EQ01A241 The National Chemical Investigations Programme 2020-2021
Chem 5, Microplastics

Need for Project

The topic of plastic waste continues to generate much public concern. This is particularly true for the visible plastic debris in our oceans and littering our coastlines. But as these materials physically break down they form the less–visible microplastics that are disseminated throughout our homes and the natural environment.

Microplastics are generally defined as being plastic particles of less than 5 mm. Whilst largely resistant to biodegradation, plastic materials are subject to wear and tear as well as abiotic degradation which can ultimately lead to microplastic formation. The loss of synthetic clothing fibres, and synthetic microbeads are another source. Microplastics are now ubiquitous in the environment.

Examples of microplastic litter

In this project we are looking closely at the behaviour of microplastics in different types of wastewater treatment works (WwTWs). The products of WwTWs (both treated effluent and sludge) are one of the ways microplastics can enter the environment.

Microplastics leave our homes and industrial premises and enter the sewerage system and WwTWs on a daily basis. Unfortunately, plastic polymers are very resistant to biodegradation and so cannot be eliminated by conventional sewage treatment. They are, however, subject to physical processes like settling which diverts a large proportion into sludge.

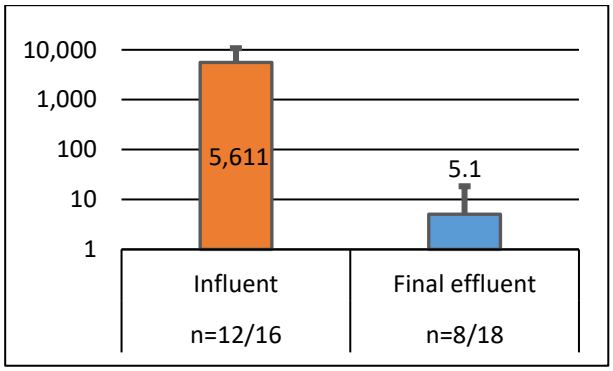
To help understand the cost-effectiveness of potential interventions, it would be helpful to assess which treatment types perform well or less well with respect to diverting microplastics from effluent to sludge.

Almost all WwTWs in the UK utilise secondary treatment. That means they include both settling processes (primary) and biological treatment (secondary). There are a number of different biological treatment types. In addition, many now have a tertiary stage, which can include physical or chemical measures to further improve the final effluent. Different variants of anaerobic sludge digesters are used to treat the sludge. As yet, whilst we know that WwTWs perform well as a group at removing most microplastics from effluent, we do not yet understand which stages and process types are most effective.

Whilst the public desire for information regarding microplastics is very high, the subject as a science is still in its infancy. Thus, it is vital not only to carry out more research, but that the approach and quality control is sufficient to generate repeatable results. This project has been designed to give reliable information on how microplastics behave within our different WwTWs.

Project Delivery

The performance of different treatment stages to remove microplastics from the influent within WwTWs is poorly understood. Both Regulators and those in the Industry need reliable information on the effectiveness of these different steps as they consider how best to manage the issue.



Reduction in the number of microplastics found in 8 WwTWs (average and standard deviation of all samples greater than the LOQ, values <LOQ treated as 0, UKWIR Report 'Sink to River, River to tap')

This work will help Industry and Regulators to answer the major questions regarding different WwTW types and their stages:

- Does the fate of different size groups of microplastics (0.2-5 mm, 25-200 µm and 6-25 µm) differ in WwTWs?
- How does the fate of different plastic polymers differ?
- Does the mass rather than number of different polymers differ with treatment stage?
- Do the results differ with season?

EQ01A241 The National Chemical Investigations Programme 2020-2021
Chem 5, Microplastics

- Can a mass balance of the fate of microplastics be constructed?

Objectives

- With participating Water Companies to instigate a sampling campaign at 10 different WwTWs across England and Wales
- To quantify, with suitable QA/QC control, the presence of microplastic particles entering and leaving wastewater treatment works.
- To identify which treatment type and stage is most successful in the removal of microplastics from the influent waste stream.
- To establish whether there are any differences in fate according to polymer type or size and/or whether time of year has an influence

Work programme

1. Coordination with UKWIR

   1.1 Liaising with Project Steering Group (PSG) on sites to sample and local assistance
   1.2 Monthly progress reports to Project Manager (PM)
   1.3 Start-up, interim and final meetings with all stakeholders
   1.4 Write progress and final report.

2. Field work

   2.1 Construct sampling rigs and train sampling team in their use
   2.2 Commence field sampling for 10 WwTWs with 4 visits over the course of 2020/21

3. Processing and analysis.

   3.1 Prepare positive and negative controls for the different polymers
   3.2 Manage consistent sample processing at UKCEH Lancaster
   3.3 Share analysis of microplastics between UKCEH Wallingford and NOC

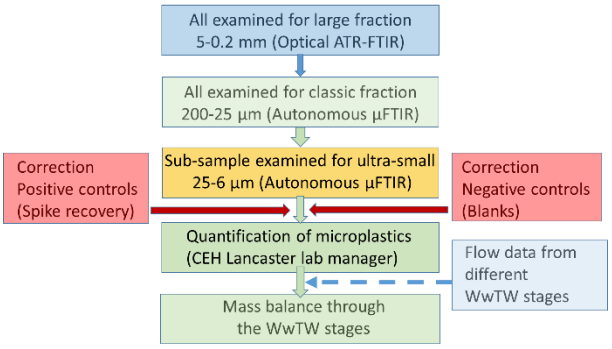
Timetable

The project will commence in March 2020, field work start in April 2020 and analysis completed by April 2021. A final report will be produced in September 2021 with a workshop planned for March 2022 to disseminate findings.

Benefits

Through an intensive programme of field work and analysis, this will represent the most comprehensive study yet carried out on the behaviour of microplastics throughout current wastewater treatment types and stages.

The outputs from the project will improve the understanding of the Water Industry with respect to the challenge of microplastics entering and leaving WwTW in the UK. It will identify how effective a representative range of treatments are at removal of these particles.



Sequence of microplastics analysis planned

Outputs and deliverables

A clear and concise report will be produced informing the Water Industry and regulators on the presence and fate of microplastics throughout a representative range of treatment facilities. It will conclude with observations on the most effective components of WwTWs at removing microplastics from the waste streams.

Project team

The project will be led by the UK Centre for Ecology & Hydrology with collaboration from the National Oceanography Centre and Aqua Enviro. UKWIR's Programme Lead for the project is Howard Brett (waste water) and the Project Manager is Brian Ellor.

UK Centre for Ecology & Hydrology

National Oceanography Centre

AquaEnviro