# EQC³ 2022

2022 International Conference on Environmental Quality Concern, Control and Conservation

May 05th, 2022
Taiwan

## Organized by

National Chung Hsing University, Taichung, Taiwan
National Kaohsiung University of Science and Technology, Kaohsiung, Taiwan

## Co-organized by

King Mongkut's University of Technology Thonburi, Thailand
The Center of Excellence on Hazardous Substance Management, Thailand
University of the Philippines-Diliman, Philippines
Mapúa University, Philippines
Hanoi University of Technology, Vietnam
Ho Chi Minh City University of Technology, Vietnam
University of 17 Agustus 1945 Surabaya, Indonesia
Khon Kaen University, Thailand
Nguyen Tat Thanh University, Vietnam

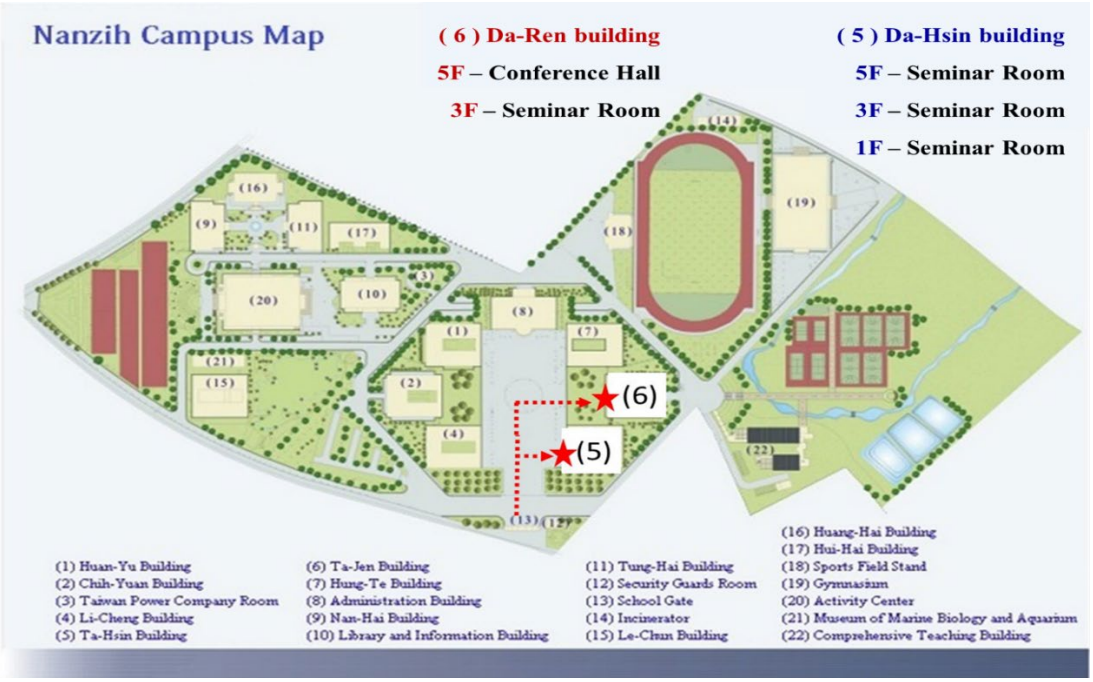
# CONTENTS

# PROGRAM AT A GLANCE

## Tentative program schedule, GMT+8 (Taiwan time)

<table>
<tr><th>Time (GMT+8)</th><th colspan="4">Program</th></tr>
<tr><td>08:30 - 09:00</td><td colspan="4">Registration (5F, A conference hall -Da-Ren Building)</td></tr>
<tr><td>09:00 - 09:10</td><td colspan="4">Opening Ceremony<br>Welcome Speech by Prof. Chitsan Lin<br>National Kaohsiung University of Science and Technology, Taiwan</td></tr>
<tr><td>09:10 - 09:20</td><td colspan="4">About EQC$^3$ Conference<br>Prof. Ming Chun Lu<br>National Chung Hsing University, Taiwan</td></tr>
<tr><td>09:20 - 09:40</td><td colspan="4">1$^{st}$ Plenary Speech, Prof. Changha Lee<br>Topic: Prediction of Micropollutant Abatement during Ozonation: From Lab to Field<br>Seoul National University, Republic of Korea</td></tr>
<tr><td>09:40 -10:00</td><td colspan="4">2$^{nd}$ Plenary Speech, Prof. Chia-Hung Hou<br>Topic:Recent advances in capacitive deionization technology<br>National Taiwan University, Taiwan</td></tr>
<tr><td>10:00 – 10:30</td><td colspan="4">Group Photo/Coffee Break</td></tr>
<tr><td>10:30</td><td colspan="4">Oral Presentation Program<br>(20 min for session keynote speaker & 15 min for oral presentation, including Q/A)</td></tr>
<tr><td rowspan="2">10:30 - 12:05</td><td>Session A-1<br>(2F, Da-Hsin Building)</td><td>Session A-2<br>(3F, Da-Hsin Building)</td><td>Session A-3<br>(4F, Da-Hsin Building)</td><td>Session A-4<br>(5F, Da-Hsin Building)</td></tr>
<tr><td>EQC-22-075<br>EQC-22-060<br>EQC-22-065<br>EQC-22-042<br>EQC-22-029<br>EQC-22-002</td><td>EQC-22-014<br>EQC-22-007<br>EQC-22-001<br>EQC-22-037<br>EQC-22-039<br>EQC-22-041</td><td>EQC-22-019<br>EQC-22-066<br>EQC-22-068<br>EQC-22-070<br>EQC-22-048<br>EQC-22-033</td><td>EQC-22-022<br>EQC-22-036<br>EQC-22-038<br>EQC-22-062<br>EQC-22-055<br>EQC-22-057</td></tr>
<tr><td>12:05 - 13:15</td><td colspan="4">Lunch (2F & 5F, meeting room - Da-Hsin Building)</td></tr>
</table>

| Time (GMT+8) | Program | | | |
|---|---|---|---|---|
| | Session B-1 (2F, Da-Hsin Building) | Session B-2 (3F, Da-Hsin Building) | Session B-3 (4F, Da-Hsin Building) | Session B-4 (5F, Da-Hsin Building) |
| **13:15 - 14:50** | EQC-22-020<br>EQC-22-054<br>EQC-22-035<br>EQC-22-025<br>EQC-22-030<br>EQC-22-017 | EQC-22-013<br>EQC-22-011<br>EQC-22-045<br>EQC-22-046<br>EQC-22-067<br>EQC-22-058 | EQC-22-026<br>EQC-22-074<br>EQC-22-064<br>EQC-22-021<br>EQC-22-028<br>EQC-22-049 | EQC-22-027<br>EQC-22-069<br>EQC-22-052<br>EQC-22-071<br>EQC-22-032<br>EQC-22-061 |
| **14:50 - 15:10** | **Coffee Break/Poster Session (3F, *meeting room - Da-Hsin Building*)** | | | |
| | Session C-1 (2F, Da-Hsin Building) | Session C-2 (3F, Da-Hsin Building) | Session C-3 (4F, Da-Hsin Building) | Session C-4 (5F, Da-Hsin Building) |
| **15:10 - 16:45** | EQC-22-044<br>EQC-22-023<br>EQC-22-072<br>EQC-22-053<br>EQC-22-059<br>EQC-22-031 | EQC-22-006<br>EQC-22-008<br>EQC-22-009<br>EQC-22-010<br>EQC-22-018<br>EQC-22-051 | EQC-22-005<br>EQC-22-063<br>EQC-22-050<br>EQC-22-034<br>EQC-22-073<br>EQC-22-024 | EQC-22-003<br>EQC-22-056<br>EQC-22-016<br>EQC-22-043<br>EQC-22-047<br>EQC-22-004 |
| **16:45 - 17:20** | **Closing Ceremony/to be held at *A conference hall (5F, Da-Ren Building)*** | | | |



# EQC HISTORY

In 2006, the EQC Conference was held first at Chia Nan University of Pharmacy and Science, Taiwan. This Conference was organized multi-nationally to exchange professional as well as academic experiences on the environmental issues of concern such as water, solid waste, hazardous waste, air pollution and environmental quality of different phases. There were delegates from Thailand, Philippines, and Korea participating in this international conference. Afterwards, the EQC is continually organized every year at Chia Nan University of Pharmacy and Science. In 2009 and 2010, the EQC was held at I-Shou University, and Chung-Hwa University of Medical Technology, respectively. In 2011, 2013, 2015, 2017, and 2019, the EQC was held at National Kaohsiung Marine University. In 2022, National Kaohsiung University of Science and Technology and National Chung Hsing University hosted the EQC conference.

# MAIN THEMES

- Water, wastewater and solid waste treatment processes
- Surface water monitoring and modeling
- Groundwater modeling and remediation
- Green and sustainable remediation
- Wastewater reclamation technologies
- Solid waste management and Treatment
- Hazardous waste management and disposal
- Air pollution control and pollution prevention
- Air quality monitoring and engineering
- Marine environmental monitoring and conservation
- Environmental quality monitoring, assessment and control
- Environmental legal aspects of concern
- Flood control and hydrodynamic modeling
- Marine monitoring and pollution prevention
- Resources recycling and sustainable engineering
- Climate change and disaster mitigation
- Ecotourism

# CONFERENCE ORGANIZING TEAM

### Conference Chair

- Distinguished Prof. Ming-Chun Lu, National Chung Hsing University, Taiwan.
- Prof. Dr. Chien-Chuan Shern, National Kaohsiung University of Science and Technology, Taiwan.

### Conference Co-Chair

- Prof. Dr. Muaffaq A. Jani, University of 17 August 1945 Surabaya, Indonesia.
- Prof. Dr. Chistan Lin, National Kaohsiung University of Science and Technology, Taiwan.

### Members

- Assoc. Prof. Shu-Chi Chang, National Chung Hsing University, Taiwan
- Assoc. Prof. Chia-Ying Chen, National Chung Hsing University, Taiwan
- Asst. Prof. Siang-Chen Wu, National Chung Hsing University, Taiwan
- Asst. Prof. Yu-Hao Lin, National Chung Hsing University, Taiwan
- Assoc. Prof. Jin Anotai, King Mongkut's University of Technology Thonburi, Thailand
- Prof. Mark Daniel G. de Luna, University of the Philippines, Philippines
- Prof. Huynh Trung Hai, Hanoi University of Technology, Vietnam
- Dr. Ir. R. A. Retno Hastijanti, Universitas 17 Agustus 1945 Surabaya, Indonesia

# INTERNATIONAL PROGRAM COMMITTEE

- Chair Prof. Jimmy C. M. Kao, National Sun Yat-Sen University, Taiwan
- Chair Prof. Tsair-Fuh Lin, National Cheng Kung University, Taiwan
- Prof. Chia-Hung Hou, National Taiwan University, Taiwan
- Asst. Prof. Nonglak Boonrattanakij, King Mongkut's University of Technology Thonburi, Thailand
- Distinguished Prof. Yao-Tung Lin, National Chung Hsing University, Taiwan
- Assoc. Justin Chun-Te Lin, Feng Chia University, Taiwan
- Assoc. Prof. Yi-Kuo Chang, Central Taiwan University of Science and Technology, Taiwan
- Distinguished Prof. Chih-Hsiang Liao, Chia Nan University of Pharmacy and Science, Taiwan
- Distinguished Prof. Jih-Ming Chyan, Chia Nan University of Pharmacy and Science, Taiwan
- Prof. Meng-Wei Wan, Chia Nan University of Pharmacy and Science, Taiwan

- Assoc. Prof. I-Ming Chen, Chia Nan University of Pharmacy and Science, Taiwan
- Prof. Yao-Hui Huang, National Cheng Kung University, Taiwan
- Assoc. Prof. Yu-Jen Shih, National Sun Yat-Sen University, Taiwan
- Prof. Chih-Huang Weng, I-Shou University, Taiwan
- Prof. Jeyong Yoon, Seoul National University, South Korea
- Prof. Changha Lee, Seoul National University, Korea, South Korea
- Assoc. Prof. Maria Lourdes P. Dalida, University of the Philippines, Philippines
- Assoc. Prof. Florencio C. Ballesteros, University of the Philippines, Philippines
- Assoc. Pro. Dr. Cybelle Concepcion M. Futalan, University of the Philippines Los Baños, Philippines
- Assoc. Prof. Angelo Earvin Sy Choi, De La Salle University, Philippines
- Assoc. Prof. Anabella C. Vilando, South East Asian University of Technology, Philippines
- Prof. Delia B. Senoro, Mapúa University, Philippines
- Assoc. Prof. Nolan C. Tolosa, University of San Agustin, Philippines
- Dr. Ir. Muslimin Abdulrahim, Universitas 17 Agustus 1945 Surabaya, Indonesia
- Asst. Prof. Sergi Garcia Segura, Arizona State University, USA
- Prof. Gintaras Denafas, Kaunas University of Technology, Lithuania
- Assoc. Prof. Violeta Kaunelienė, Kaunas University of Technology, Lithuania
- Dr. Thi-Dieu-Hien Vo, Nguyen Tat Thanh University, Vietnam

# ORAL PRESENTATION PROGRAM

**Session A-1** **Chair: Prof. Chih-Hsiang Liao** **Co-Chair: Prof. Chitsan Lin**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **10:30– 10:50** | **Keynote speech A-1:** Time Series Model Analysis on Ambient Ozone Levels at Lin-Yuan Monitoring Station, Taiwan<br>*Chih-Hsiang Liao* | EQC-22-075 (p.97) |
| **10:50 – 11:05** | Advancing Air Quality Research by Taiwan EPA-based Data Mining: A Case Study<br>*Thi-Hieu Le, Chih-Hsiang Liao, Chitsan Lin* | EQC-22-060 (p.81) |
| **11:05 – 11:20** | Temporal Variation of Surface Ozone at An Industrial Site in Southern Taiwan<br>*Duy-Hieu Nguyen, Chih-Hsiang Liao, Chitsan Lin* | EQC-22-042 (p.62) |
| **11:20 – 11:35** | Analysis of air quality data with OpenAir package- A case study of Daluio station in Southern Taiwan<br>*Wazir Aitizaz Ahsan, Chih-Hsiang Liao, Chitsan Lin* | EQC-22-065 (p.86) |
| **11:35 – 11:50** | Development of Portable IoT-Based Multi-Sensor System for Air Quality Monitoring<br>*Glenda S. Guanzon, Nolan C. Tolosa , Harold G. Pescuela , Jan Rendor D. Nolasco , Vince Rommel M. Galilea* | EQC-22-029 (p.50) |
| **11:50 –12:05** | Short-term Solar PV Power Prediction based Deep Learning Convolutional Neural Network in Smart Solar Plant<br>*Phuong Nguyen Thanh, Chao-Tsung Yeh, and Ming-Yuan Cho* | EQC-22-002 (p.25) |
| **12:05 – 13:15** | Lunch Time | |

**Session A-2 Chair: Prof. Justin Chun-Te Lin Co-Chair: Dr. Anabella C. Vilando**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **10:30– 10:50** | **Keynote speech A-2:** A pilot study of textile wastewater reclamation using a Mobile Wastewater Recycling System (MWRS-SuperCycleTM)<br>*Frank C.H. Ni, Johnny Chiang, Justin Chun-Te Lin* | EQC-22-014 (p.36) |
| **10:50 – 11:05** | Treatment of Wastewater in Sewage Treatment Plant using Photoelectro-Fenton Process<br>*Anabella C. Vilando, Delma Evita U. Beatriz, Natalie G. Carabbacan, Cecille Joana Marie S. Ferrer, Allyssa Mae RJ. Firmalan, Ynaira Claire D. Peneyra* | EQC-22-007 (p.30) |
| **11:05 – 11:20** | Isolation, selection and identification of bacterial strains from various cereal grains for decolorization of molasses-based distillery wastewater<br>*Nguyen Khoi Nghia and Vo Thi Le Trinh* | EQC-22-001 (p.26) |
| **11:20 – 11:35** | The Inhibition of DSA Anodic Dissolution in Fluorine-Containing Wastewater at Electrolysis Process<br>*Yi-Ting Liu, Yao-Hui Huang* | EQC-22-037 (p.58) |
| **11:35 – 11:50** | Application of Low-Solubility Dolomite as Seed Material for Struvite Recovery (NH4MgPO4. 6H2O) from Synthetic Wastewater using Fluidized-Bed Crystallization (FBC) Technology<br>*Thi-Hanh Ha, Nicolaus N.N. Mahasti, Ming-Chun Lu, and Yao-Hui Huang* | EQC-22-039 (p.60) |
| **11:50 –12:05** | The simultaneous removal mechanism of Boron and Nickel via co-precipitation and adsorption from synthetic nickel-boron-containing wastewater<br>*Chun-Wei Lin, Yao-Hui Huang* | EQC-22-041 (p.61) |
| **12:05 – 13:15** | Lunch Time | |

**Session A-3 Chair: Assoc. Prof. Nolan C. Tolosa Co-Chair: Prof. Chih-Huang Weng**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **10:30– 10:50** | **Keynote speech A-3:** Development of An Automated Vermicomposting System for Quality Production of Vermicast and African Night Crawler<br>*Nolan C. Tolosa, Alexandra Karyll L. Silveo, Kent Marie Dominic P. De Guzman, andMyrjun S. Escalada* | EQC-22-019 (p.40) |
| **10:50 – 11:05** | Utilization of Used Waste of Oyster Mushroom Planting Media as a Media for Worm Livestock to Reduce Pollution and Agricultural Industry Waste<br>*Ridho Yanuar* | EQC-22-066 (p.87) |
| **11:05 – 11:20** | Utilization of Wood Waste become a Craft that Represents the Nation's Culture to Increase Economic Value and Reduce the Collection of Waste in the Environment<br>*Helda Febrina and Rahmat Ihsanul Ubaidillah* | EQC-22-068 (p.89) |
| **11:20 – 11:35** | Recycling Plastic Waste into High-Value Handicrafts in Indonesia<br>*Erni Puspanantasari Putri and Jaka Purnama* | EQC-22-070 (p.91) |
| **11:35 – 11:50** | Immobilization of Heavy Metals in Soil using Biochar Derived from Agricultural Wastes<br>*Yu-Jie Chien, Chih-Huang Weng, Kesinee Iamsaard, Mel Adelle C. Ocba, Yao-Tung Lin* | EQC-22-048 (p.68) |
| **11:50 –12:05** | Preparation of Porous Biochar Derived from Sawdust and its application on Sulfamethoxazole Removal<br>*Vu-Anh Le, Suwadee Kongparakul, Chanatip Samart, Thi Tuong Vi Tran* | EQC-22-033 (p.54) |
| **12:05 – 13:15** | Lunch Time | |

**Session A-4 Chair: Prof. Angelo Earvin Sy Choi Co-Chair: Dr. Alexander L. Ido**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **10:30– 10:50** | **Keynote speech A-4:** A Screening Design of The Ultrasound Assisted Oxidative Desulfurization of Diesel Oil<br>*Angelo Earvin Sy Choi, Susan Roces, Nathaniel Dugos, Meng-Wei Wan* | EQC-22-022 (p.43) |
| **10:50 – 11:05** | Optimization of Process Parameters in the Upgrading of Scenedesmus Obliquus Oil to High-Quality Liquid-Phase Biofuel by Nickel-Impregnated Biochar Catalyst<br>*Alexander L. Ido, Mark Daniel G. de Luna, Dennis C. Ong, Sergio C. Capareda* | EQC-22-036 (p.57) |
| **11:05 – 11:20** | Degradation and Mineralization of RB5 by Visible Light-Assisted Fenton Process in Oxalic Acid System<br>*Wei-Zheng Li, Yao-Hui Huang* | EQC-22-038 (p.59) |
| **11:20 – 11:35** | Total Phenolics and Antioxidant Activities of Momordica Charantia Leaf<br>*Tran Bui – Phuc, Nguyen Dinh – Phong, Ngo Hoang – Duy* | EQC-22-062 (p.83) |
| **11:35 – 11:50** | Cobalt Oxide Decorated with Activated Carbon as a Pseudocapacitive Composite Electrode for High-Performance Desalination in Hybrid Capacitive Deionization<br>*Po-Chang Wu and Chia-Hung Hou* | EQC-22-055 (p.76) |
| **11:50 –12:05** | Immobilization of Cu, Ni, Zn, and Cr in Paddy Soil by Biochar: A Short-Term Laboratory Incubation Study<br>*Mel Adelle C. Ocba, Chih-Huang Weng, Kesinee Iamsaard, Yu-Jie Chien, Jing-Hua Tzeng, Mark Daniel G. de Luna, Yao-Tung Lin* | EQC-22-057 (p.78) |
| **12:05 – 13:15** | Lunch Time | |

**Session B-1 Chair: Prof. Chia-Hung Hou Co-Chair: Dr. Thi-Dieu-Hien Vo**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **13:15 – 13:35** | **Keynote speech B-1:** Wastewater Desalination via Flow-Electrode Capacitive Deionization (FCDI) Using Carbon Nanotubes/Activated Carbon Hybrid<br>*Chia-Hung Hou and Guan-Yu Chen* | EQC-22-020 (p.41) |
| **13:35 – 13:50** | Effects of Organic Matter during Biological Treatment on Ultrafiltration Membrane Fouling in Refinery and Petrochemical Wastewater Treatment<br>*Robitur Rizqo, Yi-Ting Chen, Tsair-Fuh Lin* | EQC-22-054 (p.75) |
| **13:50 – 14:05** | Removal of boron from synthetic wastewater by three-stage calcium-based chemical oxo-precipitation (COP) and its application in real FGD wastewater treatment<br>*Jun-Yi Wu, Yao-Hui Huang* | EQC-22-035 (p.56) |
| **14:05 – 14:20** | Efficient Removal of Eriochrome Black-T from Aqueous Solution through Activated Carbon from Residual Coffee Grounds<br>*Efren Paul I. Arevalo, Nathaniel E. Quimada, Val Irvin F. Mabayo* | EQC-22-025 (p.46) |
| **14:20 – 14:35** | Reclamation of Aluminum as α-Al(OH)3 in an Aqueous Solution by Fluidized-Bed Homogeneous Crystallization Technology<br>*Yu-Hsiang Chiu, Yao-Hui Huang* | EQC-22-030 (p.51) |
| **14:35– 14:50** | Recovery of Copper and Nickel Ions from Printed Circuit Board Wastewater via Fluidized Bed-Homogeneous Granulation Process<br>*Nathaniel E. Quimada, Mark Daniel G. De Luna, Ming-Chun Lu* | EQC-22-017 (p.38) |
| **14:50– 15:10** | Coffee Break/Poster Session | |

**Session B-2 Chair: Dr. Nicholas Kiprotich Cheruiyot Co-Chair: Ms. Thi-Hieu Le**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **13:15 – 13:35** | **Keynote speech B-2:** PBDE Reduction in The Startup of Municipal Solid Waste Incinerators<br>*Nicholas Kiprotich Cheruiyot, Guo-Ping Chang-Chien, Lin-Chi Wang, Jou-Yu Yeh, Kun-Hui Lin* | EQC-22-013 (p.35) |
| **13:35 – 13:50** | Bioethanol Production from Pineapple (A. Comosus) Fruit Rejects via Anaerobic Fermentation Process<br>*Angel Kaye M Arazo, Lonamie D Carreon, John Michael A Valdon, Johnah Marie D Vieña, Allen Rhay B Bayantong and Maribel S. Tizo* | EQC-22-011 (p.34) |
| **13:50 – 14:05** | Persistent Organic Pollutant Lindane Degradation by Alkaline Cold-Brew Green Tea<br>*Chi-Wei Wang, Shu-Chi Chang, Chenju Liang* | EQC-22-045 (p.65) |
| **14:05 – 14:20** | Agricultural Waste Biochar Mulches Coated with Polylactic Acid for Improving The Soil Quality<br>*Kesinee Iamsaard, Chih-Huang Weng, Han-Yu Hsueh, Jenn-Wen Huang, Yao-Tung Lin* | EQC-22-046 (p.66) |
| **14:20 – 14:35** | Independent Household Organic Wate Treatment to Create a Green Independent Village of Organic Fertilizer<br>*Andika Puji Wirawan* | EQC-22-067 (p.88) |
| **14:35– 14:50** | Assessing Waste Disposal Status and Influencing Factors of Waste Classification at High Schools in Thai Nguyen Province, Vietnam<br>*Truong Thi Anh Tuyet, Duong Minh Hoa, Vu Thi Hoa, Tran Hai Dang, Hoang Thi Lan Anh, Pham Thi Thanh Huyen* | EQC-22-058 (p.79) |
| **14:50– 15:10** | Coffee Break/Poster Session | |

**Session B-3 Chair: Prof. Chart Chiemchaisri Co-Chair: Mr. Adnan Hussain**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **13:15 – 13:35** | **Keynote speech B-3:** Effect of TiO2 on the geopolymer composite membrane characteristics and antibiotic removal performances<br>*Samunya Sanguanpaka, Witaya Shongkittikul, Chitsuphang Saengam, Wilai Chiemchaisri, and Chart Chiemchaisri* | EQC-22-026 (p.47) |
| **13:35 – 13:50** | Investigation of Zeolite Derived from Modified Fly Ash for the Coomassie Brilliant Blue Dye Removal<br>*Hong-Ha T. Nguyen, Suwadee Kongparakul, Chanatip Samart, Thi Tuong Vi Tran* | EQC-22-074 (p.96) |
| **13:50 – 14:05** | Photocatalytic degradation of NO by synthesized g-C3N4 and g-C3N4@glass fiber under solar and visible irradiation<br>*Adnan Hussain, Chitsan Lin* | EQC-22-064 (p.85) |
| **14:05 – 14:20** | Sandwich-like NiCo2O4/MXene composite with enhanced catalytic activation of peroxymonosulfate for Ibuprofen degradation<br>*Hai-Ha Le, Thanh-Binh Nguyen, Chiu-Wen Chen, Cheng-Di Dong* | EQC-22-021 (p.42) |
| **14:20 – 14:35** | Characteristics of Chitosan Membrane in Combination with Moringa Leaf Extract<br>*Tran Bui – Phuc, Nguyen Dinh – Phong, Ngo Hoang – Duy* | EQC-22-028 (p.49) |
| **14:35– 14:50** | A Novel Pineapple Leaf Biochar-ZnO Composite for Efficiency Cr(VI) Removal from Aqueous Solution<br>*Kamonchanok Huangmee, Chih-Huang Weng, Kesinee Iamsaard, Jing-Hua Tzeng, Yao-Tung Lin* | EQC-22-049 (p.69) |
| **14:50– 15:10** | Coffee Break/Poster Session | |

**Session B-4** **Chair: Dr. Chiaying Chen** **Co-Chair: Dr. Jaka Purnama**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **13:15 – 13:35** | **Keynote speech B-4:** Environmental Transformation Regulates The Risks of Chemically Exfoliated Molybdenum Disulfide Nanosheets<br>*Ting-Wei Lee, Yu-Heng Lai, Cheng-Yuan Ho, and Chiaying Chen* | EQC-22-027 (p.48) |
| **13:35 – 13:50** | Sustainable Strategies in Conserving Teak Wood Forest For Furniture Products with Interpretive Structural Modeling (ISM) Approach<br>*Jaka Purnama, Erni Puspanantasari Putri* | EQC-22-069 (p.90) |
| **13:50 – 14:05** | Assessment of Heavy Metal Contamination of Surface Soil in Quezon City, Philippines using Multi-elemental Contamination (MEC) Index<br>*Josel B. Godezano, Krizzia P. Baring, James Dela Cruz* | EQC-22-052 (p.73) |
| **14:05 – 14:20** | Land Use for The Preservation of MSME at Minggon Market in Minggirsari, Indonesia<br>*Annisa Purnamasari* | EQC-22-071 (p.92) |
| **14:20 – 14:35** | Comparison of The Green Factory Label Systems in Taiwan, Thailand and Vietnam<br>*Yu-Hsiu Chen, Wen-Chi Tseng, Boi-Phung Ngo, and I-Ming Chen* | EQC-22-032 (p.53) |
| **14:35– 14:50** | Microbial Source Tracking of Fecal Contamination Using Quantitative and Digital Droplet PCR in River<br>*Yi-Chia Chen, Yi-Ting Chiu, and Tsair-Fuh Lin* | EQC-22-061 (p.82) |
| **14:50– 15:10** | Coffee Break/Poster Session | |

**Session C-1 Chair: Dr. Chi-Wei Huang Co-Chair: Dr. Acharee Kaewlaoyoong**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **15:15– 15:30** | Evaluation of Atrazine Degradation by Ferrous Ion Activated Persulfate Process in Aqueous Phase using Taguchi Approach<br>*Xuyen Thi Hong Luong, Chenju Liang* | EQC-22-044 (p.64) |
| **15:30 – 15:45** | Paracetamol Removal from Aqueous Solution through Activated Carbon from Mango Seeds<br>*Janeth E. Caculba, Jessel G. Namata, AJ Rosemay Preglo, Glyn Sanchez, Richelle A. Ogdiman, Cherry Q. Joyno* | EQC-22-023 (p.44) |
| **15:45 – 16:00** | Evaluation and Risk Assessment of Cyanobacterial Blooms, Toxins, and Taste and Odor Compounds in Drinking Water Sources<br>*Keng-Yu Lu, Yi-Ting Chiu, Tsair-Fuh Lin* | EQC-22-072 (p.93) |
| **16:00 – 16:15** | Stability of Cyanobacterial Neurotoxin B-N Methylamino-L-Alanine (BMAA) and its Isomers 2,4-Diaminobutyric Acid (DAB) and Aminoethylglycine (AEG) in Natural Water<br>*Louriejean L. Alfar, Mark Daniel G. de Luna, Analiza P. Rollon, Yi-Ting Chen, Tsair-Fuh Lin* | EQC-22-053 (p.74) |
| **16:15 – 16:30** | Development and Application of Nanopore MinION to Identify 2-MIB-Producing Cyanobacteria Species in Source Waters<br>*Jo-Chi Yao, Yi-Ting Chiu, Apramita Devi, and Tsair-Fuh Lin* | EQC-22-059 (p.80) |
| **16:30 – 16:45** | Removal of Hexavalent Chromium from Water by Magnetospirillum gryphiswaldense MSR-1 and The Investigation of Its Chromium Reducing Capabilities<br>*Wei-Che Hsiao, Li Fen Wu, Ya-Chun Zhao, Siang Chen Wu* | EQC-22-031 (p.52) |
| **16:45 – 17:20** | Closing Ceremony | |

**Session C-2** **Chair: Prof. Yu-Jen Shih** **Co-Chair: Dr. Jin Anotai**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **15:10– 15:30** | **Keynote speech C-2:** Catalytic oxidation and electrosorption of arsenic (III) over a series of nano-textured MnO2 polymorphs incorporated in goethite nanoparticles<br>*Yu-Jen Shih, Zhi-Shan Chen* | EQC-22-006 (p.30) |
| **15:30 – 15:45** | Homogeneous-Nucleation Fluidized-Bed Fenton at pH 6.0<br>*Pacharawan Wongsatit and Jin Anotai* | EQC-22-008 (p.31) |
| **15:45 – 16:00** | Characterization of Homogeneous-Nucleation Fluidized-Bed Fenton<br>*Thanakorn Kasian and Nonglak Boonrattanakij* | EQC-22-009 (p.32) |
| **16:00 – 16:15** | Synthesis of Metal Ferrite@Graphene Oxide Nanocomposite for Photocatalytic Degradation of Organic Pollutants in Simulated Wastewater<br>*Allen Rhay B. Bayantong, Cheng-di Dong, Yu-Jen Shih and Mark Daniel de Luna* | EQC-22-010 (p.33) |
| **16:15 – 16:30** | Photocatalytic Oxidative Degradation of Methylene Blue Using Novel Waste Silica-Supported Fe-Co Bimetallic Catalyst<br>*Khyle Glainmer N. Quiton, Ming-Chun Lu, and Yao-Hui Huang* | EQC-22-018 (p.39) |
| **16:30 – 16:45** | A Novel Visible-light-responsive Chitosan/N-TiO2 Composite and Eco-Friendly Packaging Film Produced from Fishery-Waste and Agricultural Waste Extracts: Optimization, Characterization, and Disinfection Mechanism<br>*Ying-Chen Chen, Chih-Huang Weng, Huey-Ling Lin, Han-Yu Hsueh, Jiunn-Lin Wu, Li-Ting Yen, Jenn-Wen Huang, Yao-Tung Lin* | EQC-22-051 (p.71) |
| **16:45 – 17:20** | Closing Ceremony | |

**Session C-3 Chair: Dr. Carl Francis Z. Lacson Co-Chair: Dr. Erni Puspanantasari Putri**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **15:10– 15:30** | **Keynote speech C-3:** Fluoride-containing Water: A Global Perspective and a Pursuit to Sustainable Water Defluoridation Management - An Overview<br>*Carl Francis Z. Lacson, Ming-Chun Lu, Yao-Hui Huang* | EQC-22-005 (p.28) |
| **15:30 – 15:45** | Development of Eco-Tourism Based on Mangrove Forest Conservation in Indonesia<br>*Erni Puspanantasari Putri* | EQC-22-063 (p.84) |
| **15:45 – 16:00** | Identifying Cellular Structure Deformation in Response to Disinfection Mechanisms Exemplified by Acetylated Shrimp Shells and Calcined Oyster Shell Powder Inactive Microorganisms<br>*Than Thi Nhu Anh, Chih-Huang Weng, Jing-Hua Tzeng, Li-Ting Yen, Yao-Tung Lin* | EQC-22-050 (p.70) |
| **16:00 – 16:15** | Study on the Relationship between the Carbon Storage of Ipomoea aquatica in Constructed Wetland and Nutrients<br>*Huang Chen Yuan, Jian Chuan Shern* | EQC-22-034 (p.55) |
| **16:15 – 16:30** | A preliminary study on the growth rate and calcium carbonate deposition rate of Pocillopora acuta using low current technique<br>*Hsing-Chuan Chiang, Jian-Chuan Shern, Tung-Yung Fan* | EQC-22-073 (p.94) |
| **16:30 – 16:45** | Characteristics and Distribution of Microplastics in Peatland: A Case Study in Long An Province, Viet Nam<br>*Nguyen Minh Ky, Chitsan Lin, Nguyen Tri Quang Hung, Hong Giang Hoang, Huu Tuan Tran* | EQC-22-024 (p.45) |
| **16:45 – 17:20** | Closing Ceremony | |

**Session C-4 Chair: Dr. Wen-Yen Huang Co-Chair: Mr. Duy-Hieu Nguyen**

| Time | Topic Name | EQC-No. |
|---|---|---|
| **15:15– 15:30** | The importance of Cham towers to tourism exploitation and development in Ninh Thuan province, Vietnam<br>*La Quoc Phong, Nguyen Ngoc Anh* | EQC-22-003 (p.26) |
| **15:30 – 15:45** | Effect of Influencers' Reviews on Young People's Awareness and Attitudes toward Ecotourism: The Moderating Role of Trust<br>*Thuy Le Ngoc Bich* | EQC-22-056 (p.77) |
| **15:45 – 16:00** | Modelling The Rice Production and Consumption in The Philippines: A System Dynamics Approach<br>*Benjamin D. Rubin, Renan S. Maglasang, Francis L. Mayo* | EQC-22-016 (p.37) |
| **16:00 – 16:15** | Ambidextrous Chair: A Sustainable Environmental Neutral Armchair for Both Right and Left Handed Persons<br>*Mary Grace S. Sabadisto and Dominico Sergie O. Valenciana* | EQC-22-043 (p.63) |
| **16:15 – 16:30** | Validation of Interventions on Iloilo City's Beaux-Arts Style Heritage Mansions.<br>*Ma. Theresa M. Austria* | EQC-22-047 (p.67) |
| **16:30 – 16:45** | An Efficient Long Short-Term Memory Approach for Load Power Prediction in Smart Solar Microgrid<br>*Phuong Nguyen Thanh, Chao-Tsung Yeh, and Ming-Yuan Cho* | EQC-22-004 (p.27) |
| **16:45 – 17:20** | Closing Ceremony | |

# POSTER PRESENTATION PROGRAM

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| **EQC-22-P1** (p.98) | Photocatalytic Degradation of Glyphosate in Water by Nano-ZrO2 Ultra-Micro Powder Prepared on Heating of Alcohol-Aqueous<br>*Shu-Lung Kuo, Edward Ming-Yang Wu, Chien-Nan Lee* |
| **EQC-22-P2** (p.99) | The Effects of Climate Change to Flooding at Downstream of Cu De River Basin, Central Viet Nam<br>*Nguyen Minh Ky, Nguyen Tri Quang Hung, Chitsan Lin, Nguyen Cong Manh, Nguyen Thi Lan Thuong, Pham Thi Le Thuy and Nguyen Hoang Lam* |
| **EQC-22-P3** (p.100) | Variation in PM2.5 Concentrations During The Covid-19 Pandemic in Ho Chi Minh City, Viet Nam<br>*Nguyen Trung Hiep, Nguyen Minh Ky, Nguyen Tri Quang Hung, Chitsan Lin and Nguyen Cong Manh* |
| **EQC-22-P4** (p.101) | Mackinawite Activated Persulfate Coupled with UV Light for Highly Efficient Decolorization of Azo Reactive Textile Dye Remazol Navy RGB<br>*Chih-Huang Weng, Yun-Chen Liu, and Yung-Shen Cheng* |
| **EQC-22-P5** (p.102) | Ultrasound Enhanced Persulfate Activated with Pyrite for Decolorization of Remazol Golden Yellow RGB<br>*Chih-Huang Weng, Chiang-Hsien Chen, Hsin-Yu Huang, and Chia-Hui Li* |
| **EQC-22-P6** (p.103) | Fluoride Treatment Using Calcium by Conventional Coagulation and Flocculation and Fluidized-Bed Granulation Process<br>*Carl Francis Z. Lacson, Ming-Chun Lu, Yao-Hui Huang* |
| **EQC-22-P7** (p.104) | Low-Temperature Catalytic Combustion of Various VOCs With Non-Noble Metal Catalyst Supported on Ceramic Fiber Filter.<br>*Jia-Yin, Lin , Yan-Fu, Chen and Chin-Liang, Wang* |
| **EQC-22-P8** (p.105) | Odor Emissions of Municipal Solid Waste<br>*Jih Ming Chyan, Zheng Long Ye, Chien Jung Lin, Pei Yi Kung, I Ming Chen, Delia B. Senoro* |

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| **EQC-22-P9** (p.106) | A Screening Design of the Ultrasound Assisted Oxidative Desulfurization of Diesel Oil<br>*Angelo Earvin Sy Choi, Susan Roces, Nathaniel Dugos, Meng-Wei Wan* |
| **EQC-22-P10** (p.107) | Nanobubble technology for textile wastewater treatment<br>*Chen, Guan-Wei, Chung-Yi Lin, Justin Chun-Te Lin* |
| **EQC-22-P11** (p.108) | Binary-pH Operated Fluidized-Bed Granulation Process for Simultaneous Recovery of Heavy Metals from Synthetic Industrial Wastewater<br>*Sheila A. Balladares, Carl Francis Z. Lacson, Ralf Ruffel M. Abarca, James I. Colades, Mark Daniel G. de Luna, Ming-Chun Lu* |
| **EQC-22-P12** (p.11) | Adsorptive Removal of Arsenic(V) and Nickel(II) from Binary Aqueous Solution Using Chitosan-Coated Bentonite<br>*Adrian V. Tiodin, Cybelle M. Futalan and Meng-Wei Wan* |

# [Plenary Speech]
# Prediction of Micropollutant Abatement during Ozonation: From Lab to Field

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## ABSTRACT

Ozonation is an effective process for the degradation of refractory chemical pollutants and the inactivation of pathogenic microorganisms. This process has been extensively studied for the treatment of water and wastewater for the past few decades, targeting different contaminants that include taste and odor compounds, toxins, metal species, and natural organic matter, as well as pathogens. In recent studies, ozonation has focused more on the oxidation of micropollutants (MPs), such as pharmaceuticals and personal care products, in drinking water and secondary wastewater. The oxidation of MPs by ozonation proceeds via the reactions with molecular ozone ($O_3$) and hydroxyl radical (•OH). To predict MP abatement during ozonation, a model that can accurately predict oxidant exposures (i.e., $\int_0^t [O_3]dt$ , $\int_0^t [\bullet OH]dt$) needs to be developed. This presentation demonstrates our recent studies regarding the development of empirical models that can predict MP abatement during ozonation. Our initial model using response surface methodology (RSM) successfully predicted MP abatement in the water source used to create the model, with the ozone dose and water quality parameters (i.e., pH, alkalinity, dissolved organic carbon concentration, and temperature) as input variables. However, when applied to other natural waters, this RSM model did not show high accuracy due to the different characteristics of organic substances. In order to develop more comprehensive models that are applicable to a wide range of water types, the fluorescence excitation–emission matrix (FEEM) data were considered as additional input variables to characterize organic substances in water samples. In addition, to subsume an enormous number of FEEM data points into the model, machine learning techniques based on different algorithms were employed. The created machine learning models using high resolution FEEM data offered more accurate prediction by better calculating the complex nonlinear relationship between organic characteristics and oxidant exposures. However, for the field application, further improvements of the prediction models are required to account for additional factors such as diffusion and dissolution of gaseous ozone and fluid dynamics.

## KEYWORDS

Ozonation; Micropollutant abatement; Oxidant exposure; Empirical model; Machine learning

# [Plenary Speech]
# Recent Advances in Capacitive Deionization Technologies

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## ABSTRACT

Capacitive deionization technologies (CDI) derived from energy storage devices (i.e., supercapacitor and battery) can provide promising opportunities to separate ions from aqueous solutions, including water purification, heavy metals and arsenic removal, nutrient recovery, and wastewater reclamation. In general, the working principles of CDI can be divided into two major categories: electrical double-layer charging by porous carbons and reversible Faradaic reactions by redox materials. In this work, we demonstrated the development of CDI technologies by using nanoengineered materials. For the past decade, nanoporous carbon electrodes prepared by biomass (e.g., templated carbon and waste biochar) were firstly introduced for electrosorption of ions. CDI shows great potential to remove unwanted ions for low-salinity desalination with low-energy consumption. Importantly, CDI-based water treatment system has been successfully proposed for the production of ultrapure water and wastewater reclamation in high tech industries. Moreover, flow-electrode CDI (FCDI) with suspension carbon-based electrodes, composed of an active material, electrolyte, and conductive additives, has further proposed to improve the desalination and energetic performance. Notably, most recent efforts have been focused on redox-flow battery desalination (FBD) with an innovative multichannel cell architecture. By taking advantage of this redox-flow aqueous system, ions can be continuously extracted from saline water with unlimited continuous operation through the charge transfer reactions of redox couples. The energy requirement of FBD was comparable to those of reverse osmosis and electrodialysis for desalination of a high-salinity NaCl solution with a concentration of 35,000 mg/L (seawater level). The results provide valuable information for future CDI studies aiming at more energy-efficient, continuous desalinations of brackish water, seawater, and high-salinity wastewater.

## KEYWORDS

Low-energy desalination; Wastewater reuse; Nanoporous carbons; Redox couples

# [EQC-22-001] Isolation, Selection and Identification of Bacterial Strains from Various Cereal Grains for Decolorization of Molasses-Based Distillery Wastewater

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## ABSTRACT

The study was aimed to isolate a number of endophytic bacteria from rice, corn, sesame and soybean grains to reduce color of the molasses after ethanol fermentation. Liquid minimal salt medium containing 30% molasses-based distillery wastewater (MBDW) was used to quantify the decolorization ability of isolated strains. The remained color of MBDW in the liquid culture medium was determined by spectrophotometer at 650 nm. The results showed that ten out of 39 isolates from rice and corn grains showed their high capacity of decolorization. G4 and G5 strains decolorized up to 30%, and 25.3%, respectively of the MBDW after three days of incubation. The results of an acessment for decolourization efficacy of three microbial by-products fermented individually with G4, G5 strains and endophytic microbial community from rice grains showed that after two consecutive treatment stages, the decolorization efficacy of these three microbial by-products was very high (60.2%, 68.5% and 79.5%, respectively) and significantly higher than that of the control treatment (only with distilled water) (34%). Basing on the 16S-rRNA gene sequence, G4 and G5 strains were indentified relatively to belong to the genus of Enterococcus and they have the closest relationship with *Enterococcus italicus* G4 and *Enterococcus italicus* G5, respectively.

## KEYWORDS

Cereal grains; decolorization; *Enterococcus italicus*; molasses-based distillery wastewater; wastewater

# [EQC-22-002] Short-Term Solar PV Power Prediction Based Deep Learning Convolutional Neural Network in Smart Solar Plant

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## ABSTRACT

This research proposes a novel solar PV power prediction by utilizing the deep learning methodology with a convolutional neural network (CNN). The convolutional layers are applied to extract different critical patterns in sequential historical data in this proposed CNN. The CNN layers are followed with dropout layers and full-connected layers to predict the futuristic value of generating solar energy with different time-horizon. The weather factors such as temperature, humidity, wind speed, pressure, and wind direction are modeled as input factors for the proposed methodology. The accuracy and performance of the proposed method are evaluated and compared with other persistent deep-learning procedures with some statistical benchmarks in terms of RMSE and MAE. The experiment results prove that the CNN methodology could achieve higher performance with better accuracy and more excellent stability compared with other approaches. Therefore, the CNN could be utilized in predicting the short-term solar PV power in the smart solar plant to enhance operational efficiency and reduce maintenance costs.

## KEYWORDS

Convolutional Neural Network; Short-term Solar PV Power prediction; Deep learning machine; Smart solar plant

# [EQC-22-003]
# The importance of Cham towers to tourism exploitation and development in Ninh Thuan province, Vietnam

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## ABSTRACT

The value of cultural heritage is immeasurable for all communities in the world. It is essential to manage cultural heritage sustainably to ensure the present economic - social - cultural needs, while maintaining those cultural legacies for the needs of future generations. This article presents exploration and development of tourism in Cham towers in Ninh Thuan province, one of the extremely famous ancient relics in Vietnam. Firstly, the author introduces the values and potential of the Cham towers, then analyzes and assesses the current status of tourism in these towers, finally, comes up with some solutions to promote and enhance the Cham towers tourism activities in the future. Especially solutions towards developing ecotourism and sustainable tourism, tourism associated with cultural preservation. In addition, this article would like to suggest a study for the anthropological tourism aspect, which is underdeveloped in Vietnam, through approaching methodologies, theories of this field, and some professionals' views on tourism anthropology in the world.

## KEYWORDS

Cham towers; Cultural heritage tourism, Sustainable tourism, Anthropology of tourism, Ecotourism.

# [EQC-22-004] An Efficient Long Short-Term Memory Approach for Load Power Prediction in Smart Solar Microgrid

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## ABSTRACT

Predicting the load power of a base solar power plant is critical to improving the profit from available solar power. This research develops a deep learning method to predict the load power by utilizing the long short-term memory model. The proposed method could increase the accuracy in hourly predicting the full load power of commercial buildings integrated with a solar power plant. The load operation is generally influenced by the weather parameters such as temperature, dew point, humidity, pressure, wind direction, and wind speed. These parameters affect the load power, which is considered the target factor. Moreover, the advanced meter infrastructure also collects the internal parameters of solar power microgrid over one year, including the battery charged and battery discharged power. These additional parameters were also examined as input parameters in the proposed method. The Long short-term memory (LSTM) algorithm is sought for predicting the full load power of the building. The performance and accuracy of the proposed LSTM are compared and evaluated with other deep learning methodologies with MSE and MAE benchmarks. The experiment results prove that the LSTM obtains greater improvement in both statistical metrics compared with another persistent method.

## KEYWORDS

Load power prediction; Load power prediction; Long short-term memory; Smart solar microgrid.

# [EQC-22-005]
# Fluoride-containing Water: A Global Perspective and a Pursuit to Sustainable Water Defluoridation Management - An Overview

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## ABSTRACT

High levels of fluoride, though, naturally occurring (which can reach as high as 2,800 mg $F^-$/L) in the environment can be toxic to various living organisms. Moreover, it can be transported by water and by its confluences and exacerbated by anthropogenic activities making it an environmental and public health concern. World Health Organization has set the standard for drinking water at 1.5 mg $F^-$/L while the average national effluent standard is 15 mg $F^-$/L. Hence, different defluoridation techniques of aqueous solutions were developed in the past years. This study provides an overview of the popular methods in defluoridation (i.e. adsorption, ion-exchangers, precipitation, membrane, electrocoagulation, and electrodialysis). The mechanisms, critical operational conditions, and research progress are presented. The results further reveal that adsorption, regarded as the primary technique for defluoridation, still needs further development and mostly on its bench-scale and is only proven effective at low initial concentrations. In this study, sorption techniques are also estimated to be 10 to 20 times more expensive in operational costs relative to the other treatments. Furthermore, the majority of the examined literature demonstrated defluoridation at limited initial concentration.

## KEYWORDS

Fluoride Defluoridation; Fluoride environmental levels; Fluoride water standards; Water treatment; Wastewater treatment

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# [EQC-22-006]
# Catalytic oxidation and Electrosorption of Arsenic (III) over a Series of Nano-Textured $MnO_2$ Polymorphs Incorporated in Goethite Nanoparticles

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## ABSTRACT

Manganese oxide ($MnO_2$) incorporated into iron oxide was prepared for arsenite (As(III)) oxidation and subsequent arsenate (As(V)) electrosorption in a capacitive deionization system (CDI). The chemical properties of $MnO_2$ polymorphs, precipitated on goethite (α-FeOOH) nanoparticles, were characterized by X-ray diffraction (XRD), scanning electron microscope (SEM), X-ray photoelectron spectroscopy (XPS), and BET surface area. The voltammetry results showed that the redox couple of Mn(III)/Mn(IV) mediate the catalytic electron transfer with respect to As(III)/As(V) redox equilibrium. The Mn site contributed a high diffusive current to the redox reactivity, meanwhile the Fe site better provided the double-layer electrostatic capacity for arsenic species. Electrolysis of arsenite under constant anodic potential mode (+1.0 V vs. Ag/AgCl) enabled assess the performance of the electrodes. The consecutive reaction kinetics was derived to determine the effect of Mn to Fe molar ratio on the rate of electrochemical oxidation and adsorption of arsenic. Among the polymorphs, γ-$Mn_{0.2}Fe_{0.8}O$ exhibited the best arsenic adsorption capacity of 48 mg-As $g^{-1}$, compared to that of α-FeOOH NPs (15 mg-As $g^{-1}$) and γ-$MnO_2$ (7 mg-As $g^{-1}$), based on multilayer adsorption model.

## KEYWORDS

Arsenic, Capacitive deionization, Electrooxidation, Goethite, Adsorption isotherm

# [EQC-22-007] Treatment of Wastewater in Sewage Treatment Plant using Photoelectro-Fenton Process

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## ABSTRACT

Wastewater needs to be treated before discharge to ensure that it does not pollute the water environment. The Photoelectro-Fenton process (PEFP) was utilized to remediate a sample from a sewage treatment facility. It is an economical, practical, and environment-friendly technology for removing organic matter in wastewater. It is an advanced electrical oxidation process that utilizes UV light to degrade organic pollutants in water. This study aims to degrade the organic pollutants, specifically the COD and BOD, and observe the influence of $Fe^{2+}/H_2O_2$ molar ratio, pH of the solution, and current density on the percent reduction of COD and BOD in domestic wastewater using PEFP. The factors were varied at 0.002 and 0.004 for $Fe^{2+}/H_2O_2$ molar ratio, pH of 2 and 4, and current density of 75 and 113A/$m^2$. The operating time ran for 90 minutes in all trials. The results showed that the highest % BOD reduction of 97.7% and highest % COD reduction of 98.54% were obtained at 0.004 $Fe^{2+}/H_2O_2$ molar ratio, pH of 4, and current density of 113 A/$m^2$. It has been proven that PEFP can effectively reduce the COD and BOD in domestic wastewater.

## KEYWORDS

Photoelectro-Fenton Process; Organic pollutant; Biochemical Oxygen Demand (BOD); Chemical Oxygen Demand (COD); Current Denisty

# [EQC-22-008] Homogeneous-Nucleation Fluidized-Bed Fenton at pH 6.0

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## ABSTRACT

Fenton process has two main drawbacks, acidification requirement and fluffy $Fe(OH)_3$ sludge generation. To overcome these disadvantages, a homogeneous-nucleation fluidized-bed Fenton reactor operated at pH 6.0 has been developed. At pH 6.0, $Fe^{2+}$ solubility was found to be 0.6 mM, the level that is still sufficient for polishing step in the tertiary treatment such as decolorization, reduction of residuals refractory pollutants and COD, etc. In addition, since effluent standards for pH of most countries are between 5.5 to 9.0, there is no need to use acid or alkaline for acidification or neutralization. Hence, TDS increment after treatment is minimal. Under the studied conditions of 1 mM $Fe^{2+}$, 2.5 – 5.0 mM $H_2O_2$, 1.7 – 41.2 m/d of superficial upflow velocity which equivalent to 24 – 1 h of HRT, and pH 6.0, total iron removal efficiency of greater than 90% could be achieved at the superficial upflow velocity of 3.4 m/d or lower. Wash out of particulate iron was observed at higher upflow velocity. Iron oxide pellets formed through homogeneous nucleation obtained during the 6-month period were amorphous and had an average diameter of 44 μm. The presence of 0.5 mM formic acid, the final aqueous intermediate from the reaction between hydroxyl radicals and organic pollutants, slightly deteriorated total iron removal performance, i.e., down from greater than 90% to 83% - 87%; however, 90% or more of formic acid being added could be removed within 12 h. This implies that Fenton reaction could proceed effectively at pH 6.0. However, as the formic acid increased to 1 mM, only 30% was removed possibly due to insufficient $H_2O_2$. Remaining formic acid formed complexes with $Fe^{3+}$ hindering the iron precipitation and interfered with homogeneous nucleation process. As a result, only 23% to 33% of total iron were removed. In addition, it was found that obtained iron oxide pellets possessed a catalytic activity in which 68% to 73% of 0.5 mM formic acid could be removed in the presence of 2.5 and 5.0 mM $H_2O_2$ without $Fe^{2+}$ supplement in a 12-h period. In conclusion, homogeneous-nucleation fluidized-bed Fenton operated at pH 6.0 was found to successfully remove both organic pollutants and total iron. Thus, it can be applied as a tertiary treatment unit for polishing purpose.

## KEYWORDS

Advanced oxidation processes; Formic acid; Hydroxyl radicals; Iron crystallization

# [EQC-22-009] Characterization of Homogeneous-Nucleation Fluidized-Bed Fenton

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## ABSTRACT

Ordinary fluidized-bed Fenton process eliminates bulky and high-moisture-content $Fe(OH)_3$ sludge, generated after neutralization of the Fenton process, by introducing foreign solid particles to stimulate heterogeneous nucleation. Obtained iron oxide-coated pellets which are rigid and contain very low moisture content can be more easily to manage and dispose. Nonetheless, the foreign material at the pellet core still increases the overall disposal cost. Homogeneous-nucleation fluidized-bed Fenton, on the other hand, employs in situ freshly-formed $Fe(OH)_3$ precipitates as the cores for nucleation and crystallization. As a result, no external supplement of solid particles is needed. This study varied the superficial upflow velocity in the fluidized-bed and $H_2O_2$ concentration from 1.6 to 38.3 m/d (equivalent to the HRT of 24 to 1 h) and 2.5 to 5.0 mM, respectively. Ferrous and pH were maintained constantly at 1 mM and 4.0. It was found that most $Fe^{2+}$ was oxidized to $Fe^{3+}$ and sequentially precipitated out via homogeneous nucleation after the initiation of Fenton reaction. Iron oxide particles obtained at the initial stage were very small; hence, the superficial upflow velocity had to be maintained at 1.6 m/d to prevent significant solid wash out. The upflow velocity was increased sequentially to 38.3 m/d once the fluidized solids became larger. Total iron removal efficiency of the fluidized-bed reactor was at 65% at the upflow velocity of 1.6 m/d and increased to 70% and 80% when the upflow velocity rose to 2.4 and 3.2 m/d, respectively, in the presence of 10 mM $H_2O_2$. However, with 5 mM $H_2O_2$, the performance was better around 78% to 80% for the upflow velocities from 1.6 to 3.2 m/d. This is because oxygen gas bubbles from H2O2 decomposition was higher at high $H_2O_2$ and, as a result, intensifying the carry over of iron oxide particles. Regardless of $H_2O_2$ concentration, total iron removal reached a plateau of approximately 85% at upflow velocity of 4.8 m/d and higher. Therefore, to successfully stimulate the homogeneous nucleation in the fluidized-bed Fenton reactor, superficial upflow velocity is considered a very important factor. Formic acid, the final soluble intermediate from the reaction between hydroxyl radicals and organic pollutants before being mineralized to carbon dioxide, at 1 mM did not cause any significant deterioration in total iron removal as initially expected. This might be because most of formic acid being added was oxidized by hydroxyl radicals through Fenton reaction leaving very low residuals to form complexes with $Fe^{3+}$. In conclusion, homogeneous-nucleation of iron oxide in a fluidized-bed Fenton reactor is feasible. Total iron and organic removals can be simultaneously achieved under optimum conditions.

## KEYWORDS

Advanced oxidation processes; Formic acid; Hydroxyl radicals; Iron crystallization

# [EQC-22-010] Synthesis of Metal Ferrite@Graphene Oxide Nanocomposite for Photocatalytic Degradation of Organic Pollutants in Simulated Wastewater

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## ABSTRACT

Dyes have been used in the manufacturing processes in papermaking, printing, textile, and dyeing industries. However, a massive volume of these dyes has entered water bodies and became a risk to water quality and eventually to aquatic life and human health. This being said, there is a need to find simple yet highly efficient and cost-effective methods to remove dye from wastewater before it is disposed into water bodies. This work investigated the potential of metal ferrite nano-enabled graphene oxide composites (M= Cu, Co, or Ni) as low-cost adsorbent and photocatalyst for removal of dye molecules from aqueous solution. Herein, $MFe_2O_4$@GO (M = Cu, Co or Ni) was synthesized via solution combustion method. The characteristics of the $MFe_2O_4$@GO, including surface area and pore diameter, elemental composition, and surface functional groups were examined. Methylene blue (MB) was used as representative dye pollutant. The maximum adsorption capacity of the $MFe_2O_4$@GO (M = Cu, Co or Ni) composites obtained from the Langmuir isotherm equation was 25.83, 50.25 and 76.34 mg g-1. The kinetics study illustrated that the adsorption of MB onto $MFe_2O_4$@GO fit the pseudo-second-order model. Moreover, photocatalytic activity of MB under UV irradiation was determined. Then, the as-synthesized $NiFe_2O_4$@GO exhibited highest performance on complete degradation of the colored water matrix in short irradiation times of 150 min with nominal catalyst loading at 0.5 g $L^{-1}$. These adsorbents and photocatalysts were promising for practical application in nanotechnology.

## KEYWORDS

Adsorbents; Graphene oxide; Metal ferrite; Methylene blue; Photocatalysts

# [EQC-22-011] Bioethanol Production from Pineapple (A. Comosus) Fruit Rejects via Anaerobic Fermentation Process

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## ABSTRACT

Pineapple (*A. comosus*) fruit rejects has been one of the contributors to solid waste management problems, which leads to environmental disorder such as rapid depletion of the world's energy supply and pollution. This study utilized whole pineapple fruit rejects as biomass for bioethanol production via anaerobic fermentation process. In the process, the pineapple fruit rejects were subjected to chopping, blending, squeezing, water bath at 100 ˚C for 4 h, and acid hydrolysis at 50 ˚C for 4 h. The effects of yeast loading and fermentation time were investigated through the central composite design of response surface methodology. The optimum bioethanol yield of 74.93±0.46 was recorded at 2 tsp yeast loading and 68.57 h fermentation time. The produced bioethanol at optimum condition was subjected to parameter testing. The results were 0.789 g/mL density at room temperature, 1.319 cSt kinematic viscosity at 27 ˚C, the higher heating value of 4600 BTU/lb, and 37.6 ˚C flashpoints. The FTIR results of the biomass showed that pineapple fruit rejects juice contained carbonyl and alcohol groups, which indicates its substantial potential for quality bioethanol production.

## KEYWORDS

Pineapple, bioethanol, anaerobic fermentation, central composite design, biomass

# [EQC-22-013]
# PBDE Reduction in the Startup of Municipal Solid Waste Incinerators

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## ABSTRACT

High polybrominated diphenyl ether (PBDE) emissions are emitted during the startup period. Unlike other persistent organic pollutants (POPs), controlling PBDE emissions based on PCDD/F formation mechanisms during this problematic period has not always been successful. The fate of residual PBDEs in the incinerators is different from PCDD/Fs, implying different degradation mechanisms. Also, PBDEs have been used as flame retardants and are thus found in high content in municipal and industrial wastes. Therefore, this study employs three groups of strategies to reduce PBDEs in this period. Flue gas samples were collected during four formation potential periods: (1) when the combustion chamber temperature was <200 ℃; (2) when the temperature was 200-400 ℃; (3) waste feeding; and (4) stable combustion. The concentrations were compared to those from a typical startup process. The PBDE concentrations in the formation potential periods were: 500 ng $Nm^{-3}$, 247 ng $Nm^{-3}$, 141 ng $Nm^{-3}$, and 113 ng $Nm^{-3}$, respectively. Adopting the control strategies reduced the concentrations by 99%, 97%, 94%, and 88%, respectively. Furthermore, the PBDE emission was reduced by 97% to 8.94 mg. Therefore, the control strategies can successfully reduce PBDE emissions during the startup process.

## KEYWORDS

Control strategies; Startup; POPs; Waste-to-Energy plants

# [EQC-22-014]
# A Pilot Study of Textile Wastewater Reclamation Using a Mobile Wastewater Recycling System (MWRS-*SuperCycle*™)

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## ABSTRACT

Wastewater reclamation was emergent and critical under water resource shortages in Taiwan, especially experienced the worst drought over 56 years during 2021. A containerized mobile wastewater recycling system (MWRS, *SuperCycle*™), which consisting of an auto-cleaning filter, a pressured ultrafiltration (UF) and subsequent two-stage reverse osmosis (RO) membranes which were installed in a 20" container was developed. Operational parameters such as flow, pressure, level with running settings for UF/RO membrane processing and cleaning are easy to access and adjust via a human-machine interface (HMI) panel. In order to evaluate its technical feasibility and stability of reclaimed water, a pilot study was conducted in a famous textile manufacturing plant in South Taiwan for three months. A pressurized hollow-fibre ultrafiltration (UF) with pore size of 0.01 μm achieved stable yield of 3-5 $m^3$/h with recovery rates of 85-90%, while the subsequent anti-scaling reverse osmosis (RO) in spiral wound modules (8040) achieved stable yield of 1.0-1.8 $m^3$/h with recovery rates between 60-75%. Even though high fluctuations of feed (ranges of COD and SS were 50~120 and 10~40 mg/L, respectively), excellent permeate quality was obtained in terms of lower cation (Fe, Ca, Mg, Al and Mn) and anion (chloride, silicate, sulphate, phosphate and nitrite) concentrations than the current used soften water and manufacturing water supply. It demonstrated the successful application of using the MWRS in the textile wastewater reclamation. However, it was noted that the membrane fouling resulting from high loading of raw textile wastewater was a potential risk for long term operation. Therefore, we suggested intensive monitoring trans-membrane pressure (TMP) is necessary and increasing frequency of chemical enhanced backwashing (CEB) as a practical strategy for the MWRS in this case.

## KEYWORDS

Textile wastewater; reclamation; ultrafiltration; reverse osmosis; membrane fouling; membrane cleaning.

# [EQC-22-016]
# Modelling the Rice Production and Consumption in the Philippines: A System Dynamics Approach

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## ABSTRACT

Despite being a large rice producer for several years, the Philippines has been suffering from a rice shortage. Hence, the shortage is supplemented by imported rice. To address this growing problem, this paper study the interactions between the production and consumption of rice along with the several factors which involve a number of changes to the production and consumption through system dynamics modeling. We focus on three scenarios on the system dynamics model, which entails the possible effect on rice self-sufficiency and import dependency ratio by simulating the realistic values on rice production and rice consumption based on the PSA data. Historical data from 1995 was utilized and analyzed to build the model to have meaningful information regarding how the system behaves with the various factors. After the model has been validated, several scenarios are simulated and analyzed on the different sustainability dimensions, specifically the Philippines' Agricultural Indicator System. Results showed that production and consumption interventions are crucial to improving the Philippines' self-sufficiency and import-dependency ratio.

## KEYWORDS

System Dynamics, Rice, Self-Sufficiency Ratio, Modelling.

# [EQC-22-017]
# Recovery of Copper and Nickel Ions from Printed Circuit Board Wastewater via Fluidized Bed-Homogeneous Granulation Process

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## ABSTRACT

The fluidized-bed homogeneous granulation process (FBHGP) was used to treat printed circuit board wastewater containing copper and nickel ions in this study. The treatment was carried out in a single reactor, simultaneously removing and granulating copper and nickel ions. In this study, the effect of total carbonate loading (10 mM, 12 mM, 15 mM, 17 mM, 20 mM) on the treatment of $Cu^{2+}$ (6.3 mM) and Ni2+ (3.4 mM) was evaluated with an initial precipitant flow rate of 15 mL/min and an initial operating pH of 6.5 that was shifted to 8.5 pH over a period of time. When 17 mM of $CO_3$ was used in the system, the synthetic wastewater containing copper and nickel ions had better results in terms of size of recovered granules, removal and granulation efficiencies, with copper removal of 97.5 percent, copper granulation of 93.1 percent, and nickel removal and granulation efficiencies of 81.2 percent and 73.6 percent, respectively. The recovered granules were >0.42 mm in size and had a rough surface, and EDX analysis revealed the presence of oxygen, copper, and nickel.

## KEYWORDS

Green Technology, Printed Circuit Board, Copper Ions, Nickel Ions, Operating pH, Molar Ratio, Precipitant, Flow Rate

# [EQC-22-018] Photocatalytic Oxidative Degradation of Methylene Blue Using Novel Waste Silica-Supported Fe-Co Bimetallic Catalyst

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## ABSTRACT

A novel Fe-Co bimetallic catalyst supported on waste silica was prepared by fluidized-bed crystallization (FBC) process. The photocatalytic oxidative (PCO) degradation of methylene blue (MB) over the FBC-derived Fe-Co catalyst (fFCS) under various conditions, such as initial pH, $H_2O_2$ dosage and catalyst loading, has been investigated. The acquired optimum conditions for PCO degradation of MB were initial pH of 3.0, 3.0 mM of $H_2O_2$, and 1.0 g $L^{-1}$of catalyst loading leading to decoloration and mineralization efficiencies of 100% and 64.57%, respectively. A contrastive Fe-Co catalyst was synthesized by a commonly used impregnation method (iFCS) to compare and prove the catalytic efficiency of the fFCS catalyst. The fFCS catalyst presented comparable decoloration and mineralization efficiencies, and remarkably lower Fe and Co leaching compared to that of the iFCS catalyst. Fourier transform infrared spectroscopy, energy dispersive X-ray spectroscopy and scanning electron microscopy were used to characterize the resulting products. The results displayed the successful incorporation of iron and cobalt on the $SiO_2$ support surface. The incorporation of Fe into Co did not only enhance MB decoloration and mineralization, but also inhibited the leaching of Co in the system implying better catalytic stability.

## KEYWORDS

Bimetallic catalyst; Fluidized-bed crystallization; Methylene blue; Photocatalytic oxidative degradation; Waste silica

# [EQC-22-019] Development of An Automated Vermicomposting System for Quality Production of Vermicast and African Night Crawler

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## ABSTRACT

The automated system can maintained an adequate range of 60-80% soil moisture content and 10-35°C soil temperature. This may affects the aerobic conditions of the bedding for the African Night Crawler. The moisture content and soil temperature of the traditional method of vermicomposting fluctuates since it cannot control the said parameters during the process of composting. With data results produced, the automated system stabilized faster compared with the traditional vermicomposting. It produces more vermicast and African Night Crawler than the traditional method of parameters monitoring in the vermicomposting. However, the results of the nitrogen and phosphorus content in the vermicast quality test for both systems have almost similar results since the substrate used for both systems are the same.

Based on the results, the soil moisture content and soil temperature of the two systems with the standard level have a difference based on the monitored results which can influence the vermicomposting process. The result shows that the soil moisture content of the automated system is approximately between 60–75 % which is within the set standard (60–80%) for vermicomposting. Whilst for soil temperature, the result shows that the soil temperature of the automated system is quite lower compared with the manual system that approximately between 25-29$^{o}$C. This shows that automation for vermicomposting has a lot of advantage in vermicast and vermi worms production that has impact to socio-economic aspect.

## KEYWORDS

Vermicomposting; Vermicast; African Night Crawler; Agricultural Waste

# [EQC-22-020] Wastewater Desalination via Flow-Electrode Capacitive Deionization (FCDI) Using Carbon Nanotubes/Activated Carbon Hybrid

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## ABSTRACT

Nanotechnology-enabled electrochemical technologies derived from energy storage devices (i.e., supercapacitor and battery) can provide promising opportunities to separate ions from aqueous solutions with high charge efficiency. For the past decade, capacitive deionization (CDI) using highly porous carbon electrodes has drawn much attention due to its low energy consumption for low-salinity water (i.e., total dissolved solids (TDS) concentration < 4000 mg/L) and environmental friendliness. Most recently, flow-capacitive deionization (FCDI), consisting of a desalination chamber and two electrode chambers, has been introduced to further increase the desalination performance over a wide salinity working range. In FCDI, carbon suspension electrodes are composed of an active material, electrolyte, and conductive additives. The main objective of this study is to utilize the carbon nanotubes/activated carbon (CNTs/AC) hybrid as a suspension electrode in FCDI for high-performance desalination of wastewater. As a result, significant improvement of the average salt removal rate (ASAR) of FCDI can be achieved by adding the CNTs into the flow-electrode. FCDI with a total carbon content of 10 wt.% and CNTs of 0.25 wt.% had an ASRR of 1.59 μmol/cm$^2$–min for desalting 0.30 M NaCl solution at 1.6 V. Notably, a high conductivity reduction (94%), high charge efficiency (> 99%), and low energy consumption (0.034 kWh/mol) were achieved by using FCDI for the desalination of real saline wastewater. The findings demonstrate the high potential of FCDI for practical application of wastewater desalination and reclamation.

## KEYWORDS

Electrochemical desalination; Wastewater reuse; Carbon suspension electrode; Capacitive deionization

# [EQC-22-021]
# Sandwich-like $NiCo_2O_4$/MXene composite with enhanced catalytic activation of peroxymonosulfate for Ibuprofen degradation

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## ABSTRACT

The development of two-dimensional (2D) transition metal carbides (MXenes) has attracted more and more attention due to their extraordinary physical properties. In this work, a sandwich-like $NiCo_2O_4$/MXene (NCMs) was used as an innovative heterogeneous catalyst for the oxidative degradation of Ibuprofen (IBP) based on peroxymonosulfate (PMS) activation. The results revealed that NCM composite exhibit a good removal efficiency of IBP in 15 min. The influence of catalyst dose, PMS dosage, initial pH, IBP concentration, co-existing inorganic ions ($HCO_3^-$ and $Cl^-$), and humic acid (HA) were extensively investigated. The co-existence of sulfate radicals ($SO_4^{\bullet-}$) and hydroxyl radicals($^{\bullet}OH$) was confirmed based upon electron paramagnetic resonance (EPR) analysis and radical scavenger tests, while $SO_4^{\bullet-}$ was identified as the main reactive species in the NCM/PMS system. Overall, this study widens the scope of employing Mxene-based composite as heterogeneous catalysts towards PMS activation for remediation of organic pollutants.

## KEYWORDS

MXene, Peroxymonosulfate, Sulfate radicals, Ibuprofen, $NiCo_2O_4$.

# [EQC-22-022] A Screening Design of the Ultrasound Assisted Oxidative Desulfurization of Diesel Oil

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## ABSTRACT

This research is focused on the analysis of raw diesel oil to be subjected to an ODS technique. The effects of time and amplitude via ultrasonication probe and the material usage of tetraoctylammonium bromide, polyoxometalate catalyst, hydrogen peroxide, organic phase to aqueous phase ratio, and temperature were studied. The JMP 11.0 software was utilized by a definitive screening design for a comprehensive statistical screening analysis to determine the significant and insignificant variables in the oxidation of sulfur compounds. Upon the oxidation of sulfur compounds in diesel oil, results suggested that the time of ultrasonication, amplication, polyoxometalate catalyst, and temperature were the only significant factors based on the probability value (p-value < 0.05). On the other hand, the hydrogen peroxide, tetraoctylammonium bromide and organic phase to aqueous phase ratio were found to be insignificant variables (p-value > 0.05). The aforementioned factors are essential due to their ability to instigate the conversion of sulfur to its corresponding sulfone forms in the ODS system amplified by high-shear mixing. Therefore, it can be concluded that further optimization analysis of the significant parameters may be attained to have deep desulfurization to pass the environmental standards. The applicability of the ODS in industrial practice can also take part in mitigating climate change worldwide.

## KEYWORDS

Diesel oil; Parametric screening analysis; Polyoxometalate catalyst; Sulfone, Sulfur; Ultrasound probe

# [EQC-22-023] Paracetamol Removal from Aqueous Solution through Activated Carbon from Mango Seeds

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## ABSTRACT

The rapid use of paracetamol increases its concentration in bodies of water, resulting in adverse effects on aquatic species and even to humans. This study uses activated carbon from the mango seeds as an adsorbent for the removal of paracetamol in aqueous solution. The activated carbon from mango seeds was characterized through Scanning Electron Microscopy (SEM) and Fourier Transform Infrared Spectroscopy (FTIR). The optimization of the operating parameters such as initial paracetamol concentration, adsorbent dose, and contact time in the removal of paracetamol was administered through Central Composite Design of the Response Surface Methodology to attain optimum removal efficiency. The result indicated that the adsorbent had a mesopore and macropore structures with functional groups such as carboxylic acid, amines, alkenes, ketones, ethers, phosphine oxides, aromatics, and alkyl halides. The optimum conditions were marked at 150 ppm initial paracetamol concentration, 1.95 g of adsorbent dose, and 64 min contact time with a removal efficiency of 94.01 ± 2.16% and adsorption capacity of 7.23 mg/g. Based on the results given, mango seeds activated carbon was effective for the removal of paracetamol in aqueous solution.

## KEYWORDS

Adsorption, activated carbon, mango seeds, central composite design, fourier transformation infrared spectroscopy, scanning electron microscopy

# [EQC-22-024] Characteristics and Distribution of Microplastics in Peatland: A Case Study in Long An Province, Viet Nam

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## ABSTRACT

Plastic pollution is recognized as one of the global environmental issues. The purpose of the study was to evaluate the characteristics and distribution of microplastics in peatland, a case study in Long An Province, Viet Nam. This study conducted field surveys and selected representative sampling sites in Thanh Hoa District, Long An Province, at ten different peatland areas. Samples are processed to determine the abundance (items per kg), particle size, color, shape, and polymer types. The levels of microplastic contamination showed that particle size was reported from 100 to 5000 μm, and the average concentration fluctuated from 0 to 360.0 items/kg in the peatland areas. Microplastics are detected in a wide range of sizes, the shape is mainly in the form of the fragment (69.6%), foam (17.4%), fiber (8.7%), film (4.3%), respectively, and their colors include white, aqua, blue, sand, orange, black, etc. FT–IR analysis of microplastic components in the peatland areas illustrated that polyvinyl chloride (PVC) is the primary polymer (70.6%), followed by polypropylene (PP), polyethylene (PE), and polyester fibers, respectively. The results demonstrated the spatial distribution of microplastics, indicating the first signals of human-related impacts on the status quo of peatland quality. Also, the findings play an important role in raising concerns about the accumulation of MPs in aquatic ecosystems. Therefore, in the long term, it is necessary to propose appropriate solutions to effectively natural resources management and protection (i.e., peatland) that deal with the pressures of socio-economic activities.

## KEYWORDS

Microplastics; Viet Nam; polyethylene (PE); peatland; polypropylene (PP); distribution.

# [EQC-22-025]
# Efficient Removal of Eriochrome Black-T from Aqueous Solution through Activated Carbon from Residual Coffee Grounds

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## ABSTRACT

Synthetic dyes, like azo dye, have been used significantly in different industries worldwide. Azo dye is an aromatic compound that contains one or more azo bonds. The most common azo dye is the Eriochrome Black T (EBT) which is used as an indicator of water hardness. In this research, EBT was considered a contaminant in a synthetic aqueous solution. Activated carbon derived from residual coffee grounds has been used as an adsorbent for the removal of EBT in an aqueous solution using batch and column adsorption method. The adsorbent dose, initial concentration, and contact time were the parameters investigated on the batch adsorption, while only the adsorption height and initial concentration were in the column. Scanning Electron Microscopy (SEM) with an acceleration of 15kV, and 200x and 500x magnification were applied to investigate the surface structures of the adsorbent. Fourier Transform Infrared (FTIR) was also applied to identify the functional groups present in the activated carbon. The Response Surface Methodology – Central Composite Design (CCD) was applied to get the optimum conditions of the independent variables. The adsorption process and mechanism of the activated carbon from residual coffee grounds were further analyzed through isotherm and kinetic study, respectively. The result showed that the adsorbent has a porous structure in a honeycomb shape. The functional group present on the activated carbon which is also an indicator of the efficiency of the adsorbent to remove EBT is aromatic with C = C – C stretch. The optimum values in batch adsorption were 0.3 g adsorbent dose, 50 ppm initial concentration, and 90 min contact time with 93.26% EBT removal. In column adsorption, there were 7 cm adsorbent height and 40 ppm concentration with 92.66% EBT removal. In isotherm, where Langmuir and Freundlich models were used, the best-fitted model in the batch was the Langmuir while in the column is Freundlich. In kinetics, where pseudo-first order and pseudo-second order were considered, the best-fitted model both in batch and column was the pseudo-second order.

## KEYWORDS

Adsorption, Activated carbon, Residual coffee grounds, Eriochrome Black T

# [EQC-22-026]
# Effect of $TiO_2$ on the geopolymer composite membrane characteristics and antibiotic removal performances

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## ABSTRACT

This research focused on the development of porous geopolymer composite membranes (PGCMs) for the removal of antibiotic presented in hospital wastewater. The PGCMs consisted of two layers, in which the porous geopolymer was applied as a support layer and the active layer was synthesized by incorporating different amount of $TiO_2$ (0, 2, 6, and 10 wt%) into the geopolymer matrix. The effects of $TiO_2$ on the geopolymer characteristics and the antibiotic removal performances were investigated. The characterization results revealed that $TiO_2$ was successfully immobilized in the geopolymer structure and the PGCMs had the strong adhesion between layers. With an increase in $TiO_2$ content, the average pore width, total pore volume, and open porosity were slightly decreasing, while the water permeability reduced from 2361 to 848 L $m^{-2}$ $h^{-1}$ $MPa^{-1}$. In the experiment of antibiotic removals (amoxicillin, ciprofloxacin, norfloxacin, sulfamethoxazole, tetracycline, and trimethoprim), the removal efficiencies of the total antibiotics ranged from 23 to 91%. the PGCM with 10% wt $TiO_2$ exhibited the highest removal efficiencies between 78-91% via membrane rejection. The addition of $TiO_2$ into geopolymer enhanced the membrane rejection of antibiotics while reduced its water permeability. The results demonstrated potential application of the PGCMs for the removal of antibiotics from wastewater.

## KEYWORDS

$TiO_2$; porous geopolymer composite membranes; antibiotics removal; hospital wastewater

# [EQC-22-027] Environmental Transformation Regulates the Risks of Chemically Exfoliated Molybdenum Disulfide Nanosheets

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## ABSTRACT

The present work illustrates the impacts of chemically exfoliated molybdenum nanosheets (ce$MoS_2$) to ecosystems are closely related to the altered physicochemical properties (e.g., ionic dissolution and phase composition) of $MoS_2$ brought about by environmental transformation processes. The results demonstrated that the *in vivo* biological responses induced by aged $MoS_2$ nanosheets were found to deviate from their primitive attributes, revealing that much attention should be given to aged $MoS_2$. The lower survival rate of embryonic zebrafish with aged ce$MoS_2$ compared to those of their pristine counterparts was attributed to the release of ionic Mo aging products during the oxidative-dissolution process of ce$MoS_2$. Furthermore, we emphasize that the transformations of $MoS_2$ nanosheets with environmental macromolecules should be considered while evaluating the impacts and environmental risks of $MoS_2$, owing to the natural organic matter-induced changes in the distribution of Mo ionic species. The released Mo species complex with different organic macromolecules to varying degrees and this mitigates the overall toxicity resulting from exposure to ce$MoS_2$. Therefore, ecological risks regulated by environmental transformations (e.g., interactions with environmental organic macromolecules) are critical and need to be accounted for when predicting the impact of ce$MoS_2$ on exposed aquatic organisms.

## KEYWORDS

Transition metal dichalcogenides; Oxidative dissolution; Environmental risks; Ionic Mo species

# [EQC-22-028] Characteristics of Chitosan Membrane in Combination with Moringa Leaf Extract

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## ABSTRACT

Membrane chitosan (CHI) - and chitosan membrane supplemented with antioxidant moringa extract (MOE) were reviewed in this study. By soaking method, water solvent was used to extract the bioactive substances from moringa leaves in Vietnam. Different concentrations of MOE were added to the CHI membrane. The CHI, CHI-2, 4, 6, 8 and 10% MOE membranes were analyzed for mechanical properties, moisture, solubility in water, transmittance, and swelling degree. The results showed that the CHI-6% MOE composite membrane exhibited the most excellent properties. Besides, the antioxidant capacity DPPH of chitosan membranes with moringa leaf extract was also measured. This study demonstrates the promising future of CHI-MOE coordination membrane that can be a desirable alternative to aggressive packaging in related fields. Membrane chitosan (CHI) - and chitosan membrane supplemented with antioxidant moringa extract (MOE) were reviewed in this study. By soaking method, water solvent was used to extract the bioactive substances from moringa leaves in Vietnam. Different concentrations of MOE were added to the CHI membrane. The CHI, CHI-2, 4, 6, 8 and 10% MOE membranes were analyzed for mechanical properties, moisture, solubility in water, transmittance, and swelling degree. The results showed that the CHI-6% MOE composite membrane exhibited the most excellent properties. Besides, the antioxidant capacity DPPH of chitosan membranes with moringa leaf extract was also measured. This study demonstrates the promising future of CHI-MOE coordination membrane that can be a desirable alternative to aggressive packaging in related fields.

## KEYWORDS

Chitosan antioxidant membrane; Moringa leaf extract; water solvent

# [EQC-22-029] Development of Portable IoT-Based Multi-Sensor System for Air Quality Monitoring

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## ABSTRACT

Air pollution has a detrimental effect on human health because of harmful chemicals produced from many anthropogenic activities in the environment. Air quality monitoring is essential to assess the condition of a safer environment. The main objective of this study is to develop a portable IoT-based multi-sensor system for air quality monitoring that measures the levels of carbon monoxide (CO), particulate matter (PM2.5 and PM10), air temperature, and wind speed. The system is composed of a Raspberry Pi board, low-cost sensors, power supply, plastic pipe casing, and a metal stand. Data gathered are stored in MySQL database, and uploaded to Amazon Web Services cloud service. The system prototype was tested and implemented for 24-hrs in seven days at two locations. One hundred forty-four (144) samples were collected continuously per day. Results for the 7-days mean of each sensor are 15.53 $\mu g/m^3$, 46.57 $\mu g/m^3$, 7.76 ppm, 26.22 $^oC$, and 0.77 m/s for PM2.5, PM10, CO, ambient temperature, and wind speed, respectively. The baseline data gathered proves the functionality and technical feasibility of the system. Hence, creating more prototypes to monitor more locations in the future is possible.

## KEYWORDS

Benzothiophene; Dibenzothiophene; Phase transfer agent; Phosphotungtic acid; Ultrasound-assisted oxidative desulfurization

# [EQC-22-030] Reclamation of Aluminum as α-$Al(OH)_3$ in an Aqueous Solution by Fluidized-Bed Homogeneous Crystallization Technology

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## ABSTRACT

Aluminum metal is easily oxidized in the natural environment and exists in the stable form of oxide. Nowadays, aluminum has been widely used in various industries, and also applied to water purification plant for coagulation of impurities. Alum and PAC often used to be as coagulants to remove the pollutants in water. During the treatment, the aluminum ion would eventually appear in the form of aluminum hydroxide. It was a kind of high moisture content sludge. The sludge treatment required more units for subsequent separation and dewatering, which would increase a lot of costs. Therefore, fluidized-bed homogeneous crystallization technology (FBHC) would be efficiently utilized for aluminum treatment to recover aluminum by synthesizing low moisture content and high crystallinity particles. In this study, 700 mg-Al/L of aluminum-containing synthetic wastewater was regarded as mainly treatment target. According to characteristic of aluminum, aluminum hydroxide could be produced by adjusting pH. Followed by the steps of precipitation, sludge aging, and granulation of crystalline aluminum hydroxide were carried out in FBHC. At pH 9.7, 39.7 m/h of up-flow velocity,0.86 kg/$m^2$h of surface loading, and addition of sedimentation tank, the total removal efficiency could achieve to 99 % and the residual concentration was 0.3 mg-Al/L. Crystalline ratio achieved to 80%. That meant the sludge could be decreased over 80% by FBHC, and be converted to crystalline aluminum hydroxide pellets.

## KEYWORDS

Fluidized-bed homogeneous crystallization technology (FBHC); Water purification plant; aging sludge; Aluminium hydroxide

# [EQC-22-031] Removal of Hexavalent Chromium from Water by *Magnetospirillum gryphiswaldense* MSR-1 and The Investigation of Its Chromium Reducing Capabilities

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## ABSTRACT

Chromium has been widely used in various kinds of industries, and contamination was found in many soils and water sources. Thus, there is an urgent need for effective remediation methods. Bioreduction of Cr(VI) has shown its advantages of high efficiency and eco-friendliness, and many pure bacterial strains have exhibited their Cr(VI) reducing capability.

Our study evaluated initial conditions, including cell density, pH, and Cr(VI) concentrations, of Cr(VI) reduction by *Magnetospirillum gryphiswaldense* MSR-1. Our results indicated that strain MSR-1 shows the highest Cr(VI) removal efficiency under a neutral condition (pH 7.0). The removal rate decreased with the increasing initial Cr(VI) concentration and the decreasing initial cell density. Cr(VI) removal rate constants, estimated by the three-half-order kinetics model at 10, 20, and 40 mg/L by the strain MSR-1, are 0.040, 0.041, and 0.013 $hr^{-1}$, respectively. The Cr(VI) removal of MSR-1 was associated with cell adsorption and chromate reductase, accounting for 23% and 77%, respectively. The extracellular, intracellular, and membrane-bound chromate reductases were present in the MSR-1 cell by evaluating its chromate reductase localization through cell crude enzyme extracts. Unexpectedly, our results also demonstrated that the Cr(VI) reducing capability of MSR-1 would not be significantly affected by the presence of magnetosomes. But, cell growth of the magnetosome-forming MSR-1 was significantly inhibited during Cr(VI) reduction. Our results suggest that the *Magnetospirillum gryphiswaldense* MSR-1 is an effective Cr(VI) reducing magnetotactic bacterium and the cellular regulation between cell growth, magnetosome synthesis, and Cr(VI) reduction requires further investigation.

## KEYWORDS

Magnetotactic bacteria; *Magnetospirillum gryphiswaldense* MSR-1; hexavalent chromium; chromium removal; chromate reductase

# [EQC-22-032] Comparison of The Green Factory Label Systems in Taiwan, Thailand and Vietnam

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## ABSTRACT

Due to incessant burning fossil fuels like coal, oil and gas since the 1800s, human activities have been the main driver of long-term shifts in temperatures and weather patterns, known as the climate change. It conducted an impact on human health by lowering environmental quality, increasing the outbreak of diseases, and accelerating the frequency of extreme weather events. As more industrial activities deduced more greenhouse gases, the green factory label systems to control the $CO_2$ emission was essential to all developed and developing countries. This research was dedicated to the understanding of green factory label systems in the new-coming developing countries of Thailand and Vietnam, as well as to make a comparison with the more developed country of Taiwan. The green factory label system applied in this study included the green building system and the cleaner production system. Among all three countries, Taiwan was leading ahead in environmental protection, remediation technology, pollution prevention, and sufficient to become a learning model for developing countries. Meanwhile, Thailand and Vietnam have just started to construct their cleaner production systems. As the results of disparities showed, an elementary green label system mostly for the domestic industry has been established within Thailand and Vietnam, however, the two countries haven't developed the rating system to show the level of the cleaner production reached, of which Taiwan has done already for general industry and for specify industry as well. It indicated an upgrade of the green systems to more refinement was imperatively required for Thailand and Vietnam to be responsible for the suppression of global warming.

## KEYWORDS

Climate change, Greenhouse gases, Green factory label, Green building label, Cleaner production system

# [EQC-22-033] Preparation of Porous Biochar Derived from Sawdust and its application on Sulfamethoxazole Removal

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## ABSTRACT

Highly efficient antibiotic adsorption was achieved using Sawdust porous (SD-P). The material was prepared by sequential hydrothermal carbonization of Sawdust and KOH activation. The adsorbent SD-P had a porous structure with a large surface area of 635 $m^2/g$ was confirmed using $N_2$ sorption and Scanning electron microscope. The effect of the solution pH and time of the adsorption process were subsequently investigated. The adsorption kinetics for Sulfamethoxazole best fitted a pseudo-second-order model, while the adsorption isotherms best fitted the Freundlich model. SD-P was easily regenerated by washing with ethanol and a recyclability test confirmed that ~99% of the initial Sulfamethoxazole adsorption capacity was decreased by less than 1% and 8% after one and four uses, respectively. Thus, considering that the SD-P showed high adsorption capacities and were derived from agricultural waste by a simple hydrothermal process, they seem highly suited for use as efficient and environment-friendly antibiotic adsorbents.

## KEYWORDS

Sulfamethoxazole; Porous carbon; Sawdust; Antibiotic; Adsorption

# [EQC-22-034]
# Study on the Relationship between the Carbon Storage of Ipomoea Aquatica in Constructed Wetland and Nutrients

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## ABSTRACT

With the global reliance on fossil fuels increasing since the industrial Revolution, carbon emissions have increased year by year, with the atmospheric $CO_2$ abundance increasing by an average of 1.78 ppm per year over the past four decades (1980-2019). But during the past decade (2010-2019), the growth rate increased to 2.4 ppm per year. At present, $CO_2$ has reached 415 ppm. $CO_2$ capture and sequestration is an important technology for mitigating climate change. Carbon sequestration is to capture its compounds in the environment and form carbonate compounds or biotype carbon, thus reducing the process of the greenhouse effect. The researchers of Lloyd, J. and Farquhar, G. point out that wetland is one of the high-productivity ecosystems on earth, plays an important role in the global carbon cycle and plays an important role in future climate change and carbon reduction research. In wetlands, plants and other producers will use atmospheric $CO_2$ for photosynthesis and store carbon in organisms and anaerobic soil at the bottom of wetlands with low decomposition rates. The increase of atmospheric $CO_2$ concentration will enhance photosynthesis, and the growth rate of plants is closely related to the nutrient concentration. Therefore, the main theme of this study is to understand the relationship between various nutrients and their concentrations and carbon sequestration in wetlands.

The experimental site of this study is located on the roof of Daxin Building, National Kaohsiung University of Science and Technology. Through a small model field experiment (group AE), different types of nutrient salts ($NO_3$--N, $NO_2$-N, TOC, TKN, $NH_3$-N, $PO_3$-) were added and their concentration was changed, and the growth rate of planting was measured regularly, and then harvested and analyzed. Finally, the content of soil organic carbon was detected before and after the experiment to estimate the amount of carbon sequestration. The correlation of nutrient salt species and concentration with carbon sequestration was obtained to obtain the carbon sequestration benefit of wetland. For the purpose of long-term carbon sequestration of wetland soil, the $CO_2$ sequestration of Ipomoea Aquatica could be removed by means of harvesting, and the carbon content in the soil before and after the experiment was measured, so as to find out the effects of different kinds of nutrients and their concentrations on carbon sequestration efficiency. This method can achieve high efficiency of carbon sequestration in a short time because of rapid growth of Ipomoea Aquatica.

## KEYWORDS

Constructed wetland, Nutrients, Carbon sequestration.

# [EQC-22-035]
# Removal of boron from synthetic wastewater by three-stage calcium-based chemical oxo-precipitation (COP) and its application in real FGD wastewater treatment

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## ABSTRACT

Chemical oxo-precipitation (COP) technology is a proven technology to remove boron from solution using hydrogen peroxide and barium chloride as precipitants. However, high barium residual concentration created another problem for the environment. In this study, the utilization of calcium as a precipitation agent was investigated due to its less-strict water standard. Three-stage calcium-based COP with a multi-filtration process was proposed to prevent the re-dissolution of boron in the calcium system. The operating parameters, including initial pH ($pH_i$), hydrogen peroxide to boron ratio ($[H_2O_2]/[B]_o$), and calcium dosing ratio ($[Ca]_i/[B]_0$) were optimized to obtain maximum boron removal efficiency. The real boron wastewater from the FGD process was also treated. Under the optimum operating parameter of $pH_r$ = 11, $[H_2O_2]/[B]_o$ = 3, and multi-dosing of calcium of $[Ca]_I/[B]_0$ = 1, $[Ca]_{II}/[B]_0$ = 0.5, and $[Ca]_{III}/[B]_0$ = 0.25 for first, second, and third calcium dosing, respectively, the boron concentration can be decreased step by step from 1000 mg-B/L to less than 1 mg-B/L in 15 minutes which is much less than the Taiwanese effluent standard (5 mg-B/L). Calcium-based COP is an alternative method that is environmentally friendly to remove boron from solution without producing secondary hazardous pollutants.

## KEYWORDS

Chemical Oxo-Precipitation; Boron removal; Precipitation; Calcium; Hydrogen peroxide;

# [EQC-22-036] Optimization of Process Parameters in the Upgrading of Scenedesmus Obliquus Oil to High-Quality Liquid-Phase Biofuel by Nickel-Impregnated Biochar Catalyst

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## ABSTRACT

Ultrasound-assisted oxidative desulfurization (UAOD) of dibenzothiophene (DBT) and benzothiophene (BT), using $H_2O_2$ as oxidant, was carried out in the presence of phosphotungstic acid and phase transfer agent (PTA) at 50 – 80 ℃. The effect of process parameters such as temperature, amount of catalyst, amount of PTA, and amount of hydrogen peroxide were investigated to determine the highest reaction rate. The ability to control and predict the influence of various process parameters during the desulfurization process is vital for the enhancement of the system. An increase in temperature from 50 – 80 ℃ resulted to an increase in the desulfurization efficiency. Deep desulfurization of DBT and BT with high selectivity was achieved after 15 min of treatment when the temperature was regulated to 80 ℃ under atmospheric pressure. The optimum amount of PTA with 0.2 g of catalyst to achieved 99% conversion of BT and DBT to their corresponding polar sulfones were 0.10 g and 0.05 g, respectively. The activity of BT also increased markedly when the amount of hydrogen peroxide increased. For DBT, as low as 16% of $H_2O_2$ can lower the concentration from 500 ppm to 10 ppm within 10 min at 80 ℃. The UAOD follows pseudo-first order kinetics.

## KEYWORDS

Benzothiophene; Dibenzothiophene; Phase transfer agent; Phosphotungtic acid; Ultrasound-assisted oxidative desulfurization

# [EQC-22-037] The Inhibition of DSA Anodic Dissolution in Fluorine-Containing Wastewater at Electrolysis Process

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## ABSTRACT

Dimensional stable anode (DSA) is widely applied in electrochemistry for decades due to its stability and producing no secondary pollutant. Electrodeposition is an environmentally-friendly method to recover metal from heavy metal-contained industrial wastewater. Residual fluoride ions that are commonly found in silicon etching rinse bath, copper melting, and metallurgical plant wastewater is a corrosive compound that can damage $IrO_2$ and $Ta_2O_5$ active layer in DSA. In this study, boric acid was investigated as a complexing agent to prevent corrosion as anodic protection of DSA for service life-prolonging. Accelerate lifetime test (ALT) method was applied to quantify the service life under high current density. In the presence of 4 mM of boric acid, anodic service life could be expanded to over 500 hours compared to the unprotected system (160 hours) under the current density of 3 $A \cdot cm^{-2}$ within 4 mM fluoride concentration in 2 M sulfuric acid solution. Compared to the other complexing agents that were investigated in previous research boric acid system could reach the higher current efficiency of 92.5%.

## KEYWORDS

Dimensional Stable Anode; Electrodeposition; Anodic protection; Boric acid; Accelerate Lifetime Test

# [EQC-22-038] Application of Fe-Cu@Al(OH)$_3$ Catalyst forDegradation and Mineralization of RB5 by Visible Light-Assisted Fenton Process in Oxalic Acid System

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## ABSTRACT

A bimetallic catalyst of Fe-Cu@Al(OH)$_3$ that is recovered from the fluidized-bed crystallization process was applied as a catalyst for the heterogeneous photo-Fenton reaction. The deposited binary oxide compound of Fe and Cu onto Al(OH)$_3$ could effectively catalyze $H_2O_2$ to produce an active radical for the degradation and mineralization of azo dye Reactive Black 5 (RB5) under yellow-light irradiation in an oxalic acid system. The operating parameters, including the concentration of oxalic acid and initial pH, were investigated to optimize the degradation and mineralization efficiency in the treatment of 100 mg/L RB5. Under the optimum parameter of 1 g/L catalyst dosage, 5.65 mM $H_2O_2$, pH 3, and 80 mg/L oxalic acids resulted in 70% of TOC removal and 100% of color removal efficiency in 3 hours operation time. The metal oxide that is recovered from heavy metal-contained wastewater was a promising material to be reused as a heterogeneous catalyst for the photo-Fenton process to degrade and mineralize organic pollutants.

## KEYWORDS

Bimetallic catalyst; photo-Fenton; Visible-light irradiation; RB5; Mineralization; Degradation

# [EQC-22-039] Application of Low-Solubility Dolomite as Seed Material for Struvite Recovery ($NH_4MgPO_4.6H_2O$) from Synthetic Wastewater using Fluidized-Bed Crystallization (FBC) Technology

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## ABSTRACT

Struvite ($MgNH_4PO_4.6H_2O$) that could be recovered from nitrogen and phosphorus–contained wastewater has a high potential as an alternative source of phosphorus fertilizer. In this work, the utilization of seeded and unseeded crystallization processes via FBC (Fluidized-bed crystallization) and FBHC (Fluidized-bed homogeneous crystallization), respectively, were compared to obtain higher phosphorus and ammonium removal efficiency. Dolomite-($CaMg(CO_3)_2$) was applied as seed material in the FBC process. Operating parameters, including pH, $[Mg]_0$ / $[P]_0$ molar ratio, and initial phosphorus concentration were first optimized in a batch reactor. Various magnesium sources, including bittern, seawater, digested solid swine manure, and commercial magnesium materials were also tested as precipitants. The hydraulic parameters of FBR (Fluidized-bed reactor), including effluent pHe, the up-flow velocity (U, m $h^{-1}$), and cross-sectional surface loading (L, kg $m^{-2}$ $hr^{-1}$) were investigated to recover phosphorus and ammonium as struvite pellets. Under optimum conditions (pH 8.8, molar ratio of Mg/P=1.3/1, up-flow rate of 40 m $h^{-1}$, cross-section loading of 2.4 kg-P $m^{-2}$ $hr^{-1}$), FBC resulted in higher phosphorus removal efficiency than FBHC system with total removal (TR) = 91.4% and a crystallization ratio (CR) = 81.7%. As confirmed by the XRD pattern, the solid products consist of magnesium ammonium phosphate ($MgNH_4PO_4.6H_2O$) from both FBC and FBHC processes.

## KEYWORDS

Dolomite; Struvite recovery; Wastewater treatment, Fluidized-bed reactor

# [EQC-22-041] The Simultaneous Removal Mechanism of Boron and Nickel via Co-precipitation and Adsorption from Synthetic Nickel-boron-containing Wastewater

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## ABSTRACT

Nickel-boron-containing wastewater is commonly found in the semiconductor packaging industries. However, the mechanism of simultaneous removal of nickel and boron via chemical precipitation was not yet clearly researched. In this study, the co-precipitation and adsorption phenomena of simultaneous removal of boron and nickel were observed during the precipitation of $Ni(OH)_2$. In the co-precipitation experiment, the synthetic wastewater with 20,000 mg-Ni/L and 2,000 mg-B/L was treated by adding 45 wt% of NaOH as a precipitation agent. Under the optimum pHi of 9.50, boron is removed effectively up to 91.1%. Meanwhile, the adsorption effect was tested by adding 4,000 mg-B/L boron solution into 32 g/L dosage of nickel hydroxide sludge. Under the optimum pH of 8.50, boron removal reached 79.6%. It could be determined that the maximum adsorption capacity of boron onto $Ni(OH)_2$ sludge reached 80.1 mg-B/g-sludge via Langmuir Isotherm Model. It is concluded that boron is removed simultaneously via co-precipitation with $Ni(OH)_2$ formation and followed by adsorption onto existed $Ni(OH)_2$ sludge surface. The XRD and FTIR analysis confirmed that the solid product consists of $Ni(OH)_2$ that was shifted under the high concentration of boric acid, indicating the occupation of boron into the lattice of $Ni(OH)_2$ precipitate.

## KEYWORDS

Nickel boron wastewater; Nickel; Nickel hydroxide; Boric acid; Co-precipitation; Adsorption; Lattice

# [EQC-22-042]
# Temporal Variations of Surface Ozone and its Precursors at an Industrial Site in Southern Taiwan

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## ABSTRACT

With emissions arising from anthropogenic sources, ozone-forming as secondary pollution ($O_3$) is a significant concern, especially in industrialized cities. Regarding Taiwan, as one of the major ozone precursors, VOC was defined as the leading cause of increasing surface ozone concentrations. Before the 2000s, there was a rising trend in $O_3$, but due to the quick drop in major pollutants, the $O_3$ level appears to have leveled off from 2007 to 2014. In this study, air quality data from 2015 to 2021 at a coastal station (Qianzhen) was used to assess the air pollution in the long term at the city center of Kaohsiung, an industrialized city on the Southwest coast of Taiwan. Statistical analysis was conducted with $O_3$ and its precursors, including NOx and VOC. The investigation exposed no improvement in $O_3$ concentration, which highest periods are in April and October despite reducing its precursors. There are signs of a shift in the dominant wind direction from Northern West to Northern during the six-year. The influence of meteorology was found when the most contribution of pollution comes from the station's Northern sector. Study findings are expected to gain insightful knowledge of pollution characteristics and their relationship with the boundary layer's meteorology. It can promote regulation development to meet its dire need and improve the urban air quality at Kaohsiung.

## KEYWORDS

openair; pollution trend; ozone precursors; meteorological effect; coastal area

# [EQC-22-043] Ambidextrous Chair: A Sustainable Environmental Neutral Armchair for Both Right and Left Handed Persons

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## ABSTRACT

Side-biased arm school desks represent an obstacle to learning from pre-school through university (Holder, 2003). A right-biased arm desk does not offer left-handed students the same arm support that right-handed students enjoy.
The main objective of this study was to design, fabricate, and evaluate the sustainable environmental ambidextrous chair for both right and left-handers. Specifically, this study aimed to: 1) design a mechanism for an ambidextrous chair; 2) evaluate the level of acceptability of the design in terms of usability, durability, and stability of ambidextrous chair for both right and left-handers; 3) determine the efficiency of the ambidextrous chair based on usability, durability, stability, ergonomics, anthropometry, and universal design. The laboratory testing was done at the Wooden Living, PHC block 24 Lot 10 Mandurriao, 5000 Iloilo City. The testing was observed by the Technical Evaluation team composed of thirty five (35) selected students, instructors/professors, and experts in furniture design. The mean was used to determine the level of acceptability of the design of the ambidextrous chair utilizing the Evaluation Checklist – modified by the researcher. The ambidextrous chair, was constructed based on the plan designed by the researcher. The working drawings prepared through the use of AutoCAD application in 2Dimensional (2D). The revision was recommended by experts upon observation during the Technical Evaluation. Results showed that 1) the design of the ambidextrous chair was done following the principles of design such as ergonomics, anthropometry, and universal design. This is a Mies Van de Rohe inspired cantilevered chair made of bended plywood seat and back, comprising a horizontal metal pipe tablet arm support attached under the seat and can be pivoted and placed in right-hand or left –hand configurations. 2) The level of acceptability of the ambidextrous chair or neutral chair as to its durability, usability, and stability as evaluated by the students, teachers, and industry practitioners/furniture experts was “very high” in all dimensions. 3) The efficiency of the ambidextrous chair was achieved based on the criteria such as usability, durability, and stability as evaluated by the Technical Evaluators and the thirty-five (35) evaluators.

## KEYWORDS

Ambidextrous; anthropometry; furniture; durability; ergonomics; sustainable; usability; universal design

# [EQC-22-044] Evaluation of Atrazine Degradation by Ferrous Ion Activated Persulfate Process in Aqueous Phase using Taguchi Approach

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## ABSTRACT

Atrazine (ATZ) is one of the most widely used herbicides for the control of annual broadleaf and grassy weeds in the world. Its residual in the environment is of great concern. This research work primarily focused on examining ATZ degradation by the ferrous ion activated persulfate (PS) oxidation process ($Fe^{2+}$-AP process) and the influence of oxidative parameters on the degradation of ATZ in aqueous phase. The Taguchi Design of Experiment methodology was used to explore the effects of various operational parameters, including ATZ concentration, dosage of $Fe^{2+}$, dosage of PS, and pH condition (Taguchi L9 orthogonal array). The optimal operational conditions were then determined based on the results of ANOVA statistical analysis. Operational conditions included, ATZ at an initial concentration of 5 mg/L, with initial concentrations of 1 mM $Fe^{2+}$, 10 mM PS, and pH = 3, at 20ºC, for a reaction time period of 3 h. The sensitivity of factors for the ATZ degradation followed the decreasing order: PS concentration, pH, ATZ concentration and $Fe^{2+}$ dosage. The results of this study provide useful operational conditions for the $Fe^{2+}$-AP process, for application to field remediation of ATZ contamination.

## KEYWORDS

Atrazine (ATZ); Taguchi methodology; Advanced oxidation processes (AOP); Ferrous ion activated persulfate ($Fe^{2+}$-AP); Sulfate radical

# [EQC-22-045] Persistent Organic Pollutant Lindane Degradation by Alkaline Cold-Brew Green Tea

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## ABSTRACT

The environmental persistence of hazardous organochlorine pesticides (OCPs) such as lindane has resulted in a need for the development of reliable remediation technology for the removal of OCPs. Green tea extract/$Fe^{2+}$ under alkaline conditions is a potential green chemistry technology proven to be effective in reducing lindane. This study investigated the feasibility of directly using green tea leaves (GT-leaf) or cold-brew tea solution (GT-sol.) with $Fe^{2+}$ additives at (bi)carbonate buffered pH 10 to treat lindane in the aqueous phase. The polyphenol was gradually released in the GT-leaf system and reached a similar concentration as that in the GT-sol. system (~800 mg L-1 at pH 6.5). Based on the analytical results of lindane degradation byproducts, it was recognized that the reductive mechanism acts as a major pathway and alkaline hydrolysis is a minor pathway. However, physical adsorption rapidly removes lindane from the GT-leaf system. A comprehensive evaluation of lindane degradation, chlorobenzene formation, degradation kinetics, and chloride liberation were conducted for the alkaline GT-sol/$Fe^{2+}$ system. The nonlinear simulations of the models developed showed good fits, with $R^2 > 0.96$. This study highlights the potential for GT-sol/$Fe^{2+}$ systems to remediate OCPs contamination.

## KEYWORDS

Organochlorine pesticide; Polyphenols; Green tea; In situ chemical reduction (ISCR); Soil and groundwater remediation; Reaction kinetics

# [EQC-22-046] Agricultural Waste Biochar Mulches Coated with Polylactic Acid for Improving The Soil Quality

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## ABSTRACT

Plastic mulch has been widely and increasingly used in agriculture to control moisture and fertilizer loss, and reduce weeds. However, the use of plastic mulch films could result in the accumulation of toxic microplastic residues. Biodegradable mulches provide an alternative option for reducing the impact of plastics pollution on agricultural. Although the cost of biodegradable mulches derived from starch mulch and paper mulch, is low, the breakdown of such mulches in the natural soil environment is slow. Herein, we fabricated novel biochar-based biodegradable mulches, which coated with polylactic acid (PLA) having multi-functions favorable for improving the soil quality. The as-fabricated biodegradable mulch was derived from agricultural wastes, which are designed to be degraded in the agricultural soil. The agricultural wastes include agricultural residue (corn waste, pineapple leaves, rice husk, rice straw, and sugarcane bagasse), fishery waste (oyster shell), and industrial food processing waste (chicken feather) were selected to produce biodegradable mulches. The mechanical, functionalities, and biodegradation properties of biodegradable mulches were characterized. The results found that all mulch samples had a character of rapid weight loss with the highest weight decreases during the first 7 days in the soil environment. The surface eroded biochar mulches were confirmed by the SEM observation. FTIR spectra analysis indicated the presence of the C, H, and O containing functional groups on the surface of biochar mulches. From the results of SEM-EDS measurements, the major essential elements (C, H, N, and O), as well as minor elements (Ca, K, Mg, and P), were detected. The soil organic matter, nitrogen, available phosphorus, and exchangeable cations improved after being treated by biochar mulches. It was found that biochar mulches could increase the microbial activity in the soil within 28 days after mulch treatment. The improvement of soil quality and plant growth trials confirmed the ability of releasing fertilizer of biochar mulch after being degraded. Biochar mulches amendment to soils are sustainable approach in improving carbon stock resulting in the climate change used to mitigate greenhouse gas emissions. In addition, the as-made biochar mulches have no labor costs associated with disposing of non-biodegradable residual films. With all of the aforementioned results, this study is the first to successfully synthesize a green multi-functions biodegradable mulch derived from agricultural wastes for future agricultural application.

**KEYWORDS**

Agricultural waste; Biochar; Biodegradable mulch; Soil quality

# [EQC-22-047] Validation of Interventions on Iloilo City's Beaux-Arts Style Heritage Mansions

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## ABSTRACT

This paper's subject of validation are the interventions as conservation efforts for the three Iloilo Beaux Arts style mansions, the Yusay-Lacson Mansion, Don Vicente Lopez Mansion and the Lizares-Gamboa built during the American colonial government in the 1930's. This study will confirm interventions done by the current homeowners, likewise, provide information if heritage conservation standards has been met in the process, hence conservation "contributes significantly to Filipino National Identity". The process explores the impacts of interventions on the three Beaux-Arts Style Mansions thru Post Occupancy Evaluation (POE) as architectural research methods, includes collecting narratives, resulting from observations on the survey of a place, research on events and inquiry. as organized "Areas of Significance" as assessment thru the "Process of Undertaking Conservation" that will confirm the impact of interventions on authenticity. The results meet the Highly Significant score as shown in the building information confirms the homeowners' weaknesses in conservation efforts as some concepts of authenticity based on known conservation standards has not been met thru the validated interventions. In conclusion, the implications of these are a critical consideration as values of authenticity for areas of significance may change depending on the types of interventions such as human and environmental factors. These conservation efforts by the homeowners have consequences on the attributes and the original design intent for the three mansions. On the review on local heritage guidelines confirms that there are no apparent policies included for residential types in Beaux-Arts Style mansions. This study may contribute to enabling awareness on sustainable conservation management planning, consequently, allow mansions to be eligible for statutory designations from heritage institutions.

## KEYWORDS

Validation of Intervention, Conservation, Significance and Authenticity, Beaux Arts style Architecture, Iloilo City

# [EQC-22-048] Immobilization of Heavy Metals in Soil using Biochar Derived from Agricultural Wastes

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## ABSTRACT

Biochar, a carbon-rich, cost-effective, and environmentally friendly material, has been used as an amendment for in-situ remediation techniques. Because of its unique properties, such as various functional groups and alkaline nature, biochar can reduce the mobility of heavy metals in the soil. Among the metal speciation in soil, the exchangeable and carbonate fraction of the heavy metal speciation showed high mobility and bioavailability in the soil. So far, only a few studies focus on the effects of biochar type, soil type, biochar dosage, and aging period on speciation transformation of metal in soil. This study assessed the effects of biochar feedstock types, including rice husk biochar (RHB), rice straw biochar (RSB), corn waste biochar (CWB), sugarcane bagasse biochar (SBB), and pineapple leaf biochar (PLB), on the transformation of Cu, Zn, Ni, and Cr in five types of soils in 300 days incubation. Without fertilizing soil (W), long-term fertilizing soil (L), red soil (R), alkaline soil (A), and forest soil (F) were selected as the testing soil. The metal concentrations in soils were spiked at 2,000 mg/kg for Cu and Zn and 1,000 mg/kg for Ni and Cr. Tessier Sequential Extraction method was used to evaluate the biochar immobilization efficiency of heavy metals soil. The exchangeable and carbonate fractions of PLB treatments in Cu, Zn, and Ni contaminated W-soil were decreased respectively by 58.84%, 53.46%, and 72.16%, the Fe-Mn oxide fraction were increased 40.22%, 52.97%, and 66.88%, respectively, and the organic matter fraction increased respectively by 15.70%, 8.07%, 5.17%. The exchangeable and carbonate fractions of RSB amended W-soil contaminated with Cu, Zn, and Ni were reduced 47.62%, 84.67%, and 67.14%, respectively, the Fe-Mn oxide fraction were increased by 34.46 %, 46.74%, and 36.98%, respectively, and the organic matter fraction increased by 9.57%,5.55%, and 5.05%. A similar phenomenon was observed in the L, R, and F soil. With various oxygen-containing functional groups among the five biochars. The heavy metals adsorption onto biochars is mainly governed by surface complexation. The precipitation was involved in immobilization of heavy metals in soil. This study demonstrates that biochars could effectively immobilize heavy metals in contaminated soils.

## KEYWORDS

Immobilization, Soil remediation, Biochar, Heavy metal, Agricultural wastes, Sequential Extraction

# [EQC-22-049]
# A Novel Pineapple Leaf Biochar-ZnO Composite for Efficiency Cr(VI) Removal from Aqueous Solution

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## ABSTRACT

Biochar shows an increasing usage in heavy metals removal from aqueous solutions; however, low adsorption capacity limited its practical application. This study firstly synthesized a novel pineapple leaf biochar-ZnO composite (PLB-ZnO) and evaluated its efficacy in removing Cr(VI) from aqueous solutions. The primary purposes were (1) to synthesize and characterize pineapple leaf (PL) and pineapple leaf biochar-ZnO (PLB) composite; (2) to evaluate the main parameters (contact time, temperature, and ionic strength) on Cr(VI) adsorption by the studies of adsorption kinetics and adsorption isotherm; and (3) to identify the removal mechanisms responsible for Cr(VI) removal. The experimental results show that the maximum Cr(VI) adsorption capacity of PLB-ZnO (33.47 mg $g^{-1}$) was much higher than that of ZnO (15.82 mg $g^{-1}$) and PLB (13.63 mg $g^{-1}$) as determined from the Langmuir isotherm model. The recycling experiment demonstrated that the removal efficiency of the PLB-ZnO remains satisfactory reusability after sixth consecutive regeneration cycle with the alkaline solution in a pressure cooker. Based on FTIR, SEM-EDS, and XPS analysis, the Cr(V) removal mechanism is involved in electrostatic attraction, complexation, and reduction. Overall, waste pineapple leaf-supported ZnO composite could effectively remove Cr(VI) from aqueous solution via adsorption coupled with reduction. This study proposes an efficient novel biochar-ZnO composite and economically viable to remove Cr(VI).

## KEYWORDS

Biochar-ZnO composite, Hexavalent chromium, Adsorption, Removal Mechanisms

# [EQC-22-050] Identifying Cellular Structure Deformation in Response to Disinfection Mechanisms Exemplified by Acetylated Shrimp Shells and Calcined Oyster Shell Powder Inactive Microorganisms

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## ABSTRACT

The annual production of shrimp and oyster shell wastes is approximately 7 million tons globally. Utilization of these wastes as environmentally friendly materials is a win-win solution against the microorganisms in the water. In this study, the performance of chitosan (CTS) derived from acetylated shrimp shells and calcined oyster shell (COS) powder in response to antimicrobial were investigated using Gram-positive (*Bacillus cereus*, *Staphylococcus aureus*), Gram-negative (*Klebsiella pneumoniae*, *Escherichia coli*), and Fungi (*Aspergillus niger*). Because the deformation of cellular structure is a critical step of a disinfection process, thus this study also aims to observe the variation of 3D microbial ultrastructure during the disinfection process and to identify the disinfection mechanism by using synchrotron-based Transmission X-ray tomography (TXM) and Soft X-ray tomography (SXT). Findings revealed that the disruption of the cell structure of microorganisms by CTS and COS lead to cytoplasm leakage, consequently decreasing the cell viability. Before the reaction, the microorganism cells were spindle-shaped and intact. After 2 h reaction with both CTS and COS, the cell walls of *K. pneumoniae* had obvious cell sag and damage, showing solid evidences of the severe attack by either reactive oxygen species (ROS) generated from COS or interfered by the $NH_3^+$ surface functional groups of CTS. Another piece of evidence is from the observation of TXM 3D morphologies, which showed the cell had deformed after interaction with CTS and COS for 6 h. SXT images also evidenced that the organelles of *A. niger* could not maintain in a healthy state after 6 h reaction. This study demonstrates that the 3D structural morphologies in conjunction with electron microscopy images with cellular physiological characteristics provides a solution to build a comprehensive view of cellular inactivation via CTS and COS.

## KEYWORDS

Transmission X-ray Microscopy, Soft X-ray Tomography, Microorganisms, Disinfection Mechanisms, Chitosan, Calcined Oyster Shell

# [EQC-22-051] A Novel Visible-light-responsive Chitosan/N-$TiO_2$ Composite and Eco-Friendly Packaging Film Produced from Fishery-Waste and Agricultural Waste Extracts: Optimization, Characterization, and Disinfection Mechanism

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## ABSTRACT

Environmentally-friendly biodegradable intelligent packaging films have attracted increasing attention due to severe environmental pollution caused by petrochemical-based polymers and food safety concerns. Meanwhile, generating a considerable amount of fishery waste (around eight million tons) from the aquaculture industry worldwide could also cause significant environmental issues. Chitosan (CTS), a non-toxic with biodegradable biopolymer, is deacetylated of chitin, rich in fishery waste, i.e., shrimp shells. The film formability, biodegradability, and biocompatibility of chitosan are suitable for developing an eco-friendly, intelligent packaging film. In addition, the secondary processing of fruits has generated up to 132,513,000 metric tons of agro-residues per year worldwide, discarded without appropriate treatment. However, extracts of agricultural residues are potential sources of natural antioxidants antibacterial agents, especially phenolic compounds, which can extend the shelf-life of food. In Taiwan, up to 140,000 metric tons of lemon, passion fruit, and red dragon fruit are produced annually and processed as juice. The waste peels are rich in phenolic compounds (such as proanthocyanins, flavonoids, and anthocyanins), which can be used as a food packaging additive. Titanium dioxide ($TiO_2$) is an outstanding photocatalyst due to its photo-disinfection activity, high chemical/physical stability, cost efficiency, and being environmentally friendly. This study aims to develop active food packaging film with lemon peel extract (LPE), passion fruit peel extract (PFPE), red dragon fruit peel extract (DFPE), and $TiO_2$ into chitosan matrix. The active food packaging films were characterized by using X-ray diffraction (XRD), Fourier transforms infrared spectroscopy (FTIR), and scanning electron microscopy (SEM), and then was evaluated for its enhancement of antioxidant and antimicrobial ability. SEM, transmission electron microscope (TEM), and atomic force microscope (AFM) were used to observe the morphologies of bacteria cells to gain insight into the disinfection mechanism. The objective of the study: (1) To develop the optimal antioxidant and antibacterial ability extracting formula for fruit residues (LPE, PFPE, and DFPE); (2) To evaluate the characteristics, physical, functional properties, and optimal formula of environmentally friendly biodegradable

intelligent packaging films (EFBIPFs). The utilization of such abundant agro-waste is a win-win strategy because it alleviates the waste problems and be used as an environmental-friendly photocatalyst.

**KEYWORDS**

Agricultural Waste, Chitosan, $TiO_2$, Antioxidant, Antibacterial, Intelligent Food Packaging

# [EQC-22-052]
# Assessment of Heavy Metal Contamination of Surface Soil in Quezon City, Philippines using Multi-elemental Contamination (MEC) Index

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## ABSTRACT

Rapid urban expansion and increase in pollution load due to unprecedented anthropogenic activities have cause different environmental issues in numerous cities in the world. In the Philippines, Quezon City (QC) is the largest city in Metro Manila in terms of area and population density. This study was executed to assess the heavy metal (HM) contamination on the surface soil of QC by determination of the multi-elemental contamination (MEC) index that indicates the degree of anthropogenic contamination of soil. Thirty-two (32) soil samples from QC were obtained and analyzed for four HMs: Copper (Cu), Nickel (Ni), Lead (Pb) and Zinc (Zn) using inductively Coupled Plasma - Optical Emission Spectrometry (ICP-OES). Results revealed that Zn (656.4 mg/kg) has the highest mean metal concentration followed by Cu (92.2 mg/kg), Pb (39.3 mg/kg) and Ni (7.3 mg/kg). Moreover, calculated MEC indices showed that 34.38% of the areas in QC were contaminated by heavy metals via anthropogenic inputs. The observed significant difference ($p=0.0413$, $\alpha=0.05$, $n=32$) in the mean MEC index of main road areas against the less busy areas of the city suggested attribution of HM contamination mainly from vehicular traffic. Comparisons of the divided main roads reveal no significant differences of the five groups ($p=0.2476$, $\alpha=0.05$, $n=32$). However, C5 road has a relatively high mean MEC and has the sole mean exceeding the value of 1 which may owe to the high traffic and vast number of automotive shops in the area. The results also suggest that the on-going construction of Metro Railway Transit 7 (MRT-7) along Commonwealth Avenue has no significant anthropogenic contribution to the soil quality of QC.

## KEYWORDS

Multi-elemental contamination; ICP-OES; anthropogenic pollution; heavy metals

# [EQC-22-053] Stability of Cyanobacterial Neurotoxin B-N Methylamino-L-Alanine (BMAA) and its Isomers 2,4-Diaminobutyric Acid (DAB) and Aminoethylglycine (AEG) in Natural Water

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## ABSTRACT

β-N-methylamino-L-alanine (BMAA) is a neurotoxic, non-protein amino acid found in over 20 different cyanobacteria genera. Research on the influence of the natural environment on BMAA stability is limited. In this work, the effects of ambient temperature, dark and visible-light settings, and outdoor conditions on the stability of BMAA and its isomers: 2,4-diaminobutyric acid (2,4-DAB), and aminoethylglycine (AEG) in natural water are elucidated. Water samples were taken from the Feng-Shan Reservoir and analyzed for pH, turbidity, and total organic carbon. The collected water samples were spiked with known concentrations of BMAA and its isomers and analyzed for stability within a 10-day duration under various environmental conditions. Results showed that BMAA and its isomers exhibited moderate stability at 4 °C. However, degradation of these compounds occurred when the water samples were exposed to dark, visible light, and outdoor conditions. With outdoor exposure, BMAA and its isomers underwent rapid degradation such that ~10% of its original concentration remained for BMAA, 41% for DAB, and 2% for AEG. These findings confirm that ambient environmental factors can diminish the concentration of cyanotoxins in natural waters.

## KEYWORDS

aminoethylglycine (AEG); β-N-methylamino-L-alanine (BMAA); cyanobacteria; cyanotoxins; 2,4-diaminobutyric acid (2,4-DAB)

# [EQC-22-054]
# Effects of Organic Matter during Biological Treatment on Ultrafiltration Membrane Fouling in Refinery and Petrochemical Wastewater Treatment

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## ABSTRACT

Refinery and petrochemical industries discharge a large amount of effluent and recycling processed water with membrane technology has become the predominant treatment protocol. However, fouling is the primary factor limiting the broader applicability of membrane-based technologies. To predict membrane fouling, polytetrafluoroethylene (PTFE) ultrafiltration membrane was employed to treat the biological treatment wastewater from Dalin refinery and Linyuan petrochemical wastewater treatment operated at different food to microorganism (F/M) ratios. Membrane autopsies were performed based on fouling determination, SEM/EDX and FTIR analysis. Additionally, the characteristics of organic matter from different units were preliminary analyzed. Results showed that organic matter removal for both wastewater treatment plants was similar in each unit; aromatic proteins, SMP, and humic acid were highly removed in the biological process. In addition, almost all kinds of organic matter were removed after the RO process. The results of a continuous running showed that the PTFE membrane was fouled with a rapid decrease of the flux at the beginning of filtration, indicating that standard blocking was the predominant mechanism at the beginning, coexisting at the end of it with cake deposition. Protein-like aromatic and SMP were the most removed organics during filtration, but there was no significant difference between different F/M ratios. Characterization of the fouled membrane revealed that the foulants in the inner surface were mainly carbon, oxygen, nitrogen and fluoride, and a small number of other elements indicated organic compound formed the fouling and agglomerated after passing through the pore. The foulants on the outer surface, mainly inorganic elements were deposited on the membrane and formed a dense cake layer. The results are expected to provide relevant information on predicting and controlling membrane fouling according to the composition and characteristics of organic matter.

## KEYWORDS

membrane fouling, F/M ratio, organic matter, ultrafiltration, foulants

# [EQC-22-055] Cobalt Oxide Decorated with Activated Carbon as a Pseudocapacitive Composite Electrode for High-Performance Desalination in Hybrid Capacitive Deionization

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## ABSTRACT

Capacitive deionization (CDI) is a promising energy-efficient water treatment technology derived from batteries and supercapacitors. CDI is feasibly practical for water purification and desalination, as well as energy storage. For high-performance desalination, pseudocapacitive-type electrode materials involving Faradaic reactions have been widely studied. Here, cobalt oxide/activated carbon (CoOx/AC) composite electrode was fabricated by the electrochemical deposition of pseudocapacitive CoOx material onto activated carbon. The surface morphology of the CoOx/AC composite electrode clearly shows the well-coated distribution of cobalt oxide nanoparticles. The high specific surface area of 505.1 $m^2$ $g^{-1}$ and a high mesoporosity of 71.2% are well maintained for the composite electrode. Benefiting from the CoOx decoration, the composite electrode exhibits electrochemical properties with high specific capacitance (84.8 F $g^{-1}$ at 5 mV $s^{-1}$) and good electric conductivity. With its highly simplified electrode processing and good pseudocapacitive-like behaviors, the CoOx/AC composite electrode is a promising candidate for high-performance hybrid CDI applications. In this study, the CoOx/AC composite electrode as the anode and the cation exchange membrane-AC electrode as the cathode were further applied in a hybrid CDI system. As evidenced, this work provides an additional strategy for developing pseudocapacitive composite electrodes, which promotes the application of CoOx/AC electrode materials in hybrid CDI systems for high-performance desalination.

## KEYWORDS

Electrochemical desalination; Hybrid capacitive deionization; Pseudocapacitance; Cobalt oxide

# [EQC-22-056]
# Effect of Influencers' Reviews on Young People's Awareness and Attitudes toward Ecotourism: The Moderating Role of Trust

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## ABSTRACT

More young people are interested in ecotourism nowadays, and they gather about it from acquaintances, family members, and from social media. With the rapid development and widespread availability of technology, a growing number of travel influencers are having an impact on young people's environmental awareness and attitudes toward ecotourism. As a result, the study aims to explain how travel influencers' reviews impact on their audiences' environmental knowledge and attitudes toward ecotourism activities, particularly bicycle touring, as well as the moderating mechanism behind this relationship – trust. The findings revealed that influencer reviews are linked to audiences' awareness of and attitudes toward bicycle touring. Furthermore, trust moderates the relationship between influencer reviews and audience awareness as well as their intent of ecotourism activities. The findings of this study contribute to a better knowledge of the predictors of young people's awareness and attitudes about ecotourism activities, as well as laying the foundation for future research.

## KEYWORDS

Influencers, Travel, Social media, Ecotourism, Sustainable tourism, Bicycle touring

# [EQC-22-057] Immobilization of Cu, Ni, Zn, and Cr in Paddy Soil by Biochar: A Short-Term Laboratory Incubation Study

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## ABSTRACT

Biochar has been widely used as a robust amendment to immobilize heavy metals in contaminated soil. However, the effectiveness of biochar on metal immobilization greatly varies on biochar properties and metal. In this study, native paddy soil was spiked with four heavy metals (Cu, Ni, Zn, and Cr) through an incubation process to achieve metal concentrations in soil higher than 2000 mg $kg^{-1}$ for both Cu and Zn and 1000 mg $kg^{-1}$ for Ni and Cr. After incubation, speciation distribution of heavy metals was determined and the spiked soil was used to evaluate the effects of five biochar's produced from rice straw, corn waste, rice husk, pineapple leaf, and sugarcane bagasse. The biochar was amended at a 10% (w/w) application rate, and the chemical speciation of heavy metals was investigated through an incubation experiment. Results showed that the Cu, Ni, and Zn in the spiked paddy soil were mostly bound in the exchangeable fraction, while Cr was essentially bound in the Fe and Mn oxide fraction. The amendment of biochar significantly improved soil pH, soil organic carbon (SOC), and cation exchange capacity (CEC). The exchangeable fraction of Cu, Ni, and Zn decreased and organic matter fraction of Cr increased upon the application of biochar in soil. This result indicated that the improved soil pH, SOC, and CEC played a substantial role in reducing the mobility of heavy metals by transforming the highly available metal speciation to stable speciation in soil. In conclusion, the biochar amendment of heavy metals is greatly affected by biochar properties and heavy metals. Pineapple leaf biochar showed exchangeable bases, such as calcium (Ca), magnesium (Mg), and potassium (K), and phosphorus which contribute the precipitation of heavy metals in soil. Significant changes in the speciation distribution of heavy metals were observed in pineapple leaf biochar, and the effect of pineapple leaf biochar amendment in the exchangeable concentrations of heavy metals were in the following order Cu > Zn > Ni.

## KEYWORDS

Heavy metals; Contaminated Paddy soil; Biochar; Immobilization; Sequential extraction

# [EQC-22-058] Assessing Waste Disposal Status and Influencing Factors of Waste Classification at High Schools in Thai Nguyen Province, Vietnam

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## ABSTRACT

The increase in waste disposal has become one of the biggest challenges for the human being in this century. Waste classification for waste recycling and management is urgent to reduce the increasing waste volume. As a number of high school students account for up to 17% total population of Vietnam and they are an indispensable part to create social transformation in waste reduction, their waste disposal behaviors are of both societal and scientific relevance. To assess the status of waste disposal and management at high schools in Thai Nguyen province and identify factors that influence the waste classification, we combined waste weighing, questionnaire surveys to 300 students from three high schools in Thai Nguyen province, Vietnam from September to October in 2020.

The results showed that the average waste was generated about 45-56kg/day and even up to over 1000 kg/day for a boarding school. Most of the wastes are mainly leaves and fallen branches. Besides, recyclable wastes such as plastic waste, nylon bags (~ 20%), cardboard (10 %), milk cartons (5%) are the main components discharged from schools. Most of the students understood waste classification and its harm to the environment. However, lack of enabling environments such as no separated bins, no mechanism/regulations on waste classification, or no guide at schools are factors that hinder the waste classification behavior of students. A high percentage (>70%) of students are willing to participate in waste reduction campaigns and suggested the best method to raising awareness is through contests/emulation for sorting and recycling garbage, the school's radio broadcasts in school, and putting the content of waste classification and recycling into the curriculum. The findings of the study provided foundations for building effective waste classification and management campaigns in high school.

## KEYWORDS

Waste disposal, waste classification, influencing factors, Thai Nguyen, high school

# [EQC-22-059] Development and Application of Nanopore MinION to Identify 2-MIB-Producing Cyanobacteria Species in Source Waters

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## ABSTRACT

Eutrophication will promote the growth of cyanobacteria, which are well known for their ability to produce diverse secondary metabolites, including cyanotoxins and taste-and-odor (T&O) compounds. Due to the potentially risks to human health and perception, studies on the removal of cyanobacteria and their haromful metabolites from water sources have increased. Therefore, understanding the cyanoabcteria species reponsible for the producing the toxins and/or T&O compounds is one of the key factors for efficiencient removal of these microrganisms and the natural contaminants. Although the quantitative PCR (qPCR) method has been successfully developed to on-site and rapidly quantify the potential producers, the method is not able to identify the responsible microorganism to species level. Therefore, a novel method to needed to be develop for the identification of the toxin- and/or T&O compound producing cyanobacterial genus/species. The demand for technologies that can operate at portable and produce longer reads has resulted in the advent of new sequencing approaches, so-called third-generation sequencing (TGS). Nanopore-based sequencing (MinION), is a new TGS platform that reads longer sequences, offers fast sequencing, and can be operated without adding any primers for the target gene fragments, is applied in this study for the detection of T&O producing cyanoabcetria.

In this study, a MinION method was developed to identify the genus/species of 2-MIB-producing cyanobacteria via 2-MIB synthesis associated operon (*mib*C gene) in environmental water samples. The composition of cyanobacterial genus/species for the source of 2-MIB is determined based on a DNA sequence database established in this study. This result demonstrates that effective identification of the genus/species of 2-MIB-producing cyanobacteria in the environmental water samples is feasible. The method provides powerful information to the managers of water resource and water utilities when facing with 2-MIB-related incidents in their source waters.

## KEYWORDS

Cyanobacteria, Taste-and-odor (T&O) compound, Nanopore MinION, 2-methylisoborneol (2-MIB)

# [EQC-22-060] Advancing Air Quality Research by Taiwan EPA-based Data Mining: A Case Study

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## ABSTRACT

Air quality is deteriorating due to excessive anthropogenic activities such as industrial operations, transportation, and the burning of fossil fuels. All these sectors have contributed to degrading air quality, causing adverse effects on human health and the environment. Therefore, air quality monitoring and pollution control techniques are the essential steps in air quality research by making new policies and introducing advanced technologies to mitigate air pollution. Furthermore, understanding the trend of pollution by different factors from the long-term monitoring data is more important to analyze and understand the peaks of pollution in the past and current situations to evaluate the significant factors of air pollution. Several tools are used for the statistical analysis of long-term air pollution to effectively manage and access extensive data for the data analysis process. In this study, R programming and its OpenAir package were introduced to advance air quality research to extract the data from unorganized data. R, the popular programming language in data science, brings advancement to the environmental field, especially air research. First, the R programming can help download, transform, and clean the data effectively; then, its OpenAir package can help plot visualized figures and combine the statistic method from raw data. The OpenAir was developed to fill a perceived gap where the dedicated set cannot be easily accessible, open-source tools for analyzing air quality data. Generally, there are around 16 plotting functions for Directional Analysis, Time Series and Trends, Model Evaluation, and Utility parts for further data analysis. In this study, the data from the Xiaogang monitoring station was used as a case study for an overview of applying R programing and the OpenAir package in air quality research. The scanning of more than 51129 observations of 21 variables was analyzed and plotted within seconds; R programming could be an effective openair robust and powerful tool in the atmospheric field.

## KEYWORDS

Air quality monitoring, Open source software, R Programing, OpenAir package

# [EQC-22-061] Microbial Source Tracking of Fecal Contamination Using Quantitative and Digital Droplet PCR in River

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## ABSTRACT

Sewage and livestock contamination of water bodies pose a definite risk to human health via waterborne pathogens. Monitoring for all waterborne pathogens in waters is generally a difficult and cumbersome exercise. Fecal-oral infection is a main infection route of pathogenic strains. *Escherichia coli.* and *Bifidobacterium* spp. normally live in the intestines of people and animals. Since *E. coli* and *Bifidobacterium* spp. can survive outside the human body for certain time, these two bacteria are often used as biological indicators for fecal pollution in water management.

The conventional monitoring method for *E. coli* and *Bifidobacterium* spp. are through viable cell enumeration on an agar plate. However, due to unfavorable nutrient, temperature, and other environmental pressures, bacteria may enter a Viable But Non-Culturable (VBNC) state, in which the bacterium is alive but does not grow nor divide. Such bacteria cannot be cultivated on conventional media, but their existence can be proved using other methods, such as quantitative PCR (qPCR) and digital droplet PCR (ddPCR). In addition, the enumeration method is not able to trace the host of contamination sources.

In this study, microbial source tracking (MST), an approach for determining sources of fecal contamination by detecting bacteria, is proposed to track the possible cources of fecal contamination in two four Taiwan's rivers. Primers targeted for 4 different host-specific *E. coli* and *Bifidobacterium* spp., including human, pig, cow, and poultry, were first designed and tested. The tested primer sets were then applied in the analysis of river water contaminated with differnet fecal sources in South Taiwan, using both qPCR and ddPCR assay.

Results show that only ddPCR assay is more sensitive and is able to detect low levels of *E. coli* and *Bifidobacterium* spp. from different hosts. ddPCR successfully quantified the presence of *E. coli* and *Bifidobacterium* from different hosts, in the samples collected from rivers, and the treatment sites of biogas residues and biogas slurry. In addition, the tracked pollution sources by MST were also in consistency with those found in near-by areas of the sampling locations, demonstrating that the ddPCR assay developed and used in this study could be a viable tool for MST studies and the results may be used for the management of water pollution.

# [EQC-22-062]
# Total Phenolics and Antioxidant Activities of Momordica Charantia Leaf

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## ABSTRACT

*Momordica charantia*, a popular edible plant in Vietnam, is used to support the treatment of several diseases very effectively. The purpose of this work was to investigate the polyphenol content and antioxidant resistance of *Momordica charantia* leaf extracts using the conventional extraction method. Extraction conditions such as solid/liquid ratio (1/10–1/30 g/mL), extraction time (1 to 3 hrs) and extraction temperature (70-90$^0$C) were performed. The phenol content and the antioxidant capacity of the dried leaf extracts obtained by immersion method with water were evaluated. Extraction with parameters found in solid/ liquid ratio 1:15 g/mL, extraction time 1 hour, and temperature 90$^0$C is the suitable condition to obtain the extract rich in phenol content (18.4 mg GAE/g dry weight). Research results show that besides fruits, their leaves also have massive potential in different industries.

## KEYWORDS

*Momordica charantia*, total phenolic, antioxidant activity, extraction, Gallic acid

# [EQC-22-063] Development of Eco-Tourism Based on Mangrove Forest Conservation in Indonesia

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## ABSTRACT

Mangroves as the most important ecosystem located between the marine and coastal zones have the highest biodiversity. Mangroves are the barns of coastal community life because they have high economic value and millions of benefits for life. The area of Indonesia's mangrove forests according to data released by the Ministry of Environment and Forestry in 2015 was 3,489,140.68 hectares and about 1,817,999.93 hectares had been damaged. The damage was caused, among others, by the conversion of mangroves into aquaculture, residential and industrial areas. Mangroves have a strategic function in creating a suitable coastal ecosystem for the life of aquatic organisms. The ecological balance of the coastal waters environment will be maintained if the existence of mangroves is maintained because mangroves can function as biofilters, binding agents, and pollution traps.

Mangrove forest conservation is an effort to protect, preserve nature in the form of area allowance as a nature reserve area. One form of mangrove forest conservation is to build mangrove ecotourism. Ecotourism is a form of tourism that is responsible for the preservation of natural areas, providing economic benefits that can create a tourism industry. Mangrove forest ecotourism is an educational tourism object that prioritizes the natural beauty of the mangrove forest and the living things in it. The development of ecotourism will have a positive impact, namely improving the environment and the economy of the community around the tourist area. The presence of this mangrove forest has a positive impact on the ecosystem, especially since the mangrove forest stores carbon which is 4 to 5 times more than mainland tropical forests. Therefore, the mangrove forest has a contribution to the absorption of carbon emissions.

The Indonesian government continues to strive to develop mangrove forest ecotourism. Mangrove forests that have been developed into natural tourism objects in Indonesia include: (i) Ecotourism Based on Mangrove Conservation in Tongke-Tongke Sinjai Village (South Sulawesi); (ii) Angke Kapuk Nature Tourism Park in the Special Capital Region of Jakarta (West Java); (iii) Mangrove Forest Ecotourism in Denpasar (Bali); (iv) Bedul Block Mangrove Forest Ecotourism in South Banyuwangi (East Java); and (v) Mangrove Forest as a Green Shield on the Karimunjawa Coast (Central Java).

## KEYWORDS

Ecotourism, Conservation, Mangrove Forest

# [EQC-22-064] Photocatalytic degradation of NO by synthesized g-$C_3N_4$ and g-$C_3N_4$@glass fiber under solar and visible irradiation

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## ABSTRACT

Photocatalytic oxidation (PCO) is an advanced technology to degrade the air pollutants from indoor an outdoor environment. Photocatalyst is also one of an environmental remediation technology used to decontamination of air pollutants to improve air quality. Air quality is degrading day by day due to the excessive amount of NO emissions into the environment from different sources such as mortar vehicles. g-$C_3N_4$ is new emerging photocatalysts towards the degradation of NO which is widely used in the photocatalytic activities due to its unique properties. In this study g-$C_3N_4$ was prepared by thermal decomposition called one step synthesis method to enhance the photocatalytic performance over NO. Prepared g-$C_3N_4$ used as raw material. The following catalyst pure g-$C_3N_4$ and g-$C_3N_4$ coated on glass fiber used as photocatalyst in the lab scale reactor under solar light and visible light. The influencing parameter in the photocatalytic activity of NO are humidity and irradiation having a potential ability to affect the performance of catalyst which are also studied in this work. In this experimental work the flow rate of NO is 3 $L.min^{-1}$ and the photocatalytic activity is operated for 30 minutes under solar and visible light. Furthure more the resulting products will be characterized such as XRD, FTIR, SEM, TEM, and EDS. The degradation efficiencies of g-$C_3N_4$ over solar and visible irradiation are (30% and 43%) while g-$C_3N_4$@glass-fiber over solar and visible irradiation are ( 40% and 60%) respectively, g-$C_3N_4$@glass-fiber shows high performance to degrade NO under visible light as compared to solar light due to efficiently absorption of visible light and g-$C_3N_4$ dopant improved the mobility of electrons on the surface of photocatalyst for the degradation of NO. The main objective of this study is to investigate an effective photocatalyst and irradiation for the degradation of NO.

## KEYWORDS

Photocatalyst, Glass fiber, NO degradation, Thermal decomposition.

# [EQC-22-065] Analysis of air quality data with OpenAir package- A case study of Daluio station in Southern Taiwan

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## ABSTRACT

In today world ambient air pollution has become one of the major reason of deteriorating health conditions among humans beings. Air pollution is a major factor that can cause acute and chronic health effects. The background of ambient air pollutant concentrations help us to find out the effectiveness of different emission control strategies. The main objective of this study was to determine the variation in concentrations of some air pollutants: ozone ($O_3$), $PM_{2.5}$, $PM_{10}$ sulphur dioxide ($SO_2$) and nitrogen dioxide ($NO_2$). In this study, air quality data from 2015-2021 at a station (Daluio) was used to assess the concentrations of these pollutants. Statistical analysis was conducted by using OpenAir package that provides a set of functions to quickly summarize and visualize air pollution data. The OpenAir function allow us to find out the source and relationship between air pollutants concentrations. A noticeable decreasing trend was observed in $PM_{2.5}$, and $PM_{10}$ concentrations during the considered time interval, that's due to the improvement plans in fuel quality and vehicle emission standards. From this Statistical analysis, no improvement in $O_3$ concentration was observed during the considered time interval. This study showed that local factors are responsible for varying concentrations of air pollutants in urban environment.

## KEYWORDS

Openair; pollution trend; visualization; Particulate matter

# [EQC-22-066]
# Utilization of Used Waste of Oyster Mushroom Planting Media as a Media for Worm Livestock to Reduce Pollution and Agricultural Industry Waste

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## ABSTRACT

Garbage is a common thing in the business industry, and if you cannot process it properly it will become a problem of environmental pollution such as air pollution and water pollution. Like one of the SME's engaged in oyster mushroom farming in Sidoarjo, Indonesia. The SME's have not been able to maximize the waste from their production. Oyster mushrooms have a harvest period of only about 3 months, after that the oyster mushroom growing media cannot be harvested anymore, the weight of used oyster mushroom growing media reaches 1 kg and in a day SME's produces up to eight thousand oyster mushroom growing media. Oyster mushroom growing media that are not used become waste because they are disposed of and not processed, and some are burned, causing air pollution problems, of course if this is done regularly it will disturb the surrounding environmental ecosystem.
Former oyster mushroom growing media can be processed into earthworm livestock media, this is better done than just throwing it away or burning it. By utilizing the former oyster mushroom growing media to become a medium for worm farming which can reduce industrial waste, prevent damage to environmental ecosystems, as well as additional income for the SME's, because with this utilization, they will get output in the form of earthworms and organic fertilizers which are very fertile and can later be for sale.

## KEYWORDS

Industrial Waste, Pollution, Oyster Mushroom, Agriculture

# [EQC-22-067] Independent Household Organic Waste Treatment to Create a Green Independent Village of Organic Fertilizer

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## ABSTRACT

Household waste is waste generated from activities carried out in the household. Based on data collected from the National Wasted Management System of Indonesia, in 2021 household waste will be the largest waste contributor with 41,1% and organic waste is in the top position at 40,9%. Organic waste is not managed properly can cause unpleasent odors. Organic waste that is disposed of improperly can also pollute the environment around it. If managed properly, household organic waste can be turned into organic fertilizer that can be used directly by the producers of the waste. Independent household organic waste treatment can cut the flow of waste distribution to the landfills.

Generally, waste treatment is carried out by the authorities at the landfills. Independent household organic waste treatment is rarely carried out for various reasons ranging from time to place of waste treatment. If this can be applied, each household can become a producer of organic fertilizer for personal use. This activity will have direct impact in the form of reducing the volume of waste distributed to landfills. With the socialization and implementation of household organic waste treatment activities, it will create an independent green village of organic fertilizer.

## KEYWORDS

Organic Waste, Organic Fertilizer, Green Village

# [EQC-22-068] Utilization of Wood Waste Become a Craft that Represents the Nation's Culture to Increase Economic Value and Reduce the Collection of Waste in the Environment

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## ABSTRACT

The development of today's increasingly rapid era, indirectly requires humans to always create something new, creative, and innovative. Indonesia as one of the countries rich in natural resources, in order to increase state income and the economic level of its people, has also begun to carry out detailed processing of each of its natural products in order to increase the economic sector to a higher level, one of which is through the manufacturing industry. Manufacturing sectors that continue to compete for the sake of creating a work or goods that can meet the wishes of consumers. This is indicated by the increasing number of MSMEs (Micro, Small and Medium Enterprises) engaged in manufacturing. MSMEs are currently an important pillar in the Indonesian economy, but the large number of MSMEs can also have a negative impact, especially on the environment, this is if the remaining production waste is not handled properly.

Industrial waste is one of the many environmental problems. In modern countries, waste has been managed as well as possible through a recycling system, but in Indonesia there are around 9,549,356.25 tons/year of waste that is not managed and left alone. The government's lack of socialization to industrial managers and the lack of awareness of industry managers themselves on the impact of waste treatment which is not really the main factor that causes this to happen often. A lot of industrial waste, especially in Indonesia, is just abandoned and just like that, one of which is wood waste from the furniture industry house. Managing wood waste into handicrafts and furniture that interprets Indonesian culture through the application of a distinctive archipelago style by offering the development of a green environmental concept, is the right step that can be done as a good way to reduce deforestation that can damage the environment. Wood waste, if disposed of, will have a negative impact on the environment. However, if wood waste is burned, it will certainly cause air pollution which is very disturbing for the community. Therefore, as an effort to develop environmental concepts, wood waste from the furniture industry can be managed into handicrafts that interpret Indonesian culture by providing a unique picture of the archipelago to maintain the existence of Indonesian culture. In addition, the recycling of wood waste can also increase the economic value for the community in order to develop an independent and prosperous economy.

## KEYWORDS

Crafts, Manufacturing Industry, Wood Waste

# [EQC-22-069] Sustainable Strategies in Conserving Teak Wood Forest for Furniture Products with Interpretive Structural Modeling (ISM) Approach

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## ABSTRACT

Teak forest has experienced a lot of decline due to illegal logging by irresponsible parties. Teak wood is used to meet the needs of small and medium enterprises (SMEs). As time goes on, furniture SMEs has increased production. The increase in furniture production is due to the increasing demand for consumer needs. Furniture SMEs as business actors process teak wood into furniture products in order to provide added value to the product. Furniture SMEs is one of the leading products in Jombang district, Indonesia. Sustainable strategy efforts to optimize resource potential require good sustainable supply chain management. The sustainable strategy is carried out by integrating economic, social and environmental aspects. The use of the Interpretive Structural Modeling (ISM) approach is very suitable in maintaining the existence of teak forests in adjusting the needs of furniture products. This method is able to provide an alternative decision that is used as a reference for decision makers at the Jombang-Indonesia district government level. The decisions taken provide results that are acceptable to the government, stakeholders, producers and consumers.

## KEYWORDS

Sustainable, Teak, SMEs, Furniture, ISM

# [EQC-22-070] Recycling Plastic Waste into High-Value Handicrafts in Indonesia

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## ABSTRACT

Plastic waste is still the main problem of environmental pollution in Indonesia. The World Economic Forum stated that Indonesia is the second-largest producer of plastic waste in the world after China. Decomposition of plastic waste naturally takes hundreds of years. This is due to the nature of plastic waste which is not easily decomposed and the processing process that can cause toxicity and is carcinogenic.

One of the efforts to reduce the environmental pollution of plastic waste is to recycle plastic waste into handicrafts. Some of the advantages of recycling plastic waste include: (i) Preventing disease in the surrounding environment; (ii) Reducing environmental pollution; (iii) conserving natural resources and human resources; (iv) Earning additional income; (v) Increasing creativity and knowledge; and (vi) Save on expenses.

The Indonesian government continues to strive to generate people's creativity to convert plastic waste into handicrafts. Some of them are as follows: (i) Utilization of waste for handicrafts in Sukunan Village, Sleman Regency, Special Region of Yogyakarta; (ii) The Cirebon Regency Government conducts literacy development based on social inclusion with the aim of recycling plastic waste into handicrafts, useful products and selling value; (iii) Family Welfare Development at Sunter Agung innovates to recycle plastic bag waste into handicrafts that have economic value; (iv) Residents of Pasar Rebo in East Jakarta innovate by turning plastic waste into artificial plant crafts; and (v) Establishment of a waste bank in Kerandangan, Senggigi Village, Batu Layar, West Lombok, as an effort to recycle plastic waste into high-value handicrafts.

## KEYWORDS

Recycling, Plastic Waste, Handicrafts

# [EQC-22-071] Land Use for the Preservation of MSME at Minggon Market in Minggirsari, Indonesia

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## ABSTRACT

MSME stands for Micro, Small and Medium Enterprises. Where MSMEs need a place or land to introduce the businesses they have so that they are widely known by many people. Utilization of land to be used with the theme of snacks or those sold by several MSMEs on every Sunday and carried out in the morning. The land is made and designed in such a way by utilizing the feel of the village and the cool trees, besides that the places provided for MSMEs sell light snacks for breakfast and fill the stomach in the morning with a village feel. The place is not only intended to use land, but also to help MSMEs to continue to preserve the businesses they have and also as a forum to support the businesses they have so that they are better known to the community.
The land that will be used will be conserved for marketing and the introduction of MSMEs in the village. In addition, the place used will be designed so that people are comfortable in shopping and also look at the products introduced by MSMEs. The land will not only be used by 1 MSME, but many will use the land that will be provided. Examples of SMEs are snacks, hand products, heavy meals, and also some arts. The benefits of the land include: (i) Utilizing vacant and abandoned land; (ii) To become a forum for MSMEs to market their products; (iii) Make it easier for the community to find the food or product they need; (iv) Earn additional income; (v) Increase creativity and knowledge; (vi) Preserving nature and enjoying the cool village feel.

## KEYWORDS

Ecotourism, MSMEs, Village land, Community creativity

# [EQC-22-072]
# Evaluation and Risk Assessment of Cyanobacterial Blooms, Toxins, and Taste and Odor Compounds in Drinking Water Sources

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## ABSTRACT

The growth of cyanobacteria and the generation of its' metabolites including toxic, taste and odorous (T&O) compounds are common challenges for source water management and drinking water safety. Through the application of bio-molecular technology, the identification and quantification of cyanobacteria and their metabolites can be obtained effectively. Moreover, as more biological information is provided, the prediction for blooms and risk for water quality deterioration can be estimated. Therefore, this study investigated cyanobacteria blooms with large-scale reservoir monitoring data (>30 lakes and reservoirs; >1000 datum points). The monitored biological parameters include chlorophyll, phycocyanin, cell count and genetic data, serving as indicators along with total phosphorus. The prediction model provides the prospect for algal growth, and level of metabolites for both toxic and T&O compound. In addition, the comparison for different indicators used in the model is complete. This proposed work can be applied in the risk assessment of cyanobacteria hazard and early warning framework in source water management for the improvement of drinking water safety.

# [EQC-22-073]
# A preliminary study on the growth rate and calcium carbonate deposition rate of Pocillopora acuta using low current technique

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## ABSTRACT

The Intergovernmental Panel on Climate Change (IPCC) released its special Report on oceans and the Cryosphere in 2019, saying that if the world elevated by 1.5 degrees , coral reefs will decrease by 70 to 90 percent. More than 99 percent of coral reefs would disappear under 2 degrees of elevated. In the summer of 2020, the waters around Taiwan hit a record high, causing Taiwan to experience the largest coral "bleaching" in decades from south to north, where corals are vulnerable to terrestrial substances and human activities. In this study, German scholar Wolf Hilbertz and American scholar Thomas J. Goreau invented an artificial coral reef (or electric coral reef) that uses low pressure to induce calcium carbonate to form attached to steel bars. The resulting material composition is very similar to that of natural coral reefs. Suitable for running in different environments. Therefore, this study uses low current to promote the combination of calcium, magnesium ions and carbonate ions in seawater and deposit and attach on the surface of corals to accelerate the growth of corals. Calcium production efficiency, to explore a more appropriate experimental environment, and select Pocillopora acuta in the waters of the South Bay of Kenting, southern Taiwan. This study evaluated the physiological effects of different current densities on the survival rate, total linear growth rate, specific growth rate, and recovery of coral wounds in Pocillopora acuta in an initial one-month trial at the Aquarium Experiment Center of the National Museum of Marine Biology.

In the early stage of the experiment, whether energization under different environmental conditions has an effect on Pocillopora acuta, using flowing water, non-flowing and control groups (Control), to explore the water quality, voltage and current, and found that the flowing water conditions are this The best operating environment for the experiment; therefore, from February 21, 2022 to March 24, 2022, a one-month preliminary test will be conducted, and the experimental conditions will use low current density (0.02A/24hr) and high The current density (0.04A/24hr), the high current density of the interval type (0.04A/6hr) and the control group (Control) were tested, and it was found that after 30 days of electricity, the high current density of the interval type (0.04A/6hr) and the control group (Control) had the highest survival rate, and the interval-type high current density (0.04A/6hr) in the total linearity change rate was significantly higher than the other energized groups; The weight change rate is higher than other conditions, but in 14 days to 28

days, this experimental condition is not the most efficient, so it is speculated that if a low current density is used, the coral calcification rate will increase, but after a long time of power on, the current The effect of calcification was not significant; the future will continue to explore whether the use of different current densities on the survival rate of Pocillopora acuta, total linear growth rate, specific growth rate and coral wound recovery and other physiological effects.

**KEYWORDS**

Biorock, feeble current, coral restoration, Pocillopora acuta

# [EQC-22-074] Investigation of Zeolite Derived from Modified Fly Ash for the Coomassie Brilliant Blue Dye Removal

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## ABSTRACT

Nowadays, the sources of waste are more and more increasing from domestic activities, livestock, and industries. Textile dyeing is the world's most polluting industry, which impacts every aspect of the environment. In this study, the high efficiency of dye adsorption was achieved using zeolite (mFA). The adsorbent derived from fly ash (mFA) via sequential fusion and hydrothermal activation method was successfully carried out with high porosity structure $S_{BET} \approx 600$ $m^2/g$. It was applied for the removal of Coomassie brilliant blue G250 dye from wastewater. The influence of pH strength, initial concentration, contact time, and adsorption dosage were studied. The best result indicates that this elimination process is followed by pseudo-second-order adsorption kinetics, and the data on adsorption equilibrium shows that the Freundlich model fits better than the Langmuir model.

## KEYWORDS

Coomassie brilliant blue G250; Fly ash; Zeolite; Dye; Adsorption

# [EQC-22-075] Time Series Model Analysis on Ambient Ozone Levels at Lin-Yuan Monitoring Station, Taiwan

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## ABSTRACT

Ozone is listed as one of ambient air quality indices with its 1-hour and 8-hour average ambient standards being regulated at 120 and 60 ppb, respectively. Besides, the ozone standards of permissible exposure limit at job sites is set at 100 ppbv (200 $\mu g/m^3$). In view of its human health impact, there's much concern about photochemical formation of ozone in the atmosphere due to NOx and non-methane VOC's, especially in the major petrochemical industrial parks in southern Taiwan such as Linyuan industrial park, Kaohsiung oil refinery and Renda petrochemical industrial park.

Therefore, in the long past, Taiwan EPA(TWEPA) has set up quite many air quality monitoring stations network all over the whole island. Based on the TWEPA's open source data and by using time series modeling, the objectives of this study were focused on (1) providing general information of ambient ozone levels within a selected area of Linyuan; (2) proposing a reliable time series model for the future prediction of ozone levels; and (3) propagating this research model to some other ozone monitoring stations in Taiwan.

As a result, peak values and trends of the studied dataset were analyzed and summarized according to the original dataset (66,676 observations over the period of December 31, 2013 – August 31, 2021). In addition, cyclical variations were also explored for the possible diurnal and seasonal occurrences. Furthermore, best time series model of SARIMA was obtained and further applied for model forecast purpose within 95% confidence interval. In conclusion, a holistic module of Linyuan $O_3$ data analysis developed in this study can be applied to some other ozone monitoring stations. This serves to enable Taiwan EPA to manage and control surface ozone easily in some sensitive air quality zone in Taiwan.

# [EQC-22-P1] Photocatalytic Degradation of Glyphosate in Water by Nano-$ZrO_2$ Ultra-Micro Powder Prepared on Heating of Alcohol-Aqueous

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## ABSTRACT

This study adopts the most commonly used conventional method of heating of alcohol-aqueous salt solution at an ethanol/water ratio of 5:1 for the preparation of the aqueous solution of $ZrOCl_2$. Polyethylene glycol (PEG) is added as a dispersant to form zirconium salt during the precipitation and hydrolysis of $ZrOCl_2$, so as to increase the dispersion force of its surface. Sintering of this gel solution is done at high temperatures (650°~700° C) when it is dechlorided, whereby nanoscale $ZrO_2$ ultra-micro powder is formed. Coupled with photocatalysis under visible light irradiation, glyphosate in water is removed and the goal of photocatalytic degradation achieved. The differential thermal analysis (DTA) shows that the crystal structure of monoclinic $ZrO_2$ gradually turns into that of tetragonal $ZrO_2$ as the sintering temperature increases during the preparation of $ZrO_2$ ultra-micro powder, to which PEG is added as a dispersant. This result suggests that $ZrO_2$ ultra-micro powder can sufficiently reduce molecular aggregation when an appropriate amount of PEG solution is added to it, whereby higher purity and concentration of $ZrO_2$ can be obtained.
This study applies $ZrO_2$ ultra-micro powder to the photocatalytic degradation of PCP in water under sodium light irradiation. The findings suggest that 100% degradation of water contaminated with high concentration of glyphosate can be achieved within 95 minutes when approximately 0.08% of $ZrO_2$ is added to the water. This ability to degrade glyphosate is compared with that of $ZrO_2$ ultra-micro powder prepared by additionally adding yttrium oxide ($Y_2O_3$) ceramic coating to it. The results suggest that the crystal structure of tetragonal $ZrO_2$ can easily be formed on the surface of $ZrO_2$ after $Y_2O_3$ solution is added to it, while having the following characteristics: higher purity of $ZrO_2$ crystal structure, better dispersibility of crystal structure, and better reusability of catalyst; its ability to degrade glyphosate also improves. Consequently, if a small amount of $Y_2O_3$ solution can be added to $ZrO_2$ ultra-micro powder when using heating of alcohol-aqueous salt solution for its preparation, the goal of organic matter degradation can be effectively and rapidly achieved.

## KEYWORDS

$ZrO_2$ ultra-micro powder; glyphosate; polyethylene glycol; differential thermal analysis; yttrium oxide ceramic

# [EQC-22-P2]
# The Effects of Climate Change to Flooding at Downstream of Cu De River Basin, Central Viet Nam

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## ABSTRACT

Climate change is happening quickly globally, and its impacts on water resources, especially in sea level rise and rainfall distribution. These changes can be led to severe floods in some highly vulnerable objects, e.g., tropical areas or poor communities. Climate change causes a considerable loss of economic value and living activities. In our study, the Cu De basin located in Da Nang city central Viet Nam is examined to evaluate the flooding effects in a context related to the future scenarios due to global warming and climate change. The research utilized the MIKE model (Denmark) to simulate the past flood from 1989 to 2009 and two different scenarios for 2025 and 2050. The calculated results show that the studied area will be highly flooded in the future, especially in 2050. In addition, some recommendations are also proposed to minimize these effects, and actions need to be implemented immediately to mitigate climate change.

## KEYWORDS

Climate change; floods; Cu De basin; scenarios; water resources, Viet Nam.

# [EQC-22-P3] Variation in $PM_{2.5}$ Concentrations During The Covid-19 Pandemic in Ho Chi Minh City, Viet Nam

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## ABSTRACT

The COVID-19 outbreak is spreading rapidly across the entire world and was declared a pandemic by the World Health Organization (WHO, 2020). Our investigation explores the assessment of variations in $PM_{2.5}$ concentration and AQI levels before, during, and after lockdown phases in Ho Chi Minh City, Viet Nam. In this study, we obtained $PM_{2.5}$ data available through the air quality monitoring station at the US Consulate located in the city center (https://www.airnow.gov). The data considered January 2018–May 2021 to compare variation in $PM_{2.5}$ from earlier years with the periods after the outbreak of COVID-19 from 23 January 2020 until May 2021. Results showed that a positive change in air quality had been observed in Ho Chi Minh City responding to the COVID-19 pandemic. In addition, a reduction in fine particulate matter ($PM_{2.5}$) and air quality improvement during the COVID-19 pandemic correlate with declined traffic and mandated business closures. Therefore, regarding control of health and air quality, it is essential to understand how air pollution is affected by extreme disruptions in behavior due to COVID-19.

## KEYWORDS

$PM_{2.5}$; pandemic; investigation; COVID-19; air quality; Viet Nam.

# [EQC-22-P4] Mackinawite Activated Persulfate Coupled with UV Light for Highly Efficient Decolorization of Azo Reactive Textile Dye Remazol Navy RGB

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## ABSTRACT

Effluents released from textile wastewater contain high concentration of azo dyes that are mostly non-biodegradable. Effective treatment method much be developed to treat such dye-laden wastewater. In this work, mackinawite (FeS) activated persulfate (PS) coupled with UV light ($UV_{254}$/$VUV_{185}$) was attempted to determine its efficacy in degradation of azo reactive textile dye, Remazol Navy RGB. Various dye degradation process, including FeS/PS, UV, VUV, and FeS/PS/UV/VUV were compared. The effects of salts and surfactants addition on the effectiveness of FeS/PS/UV/VUV process were performed to evaluate the applicability of such process in treating textile effluents. The effectiveness of FeS/PS/UV/VUV process are also governed by FeS and PS dosage, temperature, the irradiation period of UV/VUV. The decolorization kinetics follows a pseudo 1$^{st}$ order equation. Nearly 100% Remazol Navy RGB decolorization (30 mg/L) could be achieved within 10 min under conditions of UV/VUV 300μW/cm$^2$, persulfate 5x10$^{-4}$ M, 55°C. Findings indicated that $UV_{254}$/$VUV_{185}$ can be used in conjunction with mackinawite activated persulfate process to enhance the degradation of Remazol Navy RGB.

## KEYWORDS

Mackinawite; Persulfate Oxidation; Textile dye; UV light irradiation; Decolorization

# [EQC-22-P5] Ultrasound Enhanced Persulfate Activated with Pyrite for Decolorization of Remazol Golden Yellow RGB

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This study was supported fully by the Ministry of Science and Technology of Taiwan (MOST 109-2221-E-214 -008 -MY3)

## ABSTRACT

A general consensus has been reached on the assist of ultrasound (US) to enhance persulfate (PS) oxidation process. However, the ways of using US in the PS remain a debate issue. In this study, vary oxidation processes, including PS only, PS/US, pyrite ($FeS_2$) activated PS ($FeS_2$/PS), $FeS_2$/US, $FeS_2$/PS coupled with US (PS/$FeS_2$/US) were compared their decolorization efficiency of a common reactive azo dye, Remazol Golden Yellow RGB (Reactive Yellow 17, RGY). Experimental conditions are applied in these processes by 30 mg/L RGY, 0.2 g/L $FeS_2$, 50mM PS, US (88W/cm$^2$, 20 kHz) for 20 min, and natural pH upon necessary. Based on the fitting results of pseudo 1$^{st}$ order kinetics, the decolorization rates are in the following order: PS/$FeS_2$/US (0.0914 1/min) > $FeS_2$/PS (0.0367 1/min) > $FeS_2$/US (0.0247 1/min) > PS/US (0.0088 1/min) >> PS only (0.0001 1/min). The boosting of decolorization rate in the PS/$FeS_2$/US process is mainly attributed to the generation of both $^{\bullet}OH$ and $SO_4^{\bullet-}$ radicals, elevating temperature (55 $^{o}$C), and vigorous mixing effects. Despite longer US irradiation time in the PS/$FeS_2$/US process had increased the discoloration efficiency, a brief of 15-min US irradiation period is sufficient for decreasing the $1.8x10^4$ ADMI (true color unit) to less than 400 ADMI (effluent standard for textile and paper industries) within 30 min reaction time. Effective COD degradation was also achieved in PS/$FeS_2$/US process. The intermittent US testing in the PS/$FeS_2$/US process shows merely no differences in the decolorization efficiency of RGY. This study demonstrates that pyrite activated PS coupled with ultrasound is a promising oxidation process for treating textile industry effluents, particularly for those containing azo reactive Remazol Golden Yellow RGB.

## KEYWORDS

Pyrite; Persulfate Oxidation; Ultrasound; Decolorization; Remazol Golden Yellow

# [EQC-22-P6] Fluoride Treatment Using Calcium by Conventional Coagulation and Flocculation and Fluidized-Bed Granulation Process

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## ABSTRACT

Industrial processes generate high concentrations of fluoride in the effluent which may reach 1,000- 10,000 mg/L. Consequently, two precipitation techniques were compared for the removal of fluoride: (1) the conventional coagulation-flocculation (CCF) process and (2) the fluidized-bed granulation (FBG) process in a wide range of initial fluoride concentrations 100-10,000 mg/L. CCF was more efficient at high concentrations of 5,000 and 10,000 mg/L of fluoride with reduced turbidity. Moreover, FBG homogenous granulation was observed at lower initial fluoride concentrations of about 150-450 mg/L. The X-ray diffraction analysis revealed that the materials recovered from both processes were $CaF_2$ crystals. However, the CCF process generated sludge with 97.7 ± 1.5 % moisture content while the FBG process lowered the moisture content to 11.2 ± 3.0 %. Overall, both processes successfully removed fluoride in synthetic wastewater. Additionally, a low moisture content particle produced from the FBG process can initially suggest the development of the FBG process for fluoride removal.

## KEYWORDS

Defluoridation; calcium fluoride; moisture content; sluge; wastewater treatment

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# [EQC-22-P7] Low-Temperature Catalytic Combustion of Various VOCs With Non-Noble Metal Catalyst Supported on Ceramic Fiber Filter

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## ABSTRACT

Organic compounds with saturated vapor pressure equivalent to the atmospheric pressure (101.325 kPa) and the boiling point below 250°C are widely recognized as volatile organic compounds (VOCs) (He, Cheng et al. 2019). Owing to the high volatility at ambient conditions, the majority of VOCs could be easily released into the atmosphere and absorbed into human body through digestive tract, skin. VOCs are also harmful to the respiratory system and central nervous system even at low concentrations. Accordingly, VOCs destruction is of utmost significance from the perspectives of human health and environment. Catalysts for VOC combustion are always classified as the following categories: (1) non-noble metal oxides (2) supported noble metals (3) alloy metal nanoparticle catalysts (Zang, Zhao et al. 2019). Among these, noble metal catalysts (Au, Pt, Rh, Pd, etc.) possess superior catalytic activity and durability for VOC catalytic oxidation under low temperature. In this work, we proposed a F-01 catalyst comprised of non-noble metal oxides and supported on ceramic fiber. Abatement of various VOCs (Isopropyl alcohol, Acetone, Ethyl acetate, Toluene, Styrene) are implemented by J-01 with high catalytic performance via low-temperature combustion (200 ~ 250°C).

## KEYWORDS

VOCs, volatile organic compounds, catalytic combustion, ceramic fiber filter, non-noble metal

# [EQC-22-P8] Odor Emissions of Municipal Solid Waste

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## ABSTRACT

Municipal solid waste (MSW) is a global issue with respect to environmental protection. The characteristics of MSW is a vital foundation in the management and treatment processes. The sampling and analysis of MSW become an inevitable process in diagnosing the physical and chemical characteristics. The MSW odor emission such as volatile organic compounds (VOCs) always forms a potential negative impact to the public health. VOCs may cause breathing difficulty, damage in the central nervous system and lead to cancer. In this study, the VOCs of 36 samples collected at the tipping floors or garbage pits of three incineration plants in the Kaohsiung city located at southern Taiwan were analyzed. This implied the connections between the odor emission and various compositions of MSW. According to the obtained results, the ranges of the average contents of moisture, combustible matter, and ash were 38.42-46.00 %, 44.03-48.84 %, and 9.98-12.74 %, respectively. Based on the experimental results of VOCs monitoring for 24 hrs, record showed that the maximum VOC emission was reached within 3-5 hrs after the beginning of the garbage sorting. Then the VOC emission monotonically decreased in the following hours. The most important compositions of MSW were paper and cardboard, plastics, and food with average ranges of 32.06-34.98 %, 24.20-27.90 %, and 12.47-20.82 %, respectively. The food waste contributed 21.43-30.49 % of total VOCs at the beginning and increased to 34.78-58.75 % beyond the 5$^{th}$ hour until reaching 24$^{th}$ hr. In Taiwan, food waste was the major source of odor of MSW. These results would aid in creating strategy to decrease food waste in the MSW composition and will control the odor and the potential health risks.

## KEYWORDS

Municipal solid waste, Odor emission, Volatile Organic Compounds, Moisture content, Food waste

# [EQC-22-P9] A Screening Design of the Ultrasound Assisted Oxidative Desulfurization of Diesel Oil

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## ABSTRACT

This research is focused on the analysis of raw diesel oil to be subjected to an ODS technique. The effects of time and amplitude via ultrasonication probe and the material usage of tetraoctylammonium bromide, polyoxometalate catalyst, hydrogen peroxide, organic phase to aqueous phase ratio, and temperature were studied. The JMP 11.0 software was utilized by a definitive screening design for a comprehensive statistical screening analysis to determine the significant and insignificant variables in the oxidation of sulfur compounds. Upon the oxidation of sulfur compounds in diesel oil, results suggested that the time of ultrasonication,amplication, polyoxometalate catalyst, and temperature were the only significant factors based on the probability value (p-value < 0.05). On the other hand, the hydrogen peroxide, tetraoctylammonium bromide and organic phase to aqueous phase ratio were found to be insignificant variables (p-value > 0.05). The aforementioned factors are essential due to their ability to instigate the conversion of sulfur to its corresponding sulfone forms in the ODS system amplified by high-shear mixing. Therefore, it can be concluded that further optimization analysis of the significant parameters may be attained to have deep desulfurization to pass the environmental standards. The applicability of the ODS in industrial practice can also take part in mitigating climate change worldwide.

## KEYWORDS

Diesel oil; Parametric screening analysis; Polyoxometalate catalyst; Sulfone, Sulfur; Ultrasound probe

# [EQC-22-P10] Nanobubble Technology for Textile Wastewater Treatment

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## ABSTRACT

Textile wastewater containing dyes, recalcitrant organics and metals was a hurdle to treat and always need long hydraulic retention time in conventional biological degradation processes or further enhanced by advanced oxidation processes (AOP). In this study, micro- and nanobubble (NB) technology was applied to test feasibility either as a pre-oxidation or a post-oxidation unit before or after the current used activated sludge (AS) process. Biochemical oxidation demand ($BOD_5$), chemical oxidation demand (COD), suspended solids (SS), total dissolved solids (TDS), color, total organic carbon (TOC), inductively coupled plasma atomic emission spectroscopy (ICP-OES) were applied to analysis various wastewater samples in order to evaluate the performance. Although oxidation and aeration was a historical treatment, nanobubbles (NB) have higher surface-area ratio and can increase mass transfer ($K_{La}$). In contrast to microbubbles (MB) eventually float to surface and gone, NB can stay longer in the water media. Therefore, we conducted a series of experiments for demonstrating the application of NB technology on improvements of aforementioned water quality for various stage of textile wastewater treatment as well as potentials of color removal in different stages.

## KEYWORDS

Micro- and Nanobubble; Textile wastewater treatment; Color removal; Chemical oxidation; Aeration.

**[EQC-22-P11]**

# Binary-pH Operated Fluidized-Bed Granulation Process for Simultaneous Recovery of Heavy Metals from Synthetic Industrial Wastewater

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## ABSTRACT

The electroplating industry generates wastewater containing heavy metals such as $Pb^{2+}$ and $Cu^{2+}$, which are known health hazards. In this study, non-seeded, binary pH operated fluidized-bed granulation process was used to recover $Pb^{2+}$ and $Cu^{2+}$ from synthetic industrial wastewater. Effects of solution pH at the initial phase, carbonate loading, metal ratio ($Cu^{2+}/Pb^{2+}$), and hydraulic retention time (HRT) on the recovery and removal of $Pb^{2+}$ and $Cu^{2+}$ were investigated. The initial phase of the process was operated below pH = 8.0 and produced carbonate species while the latter phase was operated at pH = 8.0±0.2 and generated $OH^-$ species. The most favorable operating condition was found at initial pH = 6.5±0.2, 8.54 mM $CO_3^{2-}$, $Cu^{2+}/Pb^{2+}$ = 5.0, and HRT = 22.5 min. This led to highest removal and recovery 89.0% and 81.7% (for Pb) and 87.4% and 83.0% (for Cu), respectively. The mean diameter of the recovered granules ranged from 0.30 to 0.50 mm. Overall, the study demonstrated the applicability of the non-seeded, binary pH operated fluidized-bed granulation process to recover heavy metals from contaminated industrial effluents.

## KEYWORDS

bi-pH operation; bi-metal recovery; carbonate loading; electroplating industry; hydraulic retention time; wastewater treatment

# [EQC-22-P12] Adsorptive Removal of Arsenic(V) and Nickel(II) from Binary Aqueous Solution Using Chitosan-Coated Bentonite

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## ABSTRACT

This study aims to investigate the adsorptive removal of nickel and arsenic in a binary aqueous solution via batch adsorption using chitosan-coated bentonite (CCB) as a biosorbent. SEM results show that CCB has an improved surface area and pore volume when compared to pure chitosan. The effect of operating parameters such as initial Ni (II) concentration (100-500 mg/L), initial As (V) concentration (200-1,000 μg/L), adsorbent mass (0.2-1.0 g) and pH (4-8) on the removal efficiency were examined. Response surface methodology using the central composite design was applied in the optimization of the removal of As(V) and Ni(II) from binary solution using CCB. Results show that the predicted maximum removals 60.19% for Ni(II) and 80.32% for As(V) could be attained under the following optimum conditions: $\boldsymbol{C_o}$ of Ni(II) = 200 mg/L, $\boldsymbol{C_o}$ of As(V) = 400 μg/L, $\boldsymbol{pH}$ = 7.00, and $\boldsymbol{m}$ = 0.40 g. Batch equilibrium studies show that Freundlich isotherm better describes the adsorption of both As(V) and Ni(II) with coefficient of determination ($R^2$) values of 0.7879 and 0.9969, respectively. Kinetic studies indicate that the pseudo-second order reaction model best fits in describing adsorption of As(V) and Ni(II) with high $R^2$ values of 0.9340 and 0.9953, respectively.

## KEYWORDS

Arsenic; Bentonite; Binary metal system; Chitosan; Nickel; Optimization