

Microplastics pollution in a tertiary sewage treatment system

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Introduction

- ❖ Microplastics (MPs, < 5 mm in size) are classed as emerging contaminants worldwide, but currently not regulated
- ❖ Quantification and risk assessment is difficult because unlike traditional contaminants, MPs are highly diverse and their distribution in the environment is extremely variable in space and time
- ❖ MPs can enter the environment via several pathways (e.g. effluent, storm drains, runoff, CSOs, legacy litter), and management of land-based inputs is key, but their monitoring and regulation is hindered by limited empirical data in fresh- and wastewater systems
- ❖ **Aim:** Describe and model the behaviour of MPs in wastewater treatment and fluvial systems



Methods

- ❖ Site is a tertiary sewage treatment plant (STP) in Glasgow, UK
- ❖ 5-L wastewater samples collected at 8 treatment stages (Fig 1)
- ❖ 30% H₂O₂ digestion → vacuum filtration (1.2 μm GF filters)
- ❖ Stepwise quantification: (1) Visual (light microscopy); and, (2) Chemical (SEM and FTIR-ATR)

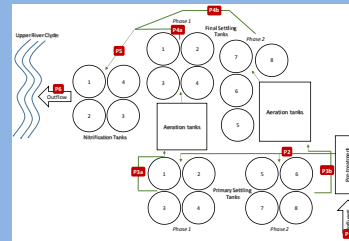


Fig 1. Sampling scheme in the tertiary STP for 8 sampling points: P1, influent; P2, pre-treatment effluent; P3a and P3b, primary effluent phases 1 and 2, respectively; P4a and P4b, secondary effluent phases 1 and 2; P5, secondary effluent, mixed liquor; P6, final effluent

(1) VISUAL

- ❖ MPs found in wastewater, mainly fibres and films
- ❖ Overall decrease from input to output but MPs observed in discharge (Fig 2)
- ❖ High local variability across sampling events (Fig 2)
- ❖ Total visual counts were 394 and 160 pieces across all sampling points for May and August, respectively

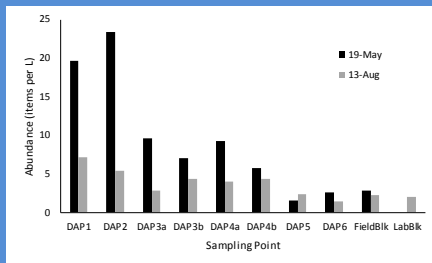


Fig 2. MP abundances in tertiary STP wastewater

(2) CHEMICAL

- ❖ Chemical characterisation is needed for accurate MP identification
- ❖ SEM can be used to separate C-based materials like plastics from inorganic debris, misidentified as MP during visual inspection (Fig 3)
- ❖ FTIR-ATR can be employed to discriminate MPs from cellulose and other confounding materials (Fig 4)

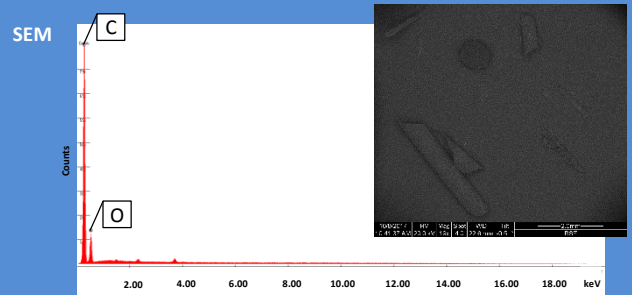


Fig 3. SEM output for suspected MP pieces collected from tertiary STP wastewater; 94% of analysed pieces (n=17) initially identified as MP were C-based

Results

Future

- ❖ Expand spatio-temporal dataset for selected STP and recipient channel (Upper River Clyde)
- ❖ Lab-based experiments to explore impact on STP efficacy:
 - ❖ Toxicity on microbial community (secondary treatment)
 - ❖ Blockages in porous media (tertiary treatment)
- ❖ This research is to generate incisive understanding of distribution and behaviour of MPs in waste- and freshwaters and determine where controls should be implemented

FTIR-ATR

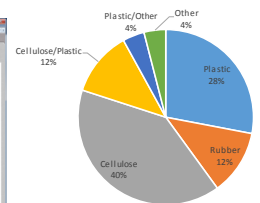
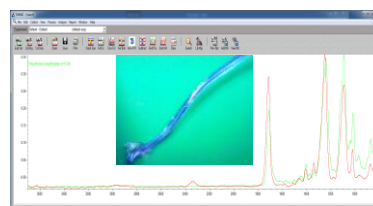


Fig 4. FTIR-ATR analysis of suspected MP pieces collected from tertiary STP wastewater; only 28% of analysed pieces (n=25) were confirmed plastics

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