JSWE-IDEA Water Environment International Exchange Award

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I am deeply honored to receive the JSWE-IDEA International Invitation Award at the 59th Annual Conference of JSWE. It is also a privilege to introduce both myself and my research at this esteemed event.

I earned my Ph.D. in Civil and Environmental Engineering from the University of Technology Sydney (UTS), Australia, in 2013, specializing in seawater desalination as an alternative water resource. Currently, I serve as an Associate Professor and Head of the Department of Environmental Engineering at Pusan National University (PNU), Republic of Korea. Prior to joining PNU, I worked as a Research Professor at Sungkyunkwan University (2017–2019) and as a Postdoctoral Research Fellow at King Abdullah University of Science and Technology (KAUST) (2015–2017).

Over the past two decades, I have authored over 150 SCIE-indexed publications and secured 15 patents in the fields of membrane-based desalination, water treatment, and water reuse. Additionally, I actively contribute to the academic community in various roles: Financial Director of the Korean Society of Environmental Engineers, Editorial Committee Member (both English and Korean) of the Korean Society on Water Environment, Vice-Chairman of the Editorial Committee of the Korea Society of Waste Management, Review Board Member of the National Research Foundation of Korea, and Associate Editor of *Process Safety and Environmental Protection* (Elsevier, IF = 6.9).

My research focuses on advanced desalination and water treatment technologies, including membrane distillation, membrane fouling characterization and control, and the detection, monitoring, and removal of emerging contaminants such as microplastics and per- and polyfluoroalkyl substances (PFASs). Additionally, my work extends to advanced membrane technologies for industrial wastewater reuse and urban resource recovery.

At this conference, I presented on the topic: "Advancing Membrane Performance with 3D Printing and Computational Fluid Dynamics". With the escalating challenges of climate change and water pollution, the need for sustainable and efficient water treatment technologies has never been more urgent. Membrane-based processes are widely utilized for water purification due to their exceptional contaminant removal capabilities. However, issues such as membrane fouling, scaling, and concentration polarization remain significant barriers to their widespread application. To address these challenges, our research integrates 3D printing technology and computational fluid dynamics (CFD) simulations to optimize membrane performance. We specifically investigated the role of flow promoters, with a focus on spacer materials, in enhancing filtration efficiency. Among the various materials tested, carbon nanotube (CNT) spacers demonstrated remarkable improvements in membrane operation. These spacers not only enhanced water flux (~30 LMH) but also achieved high ion removal efficiency while preventing scaling, even under fourfold concentration conditions. Furthermore, cooling crystallization experiments revealed that CNT spacers effectively delay crystallization and mitigate scaling, providing deeper insights into the mechanisms driving these enhancements. By improving mass transfer and reducing surface adhesion of precipitates, CNT spacers significantly extend membrane lifespan and ensure sustained high performance under challenging operational conditions. This study marks a significant advancement in water treatment technology, offering a scalable and effective solution for fouling mitigation and membrane efficiency enhancement. The findings have broad implications for industrial applications, contributing to a more sustainable and energy-efficient approach to clean water production.

Through this conference, I had the valuable opportunity to engage with superior experts from Japan and beyond. I look forward to fostering continued collaborations and exploring new avenues for international joint research in the future.