NEWSLETTER

Issue 13
June 2021

Programme

0900 h	Introduction of E2S2 program • Prof Peng Yinghong (Program Director, Shanghai Jiao Tong University) • Prof Tong Yen Wah (Program Co-Director, NUS)
0910 h	Brief on research details achievements by Project ES-1 and ES-2 lead Principle Investigators • Prof DAI Yanjun (ES-1 lead PI, Shanghai Jiao Tong University) • Prof WANG Chi-Hwa (ES-1 lead PI, NUS) • Prof HE Yiliang (ES-2 lead PI, Shanghai Jiao Tong University) • Prof GIN Yew-Hoong, Karina (ES-2 lead PI, NUS)
1000 h	Panel Discussion on potential industrial and research collaborations • Mr Patrick Pang, Chief Technology Officer & Director, National Environment Agency (NEA) • Ms TENG Wee Lin Sarah, Director, Water Quality Department, Public Utilities Board (PUB), Singapore's National Water Agency

Panel Members

For more information, please email Ms Candy Chen at chy@nus.edu.sg

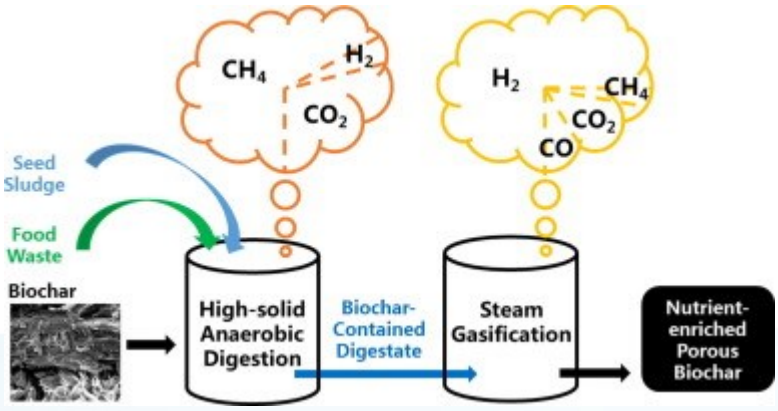
E2S2-CREATE Webinar was held on 28 May, 2021. There were over 100 attendees joining the webinar (including panellist members). In addition to present the research activities of ES-1 and ES-2 project, the team invited Mr Patrick Pang (Director, NEA) and Ms Sarah Teng (Director, PUB) for panel discussion on potential industrial and research collaborations. Attendees were very interested in the two research topics. They actively interacted with the panel members during the discussion session by asking and sharing their enquiries and concerns.

Research seminar hosted by E2S2:

E2S2 organized the research seminar by inviting Dr. Xuancan ZHU from Shanghai Jiao Tong University, who presented on Amine-Functionalized Layered Double Hydroxide for Direct Air Capture. Adsorption-based direct air capture (DAC) is now becoming a technically feasible negative emission technology, which enables the capture of distributed emissions and removes location restrictions on capture facilities. The fabrication of affordable adsorbents with large CO2 capacities, fast kinetics, and high sorption-desorption stability are of critical importance for the large-scale deployment of the DAC process. Dr Xuancan Zhu studied energy and power engineering in Tsinghua University, where he obtained a BS degree in 2014. He was awarded PhD in 2019 under the direction of Prof. Ningsheng Cai. He is currently a postdoctoral researcher in School of Mechanical Engineering, Shanghai Jiao Tong University and engaged in theoretical and applied researches on novel solid sorbents, carbon capture & hydrogen production processes, and negative emissions technologies The seminar received many positive feedbacks and some attendees expressed their interests in research collaboration with Dr Zhu.

Recent accepted/published papers from E2S2:

1 Food waste treating by biochar-assisted high-solid anaerobic digestion coupled with steam gasification: Enhanced bioenergy generation and porous biochar production



Journal: **Bioresource Technology**

Authors: **Jingxin Zhang, Yuxuan Cui, Tengyu Zhang, Qiang Hu, Yen Wah Tong, Yiliang He, Yanjun Dai, Chi-Hwa Wang, Yinghong Peng**

Keywords: **Food waste, Biochar, High-solid anaerobic digestion, Steam gasification, Waste-to-energy system**

Author's words:

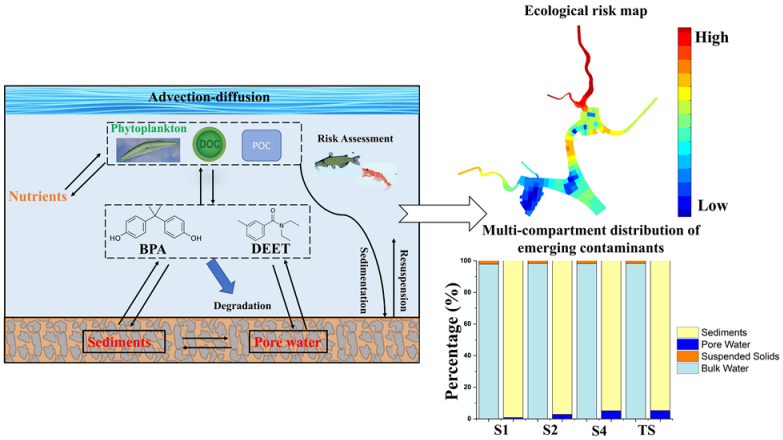
In this study, we proposed a food waste treating system by combining biochar-assisted high-solid anaerobic digestion and subsequent steam gasification of the digestate. The effect of solid level, biochar dosage in anaerobic digestion on the properties of biogas, syngas, and final biochar products were investigated. Results showed that at a high total solid level and biochar dosage of 25 g/L and 50 g/L, the accumulative methane yield reached 110.3 mL CH4/g VS and 126.7 mL CH4/g VS, respectively. From steam gasification of different digestates under 850 °C for 15 min, a maximum of 34.92 mmol/g for the hydrogen yield and 11.44 MJ/m3 for the higher heating value could be obtained for the syngas. Furthermore, the by-product produced from steam gasification was a nutrient-enriched porous biochar, which was suitable to be used as compost. Our study demonstrated a pathway for food waste treating to produce methane-enriched biogas, hydrogen-enriched syngas, and nutrient-enriched biochar.

Highlights

- Biochar-assisted HSAD and steam gasification were coupled to treat food waste.
- Over-acidification in HSAD was boosted with biochar assistance.
- Steam gasification is a feasible and efficient technology to treat the digestates.
- The final biochar product with a comparable amount of nutrients can be fertilizer.
- Energy recovery efficiency was improved by the HSAD-steam gasification system.

Recent accepted/published papers from E2S2:

2 A Comprehensive Modelling Approach to Understanding the Fate, Transport and Potential Risks of Emerging Contaminants in a Tropical Reservoir



Journal: Water Research

Authors: Xuneng Tong, Luhua You, Jingjie Zhang, Huiting Chen, Viet Tung Nguyen, Yiliang He, Karina Yew-Hoong Gin

Keywords: Emerging contaminants, Fate and transport, Multi-compartments, Integrated modeling approach, Risk assessment

Author's words:

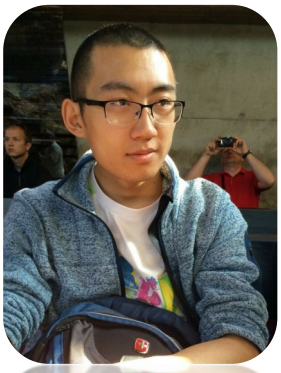
We developed a comprehensive integrated water quality modeling approach towards a better understanding of the fate and transport of emerging contaminants and comprehensive assessment of their potential risks in a tropical reservoir. Two representative emerging contaminants, namely Bisphenol A (BPA) and N, N-diethyltoluamide (DEET), were selected for this study. Unlike the traditional water quality modeling approach, the target emerging contaminants were modelled in four multi-compartments and coupled to a 3D-dimensional eutrophication model to investigate their interactions with other water quality state variables. First, the integrated model was calibrated and validated in four multi-compartments against an observed dataset in 2014. Subsequently, the correlation analysis between emerging contaminants and general water quality parameters were conducted. The potential ecological risks in this reservoir were also assessed via the trophic state index (TSI) and coupled to a species sensitivity distribution (SSD)-Risk Quotient (RQ) method. Finally, the model was applied to describe the dynamics of the two emerging contaminants and examine the direct and indirect influences of other environmental factors on their multi-compartment distributions in the aquatic environment. The comprehensive approach provides new insights into dynamic modeling of the fate and transport of emerging contaminants, their interactions with other state variables as well as an assessment of their potential risks in aquatic ecosystems.

Highlights

- A framework coupled hydrodynamic-eutrophication-emerging contaminants modelling.
- The spatiotemporal distributions of BPA and DEET were studied in four compartments.
- Main BPA and DEET components showed opposite patterns in water column and sediment.
- The potential ecological risks were assessed via TSI and the SSD-RQ method.
- Nutrients had indirect impact on dynamic distributions of emerging contaminants.

The staffs recently joined E2S2

- Dr. Wang Bo



Bo Wang obtained his Bachelor of Engineering degree in energy engineering from Zhejiang University, China (2012), joint Master of Science degree in sustainable energy from Eindhoven University of Technology, Netherlands, and the Royal Institute of Technology, Sweden (2015), and Doctor of Philosophy degree in high-temperature solar energy engineering from the Australian National University (2021, under review) before his recent commencement in the E2S2 project as a research fellow supervised by Prof. Chi-Hwa Wang.

His research interests are focused on utilizing thermal, chemical, and optical sciences to guide the design, test, and optimization of high-temperature solar-driven energy and environmental applications. In his doctoral study, he designed an indirectly irradiated solar thermochemical packed-bed reactor to achieve the endothermic reduction step of a two-step metal oxide-based chemical looping, which is a promising pathway for solar energy storage and water splitting. The novel reactive medium consists of binary Fe/Mn oxide particles was tested in the reactor under concentrated solar irradiation generated by a high-flux solar simulator. Leveraging commercial software and in-house developed programs, a numerical model was developed to simulate the chemically reactive and radiatively participative gas–solid flow for performance evaluation and operation optimization of the reactor. The solar-to-chemical efficiency reached 11.4% in the optimal case.

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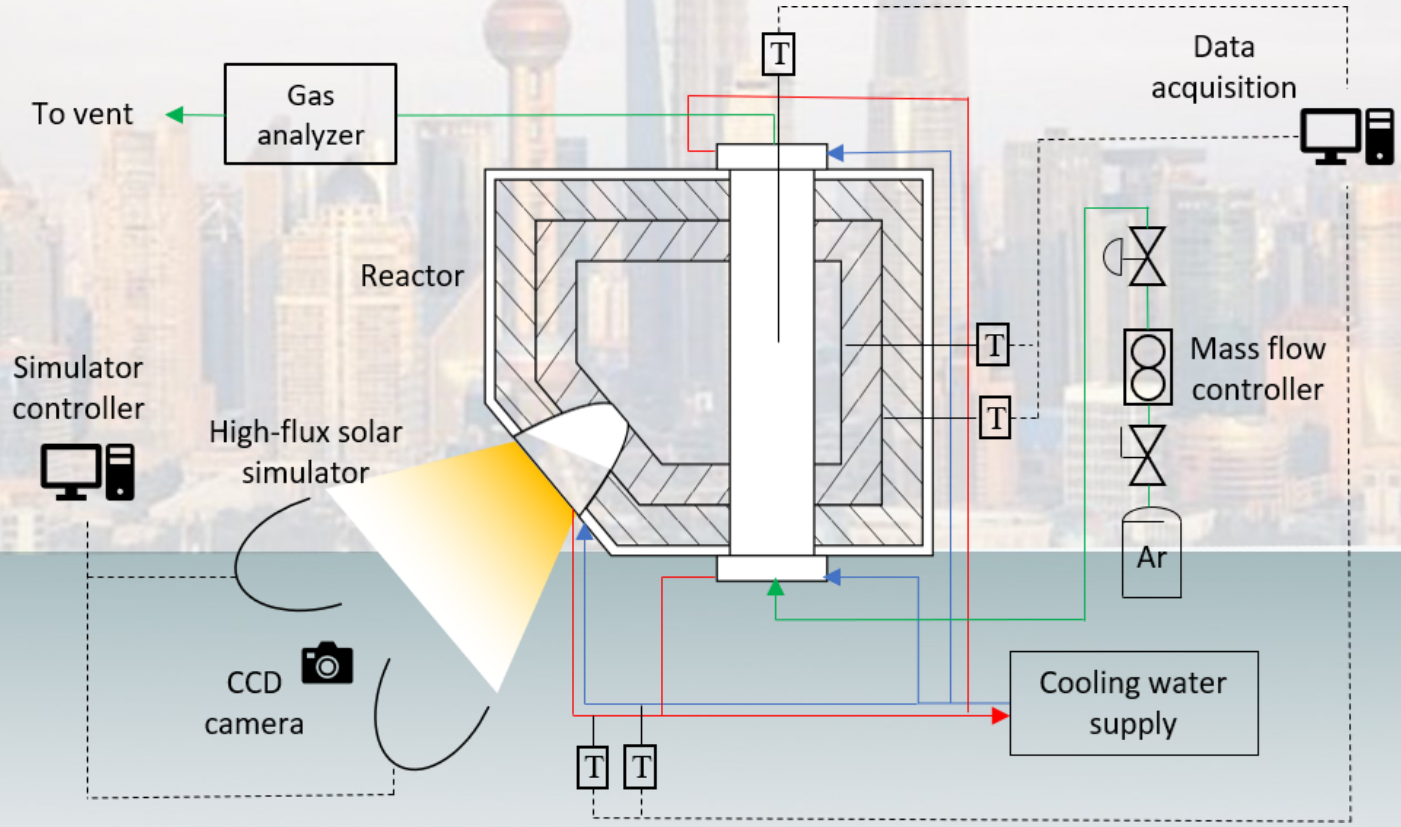

The staffs recently joined E2S2

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SELECTED PUBLICATIONS

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L. Li, S. Yang, B. Wang, J. Pye, W. Lipiński, Optical analysis of a solar thermochemical system with a rotating tower reflector and a receiver–reactor array, *Optics Express* 28 (13) (2020) 19429-19445.

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