

Micro- and nanoplastics in wastewater treatment systems and receiving waters

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Hydro Nation Scholars Programme

Introduction

- Plastic pollution is widespread and persistent; and, of growing concern are micro- and nanoplastics (MNPs) < 5 mm in size, originating from primary and secondary sources.
- MNPs can uptake and concentrate other pollutants, and are easily ingested by aquatic organisms, causing adverse physiological effects.
- MNPs are largely documented in oceans, but there is scarce knowledge in freshwaters.
- Management of land-based inputs is key, with effective strategies depending on a comprehensive understanding of source, distribution, transport, degradation, and removal of MNPs in freshwater and wastewater treatment (WWT) systems.
- **Primary aim:** Describe and model the behaviour of MNPs in WWT and fluvial systems.

Methods

- There are no standardised procedures to measure and detect MNPs.
- **Proposed approach:**
 - Spatial sampling: WWT inflow and effluent; spatial sampling up- or downstream of effluent discharge
 - Sorting: size fraction sieving, density separation, filtration, visual sorting
 - Analytical techniques for source characterisation: electron microscopy (**Figure 1**) for particle structure and spectroscopy for chemical composition and degradation.
 - Impact: bacterial growth (COD, direct count); blockages in WWT system (sand column experiments)
 - Fate: Predict MNPs load to recipient water through transport models based on flow (e.g. Delft 3D)

Expected Outcome

- Generate incisive understanding of the distribution and behaviour of MNPs in WWT and freshwater environments.
- Inform stakeholders (e.g. legislators, manufacturers, industry) to develop effective mitigation strategies.
- Relevance to Hydro Nation goals:
 - Connecting research and policy.
 - Developing the economic, environmental and social values of Scotland's water resources.
 - Raising Scotland's international profile; international knowledge exchange.

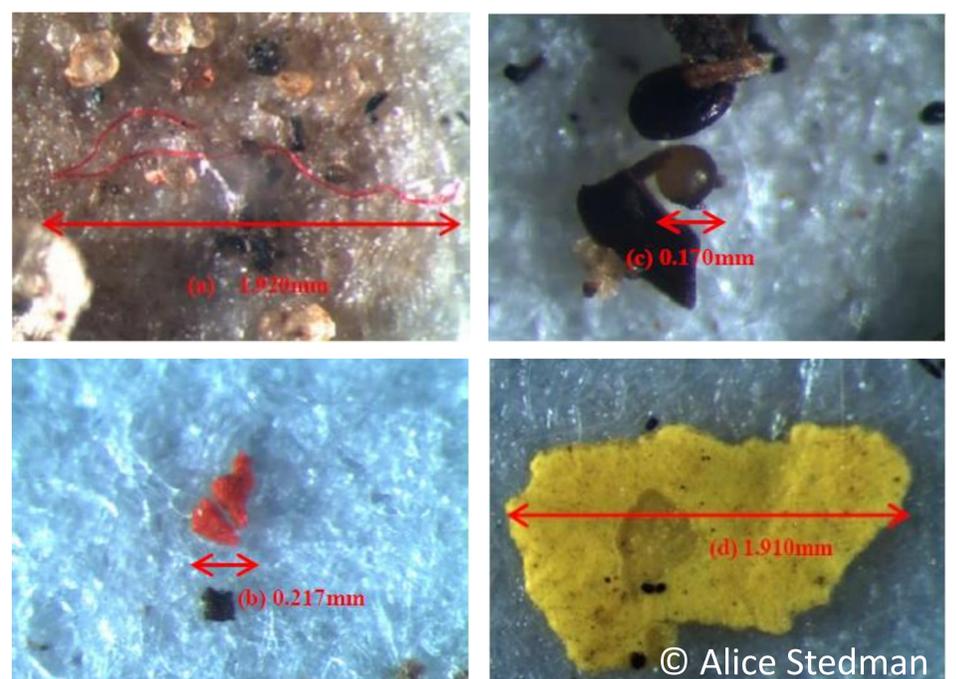


Figure 1 Electron microscopy images of microplastics collected from the River Kelvin in Scotland (unpublished work)

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