Environmental Research, Technology Demonstration and Conference Project

ECF Project:	ECF 2020-05
Project Title:	Investigation of nanobubble flotation to remove micro/nano plastic from Sewage Treatment Works (STWs) in Hong Kong
Principal Investigator:	Dr Alicia An, School of Energy and Environment, City University of Hong Kong
Total Approved Grant:	$500,000
Duration:	1/10/2021 to 30/9/2023
Project Status/Remarks:	Completed
Project Scope:	Effluent from STWs contains plastic microbeads, which are suspected of being a significant contributor of microplastics (MPs) to the marine environment. Impacts from MPs on both the aquatic environment and human health have become a new and growing topic of global concern. Recently, the abundance of MPs in influent sewage was reported by local researchers, however research, and data on their removal rate from local STWs is lacking. While current chemically enhanced primary treatment (CEPT) and secondary STW plants are capable of removing a majority of these MPs, it is important to assess impacts in the local context and investigate technologies that are appropriate for Hong Kong. The main objective of this project is to design a green and economically viable MP removal system by introducing engineered nanobubble (NB) technology, where the NBs will bind themselves with MP and floating them to the surface. Further, the collapse of these bubbles can generate reactive free radicals, such as OH^-, which can potentially degrade the MPs in wastewater. It is believed that this chemical free NB floatation system will significantly reduce or avoid the chemical consumption in STWs in Hong Kong for the effective removal of MPs from wastewater.
Summary of the Findings/Outcomes:	This project in Hong Kong addresses the issue of microplastics (MPs) present in the wastewater discharged from sewage treatment plants (STWs). Plastics, especially fine particle particles, pose a substantial environmental threat due to their small size and large surface area, making them prone to ingestion by marine organisms. Additionally, they can act as carriers for other pollutants, compounding their impact. Local researchers have reported the presence of MPs in the incoming sewage, but there is a lack of research and data on their removal efficiency in local STWs. While the current treatment processes can remove a majority of the MPs, it is crucial to evaluate their effectiveness in the local context and explore suitable technologies for Hong Kong. In this project, we designed an environmentally friendly and economically viable system for MPs removal by integrating engineered nanobubble (NB) technology with the conventional flotation process. Specifically, we investigated the use of micro-nanobubbles (MNBs) to enhance the removal of fine MPs (sized 1 and 10 μm). Results demonstrated that MNB-assisted flotation significantly improved the removal of fine MPs compared to conventional microbubble flotation, across different chemical dosages. Furthermore,

	the use of MNB-assisted flotation also showed an additional benefit of enhanced organic matter removal from wastewater, achieved by the generation of reactive free radicals like OH-. This chemical-free NB flotation system presents a promising approach to effectively remove MPs from wastewater in STWs, potentially reducing or eliminating the need for chemical treatments. In summary, this project offers a sustainable solution to mitigate MPs pollution by implementing an innovative nanobubble flotation system in Hong Kong's sewage treatment plants. This will contribute to safeguarding the marine ecosystem and reducing the environmental impact of MPs.