autonomous flight plan using Litchi flight planning software. The photographs were used to develop visual species-identification keys, based on crown and leaf characteristics and image filtering. The keys were then tested for reliability in another similarly aged validation plot, using independent volunteer observers. Identification accuracy exceeded 50% for seven of nine target species and over 70% for four of the species.

Keywords: Tree species identification keys, Dichotomous keys, Digital aerial photographs from UAV

NRMS-O-11

Relationship between topographic wetness index and soil thickness in Nam Hia creek catchment, Phetchabun, Thailand

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Abstract

Soil thickness is an important data to evaluate an occurrence probability of landslide. However, the soil thickness can be observed directly at only few points in the area which are not enough for soil thickness mapping. With this reason, a comparison between the topographic wetness index (TWI) and sampled soil thickness is an interesting method for the mapping. This study aimed to determine the relationship between TWI and soil thickness in the Nam Hia creek catchment. First, the value of the TWI was generated from digital elevation model (DEM). Then, the TWI was compared with observed soil thickness at each sampling point. Finally, a linear relationship between TWI and soil thickness was generated. The results show that the soil thickness (meters) in the area can be estimated as 0.1 of TWI. It varies between 0 and 1.66 m with the lower value on the ridge and higher value in the valley. The relationship found in this study is similar to those in Taiwan which were found in previous studies. The similar climate between Thailand and Taiwan which lead to similar erosion and weathering rates are the possible reason to describe these similar relationships.

Keywords: Topographic wetness index, Soil thickness, Landslide, Nam Hia creek catchment

NRMS-O-12

Assessment of the Lower Ping River's bank erosion and accretion, Northern Thailand using geospatial technique; implication for river flow and sediment load management

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Abstract

The Lower Ping River downstream from the Bhumibol Dam suffers from the excessive sedimentation. The rapid growth of sandbars occurs along the 158 km of the downstream reach within the succession of weir. However, within this succession of weir severe bank collapses can also occur locally as rapid growth of sandbars makes the river narrower which in turn increase its flow velocity and power. The objective of this research is to assess river bank accretion and erosion using remote sensing and GIS techniques. Comparison of satellite images from 2007 and 2017 shows that the total emerged sandbar area increases up to 6.11 km^2. The total area of river bank erosion is 1.62 km^2 and the total area of accretion is over 11.82 km^2. Digital Shoreline Analysis System (DSAS) software is also used to determine the rate of changes of river bank erosion and accretion. The DSAS output locates significant changes of river accretion and erosion along the river bank with the average rate of erosion at 1.24 m/year and the average rate of accretion at 4.89 m/year between 2007 and 2017. The rapid growth of sandbars along the river reach within the succession of weir is responsible for the shallowing and narrowing of river embankment leading to rapid overflow during flooding. The result from this study enables all authorities and stakeholders to recognize the specific location, which severely affected by river bank accretion and erosion as well as to locate the areas experienced rapid growth of sandbar and huge river channel shifting. There are several possibility implications from this study involving construction of weir, river bank collapse prevention, and management of intense in-channel sand mining along this river.

Keywords: Lower Ping River, Sandbar, River bank erosion/accretion, Succession of weir, In-channel sand mining

NRMS-O-15

ABSTRACTS

SESSION II

Natural Resources Management and Sustainability

Poster presentation

NRMS-P-01

Soil and Water Quality Assessments for Agricultural Uses in Nang Lae Sub-district, Mueang District, Chiang Rai Province

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Abstract

Assessments of soil and water quality are valuable for agricultural production, which were used for appropriate decision making regarding sustainable agricultural land uses. Therefore, this study was conducted to assess soil and water quality of different agricultural land use in Nang Lae sub-district, Mueang district, Chiang Rai province. Nine soil samples were collected from 3 land use types of agricultural area (paddy field crop, field crop and orchard). The water quality based on certain physico-chemical parameters was also determined at 10 sampling sites located along the watercourse of this area. Results of this study revealed that the soil sample of different agricultural land use was slightly acid to moderately acid (pH 5.93-6.93). Organic matter content of these soils was relative low (0.13-2.07%). These soils had relative low total nitrogen (1,200-2,800 mg/Kg). The available phosphorus and potassium were also very low to low ranged from 1.86-5.94 mg/Kg and 0-78.00 mg/Kg, respectively. These soils have low soil fertility status which possesses physical and chemical properties unsuitable for crop cultivation. Moreover, in this study we found that soil samples from paddy fields and orchard fields were contaminated with high arsenic content (4.50-6.32 mg/Kg), which was higher than the standard of National Environment Board of Thailand. In addition, the assessment of water quality based on the trophic status indicated that water bodies were classified as oligo-mesotrophic to mesotrophic status. The water was also classified as class II-III that can be used for consumption but general killing of microorganisms was required and also can be used for fisheries and agricultural.

Keywords: Soil quality, Water quality, Nang Lae Sub-district, Assessment, Land use

NRMS-P-03

Payment for ecosystem services of dry Dipterocarp forest at Phu Kao, Nongbua Lamphu, Thailand

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Abstract

Dry Dipterocarp forests in northeast Thailand provide many ecosystem goods and services to local people such as water balance, soil fertility, and non-timber forest products (NTFPs). Yet, climate variability threatens not only forest composition and structure, but also rural livelihoods. Wildfire is one of the major sources of destruction. Our study examined the demand for forest ecosystem services of Phu Kao in Phu Kao-Phu Phan Kham National Park, Nongbua Lamphu (NBLP), Thailand. Gross economic value was estimated using a market price method. The study also assessed provincial climatic variability (2007-2018), using TREND in Excel. Key provisioning services included NTFPs and water resources. Phu Kao generated approximately 2.42 million Baht from trade of NTFPs in 2018. The Hui Bong Dam irrigation project will provide a direct benefit for at least 3,000ha of farmlands. As a non-tangible benefit, villagers expressed their uniqueness as living in a "forest-surrounded community." However, amounts of annual rainfall in NBLP decreased approximately 18.65 mm/year (R^2 = 0.07), while average minimum temperature increased 0.24 °C annually (R^2 = 0.35). Wildfires occurred, on average, about 17 times/year and damaged over 336ha of forestland during 2010-2017. Payment for ecosystem goods and services was introduced as an alternative for effective forest protection at Phu Kao.

Keywords: Payment for ecosystem services, dry Dipterocarp forest, climatic variability, Phu Kao

NRMS-P-04

Potential alternative to conventional fungicides to control fungal phytopathogen by biosurfactant-producing *Bacillus licheniformis* F2.2

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Abstract

Successive usage of chemical fungicides to control fungal phytopathogen has several drawbacks. Thus, the search for a potential alternative method is still needed. One of the possible methods is to use antagonistic bacteria that are able to produce biosurfactant. *Bacillus licheniformis* F2.2 was previously isolated from fermented food in Thailand. In this work, the ability of this strain to inhibit the growth of fungal phytopathogen, as well as its ability to produce biosurfactant were determined. The results revealed that *B. licheniformis* F2.2 had broad spectrum against fungi consisting of *Acremonium furcatum*, *Colletotrichum gloeosporioides*, *Fusarium moniliforme*, *Fusarium proliferatum*, *Fusarium solani*, *Pyricularia oryzae*, and *Phytophthora palmivora* which are the causal agents of diseases in several economic plants. The percentage of inhibition were ranging from 34.79-44.51%. Based on techniques such as drop collapse, oil displacement, emulsification and hemolytic tests, indicated that *B. licheniformis* F2.2 was capable of producing biosurfactant. It was found that both antifungal activity and emulsification index of the culture filtrate from *B. licheniformis* F2.2 were maintained at a wide range of temperature and pH. These results revealed that *B. licheniformis* F2.2 have potential to be used as biocontrol agent to control fungal plant pathogen alternative to the usage of conventional chemical fungicides.

Keywords: Antifungal, *Bacillus licheniformis*, Biocontrol, Biosurfactant

NRMS-P-05

Physical and Chemical Properties of Groundwater and Surface Water for Water Resource Management in Wiang Pa Pao Basin, Chiang Rai Province

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Abstract

Wiang Pa Pao basin in Chiang Rai Province has been facing variety of anthropogenic activities and often experiences drought and flood problems annually. The basin has Mae Lao River flowing through the area, has two hot springs and consists of two major aquifer systems which are Young Terrace unconsolidated sediments aquifer (Qyt) or shallow groundwater and Old Terrace unconsolidated sediments aquifer (Qot) or deep groundwater. Accordingly, this study was conducted to investigate and compare physical and chemical properties of groundwater, surface water and hot spring in Wiang Pa Pao basin. Water samples were collected from 28 study sites including shallow groundwater (10-50 meter), deep groundwater (50-150 meter), surface water and hot spring in March 2019. Physico-chemical parameters in water bodies were analyzed to assess water quality. The results indicated that Physico-chemical parameters of hot spring were different from groundwater and surface water. Dissolved Oxygen (DO) of hot spring were low values. While, electrical conductivity (EC), total dissolved solid (TDS) and pH of hot spring were high values that was the cause of high values of EC and TDS in surface water near hot spring. Moreover, EC and TDS of most shallow groundwater were similar to surface water. Nevertheless, EC and TDS of shallow groundwater had higher values than deep groundwater. However, physical and chemical properties of groundwater were not significantly difference as compare to surface water ($p<0.05$) because they had been similar source. Besides, quality of water resource, both of groundwater and surface water, in this basin was with in standard of Ministry of Natural Resources and Environment Thailand, 2008. As the result, water resource management in the basin should consider both groundwater and surface water in planning, preventing, and resolving issues of water resource.

Keywords: water quality, water resource management, Wiang Pa Pao basin

NRMS-P-06

Biosurfactant from *Bacillus velezensis* B49 as an alternative to chemical fungicide to inhibit the growth of fungal plant pathogen

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Abstract

Phytopathogenic fungi destroy agricultural products worldwide. The farmers usually eliminate the fungi by using chemical fungicides which are toxic to both users and consumers. Biological control is a good and alternative way to reduce the usage of chemical fungicides because it is less toxic and more environmental friendly. In this study, the ability to antagonize several plant pathogenic fungi by *Bacillus velezensis* B49 was evaluated both by bacterial cells and by cell-free supernatant. The results revealed that *B. velezensis* B49 cells were able to inhibit all tested fungi including *Acrimoniumfurcatum*, *Colletotrichum gloeosporioides*, *Fusarium moniliforme*, *Fusarium proliferatum*, *Fusarium solani*, *Pyriculariaoryzae*, and *Phytophthora palmivora*. By using cell-free supernatant, the results showed that the percentages of inhibition were 17.26% for *F. moniliforme*, 18.74% for *F. proliferatum*, 33.03% for *F. solani*, 33.90% for *A. furcatum*, 59.23% for *C. gloeosporioides*, and 68.50% for *P. oryzae*. No inhibition was found against *P. palmivora*. These results indicated that *B. velezensis* B49 was able to produce several types of antifungal substances which were secreted out of the bacterial cells. Some of the substances, especially the one with anti-*Phytophthora* were heat labile. Among various bioactive substances that have antifungal activity, we are interested in the biosurfactant class. Four methods for detecting biosurfactant including drop collapse test, oil displacement test, emulsion test, and hemolytic activity test were performed. The results revealed that *B. velezensis* B49 gave positive results for all tested confirming its ability to produce biosurfactant. Taken together, *B. velezensis* B49 can be used to control plant pathogenic fungi as an alternative to chemical fungicide for sustained agriculture. Its biosurfactant, as a biocontrol agent, will be further purified and tested for its antifungal activity.

Keywords: *Bacillus velezensis*; Biocontrol; Biosurfactant; Fungal plant pathogen

NRMS-P-07

Valuing Benefits of Soil Conservation to Support Payment for Ecosystem Services in Mae Sa Watershed, Chiang Mai Province

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Abstract

Soil erosion widely affects not only upland farm productivity but also lowland environment through the processes of run-off and sedimentation. Payments for ecosystem services (PES) can be used as a tool to improve the agricultural practice to be more conservative under the beneficiaries pay principle. In the case of soil erosion, PES can be a tool to provide incentives for upland farmers to increase their adoption of soil conservation practices. This paper attempts to evaluate the economic value of soil conservation practices to give significant information for implementing the PES scheme. Soil erosions were assessed using the universal soil loss equation. The cost of soil erosion was divided into on-site and off-site components whereas the benefit of soil conservation practice was considered in terms of preventing loss of soil erosion. The cost-benefit analysis of soil conservation showed that the cost of soil conservation practice is less than benefit 1.17 times and the internal rate of return is 9% Moreover, the results can generate information to the government for policy decision making.

Keywords: Economic Analysis, Cost-Benefit Analysis, Soil Erosion, On-Site and Off-Site Cost of Soil Erosion, Soil Conservation

NRMS-P-08

Aquatic insect diversity in non-disturbed and disturbed areas at Nong Kom Koh, Nong Khai province

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Abstract

Aquatic insects are main component of aquatic food webs. Aquatic macrophytes, depending on their growth forms, and disturbance by human activities are main factors affecting aquatic insect communities in aquatic ecosystems. Aquatic insect communities in different habitat types in Nong Kom Koh were studied and data were compared between non-disturbed and disturbed areas of each habitat type. Non-disturbed area is the part of Nong Kom Koh that has been preserved and disturbed area is another part of Nong Kom Koh where human activities such as fishery, rice farming and soil dredging are allowed. Five habitat types were classified and assigned as sedge, *Lotus*, *Hydrilla*, water hyacinth and sediment. Five replicates of aquatic insect samples were collected in each habitat using a 500 µm-mesh pond-net between February and April, 2018 and samples were identified to order and family levels. Overall, six orders, 19 families were identified, out of which, 16 families were found in non-disturbed areas while 14 families were found in disturbed areas. The most abundance families were Baetidae and Caenidae (order Ephemeroptera) which made up 50% of individuals collected. These two families together with Libellulidae (order Odonata), Chironomidae (order Diptera) and Ochteridae (order Hemiptera) were common families found in all habitat types. For each habitat type, one to three more taxa were found in non-disturbed area compared to disturbed area. Habitat dominated by *Hydrilla* support highest number of taxa (13 families), % of total richness (68.42%) and diversity (BDPI score = 0.22) in non-disturbed area. Five families including Corduliidae, Chaoboridae, Culicidae, Gomphidae and Simuliidae were only found in non-disturbed areas of the habitat type where they presented. The results from our study suggest the importance of each vegetation type as habitat for different aquatic insect communities and effect of human activities on disappearance of some aquatic insect families.

Keywords: aquatic ecosystem, macrofauna diversity, aquatic insects, macrophytes

NRMS-P-09

Quality and production cost of seedlings grown with different root pruning techniques

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Abstract

About half of the cost for forest restoration with The Framework Species Method is seedling production cost. A seedling care practice of manual root pruning promotes better tree seedlings but is time consuming and labor intensive. This study aims to find a suitable nursery practice to reduce seedling production cost and to yield a good quality seedling. The study was conducted in Forest Restoration Research Unit tree nursery in Khlong Thom district, Krabi province, Southern of Thailand. Five framework tree species included *Saraca indica* (Fabaceae), *Sandoricum koetjape* (Meliaceae), *Cleistocalyx operculatus* (Myrtaceae), *Lepisanthes rubiginosa* (Sapindaceae) and *Garcinia speciosa* (Clusiaceae). Seedling biomass after six months and production cost were compared among three different production practices; 1) to put seedlings in plastic crates placed on the ground (crate), 2) to use plastic crates placed on shelves (air-pruning + crate) and 3) to put seedlings on the ground without crates (control). For *C.operculatus*, *L.rubiginosa* and *G.speciosa*, the seedling biomass was higher in the crate and air-pruning + crate practices in comparison to the control treatment. For *S.indica* and *S.koetjape*, the crate treatments did not increase seedling biomass. Across species, the cost per seedling grown in the crate, air-pruning + crate, and the control treatment were 19.08, 20.64 and 20.15 baht respectively. In addition, crate and air-pruning + crate treatments may reduce the cost of seedling production in long term time period.

Keywords: Air-pruning, Streamlining, Framework species method, Cost effectiveness, Krabi province

NRMS-P-12

Assessment of soil organic carbon and available micronutrients: A comparison between burning and non-burning paddy fields

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Abstract

In Thailand, an open burning in the paddy field is a conventional way to remove stubbles and prepare for the next crop cycle. Air pollution caused by such practice is clear; however, there is still controversial issue of its impacts on the amount of organic carbon and available micronutrients in soils. This study aimed to i) compare organic carbon (OC) content and available concentrations of Cu, Fe, Mn, and Zn between two paddy fields burning and long-term non-burning, and ii) assess spatial distribution of OC and available micronutrients concentrations. Two sets of soil samples were collected from two paddy fields based on minimum consecutive five-year periods of burning versus non-burning practices. Twenty soil samples were collected from each paddy field at a 30-cm depth, which made up a total of 40 soil samples. A field work was conducted one week after burning. Organic carbon was analyzed by the Walkey and Black method. Available Cu, Fe, Mn, and Zn were obtained by diethylenetriaminepentaacetic acid (DTPA) extraction method. The average of soil OC content in burning paddy field (2.09±0.36%) was observed significantly higher than non-burning paddy field (1.27±0.31%) (p-value <0.001), presumably because the abundance of litter was incorporated into the soil layers prior to burning. Mean available micronutrients were as follows: Fe>Mn>Cu>Zn. Abundant concentrations of Fe, Mn, and Cu were sufficient for growing rice in both sites; however, they were significantly greater in burning paddy field as compared to non-burning field. Zn deficiency occurred across paddy farming soils. On the basis of results obtained, despite the positive effects found in burning paddy soil, a better management approach should be introduced to counterbalance the negative impacts on other environmental aspects. Strategies to improve Zn availability are also required.

Keywords: Available micronutrients, Burning practice, Organic carbon, Paddy soil

ABSTRACTS

SESSION III
Environmental Engineering

Oral presentation

EE-O-01

The Effect of the Solid Retention Time on Simultaneous COD, TKN, and TP Removal from Slaughterhouse Wastewater Using Sequencing Batch Reactor

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Abstract

This study investigated the effect of short sludge retention time (short SRT) compare with a prolonged sludge retention time (prolonged SRT) on the performance of SBR system for chemical oxygen demand (COD), total kjeldahl nitrogen (TKN), total phosphorus (TP) removal and phosphorus accumulation in sludge (P-content) from the slaughterhouse wastewater treatment. By varied of short SRT at 20 and 25 days and prolonged SRT at 60 days with anaerobic/anoxic I/oxic I/anoxic II/oxic II sequencing batch reactor (AnA^2/O^2 SBR) operated a cycle time of 12 hr. This system performed under anaerobic static fill (0.5 hr), reaction time (8 hr), settling time (0.5 hr) and idle time (2.75 hr). The results showed that in each SRT had a removal efficiency of COD and TKN more than 95%. However, SRT at 60 days had lowest removal of COD and TKN, especially the low ability to remove TP was 56.34% when compared with SRT 20 and 25 days was 85.75 and 96.01%, respectively. This result indicated increasing sludge age or SRT effect to decreasing TP removal in wastewater. Although short SRT was higher TP removal more than prolonged SRT, conversely found that the P-content of each SRT did not differ statistically significant at the 0.05 level.

Keywords: Sludge Retention Time (SRT), P-content, Sequencing Batch Reactor (SBR), Nutrient Removal, Slaughterhouse wastewater

EE-O-02

Full Scale of Trickling Filter Wastewater Treatment Systems: case study between Phuket, Thailand and Englewood/Littleton Colorado, USA

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Abstract

In the practical, trickling filter (TF) is easily operated and maintained than conventional activated sludge (AS) treatment systems. However, TF is not popular in Thailand because TF could cause significant odor and insect problems, not suitable on warm climate like Thailand.

For this reason, the goals of this research, physical and chemical characteristics of influents and effluents from the Phuket's Trickling Filter (TF), Phuket Province, Thailand and Littleton/Englewood's TF, Colorado, USA were compared and discussed regarding on issues: flow rate, BOD, NH_4^+, NO_2^-, $NO_3^-$and total nitrogen (TN) removals efficiencies and results on the quantitative polymerase chain reaction (qPCR). Moreover, the criteria and key factors for design of these two TFs were compared and discussed.

High nitrogen removal efficiencies at the Littleton/Englewood's TF WWTP were found but not at the Phuket's TF because of adding methanol (external carbon source). The diagrams of these TF systems are see Figures 1 and 2. For this reason, the operation cost at the Littleton/Englewood's TF WWTP was significantly higher than operation cost at the Phuket's TF for about 10 times. The qPCR results from these two TFs is shown in Figure 3. Ammonium oxidizing bacteria (AOB), *Nitrobacter* spp. and denitrifying bacteria were found in both TFs. A very low dissolved oxygen (< 1 mg/L) concentration was found inside the tower of the Phuket's TF. For this reason, the amount of denitrifying bacteria at biofilm of Phuket's TF were dominant. This low DO could be postulated to be a main key factor to affect organic matter removal. However, high temperature for the whole year at Phuket's TF would be a key promote the activity of nitrification process. Solid retention time (SRT) ≥ 10 days from these two TFs could be used as recommendation to complete organic matter and nitrogen removals. More results between design of these two plants and qPCR results could be used to compare in order to improve the BOD and nitrogen removal efficiencies at these two TF WWTPs.

Keywords: Trickling filter; Phuket, Thailand; Littleton/Englewood; Colorado; USA

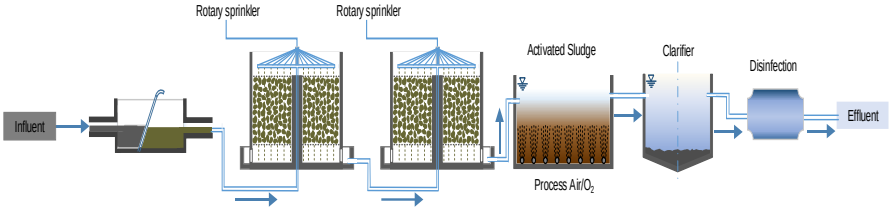

Fig. 1. Trickling Filter WWTP at Phuket, Phuket Province, Thailand

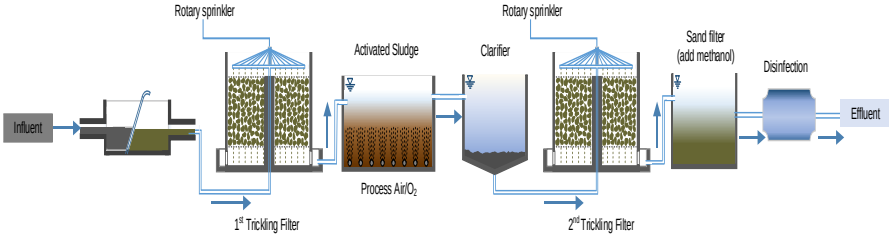

Fig. 2 Trickling Filter WWTP at Littleton/Englewood, Colorado, USA

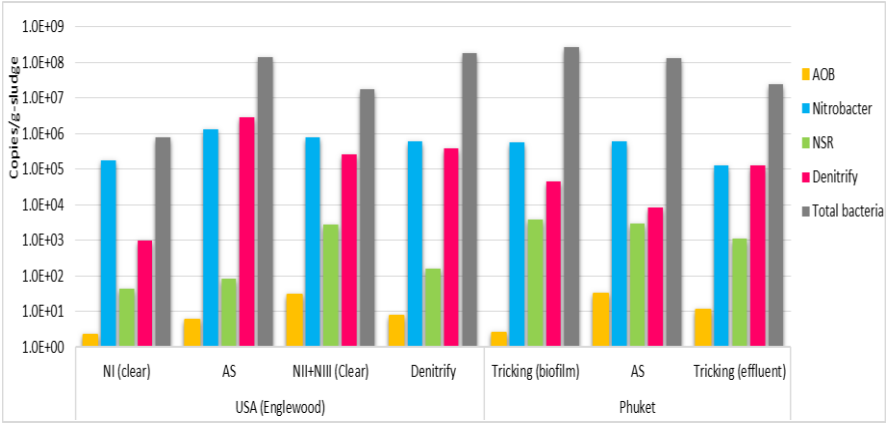

Fig 3. Quantitative polymerase chain reaction (qPCR) from Englewood and Phuket WWTPs

EE-O-03

Start-up of aerobic granulation in sequencing batch reactors treating acetate synthetic wastewater

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Abstract

Aerobic granules are large biological aggregates with compact interiors that can be used in efficient wastewater treatment. However, long start-up time is the main challenging issues for its application. The main objective and minor objective of this work were to study aerobic granulation during start-up period and to compare efficiency of SBRs between with and without calcium carbonate addition. In this work aerobic granulation was investigated in two laboratory scale sequencing batch reactors (SBRs). Both reactors were fed with acetate synthetic wastewater and operated under similar conditions during the experiment. Reactor SBR1 was augmented with $CaCl_2$ solution, while $CaCO_3$ powder was added into the reactor SBR2. The influent COD and NH_4^+-N concentrations to the SBRs were kept at 1000 $mgL^{-1}$and 60 mgL^{-1}, respectively. The organic loading rate of 2 kg COD $m^{-3}day^{-1}$ with hydraulic retention time of 12 hours was controlled. The reactors were operated under room temperature (28±2°C). The results showed that, after operation of 128 days, aerobic granules were observed in both reactors. The nitrification were occurred in both reactors. The reactor SBR2 had a slightly higher treatment efficiency than reactor SBR1. The COD, BOD and TKN removal efficiencies of both reactors were higher than 95%, 97% and 80%, respectively. The Ratio of the mixed liquor volatile suspended solids to mixed liquor suspended solids (MLVSS/MLSS ratio) of reactor SBR1 and SBR2 were 0.65 and 0.60, respectively.

Keywords: Aerobic granules, Granulation, Sequencing batch reactors (SBRs), Start-up, Calcium carbonate ($CaCO_3$)

EE-O-04

EE-O-05

EE-O-06

Removal of 1,4-dioxane by cellulose acetate and polyvinylidene fluoride blend membrane with titanium dioxide additive

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Abstract

Membrane technology has been applied to remove water contaminants from drinking water. However, it is not considered as an effective method to remove 1,4-dioxane, an emerging water-soluble organic contaminant detected in water environments and a probable human carcinogen. Development of effective membrane for elimination of 1,4-dioxane in contaminated water is; thus, required to prevent adverse health effects due to the oral exposure. In this study, we successfully developed the electrospunning method for preparation of cellulose acetate and polyvinylidene fluoride blend membrane (CA-PVDF membrane) with and without titanium dioxide additive. Also, the membranes' ability to remove 1,4-dioxane in water in the presence and absence of ultraviolet (UV) light was evaluated. While CA-PVDF membrane without titanium dioxide additive could not remove 1,4-dioxane, the membrane mixed and coated with 5% w/w titanium dioxide could respectively remove 59.6% and 74.7% of 300 mg/L 1,4-dioxane in the absence of UV light. In contrast, the CA-PVDF membrane mixed and coated with 5% w/w titanium dioxide could eliminate 1,4-dioxane at higher removal efficiency in the presence of UV light (79.6% and 87.3% of 300 mg/L 1,4-dioxane, respectively). Hence, addition of titanium dioxide into the membrane and UV light exposure are promising to improve efficacy of the membrane for removal of 1,4-dioxane and other water-soluble organic contaminants.

Keywords: Water Treatment, Membrane Filtration, Nanofiber, Electrospinning, Composite Membrane

EE-O-07

Fouling of PVDF Hollow-Fiber Microfiltration Membrane at Filtering Tannic Acid and Iron Oxide Containing Feed Water

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Abstract

Fouling of low pressure membrane is often described by organic and colloidal fouling. However, it remains unclear that organic or colloidal components in cashew-nut processing wastewater contribute to fouling of tight but high-flux microfiltration (MF) membrane. Hence, fouling of PVDF hollow-fiber MF membrane (US02-125, Kuraray, Japan) was investigated on synthetic wastewaters, i.e. tannic acid (TA, phenolic compound surrogate) and tannic acid with iron oxide (Fe_2O_3) particle, which represents inorganic colloids. Filtration set-up comprised hollow-fiber membrane module, water pump, digital pressure gauges, data logger, air compressor and digital balance which allow operation in dead-end, constant flux mode. Water quality was measured by total organic carbon (TOC) and turbidity. Filtration experiment was performed on 15 filtering cycles with periodical backwash with air and water. Membrane was stored in NaOCl solution until use in next cycles. The TOC rejection by MF membrane was negligible for TA water (~3%), while the rejection increased to 12% for TA-iron oxide water. This suggests that TA might react and adsorb to iron oxide particle. MF membrane completely removed turbidity. TA-iron oxide water made MF membrane fouled faster than TA water alone. Trans membrane pressure (TMP) at filtering TA-iron oxide increased faster than TA because the membrane surface was covered by accumulation of suspended solids. The resistance-in-series model was used to estimate the fouling resistance (Rc) of TA-iron oxide at Day 1 and Day 15. Rc increased with filtering time in a concave-down manner for TA alone but increased nearly linear with TA-iron oxide. At 95min, Rc of TA is $1.9 \times 10^9 m^{-1}$ and $2.5 \times 10^9 m^{-1}$ while Rc of TA-rion oxide is $2.7\times 10^9 m^{-1}$ and $3.8 \times 10^9 m^{-1}$ in Day 1 and Day 15, respectively. Overall, colloidal particle contributed to greater filtration resistance of the MF membrane than organic compounds alone.

Keywords: Microfiltration, Fouling resistance, Colloids, Organic compounds

EE-O-08

Application of Modified Airlift Reactor for Ferrous Iron Oxidation-Precipitation: Kinetics and Influences of Process Conditions

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Abstract

This work aims to study the effect of reactor design and process conditions on aeration performance and ferrous oxidation-precipitation kinetic in a newly developed multiphase reactor, Modified Airlift Reactor (MALR). The experiment was conducted in a tall rectangular internal-loop airlift reactor for contacting 17.5 dm^3 liquid volume. It was mainly divided into two parts including a comparative analysis of aeration performance between the new and regular reactors, and ferrous iron oxidation-precipitation in MALR in different process conditions, i.e., operate gas flow, initial ferrous concentration, initial pH, and additional ferric hydroxide particles. Aeration efficiency was determined using dynamic pressure-step method. Plus, phenanthroline method was used to measure ferrous concentration. Based on the result, the new reactor could provide better aeration efficiency up to 17% - 37% and 8% - 16% compared to regular bubble column and airlift reactor, respectively, in the range between 2.20 and 3.64 kg-O_2/kWhr. Faster oxidation yield was significantly observed at the gas flow supplied from 0.5 to 2.0 L/min due to the higher transferred oxygen as well as the liquid mixing performance. However, slight influence was observed at higher than 2.0 L/min, which can be concluded as a limiting step for enhancing oxidation yield. Moreover, ferrous oxidation is faster at lower initial concentration as the proportional effect of each concentration on aquatic pH, e.g., higher concentration resulted in lower pH than low concentration at certain condition since its kinetic reaction rate is faster at higher pH. Last, its oxidation was significantly influenced by the presence of ferric hydroxide as induce a strong autocatalytic effect on ferrous iron oxidation. Higher conversion yield of ferrous was obtained when the additional ferric hydroxide was increased.

Keywords: Aeration efficiency, airlift reactor, ferric hydroxide particles, ferrous iron

EE-O-09

Optimization of Factors Affecting the Biosynthesis of Silver Nanoparticles Using Orange Peel Extract

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Abstract

Interest in the biosynthesis of silver nanoparticles (AgNPs) has been steadily increasing over the past years in view of their numerous applications in various fields primarily due to low-cost, use of non-toxic environmentally friendly materials and ease of operation. This study investigated the influence of the experimental factors on the absorbance spectra and particle size in biosynthesis of AgNPs using orange peel extract as the reducing agent. A central composite design in response surface methodology was used with orange peel extract concentration, pH and silver nitrate concentration as independent variables. The biosynthesized AgNPs were characterized by UV-Vis spectroscopy in 350-550 nm wavelength range for monitoring absorbance spectra and dynamic light scattering to determine the particle size. The developed models accounted for the effects of peel extract concentration, pH and $AgNO_3$ concentration on peak absorbance and a characteristic shift in wavelengths, and particle size. Results showed that an increase in pH had the maximum influence on AgNPs resulting in the formation of smallest AgNPs size. The higher values of pH led to an increase in the values of absorbance peaks which also corresponded to the smallest AgNPs size.

Keywords: Green synthesis, Silver nanoparticles, Response surface methodology, UV-vis spectrophotometer, DLS

EE-O-10

Inactivation of tetracycline-resistant bacteria by a combination of chlorine and UV irradiation

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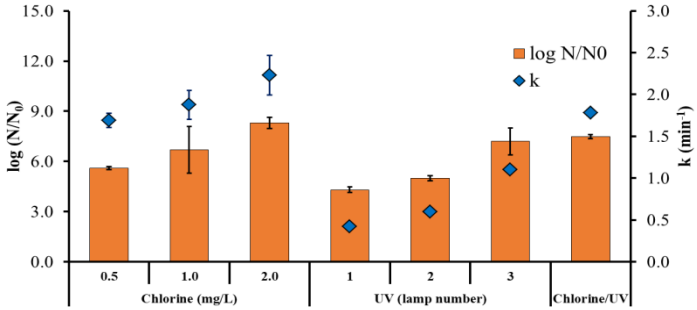
Abstract

Antibiotic Resistant Bacteria (ARB) are one of the biggest threats to global health issues. Contamination of ARB to environment has increased since the use of antibiotics is unplanned. Chlorination and UV irradiation are conventional treatment processes for inactivating pathogen. A combination of chlorine and UV irradiation (chlorine/UV) is proposed to enhance the inactivation. The study aims to investigate the inactivation kinetic of ARB by chlorination, UV irradiation and chlorine/UV processes. Tetracycline-resistant bacteria are used for representing ARB because tetracycline is widely used antibiotic in Thailand. For chlorination, the inactivations for chlorine doses of 0.5, 1.0 and 2.0 mg/L were 5.56 ± 0.08 log, 6.73 ± 1.40 log and 8.25 ± 0.32 log, respectively. The kinetic constants were 1.69 ± 0.09, 1.88 ± 0.17 and 2.23 ± 0.24 min^{-1} for chlorine doses of 0.5, 1.0 and 2.0 mg/L, respectively. UV irradiation inactivated tetracycline-resistant bacteria by 4.33 ± 0.17 log, 5.02 ± 0.15 log and 7.24 ± 0.80 log for UV intensities of 3.59 (1 lamp), 6.22 (2 lamp) and 9.03 (3 lamp) mW/cm^2, respectively. The kinetic constants were 0.42 ± 0.04, 0.60 ± 0.00 and 1.10 ± 0.01 min^{-1} for intensities of 3.59, 6.22 and 9.03 mW/cm^2, respectively. The chlorine/UV process (1.0 mg/L of chlorine and light intensity of 6.22 mW/cm^2) resulted in the kinetic constant equivalent to 1.78 ± 0.00 min^{-1} and inactivation of 7.48 ± 0.13 log.



Keywords: Advanced Oxidation Process, Antibiotic Resistant Bacteria, Chlorination, Kinetic, UV irradiation

EE-O-11

The effect of bentonite on the properties of landfill liner from clay mixed with industrial wastes

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Abstract

This research studied engineering properties of landfill liner from clay with mixed industrials wastes. Calcium carbine residue (CCR) and Water treatment residue (WTR) and clay at ratio of 40:40:20 wt.% by weight were mixed with bentonites at the variation of 0, 1, 3, 6, 9, and 12 wt.%. The mixtures were compacted for properties testing: unconfined compressive strength (UCS), hydraulic conductivity, and durability. The results showed that increase of bentonites dosage did not affect UCS. Addition of bentonite resulted in increase of hydraulic conductivity. At 1 to 3 wt.% of bentonites in compacted samples, the hydraulic conductivity that was lower than $1x10^{-7}$ cm/s (standard for secure landfill) while from 4 to 12 wt.% of bentonites made hydraulic conductivity higher than the standard. For durability, results showed that minimum slake durability index was at 3 wt.% of bentonites. It was possible that addition of 3 wt.% of bentonite can expand and fill in pore of compacted sample. The scanning electron microscope (SEM) showed that addition of optimum bentonites could fill in micro pore and led to increased UCS, reduced hydraulic conductivity and increased slake durability index.

Keywords: Landfill liner, Water Treatment Residue, Calcium carbine residue

EE-O-12

The effect of Na_2O/SiO_2 and SiO_2/Al_2O_3 ratios on engineering properties of alumino-silicious materials solidified plating sludge

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Abstract

This research studied the performance of geopolymer synthesized from the water treatment residue (WTR), bituminous fly ash (BFA) and Si waste (SWA) as solidification binder and NaOH as alkali-activator. The ratio of SiO_2/Al_2O_3 of 1:1, 2:1, 3:1 and Na_2O/SiO_2 at 0.25, 0.20, and 0.30 are conditions for study in this research. The result showed that optimum compressive strength was found in ratios of Na_2O/SiO_2 at 0.25, 0.20 and 0.30 for WTR, BFA and SWA geopolymer. When SiO_2/Al_2O_3 in geopolymer was adjusted using Si waste and aluminium hydroxide that led to increase compressive strength with an increase of the molar ratios of SiO_2/Al_2O_3. At 28 days, the compressive strength of WTR, BFA and SWA geopolymer at SiO_2/Al_2O_3 ratio of 3:1 have 8.15, 9.65 and 1.66 MPa, respectively . When 30 wt.%PS was added in WTR, BFA and SWA geopolymer, the compressive strength at 28 days decreased to 2.22, 2.57 and 1.14 MPa for WTR BFA and SWA geopolymer, respectively. It was caused an interfering effect of heavy metal in plating sludge that may be dissolved from solid to liquid and may blockade reaction of geopolymer binder. But compressive strength at 28 days of all geopolymer binder solidified 30 wt.%PS were higher than the minimum requirement for dumped in landfill disposal) 0.345 MPa. In addition, XRD result shows that a crystalline phase, sodium aluminum silicate hydrate (NASH) and heavy metal (Zn, Cr, and Fe) while SEM result shows the heavy metals precipitated on the surface of the geopolymer. It was a cause of reduction of compressive strength of geopolymer solidified plating sludge.

Keywords: Geopolymer, Water Treatment Residue, Bituminous Fly Ash, Si Waste, Plating Sludge

EE-O-13

Utilization of Bagasse Ash in Interlocking Block Production

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Abstract

In the present work, the interlocking blocks was modified by partial substitution of lateritic soil (LS) with bagasse ash (BA). The effect of ordinary Portland cement (OPC) to LS ratio of 1:3 1:5 1:7, 1:9 and 10, 15 and 20 wt.% of BA content on the engineering properties of interlocking blocks was investigated. The chemical and physical properties of LS and BA were determined by X-ray fluorescence spectrometer, sieve analyzer, and scanning electron microscope. The engineering properties of modified interlocking blocks were compared with interlocking blocks without replacement of BA. The results shows that BA was a porous material with high water adsorption. The adding BA to interlocking blocks decreased compressive strength, dry density values and lead to high void within interlocking blocks structure. The interlocking blocks at OPC:LS ratio of 1:5 with 15 wt.% of BA were perfectly suitable for inside and outside building construction

Keywords: Lateritic soil, Bagasse ash, Interlocking blocks, compressive strength

ABSTRACTS

SESSION III
Environmental Engineering

Poster presentation

EE-P-01

The study on the effects of chemical coagulation and cost estimates throughout the water supply treatment cycle of Phichit provincial waterworks authority

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Abstract

The research studied of pH effect on chemical precipitation processes in water supply using the jar test method. The water production process studied at the Phichit provincial waterworks authority in rainy season. The period of study was mid of May 2018 to mid of October 2018. The raw water was sampling at Nan River in water production process. The range of turbidity of raw water was 90.5 NTU to 364 NTU and the range of pH of raw water was 7.50 to 7.96. The adjustment of pH of raw water used NaOH. The result found that the best of flocculation conditions process made in pH of raw water was 8.5. In this condition found that the optimum dose of Poly Aluminum Chloride (PACL) the turbidity test was 4 to 50 ppm. The obtained values of two water parameters; turbidity and color, decreased at pH 8.5 of raw water. The efficiency of turbidity removal was 30 % to 64% and the color removal was 43% to 75%. The data obtained from nine of water parameters; pH, temperature, conductivity, alkalinity, total hardness, calcium, chloride. , iron (Fe) and manganese (Mn)) found no difference when pH adjustment. Chemical cost of PACL and NaOH at pH 8.5 was 0.64 to 1.31 Baht per m^3 of water supply. The equation of turbidity of raw water (X) and optimum dose of PACL (Y) was $Y = 0.0003X^2 + 0.0396X + 0.98$

Keywords: water supply, Phichit provincial waterworks authority, pH, jar test, poly aluminum chloride

EE-P-02

PM_{10} and dust fall concentrations of mobile sources in Sukhothai Municipality

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Abstract

This research aims to study of the particulate matter inventory report from mobile source in Sukhothai municipality. The 48 samples of PM10 were collected using the high volume air sampler for 24 hours sampling at the flow rate of 1.7 cubic meter per minute. The 48 samples of dust fall were collected using gravimetric technique which modified dust collected device from the Department of Pollution Control (PCD). The dust fall containers were set in August 2017 to July 2018 at 4 samples stations. The two points of traffic survey by Closed Circuit Television (CCTV) cameras. This study use the emission factor method to quantify emission. The highest of PM10 data was 108 micrograms per cubic meter at the police station site in April year 2018. The highest of dust fall data was 247 milligram per square meter per day at the police station site in April year 2018. The lowest of dust fall data was 70 milligram per square meter per day at the Trirat community station in June year 2018. The major of mobile source in Sukhothai Municipality was motorcycles and tricycles.

Keywords: particulate matter, PM10, dust fall, Sukhothai municipality

EE-P-04

COD and heavy metal of dry deposited particles on bituminous road shoulder in Tak province

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Abstract

The dust accumulated on the road surface is one of the environmental problems, especially it dirtiness in natural water sources, public canals and watercourses. The objectives of this research were to study on Chemical Oxygen Demand (COD) and heavy metal of dust on the road pavement at Wang Chao District, Tak Province. Samples collected using artificial surface. The same material as the paved road surface with size 0.30x0.50x0.05 meters arranged to be placed in parallel with the road shoulder of the road. There were nine artificial surfaces at three points. The sample collected at 1 day, 7 days, 15 days, 30 days, and 60 days. The road tested on the highway road number 1, namely Asian road, at 493Km., The characteristic of the road, was a four-lane paved road. The sample collected from November 25, 2018 to January 24, 2019.The result was found that the 1 day sampling of COD concentration varied from 56 to 120 mg / l. The 7 days sampling of COD concentration varied from108 to 164 mg / l. The 15 days sampling of COD varied from 93.1 to 194mg / l, The 30 days and 60 days of COD were report at this paper. The dust samples analyzed eight types of heavy metal, Lead, Arsenic, Cadmium,Mercury, Chromium, Manganese, Iron and Copper.The heavy metal foundthat Manganese (Mn) was 0.040 mg / l, Copper (Cu) 0.100 mg / l and iron (Fe) 1.205 mg / l.

Keywords: COD, heavy metal, bituminous road and Tak Province

EE-P-05

Composition of dry deposition from roads construction and management

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Abstract

This Research studied on the composition of dry fall from road construction and management in the area of Phaholyothin Road (Nong Ben-Khao Khat), Nakhon Sawan Province. The samples were collected at 5 roadside locations, namely, PT petrol stations, Wat Sawan, Nong Rong Temple, Tawana Resort and Chintana Phabai site. The dust fall jar was adapt from pollution control department used in this study. The dust fall sampling equipment was including of the water sampling cylindrical bottle with a diameter of about 13 cm, height 20 cm. The plastic cone shape with diameter of 8 inch use dust fall and rain collection. The plastic screening was cover for protecting the sample. The stand of the dust sampling was used 1.5 m along pipe. The basket for the bottle samples was used. The dust fall sample collected 2 month on December 2018 to January 2019. The result of dust fall found that at the PT petrol station was 94 and 78 milligrams of dust per square meter per day. The data at other sites do not exceed the national standard except Nong Rong Temple; the dust fall concentrations were 136 and 147 milligrams per square meter per day. The study of the silt on Phaholyothin Road (construction road) used vacuum. The samples collected from 5 points starting from December 2017 to January 2018. The samples took to determine the size of the dust using the Sieve Analysis Test on sizing > 600 µm and 600 - 450µm, 450 - 300µm, 300-150µm, 150 - 75µm, and < 75 µm and weighing the dust. The most of weight was in the sizing of dust more than 600 µm.

Keywords: Dust fall, dry deposition, construction road, silt

EE-P-06

EE-P-07

Enhance nitrate removal by cation supplying: The role of plants in wastewater treatment

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Abstract

Constructed wetlands (CWs) are alternative ecological methods for treating wastewater. Plants used in the CWs play important roles as they reduce excess nutrients by root uptake, etc. However, nitrogen is not completely removed, and nitrate (NO_3^-) has been produced and contaminated the effluents. Technique developments in order to improve NO_3^- removal is still needed. In this study, a lab-scale study of cation supplying on nitrate uptake by *Canna indica* L. was determined. Approximately 45 days-old of the new plants with similar size were selected and grown on a standard growth medium modified from Hogland (1950) with 1.1 mM N (0.1 mM NH_4^+: 1 mM NO_3^-) and 0.1 mM P added. The plants (n=4) were supplied with different cation sources (K^+, Na^+, Ca^{2+}, K^++Ca^{2+}, K^++Na^+ and control) and acclimated in the greenhouse of the Department of Biology, Faculty of Science, Chiang Mai University for 50 days. Statistical analyses were performed with ANOVA using SPSS Statistics version 17.0 (SPSS Inc., Chicago, IL, USA). The results showed that cation supplying to the rooting medium had significantly affected NO_3^- uptake of *C. indica*. The high uptake rates was found in the plants supplied with K^+, followed by Ca^{2+} and K^+ plus Ca^{2+}, respectively. Growth of the plants supplied with these cations did not significantly differ from the control. The plants increased height in average of 2.75 cm day^{-1} and the plants had produced 3-6 new shoots. However, the average leaf areas of the plants supplied with K^+ and K^+ plus Ca^{2+} was larger than the control plants. Hence, the addition of K^+ and Ca^{2+} greatly improves the nitrate removal rates by *C. indica*. The new technique based on these cations addition could be developed. However, further study on the NO_3^- removal from the real wastewater using *C. indica* must be carried out to assess the real potential of using this plant species in CWs.

Keywords: *Canna*, cations, nitrate removal, NO_3^- uptake, wastewater

EE-P-08

Arsenic adsorption mechanisms by iron oxide particles and iron oxide coated sands

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Abstract

Groundwater has been contaminated arsenic caused from nature and it was treated using various techniques. Adsorption process has become one of commonly water treatment methods in rural community; however, there also has some effective parameters to its removal efficiency including adsorption types, dosages, contact times, etc. This study, using different adsorbents including iron oxide particles (IOP) and iron oxide coated sands (IOCS) were investigated for arsenic adsorption. After synthesized, both adsorbents' properties were characterized by various techniques. Kinetic and isotherm adsorption models were used to explain the mechanism on arsenic adsorption. Initial concentration of arsenic 500 $\mu g.L^{-1}$ was studied by varied dosages of 4 to 24 mg of IOP and IOCS. As a result, both adsorbent diameters were selected in range from 0.7 to 2 mm by sieve analysis. For Scanning Electron Microscope (SEM) results, it showed surface morphology and detected that amorphous and spherical shape some parts at 5000 magnification on IOP and IOCS, respectively. In addition, as Scanning Electron Microscope-Energy Dispersive X-ray (SEM-EDS) analysis demonstrated that chemical compositions on the surface of IOP and IOCS including 55.28%, 33.3% of iron, 2.1%, 39.64% of oxygen, respectively. In terms of mass fraction, XRF results showed that Fe_2O_3 constituents 95.7% and 1.87% on IOP and IOCS, respectively. In terms of arsenic adsorption, 12 mg of IOP dosage were adsorbed approximately 40% removal efficiency, it was followed the Pseudo-second order with R^2 about 0.973. The results of isotherm models indicated that R^2 are 0.77 and 0.78 of Langmuir and Freundlich model, respectively. Thus, arsenic adsorbed on multilayer of IOP. In conclusion, arsenic is possibly adsorbed by small amount of IOP and IOCS also might be adsorbed arsenic via its surface morphology and chemicals composition.

Keywords: Groundwater, Arsenic, Adsorption process, Iron oxide particles, Iron oxide coated sands

EE-P-09

Scale-up factor of Cr-free Fe-Al-Cu catalyst for hydrogen production from waste-derived synthesis gas via the water gas shift reaction

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Abstract

We have prepared a series of Cr-free Fe-Al-Cu catalysts by the homogeneous one-step co-precipitation method and examined their ability to promote the water gas shift (WGS) reaction and thus facilitate the production of hydrogen from waste-derived synthesis gas. Catalysts prepared using various precursor concentrations have been synthesized on the laboratory scale in a 0.5 L reactor. For laboratory-scale synthesis, the concentration of precursor solutions in a fixed volume of distilled water was systematically varied (Fe:0.042−0.42 M, Al: 0.005−0.05 M, Cu: 0.005−0.05 M). Large-scale synthesis has been performed in a 20 L reactor (laboratory scale × 40) and precursor concentrations have been chosen in such a way as to minimize the extent of performance degradation and simultaneously maximize the amount of the produced catalyst. The prepared catalysts effectively promote the WGS reaction without facilitating undesirable side reactions, achieving efficient hydrogen production and high CO conversion. Both commercial Fe-Cr and large-scale Fe-Al-Cu catalysts achieve close-to-equilibrium CO conversions at a gas hourly space velocity (GHSV) of 3,000 $mL \cdot g^{-1} \cdot h^{-1}$, but the latter showed a higher conversion than the former at a GHSV of 40,057 $mL \cdot g^{-1} \cdot h^{-1}$ owing to the promotional effect of Cu on the easier reducibility of Fe species and the formation of additional Cu active sites.

Keywords: Cr-free, Water gas shift, Hydrogen production, Waste-derived synthesis gas, Scale-up

EE-P-10

Investigation on the preparation method of Ni−Cu−CeO_2 oxide catalyst for hydrogen production from waste-derived synthesis gas

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Abstract

The effect of preparation method on the catalytic performance of Ni−Cu−CeO_2 was investigated in High Temperature Water Gas Shift (HT−WGS) reaction. The catalyst prepared by evaporation induced self-assembly method (Ni−Cu−CeO_2−SG) exhibited very high activity as well as stability (X_{CO} > 80% at 450 °C for 25 h). This result mainly due to that the mesoporous nature of the Ni−Cu−CeO_2−SG which can provide higher surface area and facilitate the easier diffusion of gas through its mesoporous channels. The effect of the preparation method on the structure and physicochemical properties of the provided catalysts in this study were examined by nitrogen adsorption, X-ray diffraction (XRD) and hydrogen-temperature programmed reduction (H_2-TPR).

Keywords: Ni−Cu−CeO_2, HT−WGS, Evaporation induced self-assembly method, Easier diffusion, Mesoporous

EE-P-11

Performance of bimetallic NiCu−CeO_2 catalyst to produce hydrogen via high temperature water gas reaction using waste-derived syngas

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Abstract

We have studied mesoporous bimetallic NiCu−CeO_2 oxide catalysts for the High Temperature Water Gas Shift (HT−WGS) reaction, which is a technology to produce hydrogen from waste derived synthesis gas (H_2 + CO). The aim of this study is to understand the effect of mesoporosity on the catalytic activity and selectivity. The bimetallic NiCu−CeO_2, monometallic Cu−CeO_2 and Ni−CeO_2 catalysts were synthesized by the evaporation induced self-assembly method. The amount of CeO_2 was fixed to 70 wt.% in all cases investigated in this study. The Ni/Cu ratio was systematically varied to optimize bimetallic NiCu–CeO_2 catalysts. Powder X-ray diffraction (XRD), small angle X-ray scattering (SAXS) and N_2-adsorption/desorption isotherm techniques were used to understand the role of mesoporosity and bimetallic composition of various NiCu–CeO_2 oxides. Doping of Cu− or Ni− into the CeO_2 increased the surface area as well as mesoporosity of the materials. Moreover, the NiCu (1:4)−CeO_2 catalyst exhibits stable activity with 80% CO conversion after 45 h on stream at a high GHSV of 83,665 h^{-1}. Therefore, NiCu (1:4)−CeO_2 catalyst appears to be a suitable catalyst for HT−WGS.

Keywords: Bimetallic, HT−WGS, NiCu-CeO_2 catalyst, Evaporation induced self-assembly method

EE-P-12

Methane Reforming of Highly Active and Stable Ni−Ce−ZrO_2 Catalyst for Gas to Liquids (GTL) in Combined H_2O and CO_2

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Abstract

Due to high oil price, gas to liquids (GTL) technology to produce synthetic oil from natural gas attracts significant research interest. For gas to liquid (GTL) process, synthesis gas has been produced from combined steam and carbon dioxide reforming of methane (CSCRM) over co-precipitated Ni−Ce−ZrO_2 catalysts (Ni=15wt.%). The ratio of CeO_2 to ZrO_2 was systematically changed to optimize the activity of co-precipitated Ni−Ce−ZrO_2catalysts.The prepared catalysts have been characterized by BET, XRD, TPR, H_2-chemisorption, and TEM. Co-precipitated Ni−Ce−ZrO_2 catalysts with various Ce/Zr ratios have been tested with $H_2O/CO_2/CH_4$= ratio of 0.8/0.4/1.0 because H_2/CO ratio of 2 has been achieved in this reaction condition. As a result of the CH_4 conversion over the Ni−Ce−ZrO_2 catalyst over time, the Ni−$Ce_{0.8}Zr_{0.2}O_2$ and Ni−CeO_2 catalysts showed the highest CH_4 conversion due to their stability. It can be seen that the stability of the catalyst is improved when the Ce/Zr ratio is increased. Ni/Ce−ZrO_2catalysts with high Ce content can be a good candidate catalyst for CSCRM due to high oxygen storage capacity. It has been found that cubic phase Ni−$Ce_{0.8}Zr_{0.2}O_2$ catalyst exhibited $Ce_{0.8}Zr_{0.2}O_2$ and NiO nanocrystalline crystals show the highest activity and stability, bringing intimate contact between Ni and support, good dispersion of Ni and oxygen transfer during the reaction. Furthermore, co-precipitated Ni−Ce−ZrO_2 catalysts have been optimized in CSCRM to achieve a H_2/CO ratio of 2, which is suitable for Fischer-Tropsch synthesis.

Keywords: Gas to liquid, CSCRM (Combined steam and carbon dioxide reforming of methane), Oxygen transfer

EE-P-13

The comparison of catalyst activity according to Cu-$Ce_xZr_{1-x}O_2$ catalyst structure for low temperature water gas shift reaction

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Abstract

The Water Gas Shift (WGS: CO + H_2O ↔ H_2+CO_2) reaction is crucial role in production of pure hydrogen using waste-derived synthesis gas. CeO_2 supported Cu catalysts have received much interest due to their high activity for low temperature water gas shift reaction. However, the challenges still exist to overcome the sintering of Cu/CeO_2 catalyst. For this reason, researchers have tried to overcome the disadvantages of Cu/CeO_2. As a result, the partial substitution of CeO_2 by ZrO_2 was reported to enhance the structural stability of CeO_2 and to improve metal dispersion resulting from solid solution formation. In this study, we compared activity/stability of Cu–CeO_2–ZrO_2 catalysts by structure of CeO_2-ZrO_2 in WGS. In conclusion, the cubic Cu–$Ce_{0.8}Zr_{0.2}O_2$ catalyst exhibited higher CO conversion than tetragonal Cu–$Ce_{0.2}Zr_{0.8}O_2$ catalyst with a temperature range from 200 to 400 ºC at a GHSV of 72,152 h^{-1}.The high catalytic activity of the Cu–$Ce_{0.8}Zr_{0.2}O_2$ is mainly related to the enhanced oxygen mobility and high Cu dispersion resulting from large amount of defect oxygen. The cubic $Ce_{0.8}Zr_{0.2}O_2$ support can give mobile oxygen to oxidize CO to CO_2 by temporarily reducing Ce^{4+}↔ Ce^{3+}, and then is reoxidized by taking oxygen from the H_2O molecule. Moreover, we also found that the cubic Cu– $Ce_{0.8}Zr_{0.2}O_2$ catalyst has a high resistance against sintering. As a result, the cubic Cu–$Ce_{0.8}Zr_{0.2}O_2$ catalyst showed stable activity at 320 ºC for 25 h

Keywords: Water gas shift reaction, CO conversion, Cubic structure, Tetragonal structure,Mobile oxygen

EE-P-14

Evaluation of Loading of Masan Bay Streams using Load Duration Curve

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Abstract

This study evaluated the characteristics of pollutant loadings of Masan Bay Streams. The monitored water qualities and flows of 17 streams into Masan Bay during 2005~2017 were used and analyzed. The load duration curves were used to investigate the pollutant sources of each stream according to the target water quality and calculate the reduction load to achieve the target water quality. This research shown that the load duration curve could be applied in the implementation and assessment of current TMDL.

Keywords: Load Duration Curve, Water Quality, Masan Bay, Total Maximum Daily Load

EE-P-15

Study on spectral characteristics and load calculation of compost based on UAV

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Abstract

Compost which is loaded in the outdoor and agricultural area runs off into the water system during rainfall and acts as a non-point pollutant discharging nitrogen and phosphorus. However, compost is distributed irregularly in a broad watershed and is challenging to manage. In order to manage the compost, it is necessary to investigate quantitative information such as the location and the load of the compost in a single process. As a preliminary step for this aim, one of the targets in this study is to derive the spectral characteristics of the compost using UAV with a multispectral sensor. Another is to determine the accuracy of the compost load based on terrestrial LiDAR. As a result of the analysis, the IQR range of the wavelength of the compost was the narrowest at the red wavelength band range of Green, Red, Red edge and NIR wavelength band. Unlike other wavelengths, positive outliers were found in green and NIR wavelengths and could be used to classify the management status of compost. Based on the results of this study, UAV could be used to investigate the distribution, management status and load of the compost, which is a major source of non - point pollution.

Keywords: Non-point pollution, Terrestrial LiDAR, Agricultural area, GIS

EE-P-16

Bioconcentration of hazardous chemical in *Oryzias latipes*

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Abstract

There are emerging issues on the residues of hazardous chemical existing in the aquatic system. Some of them would be ingested by aquatic organisms and accumulated in their body. We focused on pharmaceuticals which would be a possible impact on aquatic ecosystems due to their ubiquitous use. The aim of this study was to investigate possible uptake and bioconcentration of pharmaceuticals in Japanese medaka (*Oryzias latipes*). Lab-scale exposure experiments were accomplished to calculate the bioconcentration factor (BCF) of pharmaceuticals in fish for 96 hours. Seven pharmaceuticals, Atenolol (ATN), Caffeine (CFE), Carbamazepine (CMZ), Fluoxetine (FLX), Losartan (LST), Naproxen (NPX) and Venlafaxine (VFX) were selected as the test compounds. The test samples were analyzed using liquid chromatography-high resolution mass spectrometry by target screening methods. As the results, seven test compounds were quantitatively detected via target screening. During the test time, the solution concentrations of parents decreased by -25-43%. The measured concentrations in fish tissue samples were at 71.8 ng g^{-1} for atenolol, 49.1 ng g^{-1} for caffeine, 242.3 ng g^{-1} for carbamazepine, 2996.8 ng g^{-1} for fluoxetine, 34.0 ng g^{-1} for losartan, 60.0 ng g^{-1} for naproxen and 18.8 ng g^{-1} for venlafaxine. The estimated bioconcentration factors (BCF) were in a range between 0.1 to 23.1 in the organisms. Among them, fluoxetine showed significantly higher BCF values, 23.1, than the other test compounds. The observation on concentrations provides information on compounds which are likely to accumulate in Japanese medaka (*Oryzias latipes*).

Keywords: Hazardous chemical, Bioconcentration, Japanese medaka

EE-P-17

A study on lifetime characteristics of insoluble catalyst anode by interlayer formation method

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Abstract

The life of insoluble electrodes is very important in electrochemical process especially in terms of economic aspect. Since the insoluble catalyst layer of the electrode is consumed after a certain period of time its lifetime is shorten when electrochemical reaction proceeds. In effort to extend its lifetime, many studies have been conducted on the electrode by using pre-treatment and/or interlayer formation before forming the catalyst layer. Insoluble electrode used under high current density condition is an important part to improve adhesion as well as thickness of the catalyst layer. The interlayer formation method is known as a typical way to extend the lifetime of the insoluble electrode. For the interlayer formation, tantalum oxide (Ta_2O_5) is coated under the catalyst electrode layer. Besides an alloy of tantalum or tantalum and titanium could be formed by Physical Vapor Deposition (PVD) although expensive equipment should be installed. Therefore an alternative method could be considered to form tantalum as an intermediate layer by a wet coating method. In this study, an interlayer was formed by coating Physical Vapor Deposition (PVD) with tantalum oxide (Ta_2O_5) and Physical Vapor Deposition (PVD) layer with tantalum oxide (Ta_2O_5) on the interlayer. The effect on the life of the electrode was investigated.

Keywords: Physical Vaper Deposition(PVD), tantalum oxide (Ta_2O_5), the interlayer, insoluble electrode, catalyst

ABSTRACTS

SESSION IV
Environmental Management

Oral presentation

EM-O-02

Comparing the results of people participation implementation in environmental management from case of Bangpakong Combined Cycle Power Plant number 5 and case of crude oil leak crisis Samed island, Rayong Province

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Abstract

This study was conducted from data related to people participation in environmental management from 2 case studies: Bangpakong Combined Cycle Power Plant number 5 (A.D. 2012) and Compensation on the environmental impact of tourism place after the crude oil leak crisis at Samed island (A.D. 2015) with objective to compare the implementation of people participation from different situation. This provided people participation as 5 forms, (Inform, Consult, Involve, Collaborate, Empower) separated as 5 levels (1- 5) of implementation, analysed data by statistics with the average score ($\bar{x}$) to compare. The result found that inform and consult to opinions, average score of the power plant project was at the moderate level ($\bar{x}$ = 2.64, 2.56) as same as compensation for the crude oil leak crisis case ($\bar{x}$ = 3.38, 3.21). For involve and collaborate, the average score of the power plant project is at low level ($\bar{x}$ = 2.47, 2.34), that was different from the compensation for the crude oil leak crisis case that was still in moderate level ($\bar{x}$ = 3.27, 3.38). For empower form, the average score of power plant project was in the lowest level ($\bar{x}$ = 2.20), it was different from the compensation for the crude oil leak crisis that was still in moderate participation level ($\bar{x}$ = 3.35). Meanwhile situation of environmental and life quality of people crisis, there would be people participation implementation completely and covering. It is also consist that the prevention and solving of environmental impacts from the developing project in normal situation with the total average score was in low level ($\bar{x}$ = 2.05) of power plant that was different from the crude oil leak crisis in moderate level ($\bar{x}$ = 3.33).

Keywords: People participation; Environmental management

EM-O-03

EM-O-04

Walkability Indexes of Current Pedestrian Facilities nearby Universiti Putra Malaysia, Serdang Campus

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Abstract

Pedestrians' safety and comfortability are one of the important factors in road traffic system as they are the most vulnerable road user. Institutional area is an area which is expected to have high density of pedestrians as well as high traffic volume. Several cases have been recorded on the conflict between both road users, however, the impact is more severe to the pedestrians. In order to reduce the number of fatalities and injuries among pedestrians, well-designed pedestrian crossing and other facilities should be built. The objective of this study was to assess the walkability indexes of three selected areas, which specifically evaluate in term of safety and comfortable elements of the current pedestrian facilities nearby Universiti Putra Malaysia, Serdang Campus. A set of evaluation form has been used to assess both elements and the evaluation was conducted based on the justification of nine parameters by referring to road cross-section of the areas together with on-site visualization. Walkability indexes of all selected sites were produced based on the parameters scoring. From the evaluation, the results showed that, for overall, 4 out of 9 parameters were following the standard and best guidelines at all selected areas, which are in terms of vertical clearance from any obstructions, safety gap between footpath and driveway, provided street lightings and traffic calming. As for the walkability, two areas recorded high indexes, which can be considered as well-built of pedestrian facilities. The highest walkability index was recorded at Gate 15, where 8 out of 9 parameters were following the best standards and guidelines. Meanwhile, Post-office Gate recorded the lowest walkability, which was only 5. This showed that, in this area, some of the pedestrian facilities were under-designed. Therefore, attention should be given in terms of providing properly built of pedestrian facilities in order to have safe and comfortable walking experiences while reducing the conflict between pedestrians and vehicles on road.

Keywords: Pedestrian crossing, pedestrian behavior, traffic vehicles, comfortability level, safety level

EM-O-05

Potential of *Sphingobium yanoikuyae* to eliminate H_2S in biogas

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Abstract

Corrosion of hydrogen sulfide (H_2S) is a major problem for biogas use. Sulfur oxidizing bacteria (SOB) is widely used in the treatment of hydrogen sulfide in biological systems. *Sphingobium yanoikuyae* stain TRE1, isolated a full-scale H_2S removal biotrickling in an ethanol plant was used to develop an H_2S removal biotrickling inoculated with a single bacterial strain. Inlet H_2S in synthetic biogas in the range of 0-2,000 ppm was fed in the biotrickling filter with immobilizing *S. yanoikuyae* on packing media. The gas upflow rate was controlled at 0.5 LPM (120 s EBRT) and counter flow with water spraying at the top of the biotrickling filter. Liquid samples were collected every 6 h to analyzed growth rate and sulfate concentration to follow the activity of *S. yanoikuyae*. The best conditions of *S. yanoikuyae* to eliminate H_2S was 1000 ppm, with 53.5% removal efficiency. A little amount of sulfate accumulated about 4.6 mg L^{-1}, with pH value decreased from 7 to 6.8. Results showed that *S. yanoikuyae* could oxidize H_2S in the biogas but higher removal efficiency is needed.

Keywords: Hydrogen sulfide, *Sphingobium yanoikuyae,* Biotrickling filters, Ethanol industry, Sulfur oxidizing bacteria

EM-O-06

EM-O-07

Performance of Pitaya Production by Using Life Cycle Methods: A Case Study in Selangor, Malaysia.

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Abstract

The demand for pitaya *Hylocereus polyrhizus* (dragon fruit) is increasing on the export market which leads to the increasing number of planted areas all over the year in Malaysia especially Selangor. Selangor, known as the third largest producer of pitaya in Malaysia, therefore Sepang is selected due to the existence of the pitaya farm almost 16 years ago. Most of the farms definitely need to come out with their total production in handling and managing the pitaya plantation. At the same time, they need to consider the environmental costs that will be contributed during the production. Thus, the purpose of this study is to analyze the performance of the pitaya production by calculating the total production cost of pitaya production and estimating the total environmental cost incurred in the system. To achieve these purposes, three methods were implemented, which are; 1) life cycle assessment (LCA), 2) environmental life cycle costing (ELCC), and 3) life cycle costing (LCC). The LCA's result shows that there are several potential impacts from pitaya production which are the ozone layer, at about 6.06 kg CFC-11 equivalent, summer smog or respiratory inorganic, estimated at 3.81 kg C_2H_4 equivalent, climate change at 3.4 kg CO_2 equivalent, carcinogens or human eco-toxicity at 1.21 kg Benzo(a)pyrene equivalent, radiation at 1.1 kg bq C-14 equivalent, fossil fuels at 0.856 kg CO_2 equivalent, eco-toxicity at 0.659 kg Cu equivalent, mineral depletion at 0.077 kg Mj Surplus equivalent, and acidification at 0.028 kg SOx equivalent. The total environmental cost for pitaya production was estimated to be RM24,917.60. After the environmental cost is included in the variable cost, the NPV is RM48,946.68, IRR is 14%, payback period is 5.46 years and the breakeven point is 39437.25. To sum up, ELCC will help to estimate the cost incurred for pitaya farm where the environmental cost is actually capable to be borne by the owner without incurring any losses. Besides, this study will help the producers and suppliers of pitaya to come out with the eco-friendly practices and to consider some allocations to protect the environment.

Keywords: pitaya production performance; ELCC; LCA; LCC;

EM-O-08

EM-O-09

Length and Weight Relationship and Fish Condition of Non-Native Fish Species in Selected Recreational Lakes, Kuala Lumpur, Malaysia

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Abstract

This study aims to determine the Length-Weight Relationship (LWR) and fish condition of non-native fish species found in four selected recreational lakes in Kuala Lumpur, Malaysia (i.e., Taman Metropolitan Batu, Taman Tasik Metropolitan Kepong, Recreational Park Bukit Jalil and Permaisuri Lake). Fishes were caught by using gill nets with different mesh sizes of (1.0, 1.5 and 2.0) cm and cast net with mesh size of 1.5 cm. Sampling were carried out from December 2017 to March 2018. The *b* value for *Oreochromis mossambicus* found at the Taman Metropolitan Batu, Taman Tasik Metropolitan Kepong and Permaisuri lakes were 2.666, 2.7114 and 2.458 while average of condition factor (K) were 1.88, 2.19 and 3.02, respectively. Meanwhile the *b* value for *Puntius schwanenfeldii*, *Puntius gonionotus*, *Clarias batrachus*, *Clarias macrocephalus* and *Clarias gariepinus* in Bukit Jalil Lake were 1.4607, 1.4536, 2.1789, 2.4681 and 2.118 while average K= 3.03, 3.76, 1.91, 1.63 and 1.31, respectively. The *b* value for *Cichla ocellaris* and *Clarias gariepinus* found in the Permaisuri Lake were 2.730 and 3.097 while K value were 1.23 and 0.6 respectively. The value of *b* indicated that the growth pattern of all non-native fish species caught were negative allometric (b<3.0). This exhibited that the fish weight decreases with increasing length where fish becomes less rotund. As for fish condition, all non-native collected during the study were mostly in good condition (1.00 <K<1.40). This can be influenced by many abiotic and biotic factors such as phytoplankton abundance, predation, water quality and food availability.

Keywords: Non-native, inland fish, Length-Weight Relationship, Condition Factor, recreational lake

EM-O-10

Microplastics in Asian green mussels (*Perna viridis*) cultured in Bacoor Bay, Philippines: Qualitative Assessment and a Closer Look on Local Management Practices

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Abstract

Microplastic research have gained popularity in recent years due to their potential as persistent organic pollutants (POPs) vectors which pose environmental and human health risks. Thus, identifying and assessing indicators of microplastic pollution are of utmost importance, and as filter feeders, bivalves play a huge role in this. In this study, the bivalve Asian green mussel (*Perna viridis*), a popular food source in the Philippines, from Bacoor Bay, Philippines was subjected to qualitative analysis to determine the presence of microplastics. Nitric-acid digestion was performed on five replicates which contained three mussels each. Through microscopic analysis, microplastics were found present on all replicates in the acid-digested mussel soft tissue. Local microplastic management practices were then looked into and a management program is suggested for policy makers and stakeholders to reduce the negative impact of microplastic pollution to both humans and the marine environment.

Keywords: microplastics; qualitative assessment; *Perna viridis*; marine pollution; environmental management

EM-O-11

An investigation and environmental evaluation on rigid polyurethane foam waste disposal in Thailand.

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Abstract

In Thailand, about 1 to 2 million refrigerators were sold annually. At the end of life cycle of refrigerators, valuable and non-valuable materials were separated for further recycling process at the dismantling site. The non-valuable material especially a rigid polyurethane foam, which is used as thermal insulation, was disposed without the management and mostly landfilled together with municipality solid waste. An open burning of the foam can be found at some landfill sites. The chemicals release during combustion– e.g. blowing agent, flame retardant and other chemical additives - may cause environmental and human health problems. As information on the polyurethane foam waste management in Thailand is limited, it is importance to explore the current situation of the foam waste management which can be used for further management planning and policy. The main objective of this study is to investigate the baseline disposal option of the rigid polyurethane foam waste and to evaluate environmental impacts arise from the highest disposal option by using SimaPro software. In order to assess environmental impacts, the data of chemical additives such as blowing agent, catalyst and flame retardant were also collected. The result revealed that the blowing agents such as HCFC-141b, cyclopentane were added in a foam production process for refrigerator. An amine group was added as catalyst and flame retardant was not added for the refrigerator application. The survey data from the dismantling sites in 5 regions of Thailand (19 samples) indicated that the disposal options of the rigid polyurethane foam wastes were landfill (47.83%), open burning (21.74%), sanitary landfill/incineration (13.04%) and refuse-derived fuel; RDF (4.35%), respectively. Based on the evaluation of environmental impact, as landfill is currently the main disposal method for the rigid polyurethane foam waste it was found that this affects the environment in terms of global warming, ozone depletion and ecosystem toxicity.
Keywords: Refrigerator, Rigid polyurethane foam, Dismantling, Disposal, Environmental impact.

EM-O-12

Assessment of the local government's solid waste management system in Carmona, Cavite: a 'Wasteaware' benchmark indicator approach customized to Philippine setting

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Abstract

This case study aims to look at how local government units in the Philippines can evaluate their solid waste management (SWM) System with the aim of generating baseline information and actionable insights that can be considered on in reinforcing its efficiency and sustainability and at the same time, minimizing its negative impact to people's health and the environment. In doing such, the 'Wasteaware' framework, an international benchmark indicators set deemed coherent and encompassing all aspects of solid waste management, was adopted and customized to the Philippine local governance landscape. Only those parameters which were within the control of local governments based on existing policies were considered. The developed performance evaluation tool based on this framework was initially applied to Carmona, Cavite, a multi-awarded local government for its exemplary SWM practices. Other than pilot-testing the evaluation tool, the initial application also caused the recording of good practices worthy of replication by other local governments. This study reveals that the provision of free waste collection service to all households and the recognition of the informal recycling sector in the SWM System can be a reality even in a municipality located in a lower middle income country like the Philippines. While the local government of Carmona can be considered to be in the right direction, there are still points that it needs to strengthen to further bolster the sustainability of its SWM System. Foremost of which are on leveraging resources from households and commercial establishments, and on engaging in inter-LGU cooperation initiatives. These two measures can be considered as vital preparations as the local government braces for the challenge of increasing demand for waste management services in the future. The results of this case study provide inputs for policy-making and new research direction relative to monitoring and evaluation of performance of local SWM Systems in the Philippines.

Keywords: Wasteaware' Integrated Sustainable Waste Management (ISWM) Benchmark Indicators, solid waste management system

EM-O-13

An investigation and Assessment of the Material and Pollutant Pathway from Dismantling of Refrigerator in Thailand

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Abstract

The refrigerator waste is one type of electronic wastes (e-waste). Nowadays, none of the dismantling stores in Thailand can appropriately dismantle the refrigerators. Moreover, there are no specific rules for controlling all e-waste in Thailand. Therefore, this study aims to study the amount of materials, materials pathway and environmental impacts of refrigerator dismantling to suggest the potential/policy to deal with the refrigerator waste. Field visits and interview of 27 of the informal dismantling stores located in each region of Thailand were conducted. For the pathways of valuable materials, the materials would be roughly separated by dismantling stores and sold to recycling stores who act as a middle man and sale the materials to processing factories so as to recycling. In 2018, the amount of recyclable materials from the refrigerator waste were estimated to be 1,297 tons of aluminium, 6,228 tons of acrylonitrile butadiene styrene, 6,473 tons of polypropylene, 8,720 tons of polystyrene, 33,960 tons of steel, 2,054 tons of copper and 313,371 litters of lubricating oil. For the estimation of environmental impacts from non-valuable materials using emission factors from SimaPro, the results indicated that the impacts came from the releasing of refrigerants to environment which was approximately 173,013,637 kg CO_2 eq. of global warming potential (GWP) in 2018. This is due to the fact that the vapour of refrigerants would be emitted to environment directly during dismantling processes. Human health effects including both the human non-carcinogenic toxicity and carcinogenic toxicity from exposure the refrigerant vapours were identifies. In order to avoid the impacts, the refrigerator waste should be dismantled by formal sectors, following the draft of WEEE Act in Thailand, however, this may affect the informal sectors' income. Thai government has to compromise, give out incentives and find ways to solve these problems.

Keywords: Refrigerator dismantling, Refrigerator waste, environmental impacts

EM-O-14

Development of rural water supply sustainability index and assessment

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Abstract

Water is fundamental for living. Regardless of income level and living condition, water should be safely managed and equally serviced. All United Nation Member States has adopted 17 Sustainable Development Goals (SDGs) in 2015 as a mutual guideline to move forward their countries to the better future. The progress is mostly in urban areas. Rural areas have left behind with improper water management system including water source protection, inefficient drinking water system and good governance around water sectors. In Thailand, rural water supply systems have faced with challenges to provided safe water supply. To underline key success in rural water supply, water supply sustainability should be assessed. To make the assessment, water supply sustainability index (RWSI) was developed for the context of Thailand and tested in Mahasarakham province. This study proposed a concept model of a multidimensional metric of water sustainability consisting of 6 key components which are *water resource* – capacity and stress, *access* – people's capacity to have access, *infrastructure* – capacity to meet public's demand, *use* – consumption and conservation, *governance* – transparency, accountability and policy effectiveness, and *adaptability* – adaptability to climate change. The RWSI showed that community water supply has encountered with lack of water source in terms of quality and quantity. Community members have no difficulty accessing to water supply consumption as it is provided to household. However, the community water supply could not meet its purpose to provide safe and clean water to the people. Its failure was due to incapability of operators and lack of system maintenance. The water supply committees are not able to manage the system properly due to budgeting limitation and inadequate required skills. To build and maintain livelihood and well beings of the local people, it is essential to improve water supply systems as it is delivered directly to households. If it is fail to provide safe and clean water, it is equal to delivering sickness to the people. Good governance around community water supply management should be built to move forward Thailand to inclusive and sustainable society.

Keywords: Rural water supply, Sustainability index, Sustainability

ABSTRACTS

SESSION IV
Environmental Management

Poster presentation

EM-P-01

Infectious waste management among health personnel on sub-district health promoting hospital in Sukhothai province

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Abstract

This descriptive research aimed to examine infectious waste management among health personnel in sub-district health promoting hospital in Sukhothai province and to investigate factors associated with infectious waste management among health personnel in sub-district health promoting hospital in Sukhothai Province. The samples were 190 health personnel recruited with multistage random sampling. Data collection was performed between January 1st and 30th, 2019 using a questionnaire. Data were analyzed using frequency, percentage, mean, standard deviation, minimum, maximum and Pearson's product moment correlation coefficient.

The results showed that most of the participants were female (79.4%) with mean age of 39.74 years. A large proportion of them were married (63.4%) and held a Bachelor's degree (65.5%). Regarding occupation, 45.9% were nurses with 17.34 years of work experience. Additionally, the participants had high levels of knowledge of infectious waste management (66.5%), attitude of infectious waste management (14.9%), motivation of infectious waste management (20.1%), support from administrator for infectious waste management (6.7%), management of infectious waste sorting (13.4%), management of infectious waste collection (12.9%), and overall infectious waste management (12.3%). Results also indicated that knowledge, attitude, motivation and support from administrator were significantly associated with infectious waste management ($r= 0.208$, $p=0.004$; $r=0.256$, $p<0.001$; $r=0.213$, $p=0.003$; $r=0.345$, $p<0.001$ respectively). However, age and work experience were not associated with infectious waste management ($r = 0.015$, $p=0.840$; $r=-0.065$, $p=0.370$). Therefore, the responsible organizations should increase knowledge of infectious waste management among health personnel in sub-district health promoting hospitals, as well as motivate and support the right method of sorting and collecting infectious waste management in sub-district health promoting hospitals.

Keywords: infectious waste management, health personnel

EM-P-02

Life cycle assessment of Nanglae pineapple production

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Abstract

Pineapple is a fruit of economic importance in Thailand. Pineapple products contributed national income over 28,000 million baht/year from their export value during 2014-2018. In the northern region of Thailand, Nanglae pineapple is considered to be a famous variety which is mainly cultivated locally in Nanglae Subdistrict, Muang District, Chiang Rai province and has been registered to be geographical indication with good taste and specific identity for local plant. Apart from its economic value, pineapple production, like other agricultural activities, is normally associated with different environmental impacts arising from agricultural inputs such as chemicals, pesticides, fertilizers and fuels, and the use of natural resources including water and soil. These factors lead to direct and indirect impacts on the environment. Therefore, this study aims to focus on assessing environmental impacts from different stages of Nanglae pineapple production by using the life cycle assessment (LCA), an environmental management tool that used to analyze and evaluate the environmental impacts associated with a product or service in all relevant stages in its life cycle. The objective of the study is to assess the impacts of growing Nanglae pineapple on the environment throughout its life cycle under a "cradle-to-farm-gate" system boundary or considering from raw material extraction, cultivating process and harvesting process. Analyzing data were collected in the 2018 cultivation year. 17 midpoint impact categories and 3 endpoint damage impacts were assessed based on the impact assessment method, ReCiPe Endpoint (Hierarchist; H). The results found that the use of nitrogen fertilizer or urea fertilizer in Nanglae pineapple cultivation caused the greatest impact on all categories. It contributed to the overall results ranging from 40% to 70%. In terms of endpoint indicators, the damage on resources was found to be highest (2.37E-12 pt) as a result of fossil fuels utilization in nitrogen fertilizer production. The results of the study can be used to improve environmental performance of pineapple production as well as to find an opportunity to reduce the cost of cultivation.

Keywords: Life cycle assessment, Nanglae pineapple, Environmental impact

EM-P-03

"One Health" concept towards environmental transboundary: a prospective wetland ASEAN network

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Abstract

An effort to overcome suffering from health-problem and to achieve better health in human beings has been researched over years. Recently, several sources attempt to integrate human -, animal -, and environmental-health as a disciplinary to be aligned in order to achieve the "One Health" concept. On the environmental dimension, its transboundary is likely the main structure of achieving One Health approach. In accordance with wetland ecosystems that comprise not only water resources but also soil, vegetation, animals, and others both in the physical and biological part, this ecosystem has been reviewed as a prospective environmental dimension model to achieve One Health approach. In 2015 representative members of the University Network for Wetland Research and Training in the Mekong Region (so-called Wetland ASEAN network) were invited to discuss with representatives from National Health Commission Office (NHCO) and Faculty of Environment and Resource Studies (FERS), Mahidol University, Thailand in order to develop a collaboration program with respect to One Health achievement through network countries, aiming at enhancing HIA and EHIA to strengthen trainers through the programs. Thus, HIA/EHIA steps were introduced as a part of research project which became a draft of proposal as an output titled "*Assessment of health impacts regarded to land use practice in wetlands of Mekong Basin*". First process to conduct the project planned is to define the determinants of health (social and economic environment-land use; attitude and social norm; social interaction; and transportation options). The physical environment has related issues on land use and health service. Diet and physical activities are issues of the personal's individual characteristics and behaviors. Second process planned to embrace five steps (screening, scoping, risk assessment, health action plan addressing, and monitoring program by local community) of HIA/EHIA into the project procedures. Then, the training programs would be set to provide for relevant stakeholders.

Keywords: EHIA, Collaboration, Wetland, Health

EM-P-04

Identification sources of $PM_{2.5}$ in Thepha, Songkhla Province, Southern Thailand

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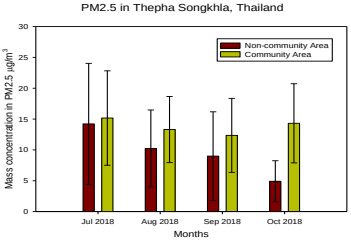
Abstract

Particulate Matters diameter less than 2.5 microns ($PM_{2.5}$) were collected seven samples (July-October 2018) in every 7 days by using DustDETEC sampler and operated with 7 liters/minute of flow rate. The results showed two locations (four stations) in Thepha city, Songkhla, Thailand. The highest monthly data in July from community areas (15.17 + 7.65 µg/m^3) that higher than non-community areas (14.21 + 9.82 µg/m^3). Emission sources of $PM_{2.5}$ were identified by water-soluble ionic species (K^+, Na^+, Mg^{2+}, Ca^{2+}, NH_4^+, SO_4^{2-}, NO_3^- and Cl^-) as well as heavy metals (Cr, Co, Pb, Cd, Ni, Mn, and As) using Principle Component Analysis (PCA). Factor loading are rotated into five sources in community areas including secondary aerosols (SA), industrial emissions (IE), vehicular emissions (VE), biomass burning (BB), mixed source of SA and soil dust (SD). Community areas are related to four sources including SA+BB, SD, IE and Sea salt (SS). We were reporting the mass concentration data through an online monitoring system relied on the website in order to rapid report to the community. Moreover, this study can be used to lead guidelines in the best practices of air pollution policy in Thailand.



Keywords: Emission sources, Songkhla, PM $_{2.5,}$ Online Monitoring

EM-P-05

Estimating human blood cyanide concentration resulting from continuous inhalation of cyanide from a gold mine

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Abstract

Cyanide is often used to extract gold from ore. As a result, cyanide compounds are released into a tailings storage facility (TSF). Under normal conditions, hydrogen cyanide (HCN) from the TSF will volatize into the air. People who are exposed to HCN in the air can experience chronic, acute or even fatal effects. Therefore, a way to predict blood cyanide concentration resulting from exposure to HCN dispersed from the TSF of a gold mine is necessary to minimize danger to public health. This study applies AERMOD and PBPK modeling to predict cyanide concentration in human blood (at 85 locations) after exposure to HCN dispersed from the TSF of a gold mine in Phichit province, Thailand. The results of this simulation were compared with actual cyanide concentrations in blood samples from people at those 85 locations. The blood samples were drawn on five different days in 2014. The results show that the predicted levels of cyanide and the actual observed levels sometimes agree and sometimes do not. In terms of the overall comparison, the predicted range successfully overlaps with approximately 50% of the observed range. Discrepancies may be the result of additional sources of cyanide exposure, such as food, smoke, drinking water, contaminated rice fields, or the movement of people.

Key words: Cyanide, Gold mine, AERMOD, PBPK, Cyanide in blood

ABSTRACTS

SESSION V
Environmental Pollution and Health Impacts

Oral presentation

EPHI-O-02

EPHI-O-03

Adsorption of Nickel and Chromium from synthetic wastewater by activated carbon derived from waste rubber tires

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Abstract

The objectives of this research were to investigate the physicochemical properties of activated carbon derived from waste rubber tires or carbon black and the optimum conditions of nickel and chromium adsorption. The physicochemical properties were structure morphology, texture, and adsorption capacity. The structure morphology and compositional analysis were observed by a field emission scanning electron microscope with energy dispersive X-ray fluorescence spectrometer. The results showed the porous structure of the activated carbon was changed and increased when compared with carbon black. The energy dispersive X-ray fluorescence spectrum showed carbon more than 80%. Brunauer Emmett Teller has characterized the textural property of the activated carbon. It was found that the surface area and total pore volume of activated carbon have been improved to 149.74 m^2/g and 1.05 cm^3/g, respectively. This total pore volume was in the mesoporous. The adsorption capacity of activated carbon can be studied by iodine number and density appears. Iodine number results showed the activated carbon absorbed the iodine solution up to 1,506 mg/g and density appears results revealed at 0.73 g/cm^3; this is a small porous of activated carbon. After that, the optimum conditions were studied with 10 mg/l of mixed aqueous solution of nickel and chromium in the synthetic wastewater, pH 5, 30 min of contact time and 3 g of adsorbent dosage. Nickel and chromium were absorbed more than 50% and 99.99% of efficiency, respectively, However, mixed aqueous solution is precipitation when the pH higher than at pH 5 and effect to remove nickel. In addition, this adsorption process could be proved by Langmuir model with correlation coefficient of nickel and chromium at 0.94 and 0.99, respectively. Consequently, these results indicated that this activated carbon was able to be used for nickel and chromium removal at optimum conditions.

Keywords: Carbon black, Activated carbon, Adsorption, Waste rubber tires, Heavy metals

EPHI-O-04

Transboundary Air Pollution in Relation to Open Burning in Upper Southeast Asia

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Abstract

Air pollution is a transboundary issue that occurs during dry season in upper Southeast Asia. The major source is open burning including forest fires and agricultural residues burning. This study aims to analyse fire hotspots using two NASA's sensor systems; Moderate Resolution Imaging Spectroradiometer (MODIS), and the Visible Infrared Imaging Radiometer Suite (VIIRS), and assess their impacts on air quality. Geographic information system (GIS) was used to create maps of fire hotspots and their density. The Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) model was used to analyze 24- and 72-hour backward trajectory (BWT) of air mass movement to Chiang Mai city during February-April 2018. Two levels of air mass arriving were set at 10 m and 1,500 m above ground level (AGL) representing local and regional influences, respectively. During the study period, directions of air mass movement were mostly from western and south-western of the city. Burned areas obtained from both MODIS and VIIRS systems were significantly different ($p < 0.05$). Correlations between $PM_{2.5}$ concentrations and Burned areas for both 24-and 72-hour BWT obtained from VIIRS were better than those of MODIS at both levels (10 and 1,500 m AGL). Influence of local open burning on air pollution was observed from both systems but VIIRS provided slightly higher correlation with hotspot count than MODIS. Both systems provided similar results for transboundary air pollution (1,500 m AGL). It can be concluded that the VIIRS data system provided higher precision than MODIS for prediction of air pollution from open burning mainly due to its finer resolution. Air mass movement at ground level (24-hour BWT at 10 m AGL) is suitable to represent local pollution and 72-h BWT at both levels can be used to predict transboundary air pollution.

Keywords: Fire Hotspot, Backward Trajectory, Air pollution, $PM_{2.5}$, Open burning.

EPHI-O-05

Modeling of particulate matter in the vicinity of Chatree gold mine in Thailand.

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Abstract

The operation of Chatree gold mine (CGM) posed health concerns among some members of communities surrounding the mine related to fine particulate matter. While CGM had regular quarterly monitoring of TSP and PM_{10} at 10 communities around CGM since its beginning in 2001 with good compliance results for the majority of time, $PM_{2.5}$ monitoring was only conducted in 2013. Lacking regular long-term $PM_{2.5}$ monitoring, a dispersion model AERMOD was applied to simulate $PM_{2.5}$ in the vicinity of the CGM to reveal $PM_{2.5}$ situation. The study used CGM's mine production activity data to calculate emission rates for fugitive dust and exhaust from mining equipment along with particulate sources outside CGM including road traffic exhaust, agricultural burning via satellite hotspots, and wind-blown dust. Transportation of particulate matters from outside the modelling domain was estimated using data from government monitoring stations in upwind provinces in Northwest, East and South directions. CGM's dataset of TSP and PM_{10} monitoring from 2001 – 2015 and $PM_{2.5}$ from 2013 were used to test the TSP, PM_{10}, and $PM_{2.5}$ model. The results showed that predictions by emission sources inside the modelling domain alone significantly underpredict. The assumption of adding upwind concentration into the modelling domain significantly improve model-observation agreement. Model results reveal that all 10 communities around CGM may experience the maximum $PM_{2.5}$ levels above the national 24-hour averaged standard concentration. A closer look at the case-study peak $PM_{2.5}$ day demonstrates that the contribution from CGM ranges from 2.6 to 33.0 percent while advection from upwind areas contributes 66.6 – 97.2 percent. Although gold mine operation alone may not lead to $PM_{2.5}$ exceeding the standard concentrations, a more important note is the compounding particulate concentrations from various sources that communities were subjected to. Comprehensive source consideration will improve future environmental impact assessment of development project to safeguard the environment.

Keywords: Air quality, Modeling, Monitoring, PM2.5, Mining (maximum 5 keywords)

EPHI-O-06

Effects of the Chlordane residues on mortality, histology and proteome profile of *Crassostrea iredalei*

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Abstract

Chlordane is an organochlorine insecticide that was used for termite control. Chlordane can persist in several environments for long time. Its accumulation in soil, water and animal tissues had been reported worldwide, however its toxic effect to marine life is limited. This study was performed to investigate the effect of chlordane to mortality, histopathology and proteome profile of Black-scar oyster (*Crassostrea iredalei*) after exposure to various concentrations of chlordane in the laboratory condition. Mortality results showed that chlordane was very toxic to the oyster. LC_{50} at 96 hours of exposure was 181 µg/l. The histopathological changes in oyster tissues including mantle and digestive gland were observed. Cell necrosis occurred when exposure dosages were high. These results indicated that chlordane may disturb shell formation and digestive system of the oyster. Additionally, proteome profile of mantle tissues was investigated by 2 dimensional gel electrophoresis (2-DE). Results showed that after 96 hours of exposure to 10 µg/l chlordane (approximately 10% of LC_{50}), 11 protein spots were altered in comparison to the control. All of these protein spot would be further identified. Our results demonstrated chlordane is highly toxic to the Black-scar oyster. Also, experimental exposure design in laboratory conditions provides an important approach to detect sensitive variation of oyster.

Keywords: Black-scar oyster, Chlordane, Histology, Proteomics, Toxicity

EPHI-O-07

Effects of Organophosphate Insecticides on Acetylcholinesterase Activity in Earthworms and Dragonfly Nymph from Highland Rose Cultivation Area in Chiang Mai Province.

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Abstract

The study aimed to investigate the effect of organophosphates insecticides on acetylcholinesterase (AChE) activity in earthworms and aquatic insects from highland rose cultivation area. The field study was designed in two seasons, dry season and rainy season. The study was carried out in the private rose cultivation farms at Baan Buak Toey Village, Pong Yeang Sub-district and the headwater area along Mae Rim River, Mae Rim District, Chiang Mai Province, Thailand. The samples of earthworms and aquatic insects were collected once a month in February, April and July 2018. The effects of insecticides were evaluated by measuring the biomarker activities of AChE. Head of earthworm and aquatic insect samples were dissected and analyzed for AChE activity using Ellman's procedure. The results showed that some AChE activity in earthworm on treatment sites were significant difference (P<0.05) as compare to the reference site in February and April. In February, the activity in treatment site was $0.01x10^{-5}$, while reference site was $0.12x10^{-5}$. The month of April, those values in treatment were $0.01x10^{-5}$, $0.01x10^{-5}$, $0.03x10^{-5}$ and reference site was $0.07x10^{-5}$. However, a different activity was observed in treatment of July it was found that $0.09x10^{-5}$, and one site was $0.03x10^{-5}$. The unit of AChE activity is mole substrate hydrolyzed/min/g tissue. A significant inhibition of AChE activity in earthworms varied in different months owing to use of insecticides by rose farmer in their field and also possibly have been influenced by use of biochar in some part of rose cultivation area. For the dragonfly nymph, the significant difference of AChE activities for months of February and April could not be observed. By contrast, in July one treatment site was significantly different (P<0.05) compared to the reference site the results showed $0.03x10^{-5}$ and one treatment site was $0.11x10^{-5}$. AChE activity in the dragonfly nymphs were not significant during February and April which possibly due to changing in temperature and dissolve oxygen in case that normal temperature and low dissolve oxygen in water causes of AChE activity increased for a short duration after that AChE activity slightly decreased and also depending on season since during rainy season the intensive rainfall cause surface runoff and subsurface flow and increases the transport of pesticides.

Keywords: organophosphate insecticides, acetylcholinesterase activity, earthworm, dragonfly nymph.

EPHI-O-08

EPHI-O-09

Acute effects of diurnal temperature range on hospital admissions for cardiovascular disease in Bangkok, Thailand

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Abstract

Diurnal temperature ranges (DTR) is an indicator related to climate change. Many previous studies have examined the effects of ambient temperature, both hot and cold, on human morbidity and mortality, but very few studies have evaluated health effect of DTR, especially those in developing countries. The present study aimed to investigate the association between DTR and hospital admissions for cardiovascular diseases in Bangkok, Thailand by obtaining daily meteorological variables from the Thai Meteorological Department from January 2006 to December 2014 and daily hospital admissions for cardiovascular diseases from the National Health Security Office during the same period. Quasi-Poisson generalized linear regression model combined with distributed lag non-linear model (DLNM) was used to investigate the association between DTR and hospital admissions for cardiovascular diseases by adjusting for daily average temperature, relative humidity, day of the week, public holiday, as well as seasonal and log-term trend. J-shape relationship between DTR and cardiovascular hospital admissions was observed. With 7.8 ^{o}C DTR as a reference point, the relative risk at extremely high DTR (at 99th percentile) during cumulative lag 0-21 days was 1.21 (95% CI: 1.00-1.46). When stratified by season, the relative risk of hospital admissions for cardiovascular diseases at extremely high DTR was greater in winter compared to summer and rainy seasons. In conclusion, this study suggests that short-term exposure to extremely high diurnal temperature change, particularly during winter, was associated with increased risk of hospital admissions for cardiovascular diseases in Bangkok, Thailand. Results from this study can provide an important scientific evidence for policy decision making in order to protect population's health from adverse effects of DTR.

Keywords: diurnal temperature range, climate change, hospital admission, cardiovascular disease, Bangkok

EPHI-O-10

The quantity and type of airborne and surface fungi at the child development center and the beauty salon in Phitsanulok province

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Abstract

Fungi play essential roles in the biosphere because they are the dominant decomposers. They have evolved spores for long-range dispersal that can cause many diseases of plants and animals. As parasites or pathogens they will transmit to host and to spread spores from one host to the next, and many species produce toxic compounds. Therefore, the objectives of this study were (1) to study of the quantity and type of airborne fungi in 9 child development center (2) to study of quantity and type of surface fungi on brushes among 38 beauty salons in Phitsanulok province

For airborne fungi, the average value was 280.82 ± 124.43 CFU/m^3, the highest value was 463.12 CFU/m^3 that didn't exceed the WHO standard (<500 CFU/m^3). The most fungi were *Curvularia sp* causing the opportunistic infection. Furthermore, the brushes in beauty salons were found fungi for 71.1 % that showed the average value was 40.1 ± 41.3 CFU/cm^2. The highest value was 140 CFU/cm^2 that was higher than the total microbial standard of surface hygiene in hospitals (<5 CFU/cm^2). The most fungi were *Cannida albicans*, 26.6 %. These fungi caused the opportunistic infection as well. The appearance of fungi might be occurred from dirty hair brushes ($p \leq 0.001$) and humidity ($p = 0.008$).

Therefore, the beauty salon owner or the authority should be aware of maintaining a clean work environment. It should provide for air natural ventilation and increasing of light inside the rooms. The equipments that directly contact to consumers should to be cleaned for establishing a good hygiene. Our findings suggest that the responsible authorities should have regularly check the environment contamination for the child development center and the beauty salon. Besides, the knowledge gaps about hygienic condition and environmental sanitation should be trained for teachers and beauticians to increase the good practices.

Keywords: Airborne, Surface, Fungi, Child development center, Beauty salon

EPHI-O-11

Noise exposure among flower garland sellers who work at the red light intersection of Warinchamrap to Ubon Ratchathani bypass road, Ubon Ratchathani Province

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Abstract

This descriptive research aims to study the noise exposure among flower garland sellers at the red light intersection of Warinchamrap to Ubonratchathani bypass road, Ubonratchathani Province. The study area was at 6 different intersections including Lukhamhan, Nongtaphon, Kham Nam Saep, Dong Uphueng, Wanarom and Nonhongthong. The study was conducted by having flower garland sellers use a noise dose meter monitor while working and then comparing it to the national standard noise levels. There were 2 representatives per each intersection. The study showed that the average noise dosimeter level throughout an 8 hour working period (TWA8) was between 58.7-78.9 dBA. The highest level collected was 78.9 dBA (or 21.57 %Dose) from the flower garland seller who works at the Dong Uphueng intersection and the lowest level was 58.7 dBA (or 1.30 %Dose) from the flower garland seller who works at the Nonhongthong intersection. While comparing the noise level with the national standard, it was found that the noise level that was monitored from all sellers were consistent with the standard (TWA ≤90 dBA). However, when the flower garland sellers are exposed to the noise for a long time, with the increase of traffic conditions, they may have chances of health risks, particularly with their hearing functions. Therefore, to prevent and solve the noise exposure problem from this type of work, the sellers should use noise protection devices such as ear plugs, complete an annual hearing test, and agencies should further help train and inform the sellers on the proper ways to handle noise protection while working.

Keyword :noise dosimeter, flower garland sellers, intersections, Ubon Ratchathani

EPHI-O-12

The inhalation exposure and health effect of PM10 of population in faculty of engineering, Naresuan University and particle management

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Abstract

From the information in researches, which were conducted from 2010 to 2017, the Faculty of Engineering, Naresuan University has encountered a dust problem. Accordingly, this research studied inhalation exposure and health effect of particulate matter with an aerodynamic diameter equal to a nominal 10 µm. (PM10). The PM10 samples were collected in different occupations using low volume air samplers with a flow rate of 1.7 L/min. The volunteers from six occupational groups (lecturers, administrative staff, students, gardeners, security officers, and housemaids) were asked to carry the air samplers for 1 working day (8 hours). Fifty samples were collected during January 2019 to March 2019. The lowest level of the inhalation exposure was from the lecturers at $0.75x10^{-4}$ mg/kg/day, and the highest level was from the security officers at $2.1x10^{-4}$ mg/kg/day. When the data was divided into 3 groups (students, skilled workers and, unskilled workers), the skilled workers exposed to PM10 less than the unskilled workers with Hazard Quotients (HQ) $8.12x10^{-3}$ and the student exposed to PM10 less than the unskilled workers with HQ $7.86x10^{-3}$, when both of them had a coefficient of determination at 59.70%. This means there is very low effect to health. It suggests that the occupations, which work outside the building, could expose to PM10 more than the occupations, which work or spend most of the time within the building. However, the result does not suggest high risk in all of six occupational groups.

Keywords: Inhalation exposure/ Health effect/ PM10/ Naresuan University

EPHI-O-14

Microplastic pollution in surface water of the Chao Phraya River in Ang Thong area

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Abstract

As the top country for plastic production and consumption, Thailand generated more than 3 million tonnes of plastic waste in 2016. As a result of improper management, 0.15 to 0.41 million tonnes of plastic waste entered annually in the aquatic environment in Thailand. In recent years, a small size of plastic waste in term of microplastics became a significant concern due to their persistence, ubiquity and potential to play as vectors for transfer organic pollutant to human and biota. This study reports the concentration of MPs of the Chao Phraya River at Pa Mok District – a huge agricultural area of Ang Thong Province. Microplastics were sampled on the river by a manta trawl with the mesh size of 300 microns. The samples were treated by hydrogen peroxide with the iron (II) sulfate as a catalyst to remove organic components and inspected under a microscope with different size ranges. The total number of microplastics were found to be 41.78 particles/m^3. The presence of different types of MPs was confirmed by FTIR spectroscopy, with a predominant abundance of polypropylene, polyamide 6, and polyester. Potential origins of these type of polymers are from plastic nets of aquatic farms and plastic films from mulching employed for cultivation.

Keywords: Microplastic, Chao Phraya River, Plastic waste, Ang Thong.

EPHI-O-15

Microplastic contamination in a typical wastewater treatment plant

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Abstract

Plastic waste has become global environmental concern due to large amount of consumption. It can be broken down by environmental degradation into smaller size range, so called microplastic, which easily spread and is ubiquitous in marine environment. One of the land-based sources of microplastics is wastewater effluent. Therefore, this study aims to investigate the amount of microplastic pollution present in urban wastewater treatment system in Thailand. Microplastic samples were collected mainly from the influent and effluent of selected WWTP and examined in order to find the types and sources. Wastewater was filtered through a set of sieves which sizes are 5 mm, 1 mm, 500 µm, and 53 µm. Microplastic samples were processed using wet peroxide oxidation method and characterized into size, color, and shape categories under stereomicroscope. Number of microplastics found was 3.4 particles per liter in the influent and 2.06 particles per liter in the effluent. When treatment capacity of 350,000 m^3 is taken into account, 7.23×10^8 microplastic particle is daily released to freshwater environment .The majority of microplastics found in both influent and effluent was fiber, and transparent microplastics were abundantly inspected. Results from FT-IR analysis showed that types of microplastic contaminated in the influent were polyethylene (PE) and polyvinylchloride (PVC), while polyethylene terephthalate (PET) and polycarbonate were found in the effluent. This finding indicates that conventional wastewater treatment plant may act as a pathway for microplastic.

Keywords: Microplastic, removal, morphology, FTIR

EPHI-O-16

The spatial variations of water quality and sediment characteristics in the Ishikari Floodplain water body

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Abstract

The waterbodies in floodplains (FWB) are among the most biologically diverse systems providing a broad range of services. Human activities have substantially degraded FWBs and might generate a heterogeneity of sediment characteristics in FWBs, which can indirectly affect water quality and ecosystem integrity. This study aimed to test the hypothesis that spatial variation of sediment characteristics can influence water quality in FWBs of the Ishikari River, northern Japan. The secondary data of sediment characteristics and water quality from 2006 was provided by Hokkaido Government Office. The results showed marsh lake sediments had significantly higher of OM, COD and TN (17.80 ± 4.29 %, 55.60 ± 18.97 mg g^{-1} and 6.51 ± 1.92 mg g^{-1}, respectively) than natural (10.55 ± 1.80 %, 32.95 ± 12.96 mg g^{-1} and 3.41 ± 1.12 mg g^{-1}, respectively) and artificial oxbow lakes (9.72 ± 3.02 %, 21.01 ± 7.28 mg g^{-1} and 3.06 ± 0.95 mg g^{-1}, respectively). Chl-a of water showed a significant correlation with sediment OM, COD and TN in summer (r = 0.42, 0.61 and 0.48, respectively). However, the water-sediment correlations in autumn were weaker than summer (r = 0.35, 0.43 and 0.44, respectively). Agricultural area within 100 m of drainage channel buffer zone (%) also showed correlation with OM, COD and TN in sediment (r = 0.39, 0.45 and 0.38, respectively). Monthly monitoring of water quality of one lake from each group showed trends that partially supported seasonally fluctuating water-sediment associations. Overall, the influence of sediment characteristics on water quality observed in summer were stronger than in autumn possibly due to suppressed biogeochemical processes associated with seasonal changes in primary production. Agricultural area surrounding drainage channel indirectly affects water quality by influencing sediment characteristics as it reflects the nutrients and organic matter loading from external sources.

Keywords: Floodplain, Sediment characteristics, Spatial variation, Water quality, Agricultural drainage channel

EPHI-O-17

Carbon footprint of Weatherstrip manufacturing

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Abstract

Rubber parts are one of the important for automotive industries particularly weatherstrip for protection of leakage of liquid phase and temperature controlling in the cabin. The raw materials of weatherstrip are polyvinyl chloride (PVC) and thermoplastic polyolefin (TPO) that consume enormous energy and raw material as well as large quantities of rubber waste. Waste and energy minimization are the company policies based on carbon footprint concept. The production of weatherstrip is comprised of two main processes including extrusion and finishing. In this study, the assessment of carbon footprint is focused on finishing process because the rubber waste is mostly generated from this process. The more rubber waste is generated, the higher carbon dioxide is emitted. The functional unit was initiated from raw material (PVC, TPO and chemicals) supply until finished products (cradle-to-gate). The finishing processes include rubber blending, cutting, and inspection. Due to semiautomatic system, the major carbon dioxide is originated from electrical consumption. The data were collected from electrical meter from each instrument and quantities of scrap (rubber waste) for one year (2018). The observed carbon footprints were calculated in ton CO_2 equivalent from multiplied products of corrected qualities and emission factors. The recycle scrap was normalized the actual scrap waste prior calculation. The carbon footprint reached highest for cutting process (11,232 ton CO_2 eq) followed by blending (7,851 ton CO_2 eq) and inspection (1,795 ton CO_2 eq). Also, studied results as guideline remodel machines in finishing process for reduced scrap waste may be collected clean technology and increase efficiency of manufacturing process.

Keywords: Carbon footprint, Weatherstrip, Finishing process

EPHI-O-18

The Phase of Transport Process During Loading from Certificate Oil Truck to Storage Tank.

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Abstract

The phase of transport process during loading from certified oil truck to storage tank was investigated. An incident was studied in case of accident occurring from abnormal conditions including tank leakage and untightly hose. The leakage of naphtha may cause explosion following by potentially domino effect of toxic fume, thermal radiation and fire spreading.

ALOHA (Ariel Location of Hazardous Atmosphere) program was applied for evaluation of explosion from highly volatile solvent (naphtha) within specified areas. The study process was focused on loading from certified oil truck to storage tank. Moreover, meteorological conditions including wind direction and speed, temperature and humidity provided additionally critical impact to domino effect. The explosion will cause domino effect with fire, toxic fume and thermal radiation from fire ball.

Due to BLEVE (Boiling Liquid Expanding Vapor Explosion) resulted from 135 scenarios simulation using ALOHA model, the large leakage hole (7-inch) caused highest critical impact followed by 3-inch leakage and puddle type leakage respectively. The uncontrolled factors including relative humidity, temperature as well as wind direction and speed affected domino effect. Within relatively high humidity and low wind speed might create vapor toxic cloud in low dispersant condition. Moreover, the oil tank structure was damaged for in each situation causing puddle type leakage. Furthermore, the explosion may produce a large fire ball with thermal radiation exceeding 10 kW/m^2 in all situations. In conclusion, the assessment results could be applied and implemented for emergency response plan related to safety work procedures and lowering human and environmental risk for workers and neighboring communities.

Keywords: ALOHA, BLEVE, Domino effect, Explosion, Naphtha

EPHI-O-19

Emission Estimates during Landing/Take-off Activities from the Commercial Aircrafts at Large International Airports in Thailand

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Abstract

This study aims to estimate the annual emissions of Carbon Monoxide (CO), Nitrogen Oxide (NO_x), and Hydrocarbon (HC) from the commercial aircrafts at Suvarnabhumi and Don Mueang airports, the two largest international airports in Thailand. The emissions were calculated based on landing/take-off cycle (LOT) which included the activities of the aircraft during taxi, take-off, landing, initial-climb-climb-out, and approach modes. The emissions during LTO cycle were calculated with the emission factors and actual flight data collected in the year 2015. More than 347,490 flight data were collected at Suvarnabhumi airport and 231,361 flight data occurred at and Don Mueang airport. The route maps were created within 1 km x 1 km resolution for each flight using XY coordinate data. The annual emissions at each coordinate along the route maps were spatially analyzed with the satellite image of the airports to provide the spatial emissions for each LOT cycle. The annual emissions during LTO cycle at Suvarnabhumi airport were about 2.23 Mtons for CO, 6.22 Mtons for NO_x and 0.81 Mtons. For the emissions at Don Mueang airport were 0.89 Mtons of CO, 1.85 Mtons of NO_x and 0.22 Mtons of HC. The spatial emissions of CO and HC at Suvarnabhumi airport were high at the end of the runway on the eastern side. High spatial emissions of NO_x were observed at the center of the runway. At Don Mueang airport, the annual CO emissions were high at the end of the runway, while the spatial emissions of HC were high at the end and center of the runway. High emissions of NO_x were observed at the center of the runway.

Keywords: Commercial aircraft emission, LTO cycle, Suvarnabhumi, Don Mueang, Thailand

EPHI-O-20

Determination of $PM_{2.5}$ -bound PAHs in Northern Thailand for health risk assessment during open burning season

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Abstract

Open biomass burning causes air pollution, which has been recognized as a major problem in Northern Thailand during dry season for over a decade because of its impacts on human health. This study aims to assess inhalation cancer risk based on concentration of 16 polycyclic aromatic hydrocarbons (PAHs) bound with fine particulate matters ($PM_{2.5}$). Daily (24 hours) $PM_{2.5}$ were collected from two sampling sites in Northern Thailand; Chiang Mai and Nan provinces during dry season (March – April) of the year 2018. In terms of spatial variation, the average $PM_{2.5}$ concentrations in these two sites were not significantly different (38.11 – 41.86 $\mu g/m^3$). Interestingly, the average PAHs concentration at Nan province (5.21 ± 4.02 ng/m^3) was significantly higher than that at Chiang Mai province (2.02 ± 1.50 ng/m^3). High PAHs concentration leads to high value of toxicity equivalent concentration (TEQ) representing risk from PAHs inhalation. The average TEQ values at Nan province was 3.6 times higher than that of Chiang Mai, resulting in higher inhalation cancer risk (ICR), which is a multiplication of TEQ and the inhalation unit risk (IUR) recommended by WHO (8.7×10^{-2} $m^3/\mu g$). The dominant PAHs (> 90% of total PAHs concentration) found at both locations were a group of high molecular weight compounds (4-6 rings of PAHs). It can be concluded that biomass burning emits fine particulate matters (PM) into the atmosphere. Moreover, toxic compounds, i.e. carcinogenic PAHs are bound with those PMs and can cause adverse health impact.

Keywords: Air pollution, $PM_{2.5}$, PAHs, Carcinogenic compounds, Biomass burning

EPHI-O-21

Stable carbon isotope composition in $PM_{2.5}$ as a tracer of biomass burning in Chiang Mai City, Thailand

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Abstract

Biomass burning activities were reportedly contributed to smoke-haze pollution in Chiang Mai Province, Thailand. In the present study we measured chemical compositions of fine particulate ($PM_{2.5}$) collected during the smoke-haze pollution in 2017. The $PM_{2.5}$ samples were collected on the roof top of Research Institute for Health Science (RIHES) building, Chiang Mai University, Chiang Mai city, during January to May 2017. The $PM_{2.5}$ samples (n=63) were collected every 2 days from ambient air using medium air volume (Laoshan Electronic Instrument Manufacturer, China) at a flow rate of 100 L/min. The total carbon (TC) content and stable carbon isotope ($\delta^{13}C$) were analyzed by elemental analyzer (EA) coupled with an isotope ratio mass spectrometer (IRMS) at Yale-NUIST Center on Atmospheric Environment, Nanjing University of Information Science and Technology (NUIST), Nanjing, China. The $\delta^{13}C$ values were used to characterize sources of $PM_{2.5}$ such as fossil fuel combustion and specific biomass burning types. The $PM_{2.5}$ concentrations were ranged from 5.4 to 79.9 µg/m^3 with the mean of 36.8±17.5 µg/m^3. Whiles, the value of $\delta^{13}C$ of TC in $PM_{2.5}$ were -26.1±0.8 ‰ and ranged from -27.4 to -24.3 ‰ which indicating contributions from biomass burning; 74% of C_3 plants and 26% of C_4 plants, respectively. This study demonstrates that the contribution from the burning of C_3 plants is dominantly in this area. While, the C_4 plants were burnt in the early dry season (January). From our knowledge this is the first report to distinguish the burning sources of plants contributing of airborne $PM_{2.5}$ during smoke-haze pollution in Chiang Mai City.

Keywords: Biomass burning, $PM_{2.5}$, Stable carbon isotope, C_3 and C_4 plants, Chiang Mai.

EPHI-O-22

EPHI-O-23

Feasibility of Air Quality Standard compliance in Phnom Penh: case of PM_{10} and $PM_{2.5}$

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Abstract

Cambodia's ambient air quality standards have only five pollutants (CO, NO_2, SO_2, O_3, and TSP) PM_{10} and $PM_{2.5}$ were not included in the NAAQS. However, the government do the daily monitoring for $PM_{2.5}$ and report weekly basis to mention the $PM_{2.5}$ standard for average 24 hrs is 50 µ/m^3. This paper presents an overview and analysis of air quality in Phnom Penh, aiming which target group of WHO standard that Cambodia would be able to achieve for PM_{10} and $PM_{2.5}$. During the period of October 2018 through January 2019, $PM_{2.5}$ and PM_{10} concentrations were measured in downtown Phnom Penh, Cambodia. The monitoring site located 12 m above ground near Businesses area with highly trafficked. Real-time data of PM_{10} and $PM_{2.5}$ concentration was collected using light scattering sensor. The average 24-h PM_{10} and $PM_{2.5}$ concentration during the sampling period was 27.62 µg/m^3 and 24.43 µg/m^3. Daily $PM_{2.5}$ concentration exceeded the WHO AQG limit for 25 µg/m^3 approximately 43.23 % of the sampling days but it lower than the limit of the Asian country. The daily PM_{10} measure concentration exceeded the WHO AQG limit for about 6.7% of sampling days, but it is 99% pass the Interim target 3 that limit of 75 µg/m^3.
The results of this analysis underline the importance of baseline PM_{10} and $PM_{2.5}$ concentration levels, which could be used in the future to assess the effectiveness of the implemented emission control strategies.

Keywords: Air quality Guideline Cambodia, low-cost sensor

EPHI-O-25

Modeling and Monitoring of Transboundary Particulate Mercury Deposition in Chaloem Phra Kiat District, Nan Province

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Abstract

Mercury (Hg) is a long-range atmospheric pollutant, which may be in gaseous, ionic, or particulate forms. Particulate Hg deposits close to the source while ionic Hg^{2+} and gaseous Hg^0 can transport in moderate and long-range, i.e. cross country. Chaloem Phra Kiat district in Nan Province is at the Thai-Lao border and 30 km from a coal-field power plant located in Lao. Coal-fired power plant in general is known as a major source of Hg emission. From October to February, wind will blow from Lao to Thai. This study examined transboundary particulate Hg deposition via modelling and field sampling approaches. AERMOD, an atmospheric dispersion modelling was applied to model transport and deposition of particulate Hg. Moreover, in 2015 and 2018, we performed field sampling of PM2.5 and PM10. Also, we obtained surface water, soil, sediment, and fish for Hg quantification. In 2015, We found that while Hg concentrations in fish were relatively low (<0.06 mg/kg) in Ban Pon and Ban Namree villages, high Hg accumulation in fish (0.41 mg/kg) was found at Huai Kon sub-district, suggesting substantial deposition of Hg in surface water at Huai Kon sub-district as predicted by AERMOD. Nevertheless, in 2018, no substantial accumulation in fish was observed. Based on the result in 2015, we applied dose–response relationship between maternal mercury body burden and subsequent childhood decrements in intelligence quotient (IQ) from literature to estimate the risk of IQ decrements as a result of Hg-contaminated consumption. Also, we estimated the external cost of Hg deposition on adverse childhood neurologic outcomes and proposed pollution prevention and corrective action measures for future Hg deposition and accumulation.

Keywords: Mercury, Monitoring, AERMOD, Transboundary, Coal-fired Power Plant

ABSTRACTS

SESSION V
Environmental Pollution and Health Impacts

Poster presentation

EPHI-P-01

Monitor and Evaluation of Particle Matter in Police Fort at Thanyaburi Hospital Intersection, Pathum Thani Province

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Abstract

Particles matter in an environment has effect on human health. Especially those working in exposed areas such as traffic police. This research was to study the amount and size of particles matter in the police fort area at Thanyaburi Hospital intersection, Pathum Thani Province. The study collected dust data, classified by size and collected traffic data by the type of vehicle, duration of 8 hours. The equipment used to study is Six Stage Viable Cascade Impactor. The study found that the amount of dust on weekdays was higher than holidays both inside and outside the police fort. Because the police fort are near many types of dust sources, but important from traffic. The study found dust size 10 microns, the most common, and followed by 2.5 microns, both outside and in the police fort, but not exceeding the specified standard. However, exposure to small dust particles over a long period of time will affect the respiratory system of those living in that area. Therefore, there should be a guideline to prevent and control dust that occurs.

Keywords: Monitoring, Particle Matter, Police Fort, Transport, Climate

EPHI-P-02

PM_{10} and dust fall concentrations of mobile sources in Kamphaeng Phet Municipality

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Abstract

This research aims to study of the particulate matter inventory report from mobile source in Kamphaeng Phet municipality. The 60 samples of PM10 were collected using the high volume air sampler for 24 hours sampling at the flow rate of 1.7 cubic meter per minute. The 60 samples of dust fall were collected using gravimetric technique which modified dust collected device from the Department of Pollution Control (PCD). The dust fall containers were set in June 2017 to May 2018 at 5 samples stations. The three points of traffic survey by Closed Circuit Television (CCTV) cameras. This study use the emission factor method to quantify emission. The two samples of 60 PM10 samples were exceeded the ambient standard of Thailand of 120 micrograms per cubic meter. The highest of PM10 data was 130.72 micrograms per cubic meter at the Chula-Kanchanaphisek fort site in 17 of January year 2018. The highest of dust fall data was 336.41 milligram per square meter per day at the Chula-Kanchanaphisek fort on February year 2018. The major of mobile source in Kamphaeng Phet Municipality was heavy diesel vehicles.

Keywords: particulate matter, PM10, Dust fall, Kamphaeng Phet municipality

EPHI-P-03

Heavy metals accumulation in fish genus *Barbonymus sp.* in an ex-mining lake at Tanjung Tualang, Perak, Malaysia and its potential human health risk

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Abstract

Water and fish samples from an ex-mining lake were collected to determine the levels of heavy metals (Fe, Zn, and Pb) contamination and bioaccumulation in the area and the potential human health risk. Heavy metals in the fish samples were determined at specific organs, namely the muscles and gills. The concentrations of heavy metals were determined using ICP-MS. One commonly found fish genus in the lake was chosen, the *Barbonymus* sp. Concentration of metals in both the water and fish samples showed a similar trend with Fe as the highest followed by Zn and Pb. The levels of the metals in water were lower than in the fishes and significant positively high correlation between the levels in the water and fishes ($p<0.05$, $r^2 = 0.980$) proved the occurrence of bioaccumulation. It was observed that metals accumulation was higher in the gills compared to the muscles. Only the level of Pb in the lake water samples exceeded the permissible limit of the National Lake Water Quality Standards for Malaysia (NLWQS) at 0.166 mg/L, while concentrations of Fe in both the muscles and gills of the fishes exceeded the standards levels of World Health Organization (WHO) and Food and Agriculture Organization (FAO) and Zn in the gills of the fishes based on FAO standards and Pb in all samples based on WHO, FAO and Malaysian Food Act (MFA). The target hazard quotient (THQ) for all metals were <1 suggesting that there is low potential health risk upon prolong consumption. Additionally, the target cancer risk (TR) for Pb was within the threshold limit. Further studies on the local fish consumption behavior and fish migration patterns are needed to complement the results achieved.

Keywords: Bioaccumulation, Inland fisheries, Metal toxicity, Target Cancer Risk, Target Hazard Quotient

EPHI-P-04

Using PRTR database to assess human toxicity and eco-toxicity: a case study on emission sources in Rayong province, Thailand

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Abstract

Thailand's Eastern Seaboard has emerged as the country's industrial hub. Rayong Province is the largest home of the petroleum and petrochemical productions as well as other heavy industries which leads its potential threat to environmental problems. This study aims to apply the USEtox Model for evaluating human and ecological toxicity based on the data achieved from the Pollutant Release and Transfer Registers (PRTR) database of the study area. The database used in this analysis consisted of 107 chemical compounds covering from pesticides, heavy metals, inorganic and organic compounds. Results from the analysis by USEtox indicated that acrylonitrile has the highest potential health impact (1.5E+0 CTUh) followed by paraquat dichloride(1.46E+0 CTUh) and chlorpyrifos (1.17E+0 CTUh) , respectively. As for environmental toxicity, ametryn is evaluated as the most toxic substance (2.02E+08 CTUe) followed by chlorpyrifos (1.66E+08 CTUe) and paraquat dichloride(2.48E+07 CTUe). It was found that these harmful substances are mainly emitted from agriculture activities except for acrylonitrile which is mainly emitted from the industrial sources. This study reveals the necessity to develop the emission data and further evaluate them for potential health and environmental impacts for future sustainable management on the area-based basis.

Keywords: Maptaphut / Rayong / PRTR / USEtox model/ Toxicity

EPHI-P-05

Ambient $PM_{2.5}$ and its ion composition in Chiang Mai Provinces during open burning season 2018

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Abstract

Chiang Mai Province experiences an annual air pollution during dry season due to intensive open burning in Southeast Asian region. This study aims to analyse ion composition of ambient particulate matters with aerodynamic diameter less than or equal to 2.5 µm ($PM_{2.5}$) during open burning season (13 February – 30 April 2018) for source identification. Daily $PM_{2.5}$ samples (24-hour sampling) were collected by using a mini-volume air sampler with a flow rate of 5 L/min. A sampling station is located in sub-urban area of Chiang Mai surrounded by agricultural field. $PM_{2.5}$ samples (n=71) were extracted in deionized water and analyzed for their ion composition by ion chromatography. Average 24-hour $PM_{2.5}$ concentration was 45.5 ± 25.7 µg m^{-3}, while min – max values were 7.0 – 185 µg m^{-3}. About 31 % (22 days) of the sampling showed that 24-hour average $PM_{2.5}$ concentration was higher than Thailand ambient air quality standard (50 µg m^{-3}). Dominant ion species of $PM_{2.5}$ were sulfate (6.75 ± 3.05 µg m^{-3}), ammonium (2.06 ± 1.10 µg m^{-3}) and nitrate (2.04 ± 0.67 µg m^{-3}). Potassium ion, which is generally used as biomass burning tracer, was also found (0.91 ± 0.42 µg m^{-3}). $PM_{2.5}$ mass concentration was well correlated with nitrate and potassium (r~ 0.7) indicating that they were mainly generated from biomass burning. Sulfate and ammonium were also well correlated (r =0.72) showing influence of photochemical reactions. Principal Component Analysis (PCA) of ions and their correlations revealed various forms of major compounds (i.e., $(NH_4)_2SO_4$ and KNO_3) and various sources of $PM_{2.5}$ in this area including biomass burning, traffic emission, agricultural activity and soil dust.

Keywords: Air pollution; Biomass Burning, $PM_{2.5}$; Ion content; Source identification

EPHI-P-06

Identification of micro-plastics in different brands of bottled water in Thailand

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Abstract

Micro-plastic contamination of drinking water is of high concern in the current field of micro-plastic research. This work focuses on quantitative and qualitative analysis of micro-plastics in different brands of PET-bottled water, purchased from Thailand. Two sets of samples were processed in equal volumes, to analyse in two ways: 1) optical microscopic sorting (≥50 µm) and 2) fluorescent tagging (6.5-20 µm and ≥20 µm). ATR-FTIR spectroscopy detected the polymer composition in both instances. Under optical microscopic sorting, an average of 36.6 ± 5.8 p/L was found for ≥50 µm particles. Fluorescence microscopic detection revealed a total average of 222.5 ± 20.4 of ≥6.5µm particles per 1 L, where 152.2 ± 18.6 p/L and 70.3 ± 8.3 p/L were found in the size range of 6.5-20 µm and ≥20 µm, respectively, with fibers dominating in both. Fluorescent tagging seemed to be a more effective technique for micro-plastic sorting than optical microscopy. FT-IR spectra indicated the presence of PET and PE mainly, which could be released from packaging material and bottle caps. The quantity of micro-plastics released in the form of fibres, increases with the decreasing particle size. These smaller sized-plastic fibres cause a potential threat to human health as they can easily penetrate cells leading to various health implications.

Keywords: Micro-plastics, PET-bottled water, Optical microscopy, Fluorescence microscopy, ATR-FT-IR spectroscopy

EPHI-P-07

Levels of Saxitoxins Toxicity in Relation to Body Size of Green Mussel *(Perna viridis)*

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Abstract

Paralytic Shellfish Poisoning (PSP) is a public health concern worldwide caused by the consumption of bivalves contaminated with Saxitoxins (STXs). In this study, levels of STXs in 270 mussels *(Perna viridis)* collected from upper and lower Gulf of Thailand during 2014-2016 were determined using Receptor Binding Assay of tritiated saxitoxin [^{3}H-STX]. Parameters including total tissues wet weight and dry weight, maximum length, and the physiological performance of mussels using Condition Index were carried out. Analysis of STXs toxicity in mussel (per individual) revealed the lower levels in smaller sized mussels (2.0-2.5 cm) and the higher in the larger sized group (6.5-7.0 cm). However, the levels of STX toxicity in µg STXeq. 100 g^{-1} flesh differed insignificantly according to size group. No apparent relationship was observed between the length of Green mussel *(Perna viridis)* and the detection of STXs in this study. As the US regulatory limit is 80 µg STXeq. 100 g^{-1} of shellfish. Toxin levels found were 2.34 – 6.15 µg STXeq. 100 g^{-1} in flesh, indicating that mussels in the study areas were safe for consumption.

Keywords: Saxitoxins**,** Paralytic Shellfish Poisoning, Gulf of Thailand, Green mussel, Receptor binding assay

EPHI-P-08

Determination of elemental composition of ambient PM_{10} and $PM_{2.5}$ during open burning season in Chiang Mai, Thailand

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Abstract

Air pollution due to open burning, occurs almost every dry season in Southeast Asia including northern Thailand. This study aims to determine and compare PM_{10} and $PM_{2.5}$ concentrations and their elemental composition during open burning season. Ambient particulate matters ($PM_{2.5}$ and PM_{10}) were collected by mini volume air samplers during 3 March to 7 April 2016 at a rooftop of a nine story building in Chiang Mai University. The samples were extracted by aqua regia (HCl : HNO_3; 3:1 v/v) and analyzed for elemental composition using Inductively Coupled plasma-Optical Emission Spectroscopy (ICP-OES). Average PM_{10} and $PM_{2.5}$ concentrations were 84.10 ± 19.56 µg/m^3 (n=36) and 96.86 ± 15.24 µg/m^3 (n=36), respectively. Average $PM_{2.5}$ concentration accounted for 83% of PM_{10} meaning that fine particulate matters are a major part of ambient aerosols during the burning season. Moreover, daily average $PM_{2.5}$ concentration obtained from this study was about 1.5 higher than Thailand ambient air quality standard (50 µg/m^3) and 3 times higher than WHO guideline (25 µg/m^3). Major elements found in the samples were Fe (1.93 and 0.09 µg/m^3), Mg (1.77 and 1.20 µg/m^3), K (0.76 and 0.84 µg/m^3) and Al (0.10 and 0.18 µg/m^3) for PM_{10} and $PM_{2.5}$, respectively. Mg, K and Al were not significantly different comparing between PM_{10} and $PM_{2.5}$ samples ($p > 0.05$), while Fe in PM_{10} was significantly higher than in $PM_{2.5}$ samples. In PM_{10} fraction, Fe was the most enriched element, while Mg was the dominant species of $PM_{2.5}$. Sources of Fe and Mg could be from soil dust resuspension. High concentration of K (biomass burning tracer) was also found, particularly in $PM_{2.5}$ samples, revealed the biomass burning source during the sampling period. Some toxic metals such as As and Pb were found (0.005 and 0.012 µg/m^3, respectively) in $PM_{2.5}$, Which could leak to health impact in a long team expose.

Keywords: Air pollution, Elemental composition, Metals, Biomass burning

EPHI-P-09

EPHI-P-10

EPHI-P-11

EPHI-P-12

A study of urinary metabolomic profiles in COPD patients during smoke haze pollution in Northern Thailand

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Abstract

Thailand especially in the northern region has faced to smoke haze pollution from the opened biomass burning, which has affected people's health particularly patients with respiratory disease e.g. Chronic Obstructive Pulmonary Disease (COPD). This study aimed to investigate the metabolic change using a comparative study of urine metabolite profiles during smoke and non-smoke periods in COPD patients from Northern Thailand. This research was a case-control study which focused on the urinary metabolic changes in COPD patients (n=48) in Mae Chaem District, Chiang Mai Province in Thailand and their family- (n=41) and neighborhood-matched (n=18) controls. Personal PM2.5 and urine samples were collected from both groups at two point of times which were smoke episode (February-March 2017) and non-smoke episode (July-August 2017). The mean concentrations of PM2.5 in smoke season (mean±SD =190.1±86.75, case; mean±SD =226.8±146.57, control) were significantly higher than in non-smoke episode (mean±SD =46.53±41.10, case; mean±SD =41.21±2.705, control). Urinary metabolomics analysis using LC-MS/MS yielded 13,188 and 10,780 in positive mode and negative mode, respectively. Orthogonal Projections to Latent Structures Discriminant Analysis (OPLS-DA) models were built to distinguish metabolic profiles. The significant differences of urinary metabolic profiles from negative mode between the two diagnosis groups, case and controls, were found in both smoke and non-smoke episodes. After validation using VIP values and Chi-square test, the masses with significantly adjusted odd ratio (AOR) were identified using HMDB database. The results showed the unique difference in select metabolites, including D-glucose, 2,3,4,5-tetrahydroxypentanoic acid, picolinic acid, 8-hydroxyguanine etc., between cases and controls in smoke season. This study provides novel evidence to support the association between air pollutants exposure and metabolic disruption, and it contributes to understanding the COPD mechanism.

Keywords: Metabolomic, COPD, Smoke haze pollution, Northern Thailand

EPHI-P-13

The heavy metal concentrations in *Panicum repens L.* and in soil at solid municipal waste landfill site, Nakhon Si Thammarat

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Abstract

The heavy metal concentrations in *Panicum repens L.* and in soil at solid municipal waste landfill site, Nakhon Si Thammarat were studied to compare the heavy metals in flood and non-flood areas and to investigate heavy metal concentrations of *Panicum repens L.* in roots, stems and leaves. The soil and *Panicum repens L.* were collected from 12 stations by triplicate of each station .Soil samples were collected at the depth of 0-30 centimeters and the *Panicum repens L.* sample was collected at the same station of the soil sample .Heave metals in samples were extracted by nitric acid and determined by Inductively Couple Plasma-Optical Emission Spectrometer)ICP-OES(including chromium, lead, nickel and arsenic .Results showed that heavy metals in soil from flood areas were significantly higher than in non-flood areas. The orders of decreasing heavy metal concentrations in soil were lead, chromium, nickel and arsenic, respectively .For of the *Panicum repens L.* in flood zone, orders of decreasing were nickel, lead, chromium and arsenic, however, heavy metal concentrations in non-flood zone ordered of decreasing were nickel, lead, arsenic and chromium, respectively .To comparing heavy metals in difference organs of the *Panicum repens L.* in flood, it was found that concentrations of arsenic and nickel in leaves were higher that roots and stems, but lead and chromium concentrations in roots were higher than in leaves and stems .As the concentrations of heavy metals in *Panicum repens L.* were lower than in soils, it was classified as non potential plants for soil remediation.

Keywords: Heavy metal, Soil quality, *Panicum repens L*

EPHI-P-14

Population structure and diversity of marine Gastropods along the shoreline of a nickel mining site in Carrascal, Surigao Del Sur

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Abstract

Nickel is a trace metal widely distributed in the environment as a result of natural and anthropogenic processes. This metal is considered harmful when it enters the body since it will interfere with the metabolism of other essential metals which can suppress or interfere with its toxic and carcinogenic effects to the body. It is for this major reason that many people along the intertidal area of a nickel mining company in Carrascal, Surigao del Sur in Mindanao, the Philippines, are so concern about the harmful effects of mining nickel in the mountains along the coast. It is not only to their fishing livelihood but also to their health since they also utilize the resources of the coast for food. Added to this is the lack of proper disposal of the mining wastes that directly are dumped into the bay resulting in siltation and contamination of the bay. We investigated the status of the bay by looking into the communities of both economically and non-economically important gastropods as potential indicators of nickel pollution in the bay. The physicochemical conditions of the seawater along the coastline were measured and identified that includes temperature, pH, salinity, and dissolved oxygen (DO) including the amount of nickel in the silt where the gastropods were collected. Results showed low richness and diversity index in the gastropods. Low species richness and diversity were observed in all areas. While nickel amounts in silt vary from area to area, we cannot make a direct correlation with its effects on diversity as the areas are also being continuously exploited by coastal communities by collecting the gastropods for food and economic purposes. However, with the varying amounts of nickel in silt, more studies are needed for the monitoring of nickel in the meat of gastropods since this may or may not affect the health of the people who will be eating them.

Keywords: Marine gastropods, Nickel, multiple linear regression analysis, Carrascal

EPHI-P-15

Heavy metals in Thai honey

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Abstract

This study was to determine heavy metal contents in 57 Thai honey samples from different botanical origins and regions of Thailand using inductively coupled plasma-optical emission spectrometry)ICP-OES(. The results showed that the levels of arsenic (As), cadmium (Cd), chromium (Cr), nickel (Ni) and lead (Pb) in the honey samples were <0.006-0.075 mg/kg, <0.001-0.015 mg/kg, 0.009-0.489 mg/kg, 0.025-30.349 mg/kg and 0.005-0.215 mg/kg, respectively. The average Ni level was significantly higher than the levels of the other heavy metals in different honey sources ($p<0.05$). The Pb concentration in the longan honey from Chiang Mai Province was the only heavy metal that was significantly higher than the longan honey from Lamphun Province ($p<0.05$). The honey from the northern Thailand had significantly higher heavy metal contents than other regions ($p<0.05$). The levels of heavy metals in Thai honey were all below the Thai food containing contaminants standard, as well as the EU and Codex Alimentarius standards. The results can be concluded that the Thai honeys are as safe food for consumption.

Keywords: contamination, food, heavy metal, honey, Thailand

EPHI-P-16

Evaluation of eutrophication state of Mae Kuang Reservoir, Chiang Mai, Thailand by using Calson's Trophic State Index

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Abstract

Eutrophication is an enrichment of nutrient in water body, which cause a high growth rate of phytoplankton and deterioration of water quality. Calson's Trophic State Index (CTSI) is an index that can indicate the situation of eutrophication in lake ecosystems by using three parameters including total phosphorus, chlorophyll-a and water transparency by Secchi's disc. The values of CTSI range between from 0 – 100 are categorized as oligotrophic (0 – 40), mesotrophic (40 – 50), eutrophic (50 – 80) and highly eutrophic (80 – 100). Mae Kuang or Mae Kuang Udomthara Reservoir is a very important reservoir in the north of Thailand and used for irrigation, flood control, water supply, and fishery. In this study, the eutrophication state of Mae Kuang Reservoir was evaluated in June and Octobe 2017. The results showed that the reservoir has started to eutrophic. In June and October, the ranges of the CTSI were 49.26 – 59.60 and 49.07- 56.04, respectively, which indicated a low eutrophic state. However, in this eutrophic condition the range of the dissolved oxygen in this reservoir were 6.2 – 7.7 mg/L indicated that the quality of water was not bad, and the living organisms can also survive. Therefore, CTSI is an environmentally simple and alternative method for monitoring and estimating the status of eutrophic in the lake ecosystems.

Keywords: Calson's Trophic State Index; Eutrophication; Phosphate; Chlorophyll-a; Turbidity

EPHI-O-13

Nitrogen Dioxide Concentration and Health Risk Assessment in Tourist Attraction in Nakhon Si Thammarat, Thailand

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Abstract

Nitrogen dioxide (NO_2) is pollutants associated with transportation. It is emitted from internal combustion of vehicle. This gas causes inflammation of respiratory system and is precursor of ground level ozone and particulate matter, which are associated with adverse health effects. It is also a source of acid rain which damage ecological system. Kiriwong Village is one of the most visited attractions in Nakhon Si Thammarat where is the perfect eco-tourism destination. Almost 100,000 visitors have visited this area in a year. Traffic density has increasing especially on holiday as well as weekend which is related with the air pollutants emitted from traffic congestion. This study aims to measure concentration of nitrogen dioxide and its correlation with human activity and meteorological conditions, after that the pollutant concentration is applied to evaluate health risk of exposure to NO_2 for local residents including children and adult. Air sample were collected for 24 hours by using passive sampler at the 3 areas in the village on weekdays and weekends during September to November 2018 (rainy seasons). The result showed that NO_2 concentrations collected on weekday from all study areas were comparable at 26.31±2.08 µg/m^3 while the concentration on weekend were higher than the value on weekday for all areas. Moreover, a significant difference among study areas was presented on weekend. The highest concentration was observed at Kiriwong Bridge where was known as the gate to Kiriwong Village. Traffic congestion was always found in this area because the visitor short time parked to take photo. However, the concentrations were accepted for air quality standard. Traffic volume had more influence than meteorological conditions on concentration of NO_2 at Kiriwong Village. The toxicological risk quotients distinguished that the local residents at some area in the village exposure to NO_2 above the recommended limits to human health.

Keywords: Nitrogen dioxide, Monitoring, Tourist Attraction, Traffic

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