EMPIR Call 2019 – Energy, Environment, Normative and Research Potential

Selected Research Topic number: **SRT-v04**
Version: 1.0

Title: Microplastics in environmental matrices: Comparison and traceability of different analytical methods

Abstract

The release and the subsequent degradation of plastics have led to increasing amounts of microplastic particles, ranging in size from a few µm to 1 mm, in the environment. The risks arising from these particles are still unclear and there are no reliable data on sources, abundance and fate of microplastic in the environment. This is due to the lack of reliable analysis procedures as prerequisite for environmental monitoring. Research is required to develop reproducible procedures for the traceable determination of the mass fraction and particle size distribution of microplastic in the environment. This should be underpinned by the provision of reference materials as a basis for quality control.

Keywords

Water, solids, air, pollution, plastic particles, standardisation, reference materials

Background to the Metrological Challenges

More than 300 million tons of polymers are produced worldwide annually, and 8-12 million tons are estimated to end up in the oceans. The presence of microplastic particles < 5 mm is documented for oceans and beaches all over the world. Plastic particles are also found in rivers, inland waters and waste water plants as well as biota, soils and air. With the Marine Strategy Framework Directive 2008/56/EC, the European Commission established a framework for EU member states to take necessary action to achieve or maintain a good environmental status in the marine environment by 2020. Likewise, further activities were agreed at the 2015 G7 summit. Comprehensive and reliable data on the source, abundance and especially the fate of various plastics in the marine and terrestrial environments is not currently available. The reason for this is the lack of unambiguous and precise detection of small amounts of synthetic polymers beside large amounts of natural particles and macromolecules in environmental matrices. Quantitative data on microplastics in the environment are a prerequisite for effective administrative regulations and risk assessments. However, the validity of the data is questionable, due to the absence of harmonised and standardised protocols for different detection methods.

Most groups working in this area validate their methods using individual reference materials, as uniform, realistic matrix reference materials do not exist. Traceable polymer calibrants and matrix reference materials (environmental samples with known microplastic content) are crucial to validate the analytical procedures (sample preparation and instrumental determination) but are not yet available. Harmonised protocols for sample preparation are also not currently available. Prior to detection, it is necessary to remove organic matrix components from field samples (aqueous and solid) and to enrich the microplastic content. The natural organic matter can be selectively oxidised (hydrogen peroxide, enzymatic oxidation) or removed by density separation. In addition, protection of the investigator's health may require disinfection of the samples, especially if they were obtained in waste water treatment or composting plants. The challenge is to avoid any loss of the microplastic particles and any alteration of their dimensions, size distributions and chemical compositions in this process.

The polymer composition of microplastic particles may be identified by microscopy, coupled with Raman or Fourier transformation infrared (FTIR) spectroscopy with high accuracy due to characteristic polymer spectra. However, the determination of particle size ranges on filters or in sediment samples is extremely time-consuming. Furthermore, restrictions are encountered (poor transparency, reflectance, fluorescence) and quantification of mass fractions has so far not been established at all. So far, the reliable determination of concentrations below 1 % has still to be achieved.

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Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on the traceable measurement and characterisation of microplastic encountered in the environment.

The specific objectives are

1. To produce suitable matrix reference materials with clearly defined realistic microplastic particle size distributions and mass fractions for the validation of analytical procedures and establishment of metrological traceability. These should include different polymer types, particle sizes and particle ages, as well as in various environmental matrices, such as different suspended matter, organic rich soils and organic poor sediments, and biota.
2. To develop methods for the characterisation of the chemical composition, particle size distribution and mass fraction of microplastics in environmental matrices, including cost-effective methods for characterisation of the particle number (up to 10^6 particles per kg of matrix), suitable for validation and use in monitoring campaigns.
3. To develop accurate and safe techniques for sample preparation, including enrichment of the microplastic material and appropriate disinfection (e.g. of sewage sludge or untreated waste water) without affecting the particle characteristics or chemical composition of the sample.
4. To validate the measurement capabilities and reference materials developed in this project by carrying out inter-laboratory comparisons between project partners.
5. To facilitate the take up of the technology and measurement infrastructure developed in the project across the measurement supply chain (NMIs, accredited laboratories), standards developing organisations (CEN, ISO) and end users (waste water treatment plants, environmental monitoring agencies).

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the research, the involvement of the appropriate user community such as industry, standardisation and regulatory bodies is strongly recommended, both prior to and during methodology development.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 2.0 M€, and has defined an upper limit of 2.3 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 35 % of the total EU Contribution across all selected projects in this TP.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Transfer knowledge to the waste water treatment and environmental monitoring sectors.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically, the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards

- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work.

Time-scale

The project should be of up to 3 years duration.