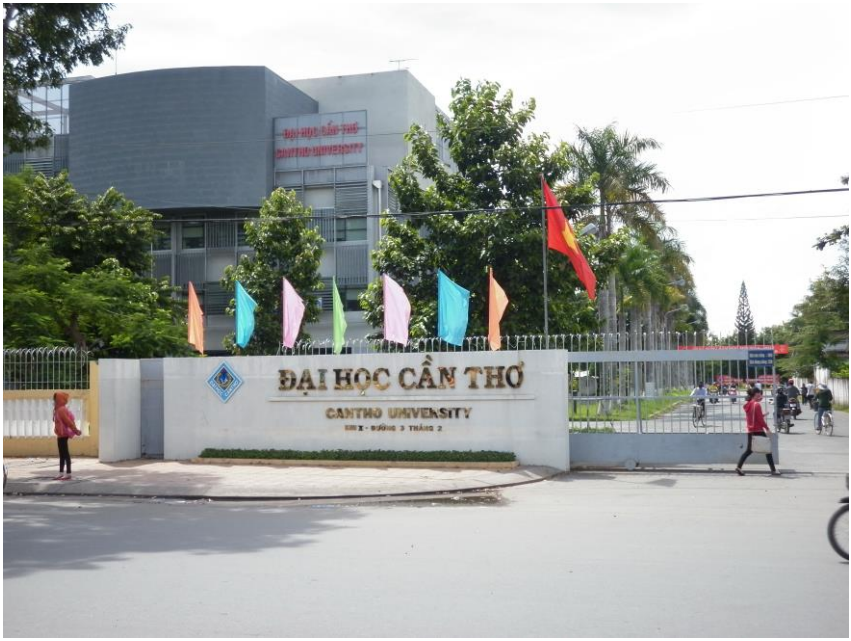
International Forum on Green Technology & Management 2021

GREEN PATHWAYS TOWARDS A SUSTAINABLE FUTURE

26th November 2021, Can Tho University, Can Tho city, Viet Nam

SELECTED ABSTRACTS



INTRODUCTION

The IFGTM-2021 was first announced in 30th May 2021. Totally 122 abstracts have been submitted to the conference. The conference committee has selected 36 abstracts for oral presentation at seven technical sections including (1) Application of filter materials for wastewater treatment, (2) Innovation technology in wastewater treatment, (3) Environmental modelling, (4) Land-use and sustainable development, (5) Plastic waste and environmental monitoring, (6) Air pollution; (7) Air pollution treatment technology.

Among 122 abstracts, 48 manuscripts were submitted for reviewing and 46 manuscripts were accepted for publishing at the *Vietnam Journal of Science and Technology (Special issue on "**Green Pathways toward Sustainable Future**").*

Participants from several countries including Germany, Korea, Japan, USA, Thailand and Viet Nam. They have been working for different Universities and Institutions around the world including Can Tho University, University of Thu Dau Mot, Hue University, Duy Tan University, Da Nang University, Nguyen Tat Thanh University, National University of Civil Engineering, Institute of Environmental Technology – Vietnam Academy of Science and Technology, Ho Chi Minh City University of Technology, Institute for Environment and Resources – HCM, VNU University of Science, Vietnam National University, Ho Chi Minh, Thuyloi University, Can Tho University of Medicine and Pharmacy, Hanoi University of Science and Technology, University of Science, Vietnam National University Ho Chi Minh City, University of Science, Vietnam National University, Hanoi, Ho Chi Minh city University of Natural Resources and Environment, Institute of Environmental Technology, Vietnam Academy of Science and Technology, Hanoi, University of Economics and Law, Ho Chi Minh City, Vietnam, KU Leuven (Germany), Hamburg University (Germany), University of Tuebingen (Germany), Nagasaki University (Japan), Sophia University (Japan), The University of Kitakyushu (Japan), Tokyo University of Agriculture and Technology (Japan), Mahasarakham University (Thailand), Hallym University (Korea), Bangladesh Agricultural University (Bangladesh), University of Hull (UK), University of Southampton (UK), University of Louisiana at Lafayette, Lafayette, Louisiana (USA).

The IFGTM 2021 is organized at Can Tho University and we would like to thank for your strong supports and collaboration that make the success of the IFGTM 2021.

CONFERENCE PROGRAM

The 11th International Forum on Green Technology and Management 2021:
GREEN PATHWAYS TOWARDS A SUSTAINABLE FUTURE

Date: November 26, 2021: Virtual Conference
Venue: Campus II, Can Tho University, 3/2 street, Can Tho City, Vietnam
Language: English
Organized by Can Tho University
Co-organized by the International Forum on Green Technology and Management 2021

A. OPENING REMARKS AND PLENARY SESSION

Time	Activity
	Chair: Prof. Vo Quang Minh, *Can Tho University* **Co-chair: Assoc. Prof. Vo Le Phu, *Ho Chi Minh University of Technology*** **Zoom link:** **https://zoom.us/j/92839740882?pwd=bDBWKzBGYVU3bFAvQVgvMzN4a3ZZUT09** **Meeting ID: 928 3974 0882 Passcode: 261121**
7:00-7:45	Registration
7:45-8:00	Introduction Dr. Phan Kieu Diem, *Can Tho University*
8:00-8:10	Welcome speech by Vice Rector of Can Tho University Prof. Tran Ngoc Hai, *Can Tho University*
8:10-8:20	Welcome speech by Chairman of IFGTM consortium Prof. Huynh Trung Hai, *Ha Noi University of Science and Technology*
8:20-8:40	Mekong delta: its importance, vulnerabilities and possibilities Dr. Atshusi Ishimatsu, Emeritus Professor, *JICA Can Tho University project*
8:40-9:00	Biomass blending and densification to enhance energy properties of perennial grasses and agricultural residues Dr. Wichitra Singhirunnusorn, Director of Multidisciplinary Research Center for Environmental Sustainability, *Mahasarakham University, Thailand*
9:00-9:05	Wrap-up session Prof. Vo Quang Minh
9:05-9:10	Online meeting photos and parallel sessions instruction Dr. Phan Kieu Diem

B. PARALLEL SESSIONS

Session 1: Application of filter materials for wastewater treatment **Chair: Prof. Trinh Van Tuyen, *Viet Nam Academy of Science and Technology*** **Co-Chair: Assoc. Prof. Hoang Cong Tin, *Hue University of Science***	**Session 2: Innovative technology in wastewater treatment** **Chair: Assoc. Prof. Tran Van Quang, *Da Nang University*** **Co-Chair: Dr. Pham Thi Thuy, *Ha Noi University of Natural Sciences***
Session 3: Environmental modelling **Chair: Assoc. Prof. Nguyen Manh Khai, *Ha Noi University of Natural Sciences*** **Co-Chair: Assoc. Prof. Van Pham Dang Tri – *Can Tho University***	**Session 4: Land-use and sustainable development** **Chair: Dr. Nigel Downes, *Can Tho University and GIZ*** **Co-Chair: Dr. Dao Minh Trung, *University of Thu Dau Mot***
Session 5: Plastic waste and environmental monitoring **Chair: Assoc. Prof. Tran Thi Viet Nga, *National University of Civil Engineering*** **Co-Chair: Dr. Tran Sy Nam, *Can Tho University***	**Session 6: Air pollution** **Chair: Assoc. Prof. To Thi Hien, *Ho Chi Minh University of Science*** **Co-Chair: Dr. Thai Phuong Vu, *Ho Chi Minh city University of Natural Resources and Environment***
Session 7: Air pollution treatment technology **Chair: Assoc. Prof. Tran Thi Hien Hoa, *National University of Civil Engineering*** **Co-Chair: Dr. Nguyen Thanh Giao, *Duy Tan University***	

SESSION 1: APPLICATION OF FILTER MATERIALS FOR WASTEWATER TREATMENT

Time	Presentation
	Chair: Prof. Trinh Van Tuyen, ***Viet Nam Academy of Science and Technology*** **Co-Chair: Assoc. Prof. Hoang Cong Tin,** ***Hue University of Science*** **Zoom link:** **https://zoom.us/j/92839740882?pwd=bDBWKzBGYVU3bFAvQVgvMzN4a3ZZUT09** **Meeting ID: 928 3974 0882 Passcode: 261121**
9:15-9:35	Experiment on water filter material production from clay and rice husk Presenter: MSc. Nguyen Trung Hiep, *Ho Chi Minh City University of Natural Resources and Environment*
9:35-9:55	Removal of the antibiotic sulfamethoxazole from water by biobed system Presenter: Dr. Tran Van Son, *Faculty of Environmental Sciences, University of Science, Vietnam National University*
9:55-10:15	Recovery of N and P from piggery wastewater by activated carbon produced from agricultural waste Presenter: Dr. Le Thi Hoang Oanh, *University of Science, Vietnam National University*
10:15-10:35	Study on recycle of granulated blast-furnace slag as an adsorbent for ammonium remediation in wastewater Presenter: Dr. Trinh Minh Viet, *Institute of Environmental Technology, Vietnam Academy of Science and Technology*
10:35-10:55	Photocatalytic degradation of Enrofloxacin by TiO_2 and Bi_2Se_3/TiO_2 nanomaterials Presenter: Assoc. Prof. Le Huu Phuoc, *Faculty of Basic Sciences, Can Tho University of Medicine and Pharmacy*
10:55-11:00	Wrap-up session Prof. Trinh Van Tuyen

SESSION 2: INNOVATIVE TECHNOLOGY IN WASTEWATER TREATMENT

Time	Presentation
	Chair: Assoc. Prof. Tran Van Quang, *Da Nang University* **Co-Chair: Assoc. Prof. Pham Thi Thuy, *Ha Noi University of Natural Sciences*** **Zoom link:** **https://us06web.zoom.us/j/4658042537?pwd=SGoxRFN6VFg1Qm13OXkwZkxYeXJ3Zz09** **Meeting ID: 465 804 2537 Passcode: 261121**
9:15-9:35	Effects of calcium nitrate and iron (III) chloride on the improvement of urban lake water quality Presenter: Dr. Bui Thi Thuy, *Thuyloi University, Vietnam*
9:35-9:55	Modification of agricultural-waste-based activated carbons for removal/recovery of phosphate from domestic wastewater Presenter: Dr. Pham Tien Duc, *Chemical Engineering Department, Faculty of Engineering Science, KU Leuven*
9:55-10:15	Study on characteristics, heavy metals pollution in industrial sludges and using effective extraction method to recover heavy metals from sludges Presenter: Dr. Nguyen Thuy Chung, *School of Environmental Science and Technology, Hanoi University of Science and Technology*
10:15-10:35	Water management for sustainable fisheries: Bangladesh perspective Author: Prof. Mst. Kaniz Fatema, *Bangladesh Agricultural University*
10:35-10:40	Wrap-up session Assoc. Prof. Tran Van Quang

SESSION 3: ENVIRONMENTAL MODELLING

Time	Presentation
	Chair: Assoc. Prof. Nguyen Manh Khai, ***Ha Noi University of Natural Sciences*** **Co-Chair: Assoc. Prof. Van Pham Dang Tri,** ***Can Tho University*** **Zoom link:** **https://us06web.zoom.us/j/6413143476?pwd=TWs3enhGS2RseWVIRUNnenhYcFJadz09** **Meeting ID: 641 314 3476 Passcode: 261121**
9:15-9:35	Use a mathematical model to simulate the nutrients (N, P) in water and sludge of catfish (*Pangasianodon Hypophthalmus*) ponds in Vietnam Presenter: Mr. Le Xuan Thinh, *School of Environmental Science and Technology, Hanoi University of Science and Technology*
9:35-9:55	Linking of Land Subsidence and Groundwater Level Decline in Mekong Delta: A Review Presenter: Dr. Ha Quang Khai, *Ho Chi Minh City University of Technology*
9:55-10:15	Assessment ground ozone (O_3) impacts on agricultural crop yields in the Mekong Delta, Vietnam Presenter: Mr. Nguyen Hoang Phong, *Ho Chi Minh City University of Technology*
10:15-10:35	Assessing Social Vulnerability to Riverbank Erosion in Main Streams of the Vietnamese Mekong Delta Presenter: Mr. Phan Ky Trung, *College of Environment and Natural Resources, Can Tho University*
10:35-10:55	The seasonal groundwater salinity and its use in the coastal Vietnamese Mekong Delta Presenter: Mrs. Duong Quynh Thanh, *College of Environment and Natural Resources, Can Tho University*
10:55-11:15	Enhancing Quality of Life through Sustainable Urban Transformation in Cambodia: Introduction to the Build4People Project Presenter: Dr. Michael Waibel, *Center for Earth System Research and Sustainability, Hamburg University, Germany*
11:15-11:35	Prediction of groundwater arsenic level based on a superior regression model Author: Prof. Nabendu Pal, *University of Louisiana at Lafayette, USA*
11:35-11:40	Wrap-up session Assoc. Prof. Nguyen Manh Khai

SESSION 4: LAND-USE AND SUSTAINABLE DEVELOPMENT

Time	Presentation
	Chair: Dr. Nigel Downes, *Can Tho University and GIZ* **Co-Chair: Dr. Dao Minh Trung, *University of Thu Dau Mot*** **Zoom link:** **https://us06web.zoom.us/j/9603620686?pwd=RW9jQ1lFMVdMOWRCWDNNVitnRW9Zdz09** **Meeting ID: 960 362 0686 Passcode: 261121**
9:15-9:35	Assessment of rooftop solar power potential in commercial and industrial sector: some reference cases in Da Nang city Presenter: Assoc. Prof. Tran Anh Tuan, *University of Sciences, Hue University*
9:35-9:55	Developing solution roadmaps for rice production in flooding area of the Vietnamese Mekong Delta adapting to uncertain changes in climate and surface water resources Presenter: Mr. Hong Minh Hoang, *Mekong Delta Development Research Institute, Can Tho University*
9:55-10:15	Anthropogenic threats to geosites of south-central coast, Vietnam Presenter: PhD student. Hoang Thi Phuong Chi, *University of Science, Vietnam National University Ho Chi Minh City*
10:15-10:35	Relationship of urban heat with building density and green spaces - a remote sensing-based study across Vietnam's metropolitan areas Presenter: Dr. Andreas Braun, *Institute of Geography, University of Tuebingen, Germany*
10:35-10:55	Users' perspectives for sustainable transformation pathways of Vietnam's building sector Presenter: Dr. Nguyen Thi Thu Thuy, *Center for Earth System Research and Sustainability, Hamburg University, Germany*
10:55-11:15	Blue Dragon programme; preparing for the next step Presenter: Dr. Tjeerd Dijkstra, *Blue Dragon, Can Tho University, Vietnam*
11:15-11:20	Wrap-up session Dr. Nigel Downes

SESSION 5: PLASTIC WASTE AND ENVIRONMENTAL MONITORING

Time	Presentation
	Chair: Assoc. Prof. Tran Thi Viet Nga *National University of Civil Engineering* **Co-Chair: Dr. Tran Sy Nam, *Can Tho University*** **Zoom link:** **https://us06web.zoom.us/j/82218299781?pwd=RS9lcnJQcGNKeGZpMTl3Z2o2aDFZUT09** **Meeting ID: 822 1829 9781 Passcode: 261121**
9:15-9:35	Distribution of micro-plastic in wastewater and sludge from the plants producing recycled plastic – seeds Presenter: Assoc. Prof. Nguyen Thi Van Ha, *Ho Chi Minh city University of Natural Resources and Environment*
9:35-9:55	Abundance and characteristics of microplastics in surface water of Can Gio sea Presenter: MSc. Nguyen Thi Thanh Nhon, *University of Science, Vietnam National University Ho Chi Minh City*
9:55-10:15	Status of lead contamination in soil at Dong Mai handicraft village, Van Lam district, Hung Yen province Author: Assoc. Prof. Nguyen Thi Ha, *University of Science, Vietnam National University, Hanoi*
10:15-10:35	Artificial breeding and larval rearing techniques of ayu (*Plecoglossus altivelis*) with the purpose of conservation Presenter: Dr. Ha Manh Linh, *Nagasaki University, Japan*
10:35-10:55	Sustainable consumption through mindful lifestyle to reduce plastic waste Presenter: Dr. Tran Thi Minh Hang, *University of Science, Vietnam National University*
10:55-11:00	Wrap-up session Assoc. Prof. Tran Thi Viet Nga

SESSION 6: AIR POLLUTION

Time	Presentation
	Chair: Assoc. Prof. To Thi Hien, *Ho Chi Minh University of Science* **Co-Chair: Dr. Thai Phuong Vu, Ho Chi Minh city University of Natural Resources and Environment** **Zoom link:** **https://us06web.zoom.us/j/2690296272?pwd=WWlrTFhJeFFpaldxNkNDR0JZM1ladz09** **Meeting ID: 269 029 6272 Passcode: 261121**
9:15-9:35	The first investigation on characteristics and sources of organic and elemental carbon in $PM_{2.5}$ in Ho Chi Minh City, Vietnam Presenter: Assoc. Prof. To Thi Hien, *University of Science Vietnam National University Ho Chi Minh City*
9:35-9:55	Emission fine particulate matter $PM_{2.5}$ from cooking activities Presenter: Mr. Pham Quoc Kiet, *University of Science, Vietnam National University Ho Chi Minh City*
9:55-10:15	Concentrations of $PM_{0.1}$ and $PM_{2.5}$ at high polluting event days in Hanoi and the effects of meteorological conditions Presenter: Dr. Ly Bich Thuy, *School of Environmental Science and Technology, Hanoi University of Science and Technology*
10:15-10:35	The effect of incense burning on indoor PM_{10} and $PM_{2.5}$ under ventilation conditions Presenter: MSc. Duong Cong Thinh, *Ton Duc Thang University*
10:35-10:55	Study on the outdoor microbiological contamination at some crowded public places in Ho Chi Minh city Presenter: MSc. Dang Diep Yen Nga, *University of Science, Vietnam National University Ho Chi Minh City*
10:55-11:00	Wrap-up session Assoc. Prof. To Thi Hien

SESSION 7: AIR POLLUTION TREATMENT TECHNOLOGY

	Chair: Assoc. Prof. Tran Thi Hien Hoa, *National University of Civil Engineering* **Co-Chair: Dr. Nguyen Thanh Giao, *Can Tho University*** **Zoom link:** **https://us06web.zoom.us/j/7261779407?pwd=YjQrZjE1QkYrQUF2Mk9aTFRVMTN4UT09** **Meeitng ID: 726 177 9407 Passcode: 261121**
9:15-9:35	Capture and removal of pathogens and $PM_{2.5}$ fine dust using copper nanoparticles coated fiber filter for air treatment Presenter: Ms. Eunsil Kang, *Hallym University, Korea*
9:35-9:55	Innovative application of melamine sponge with a copper-organic framework (Cu-CPP) as a multi-functional filter in air purifiers Presenter: Dr. Le Thi Cam Van, *Hallym University, Korea*
9:55-10:15	The effect of catalyst calcination temperature on catalytic decomposition of waste HFC-134a over γ-Al_2O_3 Author: Mr. Mahsab Sheraz, *Hallym University, Korea*
10:15-10:35	A preliminary investigation of pharmaceuticals and personal care products occurrence in atmospheric particulate matter in Hanoi, Vietnam Presenter: Dr. Nguyen Hai Doan, *Sophia University, Japan*
10:35-10:40	Wrap-up session Assoc. Prof. Tran Thi Hien Hoa

C. CLOSING & ANNOUNCING IFGTM 2022

Time	Activity
	Chair: Prof. Huynh Trung Hai, *Ha Noi University of Science and Technology* **Co-Chair: Assoc. Prof. Nguyen Van Cong, *Can Tho University*** **Zoom link:** **https://zoom.us/j/92839740882?pwd=bDBWKzBGYVU3bFAvQVgvMzN4a3ZZUT09** **Meeting ID: 928 3974 0882 Passcode: 261121**
11:40-11:50	Presentations Awards Prof. Huynh Trung Hai, *Ha Noi University of Science and Technology*
11:50-12:00	Announcement for IFGTM2022 Prof. Trinh Van Tuyen, *Viet Nam Academy of Science and Technology*
12:00 -12:10	Closing remarks Assoc. Prof. Nguyen Van Cong, *Can Tho University*

In the event of difficulties, please contact Dr. Nguyen Xuan Loc (+84 918.889.024), Mr. Phan Hoang Vu (+84 944.129.127), Mr. Ly Van Loi (+84 902.870.964) or Mr. Cao Thanh Tuan (+84 774.881.969) for Zoom technical assistance.

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OPENING REMARKS AND PLENARY SESSION

Welcome Speech by The Vice Rector of Can Tho University

Distinguished guests, scientists, ladies and gentlemen, participants joining from around the world:

First of all, on behalf of Can Tho University, it is my great pleasure to welcome you to the 11th International Forum on Green Technology and Management (IFGTM) consortium entitled "Green pathways towards a sustainable future", organized by Can Tho University, Vietnam.

At present, we are tackling many challenges such as climate change, energy access, environmental degradation, sanitation and water availability. Such global problems pose major socioeconomic, technical and environmental challenges to mankind. Achieving inclusive development and the sustainable development goals requires creative and innovative green approaches or pathways. Here science and technology must lead the charge, transitioning development towards a green, circular, sustainable, inclusive, future. All that we do must be nature-based and cantered around people, for they are the actors and drivers of sustainable development, in order to leave no one behind.

The IFGTM 2021 brings together scientists from a wide range of disciplines to develop collaborative approaches to better understand changes and respond to them. The IFGTM 2021 addresses the current and future challenges for sustainable development such as water and air pollution, the inappropriate land use, and the improper disposal of waste into the environment.

The results and solutions presented today aim to provide innovative and practical solutions and applied green technologies which can be formulated, transferred, and replicated to other parts of the world. This strengthens our global network and knowledge exchange and helps us all gain a better understanding of new opportunities that exist. At the conclusion of the conference, take-home messages will be provided, which will serve as useful references for our important choices in terms of improved natural resource management, environmental protection, climate change adaptation and mitigation towards a sustainable future.

Ladies and gentlemen, Can Tho University is widely recognized as the premier university in the Mekong Delta. Promoting our Delta's sustainable growth and

development under the threat of global challenges is one of the main concerns of our University. We understand that the global challenges are trans-national in nature and trans-institutional in solution. They cannot be addressed by any one government or institution acting alone. They require collaborative action among governments, international organizations, corporations, universities, NGOs, and creative individuals. Therefore, our ambitious aim is to broadly collaborate with both national and international universities and research institutions to work and advance together on the urgent and large-scale problems of our time, such as climate change, environmental changes or the risks related to global health to achieve the long-term sustainable development of the Delta. We look forward to advancing cooperation with our national and international partners towards sustainable development.

On this occasion, I would like to introduce the Sustainable Development of the Mekong Delta (SDMD2045) platform, which was recently established with the collaboration of Can Tho University, the Delta provinces, and various national and international partners ranging from research institutes and universities, to industry, business, and local communities.

Once again, we are at a key moment in the evolution of our global approach to the challenges of development, environment and the transition to green pathways for a sustainable development scenario. Our university is continuing to make every effort to advance scientific knowledge and dialogue, particularly in the fields presented today, to key stakeholders in order to transform scientific results into recommendations and actions that will contribute to the sustainable development of our Delta.

Finally, thank you all very much for your great efforts to participate today in our virtual conference to ensure its success. I sincerely believe the conference will be successful, both scientifically and bring great collaborations and contributions towards sustainable development.

We wish all our distinguished guests, scientists, and colleagues good health, luck, and success.

Best wishes for a successful conference!

Thank you.

Mekong Delta: Its Importance, Vulnerabilities, and Possibilities

Atsushi Ishimatsu

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Abstract

The Mekong Delta is notable in many ways. It is extremely rich in fauna and flora, produces a tremendous amount of food for humans, but is highly vulnerable to impacts of anthropogenic environmental changes including climate change. This presentation will give a brief introduction of the uniqueness of the Mekong Delta, its importance in biodiversity and food production, selected topics of its environmental concern, and an initiative that Can Tho University has recently set out for the sustainable development of the region.

[Uniqueness]
The Mekong Delta is unique among world deltas because of its huge area (40,600 km^2) supplied by the two main channels of the Mekong River. The land is surprisingly flat such that the area lower than 2 m above sea level accounts for 50% of the total area (20,900 km^2), which is far larger than the areas < 2 m height in any other river deltas of the world (Syvitski et al. 2009). In fact, a recent estimate indicated that the Mekong Delta may be much lower than previously estimated (Minderhoud et al. 2019). Geological studies have revealed that ca. 6000 years ago, the coastal line lay near the present-day border to Cambodia (200 km from today's coastline), after which the delta rapidly developed to form the present landscape (Nguyen et al. 2000).

[Importance]
The Mekong Delta has been remarkably fertile due to rich supply of water, nutrients, and sediments by the Mekong River. Consequently, it nurtures myriads of animal and plant species. More than one thousand new species have been discovered in the Mekong Delta between 1997 and 2009 (VIETJO 2009), which is roughly 50% of the species newly found between 1994 and 2014 in the greater Mekong Region (World Wildlife Fund 2021). As being of a low-lying, water dominated landscape, aquatic fauna is rich in the Mekong Delta, among which air-breathing fish are particularly diverse and abundant. The large delta is hypothesized as the site of vertebrate transition from water to land in the

Paleozoic age (Ahlberg 2019), and accordingly, the Mekong Delta is of special interest to evolutionary scientists. For example, (Mai et al. 2019) reported the distribution of an amphibious oxudercine goby, *Periophthalmodon septemradiatus*, up to 150 km from the coast. Further investigation of this fish could contribute to better understanding of the terrestrialization process of vertebrates.

The Mekong Delta has been the central site of both aquaculture and agriculture production in Vietnam. Approximately 70% of national fish production and 80% of shrimp production are from the Mekong Delta (Aquaculture Vietnam 2021). Shrimps *Litopenaeus vannamei* and *Panaeus monodon* are the major aquaculture products from the delta, with total export value of 3.85 billion USD in 2020 (Ministry of Agriculture and Rural Development 2021) and with main export markets including US, EU countries and Japan. The striped catfish, *Pangasianodon hypophthalmus*, the major aquaculture fish in this region, is exported to more than 140 countries, gaining turnover of 1.54 billion USD in 2020. The catfish yield amounts to 200-400 tons/ha/crop (De Silva and Phuong 2011), hyper-intensive based on the criteria of the Food and Agriculture Organization. Capture fisheries are also important in the Mekong Delta, amounting to 40% of the national production in 2013. About agricultural production, the Mekong Delta produces 55%, 60% and 30% of rice, fruit, and vegetables in Vietnam (Foreign Agricultural Service 2020; Uiterwijk and Vu 2017). The rice output in Vietnam ranks fifth in global production.

[Vulnerabilities]
Because of changes in the local environment due to food production and other human activities in the region as well as global changes in the climate and other environmental conditions, the Mekong Delta is facing a number of environmental problems. First, because of the extremely flat topography, the Mekong Delta is expected to be severely affected by seawater inundation as a combined consequence of sea level rise and land subsidence. A report by the Ministry of Natural Resources and Environment demonstrated that when sea level rose by 100 cm, a large part of the western part of the Delta would be submerged, e.g., Kien Giang (inundation percentage 77%), Can Mau (58%), Hau Giang (82%), Bac Lieu (49%) and Soc Trang (54%) Provinces, with lesser extents of submersion (20-30%) projected for the eastern provinces, Ministry of Natural Resources and Environment 2016). Although a 100-m rise in sea level is unlikely to occur even in the worst-case scenario of global warming by the end of the century, the recent estimate of the Mekong Delta altitude, which is substantially lower than previously reported (Minderhoud et al. 2019), warns that precautious monitoring is mandatory for the safeguard of the local society and industry. Mangrove forest functions as a protection of the coastal areas, infrastructure, and society from erosion, storms, high waves and other extreme weather. The rapid development of coastal shrimp aquaculture in the Mekong Delta

has diminished the mangrove forests and is thereby deteriorating ecosystem functions of the mangrove forests (Son et al. 2015).

A negative impact of the two food production industries, aquaculture and agriculture, is pollution by chemicals used to control and protect cultured animals and plants. Vietnam is ranked one of the top users of antibiotics in the world (Lulijwa et al. 2019), which has resulted in frequent rejection of Vietnamese seafood by importing countries such as the US, EU, and Japan (Nguyen et al. 2017). Antibiotics have been detected in the culture environment, sediments and farmed animal tissues, with the consequences of human, wildlife and environmental health (Lulijwa et al. 2019). A nonprofit organization in US recommended to "avoid" Vietnamese *P. hypophthalmus*, unless the fish is certified, due to concern about chemical contamination (in particular antibiotics) and negative impact of effluent, mainly sludge discharge, on the environment (Monterey Bay Aquarium Seafood Watch 2021).

Another emerging environmental issue is contamination by plastic litter on land and in water. A recent study indicated that the Mekong River is one of the major rivers that discharge a huge number of plastic debris into the ocean (Lebreton et al. 2017). To the best of my knowledge, impact of plastic debris on mangrove ecosystem has been little studied and needs urgent investigation. Vietnam government is aware of the seriousness of these environmental issues, and enforced several resolutions and decisions, specifically targeting the Mekong Delta (Resolution 120 and others).

[A way forward]
Can Tho University (CTU) set forward a framework, called SDMD Outlook 2045, to battle these issues. SDMD stands for Sustainable Development of Mekong Delta, and the 2045 is the year by which the country strives to become a developed country, and it is 100 years after the country declared independence. SDMD 2045 aims to organize a forum for collaboration with provinces, private sectors, and communities of the Mekong Delta, implement programs and projects with them, and establish an information and data exploration center to better utilize the existing and planned data sources throughout the Mekong Delta. Several preliminary activities have been already started, to which Japan International Collaboration Agency, JICA, has been intimately involved. CTU wishes that SDMD 2045 will be a model framework with which academia, governments, industries and communities collaborate to maintain environmental health and attain sustainable development. CTU cordially invites interested attendants of IFGTM2021 to join SDMD 2045.

Biomass Blending and Densification to Enhance Energy Properties of Perennial Grasses and Agricultural Residues

Wichitra Singhirunnusorn

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Utilizing perennial grasses and agricultural residues as feedstock for bio-power plants has gained more attention due to the rising costs of current biomass materials and their seasonal availability. Despite its energy content and yield, perennial grasses and crop residues have some disadvantages such as lower in density and durability. Nevertheless, the improvement of energy density and fuel efficiency can be achieved through the biomass densification approach.
The densification process of both briquette and pellet can enhance the physical properties of grass biomass, in particular energy density, which provides the advantages of heat production and electricity generation over the commonly used biomass fuel. However, the use of such a biomass, particularly agricultural residue is also limited because of the different properties and characteristics, limited availability, and seasonal variation. Producing biofuel from a single-type biomass has problems regarding material shortages, unstable quality, and high storage costs. Therefore, the blending scheme of biomasses can reduce these limitations and improve the energy efficiency of the materials.

Keywords: *biomass blending; densification, energy density, perennial grasses, and agricultural residues*

SESSION 1: APPLICATION OF FILTER MATERIALS FOR WASTEWATER TREATMENT

Experiment on Water Filter Material Production from Clay and Rice Husk

Thai Phuong Vu[1,*], Huynh Ke Toan[2], Nguyen Trung Hiep[1], Nguyen Tan Thong[1]

[1] *Institute of Sustainable Development and Research, Hochiminh City University of Natural Resources and Environment, Vietnam*
[2] *Faculty of Environment and Labour Safety, Ton Duc Thang University* and Kien Giang Water Supply and Drainage Company Limited, *Vietnam.*
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Abstract

This research was conducted to produce a raw water filter material with the main components of clay and rice husk. The rice husk and clay were mixed with ratios following as 0:1 (M1-reference), 1:1 (M2), 1:2 (M3), and 1:4 (M4). The mixed material size (L:W:H) of 2.0 x 1.0 x 0.5 cm were dry at 30 - 40^{0}C within 48 hours. This material was burned by 2 phases at 450-600^{0}C (15 min), then continue to be burned at 885^{0}C (60 min). Cooling time after burning was 3 hours. Results of material morphology (SEM) showed that M1 morphology was not defined and no pore. The M2, M3, M4 were many pores depended on mixed ratios between rice husk and clay. M2 had many big pores (>10 µm) which was not good as water filter application. M4 had many small and homogenous pores (1-2 µm) which were very good for water filter application. Experimental results using BET equation of Nitrogen 77.3k showed that M1. M2, M3, M4 surface areas were 33.97, 36.94, 39.65, 47.62 cm^2/g and capillary were 0.025, 0.029, 0.033, 0.043 cm^3/g, respectively. This presented that M4 material was the best for rural water quality improvement application.

Keywords: *clay, rice husk, porosity, surface area, water filter material*

Removal of the Antibiotic Sulfamethoxazole from Water by Biobed System

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Abstract

The antibiotic sulfamethoxazole (SMX) frequently presents in water environment and can cause negative impacts to aquatic ecosystems and human health. Biobeds are biofilter systems that have been widely applied for treatment of pesticides, however little is known about the potential of biobeds in antibiotic removal. In the present study, the biobed system was used for eliminating SMX from water (initial concentration of 5 ppm). The biobed (height: 100 cm, diameter: 20 cm) comprised of a rice straw layer and a biomixture layer containing eggshell, rice straw and coconut fiber; acvitated carbon, sand and gravel were used as support media. Materials in the biomixture layer were characterized by Fourier-transform infrared spectroscopy (FTIR), X-ray Diffraction and X-ray fluorescence technique. The culture-dependent approach was applied to determine bacterial population being tolerant to SMX in the biomixture. The results showed that after 20 and 165 experimental days, the SMX treatment efficiency was 74.29% and 85.95%, respectively. The FTIR analysis confirmed the presence of the S=O group in the biomixture. The number of bacteria growing in SMX-nutrient medium was 64.7 x 10^5 CFU/g. The findings highlight the efficient treatment of SMX and suggest the potential applications of biobed systems in antiobiotic removal in the future.

Keywords: *antibiotic, biobed, sulfamethoxazole, treatment*

Recovery of N and P from Piggery Wastewater by Activated Carbon Produced from Agricultural Waste

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Abstract

Piggery wastewater contains high content of N and P, which are the primary cause of surface water eutrophication. Removal of N and P are less superior to recovery of them as important nutrients for crops. This study assessed activated carbons (ACs) produced from coconut pitch and peanut shell in recovery of N and P from piggery wastewater. The ACs were produced by impregnation method using $CaCl_2$ 6M. Material analysis showed significant increase in surface charge of ACs. The optimal adsorption conditions were dependent on ionic species (PO_3^-, NO_3^-, and NH_4^+), as well as type of agricultural waste; and less dependent on AC production methods (non-impregnation, pre-impregnation, and post-impregnation). The saturated adsorption times were longer for ACs produced from coconut pitch in case of PO_3^- and NO_3^- ions; and shortest for NO_3^- with 4-5 hours. Optimal pH for adsorption were 9, 4 and around 7 in the order of ions, respectively. Corresponding maximum adsorption efficiencies were more than 90% and 80% for PO_3^- and NO_3^-, and around 10% for NH_4^+; whereas adsorption capacity was highest for NH_4^+. The results exhibited a promising application of ACs from agricultural waste for N and P recovery from piggery wastewater.

Keywords: *pigery wastewater, N and P adsorption, activated carbon, peanut shell, coconut pitch*

Study on Recycle of Granulated Blast-Furnace Slag as an Adsorbent for Ammonium Remediation in Wastewater

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Abstract

Blast-furnace slag (BFS) is enormously generated each year and has been considered as hazardous solid waste which is posing a significant pressure on waste treatment in term of storage and transportation. This study aims to recycle BFS as a material for ammonium adsorption from aqueous solution. Natural-state BFS and acidic-modified by using HNO_3 at various concentration of 0.5M, 1M, and 3M (A-BFS1, A-BFS2, and A-BFS3) was examined. The surface characteristics of the materials were determined by BET analysis and Scanning Electron Microscope. The adsorption of ammonium on the BFS materials was conducted in batch mode at various condition of contact time, pH level, adsorbent dosage, and initial concentration of ammonium. The results indicated that the HNO_3 modification exhibited pore creations and surface enhancement as the A-BFS3 has 25.7 times larger in surface area and 10.3 times pore size improvement. The A-BFS3 showed good ammonium adsorption capacity among others, which is 1.81 mg/g at the optimum conditions of pH 6, contact time of 120 min, and dosage of 0.5 g in 50 mL of 20 mg/L ammonium solution. Langmuir and Freundlich adsorption isotherm models of the A-BFS3 material showed a relatively good correlation with R^2 values of 0.999 and 0.9625, respectively.

Keywords: *blast-furnace slags, adsorption, ammonium, wastewater, acidic modification.*

Photocatalytic Degradation of Enrofloxacin by Tio_2 and Bi_2se_3/Tio_2 Nanomaterials

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Abstract

Antibiotic residues in aquaculture wastewater are considered as an emerging environmental problem. To degrade antibiotic residues in aqueous environment, we fabricated TiO_2 nanotube arrays (TNAs), Bi_2Se_3 nanoparticle (NP)-decorated-TNAs, which were applied for assessing the photocatalytic degradation of enrofloxacin. The TNAs was synthesized by anodization using an aqueous NH_4F/ethylene glycol solution. Bi_2Se_3 NPs were synthesized by plasma- assisted exfoliation method, and used to decorate on TNAs. The photocatalytic performance of TNAs and Bi_2Se_3/TNAs was studied by monitoring the degradation of enrofloxacin under ultraviolet (UV)-visible (Vis) illumination by LC-MS/MS method. All the TiO_2 nanostructures exhibited anatase phase and well-defined structure of nanotube arrays. The TNAs and Bi_2Se_3/TNAs nanomaterials degraded effectively and rapidly enrofloxacin with initial concentration 500 µg/L. In addition, the enrofloxacin removal percentages of TNAs and Bi_2Se_3/TNAs were 94.4% and 100% after 20 min treatment under UV-VIS irradiation (120 $mW \cdot cm^{-2}$), respectively. Moreover, the reaction rate constant of Bi_2Se_3/TNAs was higher than that of TNAs (0.263 min^{-1} vs. 0.157 min^{-1}), which could be attributed to the localized surface plasmon resonance effect of Bi_2Se_3 NPs and the enhanced charge separation effect occurring in the hydrid Bi_2Se_3/TNAs system. Briefly, TNAs and Bi_2Se_3/TNAs were synthesized successfully and possessed high-performance in photocatalytic degradation of a representative antibiotic of enrofloxacin.

Keywords: *TiO_2 nanotube arrays, Bi_2Se_3, enrofloxacin, photocatalysts, LC-MS/MS.*

SESSION 2: INNOVATIVE TECHNOLOGY IN WASTEWATER TREATMENT

Effects of Calcium Nitrate and Iron (III) Chloride on the Improvement of Urban Lake Water Quality

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Abstract

This study aimed to demonstrate the improvement of the lake water quality (i.e. total suspended solid (TSS), turbidity, chemical oxygen demand (COD) and algal reduction) by using the combination of calcium nitrate ($Ca(NO_3)_2$) and ferric chloride ($FeCl_3$) under the addition of copper sulfate $CuSO_4$ 4%, with respect to the effects of the $Ca(NO_3)_2/FeCl_3$ ratio, treatment time, and mixing regime. Samples were collected from Trieu Khuc Lake and all experiments were conducted in the lab scale. Overall, the greatest performance was obtained at the incomplete mixing regime in the injection of $Ca(NO_3)_2/FeCl_3$ ratio of 1:1 (v/v) and the treatment time of 3 hours; with removal efficiencies of TSS, turbidity, COD, and algal reduction of approximately 77%, 82%, 85%, and 56%, respectively. The addition of $CuSO_4$ of 4 mg/L played a major role in algal reduction via pH shifting. The flocs creation from the pollutants and the positively charged species via the dissolution of $Ca(NO_3)_2$ and $FeCl_3$ in the water and denitrification mechanism were found to be fundamental for enhancing treatment performance. The results from this study confirm that the use of $Ca(NO_3)_2$ and $FeCl_3$ under the addition of $CuSO_4$ of 4 mg/L would be a reliable tool for pollutants reduction, looking forward to control of the urban lake water quality.

Keywords: *Algal reduction, denitrification, flocculation, urban lake, water quality.*

Modification of Agricultural-Waste-Based Bio-Charcoal for Phosphate Removal/Recovery from Domestic Wastewater toward Circular Economy

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Abstract

Phosphorus scarcity has been concerned for many years since the phosphate-rock reserves are non-renewable resources and they are depleting in high rate due to the extensive extraction for their application in almost all the fields, especially in agriculture. A major part of extracted phosphate rock was to produce fertilizers for agricultural purposes and the excess of used fertilizers eventually ended up in aquatic environment, causing many environmental problems, such as eutrophication. In Circular Economy approach, phosphate in waste streams can be considered as a new phosphorus resource. Taking this approach, this study focused on removing and recovering phosphate in domestic wastewater using the modified activated carbon produced from agricultural waste such as rice husk, rice straw and sugarcane bagasse. These materials were modified in different solutions with $MgCl_2$ concentration range from 0.5M to 2.5M. The activated carbons produced from original materials and modified materials then went through a series of leaching tests and batch tests to determine and compare their capability of removing/recovering phosphate. The phosphate removal efficiencies were determined by ammonium molybdate spectrometric method. The Magnesium content of these materials were also identified dry digestion in platinum crucible followed by acid treatment and titration method. The maximum Magnesium content of rice straw-based biochar reached 35% at the Magnesium concentration of 0.5M while in the case of rice husk-based biochar, to reach the equivalent content the Magnesium concentration was 2M. The phosphate removal efficiencies were also high, up to 96.35% in the case of rice husk-based biochar and 93.69% in the case of rice straw-based biochar. These findings have implied an optimization of modifying rice husk and rice straw for wastewater treatment purpose.

Keywords: *modification, phosphate recovery, phosphate removal, rice husk, rice straw, biochar*

Study on Characteristics, Heavy Metals Pollution in Industrial Sludges and Using Effective Extraction Method to Recover Heavy Metals from Sludges

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Abstract

Sludge from wastewater treatment plants (WWTPs) in industrial park is currently a serious problem in Vietnam as well as many countries around the world. Unlike other by-products, sewage sludge from WWTPs contains a lot of toxic components, heavy metals, persistent organic substances and many other hazardous ingredients in high concentrations. Up to now, there has not been a Vietnamese study focusing on systematically assessing the level of toxic pollutants in industrial sludge in Vietnam. Therefore, this study focuses on evaluating the characteristics of industrial wastewater sludge in a specific industrial park, and thereby determining the characteristics and current status of heavy metal pollution in the sludge compared with agricultural soil samples. We determined the heavy metals enrichments and their possible sources in industrial sludges from different sampling time. The results show that industrial sludge exhibits very high pollution for some typical heavy metals, especially Cu and Cd. The analysis of the correlation relationship between heavy metals also helps to identify the source of emission of heavy metals in the sludge sample. The PI, Igeo indexes are also 2-10 times higher than the control soil samples. In addition, the study also used citric acid, GLDA and ascorbic acid solutions as a method of heavy metal extraction from sludge with relatively high efficiency (~80%). Among the chelators, GLDA can be selected as the most effective removal with high pacacity to remove Cu and Pb.

Keywords*: industrial sludges, heavy metal removal, pollution, enrichment*

Water Management for Sustainable Fisheries: Bangladesh Perspective

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Abstract

Bangladesh has diverse and complex water resources in the form of rivers, *beels*, seasonal wetlands, *haors*, streams and vast seasonally inundated floodplains and Bay of Bengal which are rich and retain global significance. The bountiful water bodies of Bangladesh are rich in fishery resources and supported millions of rural households, including the very poorest which are critically dependent on water resources. Bangladesh has inland waters of 4.7 million hectares and vast marine fisheries resources expanding over an Exclusive Economic Zone (EEZ) of 166000 km^2. Fisheries sector contributes 1.92% of the country's export earnings, 3.61% of its GDP, provides 60% of the national animal protein consumption and 24.41% to agricultural sector. There are about 16.5 million people (about 11% of total population) are directly or indirectly associated with the fisheries sector for their livelihood (2018-19). In Bangladesh, agriculture is still the major water using sector for surface and groundwater irrigation for crop cultivation than fisheries sector. The increasing demand of water is growing rapidly in other socio-economic uses such as in fishery, in the urban and industrial sector, navigation, and household uses which ultimately cause further stress to water resources of Bangladesh. Therefore, availability and sustainability of usable water is a high concern for future food security. Water requirements for fisheries comprise the requirements for freshwater, estuarine and floodplain capture fishery, freshwater aquaculture and brackish water shrimp production. Fisheries in the coastal zone range from fully inland freshwater fishery, shrimp and brackish water fishery to marine fishery in the Bay of Bengal. There are a number of water conflicts of interest between agriculture and fisheries and also between agriculture and aquaculture in the relative use of the water. Both agriculture and fisheries have major significance for food source in Bangladesh. Agriculture and fisheries have traditionally been complementary activities, but increasing population and intensification of agriculture have brought these sectors into conflict. In Bangladesh, *beels* or shallow wetlands are dewatered or drained to allow dry season agriculture and this arrangement

adversely affects fisheries, ecosystem and their livelihood support in the short and long terms. Thus, water management needs to be balanced for rice cultivation, capture fisheries, shrimp production and aquaculture. Gradual siltation, pollution, construction of FCDI (Flood Control Drainage and Irrigation), arsenic and excessive dissolved iron in ground water, salinity in the shallow aquifers in the coastal areas, lowering ground water level are growing threat for sustainable water management in fisheries. Simultaneously, water scarcity, drought, soil acidification, pollution of groundwater, physical structure of the waterbody network, mismatched size of the irrigation network with water capacity, lack of local management of water resources by farmers/fishermen, and farmers/fishermen reluctance to participate in water management are few visible evidence of challenges for water management for sustainable fisheries in Bangladesh. Strong sustainable development in fisheries should be ensured to enhance environmental quality, biological integrity, ecosystem health and biodiversity. Participatory water management, fishery management and enhancement of habitat restoration, strong linkages and cooperation building through partnership of GO, NGO, and DoF (Department of Fisheries), better partnership between different ministries of water resource management must be ensured for sustainable use of water for fisheries and agriculture. Finally, adoption of an integrated approach such as the culture of aquatic organisms in rice paddies and irrigation waters, seasonal rotations of crop cultivation with aquaculture, and various forms of integrated agriculture–aquaculture systems (Rice–Fish Systems; Crops, Livestock, and Aquaculture systems) might be some promising options to reduce water conflicts between agriculture and fisheries as well as is a positive way-out to socioeconomic benefits and the efficient use of water resources of Bangladesh.

Keywords: *Fisheries, Integrated agriculture-aquaculture systems, Water management*

SESSION 3: ENVIRONMENTAL MODELLING

Use a Mathematical Model to Simulate the Nutrients (N, P) in Water and Sediment of Catfish *(Pangasianodon Hypophthalmus)* Ponds in Vietnam

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Abstract

Pangasius (*Pangasianodon hypophthalmus*) is a freshwater fish with high economic value which has been exported to more than 130 countries in the world includes European, Asian, American regions. It is produced and processed mainly in the Mekong Delta region. Pangasius farming is developing very fast in the last 20 years leads the fish is more susceptible to disease and the processed feed has high nutritional content, especially rich in Nitrogen (N) and Phosphorous (P) which was partially consumed then cause high pollution to the environment.

This study aims to establish a mathematical model (coded by MATLAB software) to identify the biological processes of nutrients in water and sludge of catfish ponds. The modeling results show that the Total Inorganic Nitrogen (TIN) in water in the model range from 0.66 – 8.56 mg/L, actual in the range of 0.66 – 6.79 mg/L, the average error was 24.3%; the Total Inorganic Phosphorous (TIP) in water in actual: 0.51 - 3.66 mg/L, in modeling: 0.51 to 3.96 mg/L, average error was 49.5%. The Total Nitrogen in sediment (TNS) in actual: 0.11 – 3.99 mg/L, in modeling: 0.11 – 4.06 mg/l, average error was 17.7%; the Total Phosphorous in Sediment (TPS) in actual: 1.77 - 6.67, modeling: 1.77 - 5.44 mg/L; average error was 12.7%. The calibration of the model by using the data which was measured in previous study [9] and adjusted by data measured in the pond in Vietnam. This will help to adjust the parameters suit to the Vietnam weather condition. These result of concentrations in both actual and modeling were in the range of environmental condition for fish development as indicated in another research.

Keywords: *Pangasius, modeling, Phosphorous (N), Nitrogen (N)*

Linking of Land Subsidence and Groundwater Level Decline in Mekong Delta: A Review

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Abstract

Worldwide, land subsidence coupled with climate change impacts in coastal and delta cities has drawn much attention from academies and policy managers. In the Mekong Delta region, land subsidence is increasingly become a serious problem. This paper introduces geological condition and critical review on the cause of land subsidence in the area by summarizing previous literatures and data. A broad issue will be covered including the decline of groundwater level, observation and sources of land subsidence, and the management practices of land subsidence. The results show that unconsolidated sediment, thick of organic-rich soft clay layer, tectonic activities, groundwater abstraction, land use change, sand mining and reduction of sedimentation from upper stream are the main causes of land subsidence in the area. Groundwater abstraction and tectonic activities can cause compaction in deep aquifers, meanwhile the remaining sources contribute directly to the subsidence on the land surface. Recent studies suggested that recovery of groundwater pressure head may reduce land subsidence rate; therefore, reduction of groundwater abstraction and artificial recharge can be the promising approach to minimize land subsidence problems. However, the previous studies' results also implied uncertainties for estimation of land subsidence rate by satellite image analysis methods and lack of onsite monitoring system of land subsidence and groundwater level. The present paper also suggests that improvement of land subsidence and groundwater monitoring system are necessary for managing land subsidence in the Mekong Delta.

Keywords: *groundwater abstraction, land subsidence, Mekong Delta, natural compaction, satellite images, sedimentation*

Assessment Ground Ozone (O_3) Impacts on Agricultural Crop Yields in Mekong Delta, Vietnam

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Abstract

Sustainable development of the Mekong Delta Region (MDR) is an urgent mission as the local agricultural sector plays a quite important role in the national economy, which contributes more than 50% of food production, 90% of the total exporting rice, and accounts for about 20% of Vietnam's Gross Domestic Product (GDP). Currently, tropospheric O_3 has been evaluated as an air pollutant, causing crop yield reduction and significant economic damage. This study had built a methodological framework based on the application of the coupled WRF/CMAQ model in order to assess the status of ground O_3 concentration allocation in the region with typical cases of the dry and wet seasons in 2018, combined with existing exposure-response functions to quantify agro-economic losses. With the simulated ground O_3 concentration ranging from 8 to 140 $\mu g/m^3$, the economic impacts to rice and maize production were determined to reach more than 700 billion VND, accounting for approximately 0.35% in the total Gross Regional Domestic Product (GRDP) of the whole region in 2018. Moreover, this is also considered a baseline study to serve as a basis for extensive assessments and propose ground O_3 pollution control policies in the near future.

Keywords: *Ground ozone, WRF/CMAQ model, exposure, crop production losses, economic damage*.

Assessing Social Vulnerability to Riverbank Erosion in Main Streams of the Vietnamese Mekong Delta

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Abstract

Climate change and trans-boundary development in world's major deltas, including the Vietnamese Mekong Delta (VMD) have exacerbated environmental risks. Land subsidence, riverbed sand mining, and intensive groundwater extraction have all contributed to lower channel bed levels, resulting in riverbank erosion and the loss of assets and livelihoods for local residents. This study investigated the drivers and classified the social vulnerability index (SVI) of local communities affected by riverbank erosion along two main branches in the VMD. Direct interviews were conducted with 218 erosion-affected households along the Mekong and Bassac rivers in Dong Thap and An Giang provinces to create the SVI. More than 70% of total surveyed households belonged to highly, moderately, or low vulnerability groups, suggesting a range of affected communities within the sample, some of whom had the ability to cope with its short-term impacts. However, the SVI revealed significant geographical heterogeneity, with communities along the Mekong branch being more vulnerability than those along the Bassac. Recommendations from our investigations include the establishment of community awareness programs and policy changes that assist local residents' livelihoods adaptation. Stakeholder participation was possibly the most important tool towards aiding local people cope with the complex impacts of riverbank erosion.

Keywords: *Riverbank erosion; Social vulnerability; Vietnamese Mekong Delta*

The Seasonal Groundwater Salinity and Its Use in the Coastal Vietnamese Mekong Delta

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Abstract

Groundwater is vital as the main freshwater supply for agricultural development and domestic use in many coastal areas. However, this resource has been endangered due to saline intrusion further into coastal aquifers. This research aimed to assess groundwater exploited activities and quality under the impact of saltwater intrusion into the Vietnamese Mekong Delta coastal plains, a case study in Vinh Chau town, Soc Trang province. The study was conducted using a quantitative method, including semi-structured and structured interviews for household and local governments; and collecting groundwater samples in dry and wet seasons. The results showed that salinity levels measuring at domestic wells ranged from 0.43 ppt to 3.16 ppt. The salinity varied spatially and temporally, which its values were low along the coastline and became higher toward the inland. In particular, most of the water samples were within the limit of the national technical regulation on groundwater quality (QCVN 09-MT: 2015/BTNMT). Besides, increasing groundwater demand for domestic usage and irrigation has led to over-exploited and degraded groundwater resources in terms of quantity and quality. The salinity hazard of irrigation water suggested that the saline hazard zone classification could support the planning and management of the coastal provinces.

Keywords: saltwater intrusion, *groundwater quality, exploitation, VMD coastal region, Vinh Chau town*

Enhancing Quality of Life through Sustainable Urban Transformation in Cambodia: Introduction to Build4people

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Abstract

This paper introduces the research agenda and preliminary research results of the long-term Build4People project, funded by the German government. Build4People's rationale is based on Phnom Penh's dynamic economic growth, which is coupled with unsustainable urbanization and increasingly resource-intensive lifestyles of the urban citizens. The estimated doubling of the urban population in Cambodia expected by 2030 offers a unique window of opportunity. However, buildings are rarely constructed in a sustainable way. The overall aim of Build4People is to analyse and support the transformative shift in Phnom Penh's urban development pathway towards higher sustainability and better urban quality of life. The entry points for the research are the building and neighbourhood planning sectors. Methods and key instruments applied are, among others, urban living labs,

transition management approaches, sustainable building business incubators and subsequent experimental implementation. A further approach of Build4People is capacity development, particularly in regard of preparing a new urban planning master course which shifts away from predominantly design-led approaches and moves towards more governance-orientated schemes of planning for sustainable urban transformation. All of these measures are expected to generate applied knowledge for local stakeholders and a solid basis for evidence-based decision-making. This shall also contribute to more integrated and inclusive urban development and a planning culture increasingly understood as a process and dialogue. It will be concluded that applied research projects such as Build4People can only work out solutions for sustainable urban development together with urban society. By actively communicating and cooperating with multiple stakeholders, their concerns and competencies can be integrated into the research process.

Keywords: *Integrated urban people-centric development, pro-environmental behaviour and sustainable living, Royal Kingdom of Cambodia, sustainable buildings, sustainable urban transformation, urban quality of life.*

Prediction of Groundwater Arsenic Level Based on a Superior Regression Model

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Abstract

Vietnam is one of the Southeast Asian countries where groundwater contamination has become a major public health concern. Industrial waste and fertilizer runoff from farming areas have contaminated groundwater with dangerous elements including arsenic. The man-made arsenic pollution is happening on top of the naturally occurring arsenical compounds leeching arsenic in groundwater deep underground. Over the last few decades, international organizations and Vietnam national as well as local government agencies have been undertaking surveys in the affected areas to assess the level of arsenic pollution to mitigate the problem. To help the overall objective of setting appropriate policy guidelines, we have undertaken an interesting research project where existing survey data from An Giang province (within the Mekong Delta Region) have been used to build a regression model of arsenic prevalence in the groundwater based on the area's geographic characteristics. Using a borehole's depth and its distance from the nearby Bassac river, we provide a superior regression model which can help any user to predict the amount of arsenic in the groundwater extracted from the borehole, instead of undertaking an elaborate chemical analysis of the water which can be both expensive as well as time-consuming. This approach of developing a suitable regression model, based on the existing survey data, is not only quick and inexpensive, but also can be adopted in many other areas and for other contaminants as well.

Keywords*: groundwater contamination, least squares method, prediction mean squared error, prediction mean absolute error, skew-normal distribution*.

SESSION 4: LAND-USE AND SUSTAINABLE DEVELOPMENT

Assessment of Rooftop Solar Power Potential in Commercial and Industrial Sector: Some Reference Cases in Da Nang City

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Abstract

This paper examines the economic potential for rooftop solar photovoltaic (PV) deployment of two commercial and industrial facilities, namely Hoa Tho Garment Factory and Vinh Trung Plaza in Da Nang city. The roof footprint of facilities was measured with Google Earth Pro coupled with Roof Pitch Factor, and the Cost-Benefit Analysis was used to quantify the Discounted Payback Period of proposed rooftop solar PV systems. The analysis results showed that the commercial case required high power demands, but its solar PV yield was negligible due to the limited roof footprint and high hill-shade effect. Meanwhile, the solar PV production of the industrial facility is much higher because of their large roof footprint and low hill-shade effect. The economic analysis showed that two case studies obtained high financial viability due to abundant solar radiation in the city and the recently plummeted cost of solar panels; in which, the economic potential of the commercial facility was higher than that of the industrial one. Such results are expected to assist the city in making informed policy decisions on the rooftop solar PV development.

Keywords: *Cost-Benefit Analysis, Da Nang city, economic potential, rooftop solar PV.*

Developing Solutions Roadmaps for Rice Production in Flooding Area of the Vietnamese Mekong Delta Adapting to Uncertain Changes in Climate and Surface Water Resources

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Abstract

Climate change, hydropower dams, and socio-economic development in the Mekong River areas have resulted in unpredictable changes in surface water resources and agricultural practices in the Vietnamese Mekong Delta (VMD), the decisions making on water resource management challenging in the region. This study aims at applying the Dynamic Adaptive Policy Pathways (DAPP) approach to develop solutions roadmaps supporting rice production in the Mekong Delta with a projection to 2030 under the context of uncertain changes on surface water resources. Data were collected from local officers, farmers, experts at Can Tho University, TU Delft University, and Utrecht University via using semi-structured interview techniques including stakeholder workshops, group discussions, and in-depth interviews. The proposed solutions from stakeholder's opinions were evaluated at different socioeconomic and environmental dimensions, especially focusing on the time of executing the tipping point of each solution. The study presents two solutions roadmaps developed as examples to promote rice production in flooding area of the VMD, which are validated and consolidated by the participated stakeholders. The DAPP approach could be suitable to support decision-making on surface water resources management in the context of uncertain changes, it is helpful reference for policy makers on agricultural land and water use planning. And further studies should be developed to apply this approach to other regions in the VMD to reinforce the applicability of the DAPP approach on supporting decision-making in the context of increasingly uncertain changes in the VMD.

Keywords: *Decision-making approach, uncertain changes, water resources management, Vietnamese Mekong Delta*

Anthropogenic Threats to Geosites of South-Central Coast, Vietnam

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Abstract

Geological heritages, geoheritages, or geosites – important sites for discovering and studying Earth history – appeared 20 years ago in a few papers in Vietnam. Although geosites have values, and services, they are not clearly and legally protected by national law documents. Therefore, they are threatened by a huge variety of human activities. This paper aims to identify the anthropogenic activities that stress these geosites based on field trips and literature reviews. The results point out three main sources of human threats: 1) inadequacy of scientific awareness of both scientists and managers; and especially the national inventory program on geoheritage; 2) lacking legal document for the geoconservation strategy; leading to 3) the economic impacts on the vulnerability and lost of geoheritage. All of these threats are discussed through the case study of the south-central coast of Vietnam where significant geodiversity occurs. Threats from economic activities include mining, infrastructure construction, tourism, military, and rubbish dumps. This is where conservation of geoheritages needs to be promoted and taken more seriously within the national management as well as the community.

Keywords: *anthropogenic threats, geoheritage, geosite, geoconservation*

Relationship of Urban Heat with Building Density and Green Spaces - A Remote Sensing-Based Study Across Vietnam's Metropolitan Areas

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Abstract

Urban heat island effects are an increasing challenge for metropolitan areas, especially in regions where climate change increases the frequency of extreme temperatures. The consequences for human health are understood and must be addressed by urban planning. Although many studies currently exist regarding relationships of adaptation measures and urban heat amongst individual single cities, there is little general understanding on how urban development impacts temperature at large scales. In this study we analyze the correlation between urban heat and two indicators of urban morphology: the green spaces and the density of buildings. We hypothesize that the relation between building density, urban green space and urban surface temperature can be quantified openly available techniques of Earth observarion. To grant an objective and consistent analysis over the entire country of Vietnam, we use information from different high-resolution imaging satellites. The computation of Pearson correlations across 58 Vietnamese districts confirms the hypothesis, indicating a negative impact of urban green space (-0.217), a positive impact of building density (+0.392) and an even stronger relationship with both indicators combined (+0.435). The findings are discussed with data of three research projects involving the cities of Hồ Chí Minh, Đà Nẵng, and Huế, and interpreted regarding regional differences and implications for urban planning.

Keywords: *local climate, remote sensing, urban heat island, urban planning.*

Users' Perspectives for Sustainable Transformation Pathways of Vietnam's Building Sector

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Abstract

In the last two decades, high-rise buildings (HRBs) have been the fastest growing housing typology to accommodate the increasing population of Vietnam's major cities. Although a green building movement in Vietnam can be observed and policies to promote energy efficiency of buildings have been initiated, there has been no widespread implementation, yet. Besides construction practices, the operation of HRBs significantly contributes to the sector's heavy carbon emission and energy consumption. This goes along with recent findings from the 2020 report of the Global Alliance for Buildings and Construction et al. "Towards A Zero- Emission, Efficient and Resilient Buildings and Construction Sector"1 which states that increasingly the operation of buildings is contributing to the increase of carbon emissions worldwide.

The authors of this paper maintain that this might result from the resourceintensive lifestyles of the rapidly increasing urban middle-class population – the main targeted customers of HRBs market. There is however a lack of understanding from the dimension of building users. This paper fills this gap by providing statistical insights based on a case study of HausNeo certified Green Building project in Ho Chi Minh City. Data are extracted from a household survey encompassing more than 1,000 households in Hanoi and HCMC. Empirical evidence of this survey shows that residents of the HausNeo building consume significantly less electricity compared to those living in conventionally constructed buildings. As explanation for this, three categories of different reasons could be identified: households'demographic and socioeconomic conditions, the building and the apartments' physical design and structure as well as the apartment users' environmental awareness. In conclusion, this paper responds to the apparent need for a multidisciplinary approach to promote the sustainable transformation of the building sector. Last but not least, it also aims to contribute to a more people led development of Vietnam's sustainable building policies and practices.

Keywords: *Sustainable buildings, user behavior, green building certification, environmental awareness, housing policies, environmental governance.*

Blue Dragon Programme; Preparing for the Next Step

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Abstract

This paper describes a possible outline for the approach of the next step of the blue dragon programme; the framework for cooperation between Vietnamese and Dutch authorities with focus on integrated water resources management challenges in Mekong Delta Vietnam until 2030. As everyone else the programme had to deal with the impact of covid-19. To accelerate during the remaining part of phase 1 (until 2022) and to prepare for phase 2 (2023 - 2026), flexibility and creativity is required. Therefore, the Blue Dragon partners are now preparing their next steps. The possible outline for the approach in this paper forms a basis for discussion with partners. In the first half of 2022 this will result in a blue deal proposal for funding of Phase 2.

SESSION 5: PLASTIC WASTE AND ENVIRONMENTAL MONITORING

Distribution of Micro-Plastic in Wastewater and Sludge from the Plants Producing Recycled Plastic - Seeds

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Abstract

There are more than 330 tons of plastic produced each year in around the world and it is estimated to increase three folds in 2050. The common presence of micro-plastic in water raise serious concerns at global scale due to its adverse impacts on human health and ecosystem. The waste water and sludge from the preliminary plants of recycled plastic granules are an important continuous source of micro-plastic discharged to surrounding environment. The waste water and sludge samples were collected at three plastic recycle plants in May 2020 and then analyzing for macro and micro plastic (size from 0.1 – 5 mm). The investigating results from 3 plants indicate that the emission rate of micro-plastic was about 5.8 -6.6% of investigate. Concentrations of micro plastic in water varied from 17.2 to 23.3 g/l, of which, 50% is 2 - 5 mm plastic, 18-37% of 1-2mm size, 5-7% of 0.5 -1 mm size, 4-5% of 0.15 -0.5 mm size and 4-19% has size over 0.1 mm. Their distribution depends on plastic types used for processing and plants' operation. Control the micro-plastic emission at such sources will contribute into reduce of micro-plastic in environment.

Keywords: *micro-plastic, recycled plastic granules, wastewater, sludge*

Abundance and Characteristics of Microplastics in Surface Water of Can Gio Sea

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Abstract

Vietnam has a long coastline with a lot of anthropogenic activities leading to the high potential of microplastics pollution in the marine environment. Can Gio Sea is the receiving place of inland waters from Ho Chi Minh city, Vung Tau city, and Tien Giang province, they are all populous areas with high risk of microplastics discharge into the surface water. To get more insights into the microplastics pollution of Can Gio Sea, this study aims to investigate the abundance, physical characteristics as well as chemical composition of microplastics. The study was conducted in 2019 with 15 surface water samples were collected 500 m from the shore in a sampling area length of about 20 km. In total, 808 microplastic pieces were detected in all samples with the average abundance is 0.267 ± 0.107 pieces/m^3. Different morphologies of microplastics were analyzed, the results showed that fragment (47.52%), white and transparent (49.80%) were dominant. In terms of composition, polypropylene and polyethylene accounted for the largest proportion (56% in total). At different sampling points, the number of microplastic pieces is different because they are affected by wind and sea currents, making the uneven microplastic distribution. The origins of microplastics could be from the discharge of tourist and aquaculture activities along the coast or receiving from inland rivers.

Keywords: *Microplastics, Chemical composition, Can Gio Sea, Ho Chi Minh City.*

Status of Lead Contamination in Soil at Dong Mai Handicraft Village, Van Lam District, Hung Yen Province

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Abstract

Dong Mai handicraft village, Van Lam district, Hung Yen province is very famous for used-lead acid battery (ULAB) recycling since the 1970s. Although all of the ULAB facilities have been moved to the industrial area outside the village since 2014, the consequences from ULAB activities still affect the local people, notably lead contamination in soil and it risk to human health. In this study, lead content of 182 soil samples at home gardens, 7 soil samples at public areas and 29 workers clothe samples were analyzed using Niton XL2 XRF Analyzer. The sampling was conducted in 3 campaigns (2013, 2017 and 2019). The results showed that the lead content contaminated in soil is very high, especially in some home gardens that ranged from 3,523 to about 14,000 ppm. The highest lead contents in the public areas recorded about 37,220.26 ppm that much greater than regulated in QCVN 03-MT: 2015/BTNMT - National technical regulation on the allowable limits of lead in the residential soils (70 ppm). In addition, the lead accumulation in workers' clothes was found reaching 85,929.16 ppm which is required for further health risk assessment study.

Keywords: *Dong Mai handicraft village, recycling, lead, soil contamination, Niton XL2 XRF Analyzer*

Artificial Breeding and Larval Rearing Techniques of Ayu (*Plecoglossus Altivelis*) with the Purpose of Conservation

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Abstract

The ayu (*Plecoglossu altivelis*) population in Vietnam, representing the southernmost population of species, is small and considered at risk of extinction. Our study describes the artificial breeding and larval rearing techniques that can be applied to produce fish seed in artificial conditions. Fish eggs and sperm are taken from matured fish by gently push on the fish's abdomen, then taken into artificial insemination by gently mixing. The fertilized eggs then incubated in running freshwater (the incubation period is about 14 days). After hatching, larvae are kept in the brackish water of 10‰ salinity (to maintain live food) with disordered oxygen around 7–8 mg/L. From the 1st to 35th day after hatching (DAH), the larvae are feed with live rotifers (commercially available). From 15th DAH, concurrently feed with rotifer, the larvae are feed with brine shrimp nauplii (commercially available) and familiarized with artificial food. After obtaining a body length of 4–5 cm and eating artificial food of 0.5–0.8 mm grain, fish are transferred into a fingering nursery with freshwater for further cultivation. We also noticed that the susceptible stages of ayu larvae are at around 16th and 40th DAH. This work provides necessary information for making a conservation plan for the ayu population in Vietnam.

Keywords: *ex-situ conservation, larviculture, species conservation, sweetfish*

Sustainable Consumption through Mindful Lifestyle to Reduce Plastic Waste

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Abstract

Plastic waste has become a globally critical issue nowadays. One of the main drivers of the problem is the unsustainable consumption pattern of societies. Recently, many pieces of research have investigated the relationship between a mindful lifestyle and sustainable consumption. This study aims to provide an overview of mindful consumption as a tool for reducing plastic waste towards sustainability and analyses the impacts of mindful lifestyle on the attitude and practice of plastic use and green consumption. An online survey was conducted with the mindful lifestyle community and non-mindful lifestyle community in Vietnam to study the impact of lifestyle on their consumption pattern. The result analysis shows that with mindfulness, individuals tend to take care not only of their well-being but also of communities and the environment. The mindful lifestyle community participates more in waste sorting, reuse, and recycling programs. They also support green products, using less single-use plastic products, and tend to have greener consuming patterns, as they believe that protecting the environment and reducing the use of natural resources can bring their lives more happiness and sustainability. The findings suggest that a mindful lifestyle can be an effective and green pathway in raising awareness and changing environmental behavior to combat the plastic waste problem.

Keywords: *mindful consumption, mindful lifestyle, plastic waste, sustainable consumption*

SESSION 6: AIR POLLUTION

The First Investigation on Characteristics and Sources of Organic and Elemental Carbon in $PM_{2.5}$ in Ho Chi Minh City, Vietnam

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Abstract

This paper provides insights into the characteristics and sources of atmospheric carbonaceous aerosol in Ho Chi Minh City (HCMC). 48-h $PM_{2.5}$ samples were collected at two urban sites (NVC and TD) in the University of Science, Vietnam National University HCMC, and one background site in the Can Gio mangrove from January to April 2021. Organic carbon (OC) and elemental carbon (EC) in PM2.5 were simultaneously measured by an OCEC analyzer (Model 5L, Sunset laboratory Inc., USA). The mean concentrations of OC and EC during the sampling period were 14.31 ± 6.06 µg/m^3 and 2.30 ± 0.07 µg/m^3. OC and EC accounted for 39.52 ± 14.32% and 6.33 ± 2.46% of the concentration of $PM_{2.5}$. The OC/EC values of NVC and TD were 6.95 ± 2.67 and 6.11 ± 1.76, showing a formation of Secondary Organic Carbon (SOC) occurred. The OC/EC minimum ratio method was used to estimate the SOC in NVC and TD sites. The calculated SOC values were 7.26 at the NVC and 9.94 µg/m^3 at the TD, which accounted for 52.60 % and 64.69 % of the average OC concentration in each sampling site. Analysis of OC and EC fractions to find the main sources of carbonaceous aerosol in HCMC during the sampling period indicating that the carbonaceous aerosol pollution comes from diesel vehicles exhaust and the combustion of coal and biomass was predominant.

Keywords: *Elemental Carbon, Organic Carbon, $PM_{2.5}$, Ho Chi Minh City*

Emission Fine Particulate Matter $PM_{2.5}$ from Cooking Activities

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Abstract

Cooking is one of the major sources that contribute to indoor $PM_{2.5}$ emissions. The study is conducted to collect information about cooking activities in District 10 for assessing $PM_{2.5}$ emission characteristics from cooking different dishes in house. Through collecting 387 questionnaires in the area of District 10, the results showed that the main cooking subjects are women (accounting for 86.8%) in the age group from 30 to 60 years old with the main job as a housewife (accounting for 53.3%). In addition, gas stoves are commonly used (accounting for 71.6%) with the three main cooking styles are soup (97.2%) and stir-frying (89.4%) and fried (77.0%). Based on that, the study measured the concentration of $PM_{2.5}$ when cooking five different dishes on the gas stove and the electric stove at three cooking modes: non- ventilator, medium wind speed and high wind speed. $PM_{2.5}$ concentrations were measured by an Airvisual Node sensor and Impactor $PM_{2.5}$ placed beside the hearth and above the cooking stove, with a distance to the ground 1.4 m. The results showed that cooking of different dishes tended to emit different concentrations of $PM_{2.5}$. The soup emitted $PM_{2.5}$ with a high concentration in the process of de-aromatic garlic and stir-frying pie, whereas the concentration of $PM_{2.5}$ that the stir-frying and frying emitted tended to increase rapidly with the high temperature of the oil. The intensity sequence for $PM_{2.5}$ emissions decreased as follows in general: frying (169.7 ± 59.5 µg/m^3) > stir-frying (44.4 ± 8.2 µg/m^3) > soup (35.7 ± 10.6 µg/m^3). The concentration of $PM_{2.5}$ emitted when cooking on gas and electric stoves is 112.1 ± 44.8 µg/m^3, 73.5 ± 28.2 µg/m^3, respectively. The average concentration of $PM_{2.5}$ when cooking without the ventilator, with medium wind speed and high wind speed was 202.0 ± 66.5 µg/m^3, 53.9 ± 13.1 µg/m^3 và 22.6 ± 4.45 µg/m^3, respectively.

Keywords: *$PM_{2.5}$, indoor cooking, electric stove, gas stove, indoor air pollution*.

Concentrations of $PM_{0.1}$ and $PM_{2.5}$ at High Polluting Event Days in Hanoi and the Effects of Meteorological Conditions

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Abstract

High levels of fine ($PM_{2.5}$) and ultrafine ($PM_{0.1}$) particles in the atmosphere can cause adverse effects on the environment and human health. This study aims at determining the mass concentrations of PM and meteorological influencing factors in high pollution event days in Hanoi. Daily samples of $PM_{2.5}$ and $PM_{0.1}$ were collected at a mixed site in Hanoi, Vietnam, from the middle of October to December 2020. High pollution events were determined based on $PM_{2.5}$ concentrations and analyzed for its average concentration and intensity (number of days). The regression analysis and correlation matrix were determined by R software, version 4.04. Seven high pollution events were recorded for 2.5 sampling months. The daily $PM_{2.5}$ concentrations were in the range of 19 - 147 µg/m^3. Those of $PM_{0.1}$ varied from 2 to 13 µg/m^3 with an average of 6 µg/m^3. The investigated meteorological factors can explain 70% $PM_{2.5}$ variations but only 47% of $PM_{0.1}$ variation.

Keywords: *$PM_{2.5}$, $PM_{0.1}$, high pollution events, correlation, regression analysis*

The Effect of Incense Burning on Indoor PM_{10} and $PM_{2.5}$ under Ventilation Conditions

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Abstract

This study determined emissions of incense burning, a traditional worship activity in Asian countries, under different ventilation conditions. The tests were conducted in a chamber with a volume of $1m^3$ (1x1x1 m^3) with experimnets without ventilation and mechanical ventilation ($6m^3/h$). Four kinds of traditional and aromatic incense sticks with lengths (in centimiters) of 27.0 (traditional Inc1 - yellow), 21.5 (aromatic Inc2 - brown), and 30 (aromatic Inc3 - dark yellow) and 19.0 (traditional Inc4- dark red color). The insence, at 0.5 m in height, was burned inside the chamber. PM10 and PM2.5 were monitored directly before, during and after burning insence by using Air Quality Detector (GM8803 and SIBATA - LD-5R) at positions of 0.5 m in height of the chamber. Study results showed that variation of PM concentrations were seperated into 3 phases: (1) PM concentrations incsreased very fast within 15 min after burning, (2) PM concentrations were stable within 20-35 min, (3) PM concentrations decayed gradually. The maxinum concentrations of PM10 for Inc1, Inc2, Inc3, Inc4 were 2138, 2293, 2259, 2210 $\mu g/m^3$ without ventilation, respectively and decreased about 40-70% under ventilation. The maxinum PM2.5 concentrations were about 870 – 1210 $\mu g/m^3$ with and without ventilation.

Keywords: *Incense, $PM_{2.5}$, PM_{10}, ventilation*.

Study on the Outdoor Microbiological Contamination at Some Crowded Public Places in Ho Chi Minh City

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Abstract

The purpose of this study is to assess the outdoor microbiological density at some crowded public places in District 1 in Ho Chi Minh City. The samples were collected at two locations, Nguyen Hue Pedestrian Street and Ben Thanh Market, by Koch's sedimentation method. Bacteria and mold samples were collected twice per week, from June to August 2020. The sampling plate was set at the height of 1.5 meters above the ground, and the sampling time was 15 min. The sample was placed in the incubator at 37 ± 1^{o}C for 24h - 48h for bacteria and 25 ± 1 ^{o}C for 72h - 120h for fungi. The results showed that the density of microorganisms depended on traffic density, number of pedestrians, and construction activities. The microorganism's density in the morning was higher than this in the evening during a weekday. While at the weekend, the density of microorganisms in the evening was higher than in the morning. The average density of bacteria and fungi at Nguyen Hue street was 6167.3 (CFU/m^3). Among the sampling locations, the density of those microorganisms in Ben Thanh market was higher at 15260.1 (CFU/m^3) in the morning. Heavy traffic density and construction activities greatly affect microbial density. The study had identified the dominant microorganisms in the out-door air, discovered bacteria species including *Micrococcus luteus*, *Saphylococcus simiae*, *Saphylococcus arlettae* and the common molds as: *Aspergillus brasiliensis*, *Aspergillus tamarii*, *Fusariumoxysporum*."

Keywords: *bacteria and mold, microbiological density, out-door air*

SESSION 7: AIR POLLUTION TREATMENT TECHNOLOGY

Capture and Removal of Pathogens and $PM_{2.5}$ Fine Dust Using Copper Nanoparticles Coated Fiber Filter for Air Treatment

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Abstract

Recently, COVID-19, a respiratory infectious disease, is spreading all over the world, and due to this, interest in removing various strains and viruses, such as coronavirus, which is the causative agent of COVID-19, from the air is increasing. However, current air purifiers are focused on removing fine dust in indoor air, so it is urgent to develop a filter or device capable of antibacterial and antiviral treatment.

Objective: To obtain various types of air filters based on antibacterial active metal Cu which is low cost, high efficiency and reusable to enable removal of fine dust and microorganism.

Methods: We present an easy green synthesis method for copper nanoparticles (Cu-NPs) using in situ growth dip-coating on non-woven fiber (NWF) filters and meltblown HEPA fiber filters. We also evaluate the multifunctional potential of both filters in air pollution treatment.

Results: In the PM capture test, the Cu-NPs/HEPA filter shows high efficiency (~99.99%) through electrostatic interaction between charged fibers without pressure drop. On the other hand, the Cu-NPs/NWF filter showed a low collection efficiency in normal cases, but the efficiency increases the most when a (+) charge is applied to the filter. In addition, in the anti-pathogen inactivation test, the filter coated with 9.89 wt% Cu-NPs kills all E. coli within 5 min.

Conclusion: As a result, Cu-NPs-coated filters show great potential for robust and efficient collection and removal systems suitable for indoor environments.

Acknowledgements

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Innovative Application of Melamine Sponge with a Copper-Organic Framework (Cu-Cpp) as a Multi-Functional Filter in Air Purifiers

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Abstract

Covid-19 has drawn great attention on the necessities to establish pathogen-free indoor air. This paper aims to offer an insight into the potential application of a multi-purpose filter to remove fine particulates and disinfect pathogens using melamine sponge with a copper-organic framework. In-situ growth dip coating method was applied to coat Cu-based coordination polymer particle (Cu-CPP) on melamine sponge (MS). The integration of Cu-CPPs with high crystallinity and highly active surface area (1318.1 m^2/g) enabled Cu-CPP/MS to have an excellent capture rate (99.66 %) and an instant disinfection rate of 99.54% for *Escherichia coli*. Electrostatic attraction seemed to play a crucial role in capturing negative-charged pathogens effectively by positive charges on Cu-CPP arising from unbalanced copper ions in Cu-CPP. Disinfection of pathogens was mainly attributed to catalytically active Cu^{2+} sites. Organic ligand played an important role in bridging and maintaining Cu^{2+} ions within the framework. This study highlights the design of a new capture-and-disinfection (CDS) air filter system for pathogens using Cu-CPP/MS. It can be applied as a substitute for conventional HEPA filters.

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The Effect of Catalyst Calcination Temperature on Catalytic Decomposition of Waste Hfc-134a over Γ-Al_2o_3

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Abstract

Background: Climate change is grievous and it has been substantively measured worldwide. Since the 1880s, the National Aeronautics and Space Administration (NASA) has noted that the surface temperature has increased by 1.3 °C (~2.7 °F). The reason behind such disasters is related to human activities such as the use of greenhouse gases. Although human life has improved through the use of fluorinated greenhouse gases as refrigerants and in air conditioning systems. These gases have a very high global warming potential (GWP) compared to the other greenhouse gases such as HFC-134a. This research contains the decomposition techniques for waste 1,1,1,2-tetrafluoromethane (HFC134a). HFC-134a is a potent synthetic GHG with a GWP of 1300. The rise in demand for air conditioners has caused a steep increase in the atmospheric concentration of HFC-134a.

Objective: To determine the optimal calcination temperature for destruction of high GWP refrigerant HFC-134a with maximum capacity.

Methods: This research explores the thermal and catalytic pyrolysis of waste HFC-134a over γ-Al_2O_3 calcined at temperatures of 550 °C (A550), 650 °C (A650), 750 °C (A750), and 850 °C (A850). The physicochemical properties of catalysts were studied through thermogravimetric analysis (TGA), Brunauer–Emmett–Teller equation for nitrogen physisorption analysis (BET), X-ray diffraction (XRD), and temperature-programmed desorption of ammonia (NH_3-TPD).

Results: The non-catalytic pyrolysis of HFC-134a showed less than 15% decomposition of HFC-134a. Catalysts increased the decomposition as A650 revealed the highest decomposition efficiency by decomposing more than 95% HFC-134a for 8 h followed by A750, A850, and A550.

Conclusion: The optimal calcination temperature was determined and the larger surface area and pore volume paired with a low amount of strong acidic sites were considered as the main contributors to the comparatively longer catalytic activity of A650.

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A Preliminary Investigagion of Pharmaceuticals and Personal Care Products Occurrence in Atmospheric Particulate Matter in Hanoi, Vietnam

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Abstract

Air pollution has become a principal environmental issue around the world, and concern about the relation between atmospheric contamination and social and health problems has increased over the last few decades, especially in large cities in the developing countries. Despite the continuously increasing contamination of the emerging organic contaminants such as pharmaceuticals and personal care products (PPCPs) in atmosphere in Hanoi, Vietnam, there is little information regarding their presence in air. The present study conducted screening 163 PPCPs from 12 atmospheric particulate matter samples collected in Hanoi with a novel analytical method, LC-QTOF-MS-SWATH. Our results identified and quantified 6 of the 163 PPCPs. All of 6 PPCPs were detected for the first time in this city. The total PPCPs concentrations in the night-time were 3 times higher than those in the daytime. Their total concentration ranged from 37.3 to 401.0 pg m^{-3} (median: 143 pg m^{-3}). The number of PPCPs detected per sample ranging from 1 to 5 (median: 3), and their figure found was higher in the night-time than that of the daytime. These PPCPs detected were used as antibiotics, antifungal drug, antibacterial agent, sunscreen agent, and analgesic agent.

Keywords*: Target screening analysis, LC-QTOF-MS-SWATH, PPCP, air particle*

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