Technical Seminar: Green Innovation Webinar Series No.1

1. Low-Cost High Performance Daytime Passive Radiative Cooling Technology with Zero Energy Input for Mitigating the Climate Change

2. Data-driven Decision Making for Waste Management and Rouse Efficiency: Path to a Circular Economy

Organized by: THE HONG KONG INSTITUTION OF ENGINEERS 香港工程師學會 Environmental Division 環境分部

Supported by: CityU School of Energy and Environment 香港城市大學 City University of Hong Kong; HKWMA HONG KONG WASTE MANAGEMENT ASSOCIATION 香港廢物管理學會; HKIQEP 香港環專會; CIWEM Chartered Institution of Water and Environmental Management Hong Kong Branch

Date, Assembly Time & Place

25 November 2020 (Wednesday) 18:00-20:00, HKIE Headquarters, ATAL Room

Programme Highlights:

The Green Innovation Webinar Series aims to enhance the collaboration between HKIE and universities through exchanging new environmental technologies and novel research projects ideas via the interactive online platform. This is the first series consisting of 2 talks to be delivered by the professors from School of Energy and Environment of City University of Hong Kong.

For the first talk, buildings consume large amounts of resources and have a major impact, affecting the environment and sustainability of modern society. The demand for cooling systems in cities has increased over recent decades, both in commercial and residential areas. As air cooling systems are so prevalent, the energy consumed by air conditioning systems has become one of the largest proportions of worldwide energy usage. There are various techniques for space conditioning. Among the various innovative options, passive radiative coolers are more attractive since they are environmentally friendly (refrigerant-free), with zero-energy consumption, no vibration and quiet in operation. By using special properties of materials to selectively reflect and emit photons in different wavelength regimes, net cooling can be achieved if the emission of infrared energy to outer space (where the radiation background temperature is 2.7 K) exceeds the absorption of sunlight and other environmental thermal radiation. In this talk, we will present different types of daytime

passive radiative coolers. First, a multi-layer photonic daytime passive radiative cooler enclosed by a vacuum system together with a sun shade has been shown to reduce the ambient temperature by almost 10 °C under direct sunlight in Hong Kong's hot and humid climate. Second, followed by the multi-layer photonic daytime passive radiative cooler, another daytime passive radiative cooler has also been developed and tested using TiO2. Third, inspired by the Saharan silver ants, a biomimetic polymer-based daytime passive radiative cooler has also been designed, fabricated and tested. A numerical analysis to estimate net cooling power has been conducted based on the measured optical properties, resulting 144 W/m2 during the daytime. Most importantly, an ambient air temperature reduction of 6.2 °C is achieved experimentally in a non-vacuum enclosure during the peak daytime in Hong Kong. Fourth, we have also developed a mathematical model to determine the indoor ambient air temperature reduction inside an apartment by incorporating passive radiative coolers with HVAC systems. The simulation results show that a 100 m2 passive radiative cooler covered on the rooftop of a building can reduce the indoor ambient air temperature by about 3 oC ideally when 5 people reside in the room, saving 10-15% electricity consumption of a traditional air-conditioning system. Experimentally, we have also built a small scale model house equipped with the daytime passive radiative cooler. An indoor air temperature reduction of about 2 oC inside the model house has been achieved during the daytime under direct sunlight. Recently, we have also developed a large scale daytime passive radiative cooler and its field investigation is conducting in progress. Last, other potential applications of using the daytime passive radiative cooling technology, such as textiles, has also been discussed in this presentation. Overall, through this talk, we aim to promote the daytime passive radiative cooling technology to the industries in Hong Kong. We believe that our developed daytime passive radiative coolers can inspire future architectural and engineering design to reach net-zero energy buildings, contributing to a cleaner environment for Hong Kong.

For the second talk, in the 2017 Policy Address, the Hong Kong Government committed to combat climate change by reducing carbon emission up to 70% by 2030. The adoption of a circular economy over a traditional linear economy is one of the key routes to achieve a low carbon future that can mitigate Hong Kong's waste management crisis as well. Despite the inherent benefits of the circular economy, its adoption is low due to the lack of data and tools for improving resource efficiency and waste management. In this talk, Dr. Shauhrat Chopra will highlight the utility of tools such as Life Cycle Assessment (LCA). In addition to well-established tools like LCA for data-driven decision making, the talk will also showcase the opportunity for the development of novel Information and Communication Technologies (ICT) tools. In particular, blockchain enabled data-driven tools may have the capability to improve trust and transparency in supply-chain networks, platforms for shared and performance economy, stakeholder participation, and governance and management of organizations. For this reason, Dr Chopra will share the potential opportunities and limitations of the blockchain technology for circular economy applications. Finally, the talk

will emphasize the significance of data-driven tools and systems analytics to avoid unintended negative consequences of engineering decisions on the environment.

Speakers

The first talk will be presented by Dr Edwin Tso, Assistant Professor, School of Energy and Environment, City University of Hong Kong. He received his Bachelor's degree in Mechanical Engineering (First Class), MPhil degree in Environmental Engineering and PhD degree in Mechanical Engineering from The Hong Kong University of Science and Technology (HKUST) in 2010, 2012 and 2015, respectively. He was awarded the Fulbright – Research Grant Council (RGC) Hong Kong Research Fellowship in 2014, and studied at the University of California, Berkeley (UC Berkeley) in 2015. After he came back from the UC Berkeley, he was a Research Associate at the Department of Mechanical and Aerospace Engineering (MAE), HKUST from 2015-2016, and promoted to the rank of Research Assistant Professor (2016-2018) before he joined CityU in Sep of 2018. He was also a Junior Fellow at the HKUST Jockey Club Institute for Advanced Study from 2016-2018 when he was at HKUST. Dr. Tso's research interest covers thermofluid, heat transfer, energy and built environment, and energy efficient building technology, particularly, in the fields of adsorption technology, thermal diodes/switches, nanofluids/hybrid nanofluids, thermochromic smart windows and passive radiative cooling using numerical simulations as well as advanced experimental techniques. Dr. Tso has published about 40 journal papers and 22 conference papers. He is also active in entrepreneurship and technology transfer, and has obtained several patents and has been involved in setting up a start-up in late 2012.

The second talk will be presented by Dr Shauhrat S Chopra, Assistant Professor, School of Energy and Environment, City University of Hong Kong. He obtained his Integrated Masters of Science in Systems Biology from the University of Hyderabad, India in 2011. He received his PhD in Civil and Environmental Engineering from the Swanson School of Engineering at the University of Pittsburgh, USA, in 2015. His doctoral dissertation was focused on resilience of complex systems including economic systems, industrial symbiosis, and critical infrastructure systems at urban and national levels. Before joining the School of Energy and Environment, Shauhrat worked as a Postdoctoral Researcher at the Institute for Environmental Science and Policy, University of Illinois at Chicago, on the U.S. EPA funded LCnano project focused on sustainable design of future transformative nano-enabled products. His data-driven research is focused on designing indicators for sustainability and resilience of the built environment in support of environmental decision-making.

Language

English

Registration & Enquiries

The seminar is free of charge with maximum of participants of 100. For registration, please complete the online enrollment form in Environmental Division website (http://www.ev.hkie.org.hk). Successful applicants will be notified before the event. For enquiries, please contact Mr. Benjamin Lam at bencamay1119@gmail.com . Attendance certificate will be awarded after seminar.