

Completion Report

Project Number: MCEF21102

Project Title: Impact of pharmaceuticals and personal care products on plankton communities in western and southern waters of Hong Kong, and migratory measures

Name of Organisation: The City University of Hong Kong

Reporting Period: From 1st January 2023 to 1st January 2026

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Executive Summary

This project aimed to assess the impact of pharmaceuticals and personal care products (PPCPs) on plankton communities in Hong Kong's western and southern waters and to develop a practical mitigation method. The research was structured across five stages, from establishing detection protocols to developing a biochar-based removal strategy.

A standardised analytical protocol was first established for five target PPCPs (BP-3, DEET, TCS, HMS, OC). Sampling at Stonecutters Island and Ngong Ping sewage treatment works revealed that conventional treatment processes (CEPT and SBR) often have poor and variable removal efficiencies for these compounds, with some showing negative removal, confirming that sewage effluent is a significant source of PPCPs entering the marine environment.

Using the marine diatom *Chaetoceros neogracilis* as a model, laboratory experiments demonstrated that benzophenone-3 (BP3), a common UV filter, is "very toxic" (EC50 of 0.4 mg/L), inhibiting growth and photosynthesis. Transcriptomic analysis revealed that BP3 and its metabolites disrupt fundamental processes including photosynthesis, nitrogen metabolism, and the structural integrity of the diatom's silica frustule. Further mechanistic investigation using the diatom *Thalassiosira pseudonana* exposed to BP mixtures (BP13, BP18, BP38, BP138) showed mixture-specific effects, with the ternary mixture BP138 exerting the most comprehensive impact on pathways related to chromatin remodelling, cell wall organization, and silica deposition. These laboratory findings were validated in field-based microcosm experiments using natural phytoplankton communities. Exposure to BP3 mixtures at environmentally realistic concentrations led to a significant reduction in diatom abundance (up to 62%), a shift in community composition towards smaller picoplankton, and a decrease in overall community diversity.

In response to the identified problem, the project developed a cost-effective mitigation strategy using sludge-derived biochar. Batch adsorption experiments showed that this biochar, produced from sewage sludge, is a highly effective adsorbent for triclosan (TCS), achieving removal efficiencies of up to 95.51% under optimised conditions. Results of this project were presented at an international conference for the scientific community.