ANDROMEDA

Analysis techniques for quantifying nano- and microplastic particles and their degradation in the marine environment

DURATION
1/04/2020 - 31/03/2023

BUDGET
249 000 €

PROJECT DESCRIPTION

Context

In recent years, there have been significant developments in the identification and characterization of micro- and nanoplastics in marine environmental matrices such as water, sediments and biota. A broad range of analytical methods is available with high variation between methods in their level of comprehensiveness, applied detection mode, pre-treatment and measurable particle size range. The choice for the optimal analysis method is project dependent: whereas many research projects may require the need to identify and characterise microplastics smaller than 10 µm, cost-effective methods focussing on larger microplastics may be more appropriate within monitoring, citizen science or for educational purposes. For both types of methods, there is a clear need for further method-development, harmonisation and validation in order to increase comparability and quality of research results. Special attention is needed for methods able to identify plastic particles which are difficult to analyse with current spectroscopic methods, such as tyre wear particles or paint particles.
A certain proportion of microplastics result from macroplastic litter fragmentation caused by UV degradation, mechanical abrasion and microbial degradation. These processes do not only impact the physical characteristics of the microplastics, but also affect the chemical composition through oxidation processes or by the leaching of chemical additives. Since these degradation processes are very slow under the normal range of conditions encountered in the marine environment, there is a need to develop accelerated degradation methods under laboratory-controlled conditions, in which microplastics are subjected to stressors that mimic natural degradation at a higher speed. These accelerated degradation techniques may also have the potential to produce degraded reference materials.

General objectives

The aim of ANDROMEDA is to develop an instrument platform for in situ and cost- effective analysis of microplastics, advanced characterization of microplastic materials and for accelerated microplastic degradation and degradation characterization.
The main objectives of ANDROMEDA are to:

- Achieve cost-effective analysis of microplastics by in situ-methods and low-cost laboratory analysis, including efficient sampling.
- Develop and optimize advanced techniques to measure and quantify small and challenging types of micro- and nanoplastic particles.
- Investigate the degradation and fragmentation mechanisms of plastic into micro- and nanoplastic particles.
- Study the release of additive chemicals during fragmentation and degradation processes.
- Disseminate project results and developed protocols to a range of audiences, including public authorities, the private sector, academia and the general public.

ANDROMEDA

Methodology

Within Andromeda, methods will be developed or optimised to analyse micro- and nanoplastics. Different techniques will be applied, including the detection of chemical markers, the use of hyperspectral imaging, detection of fluorochromes and the use of µFTIR, Raman and electron microscopy. The lower size limit of microplastic particles that can be detected is method dependent, but will vary from 300 µm to 200 nm. Method comparison and validation, applying real samples, is a central topic within Andromeda. The Belgian project partners ILVO and VLIZ focus their research within the Andromeda project on analytic methods based on fluorochromes (Fig. 1). By making microplastics fluorescent, particles can be cost-efficiently quantified in water, sediment and biota by automated image analysis.
Within the Andromeda project, special attention will go to the detection of tear wear particles and paint flakes. Accelerated degradation of microplastics will be studied, using photo-, thermos-, bio- and chemical oxidation techniques. These will also involve the study of additives leaching, including phthalates, organophosphate esters, bisphenols and dicarboxylic acids.

Impact and expected results

Andromeda aims to deliver a range of quality controlled methods to determine microplastics in different matrices of the marine environment: water, sediment, biota and air. The features, strengths and limits of the optimized methods will be listed, which will allow researchers to select the most appropriate method, depending on their research goals: from citizen science, monitoring or large-scale research projects to the analysis of small microplastics. Such methods have the potential to have high impact as a basis for developing our understanding of the occurrence and distributions of these particles in the marine environment and will support the necessary work needed to assess their potential uptake and impact on marine organisms.
The development of methods to study microplastic degradation is also an important topic of the Andromeda project. This work is expected to have a high impact as it will establish a basis for studying degradation mechanisms and the formation of environmentally relevant degradation products and intermediates. Production of environmentally relevant reference materials (irregular shaped, partially degrade) can be a crucial step forward to significantly improve the environmental relevance of microplastic research.

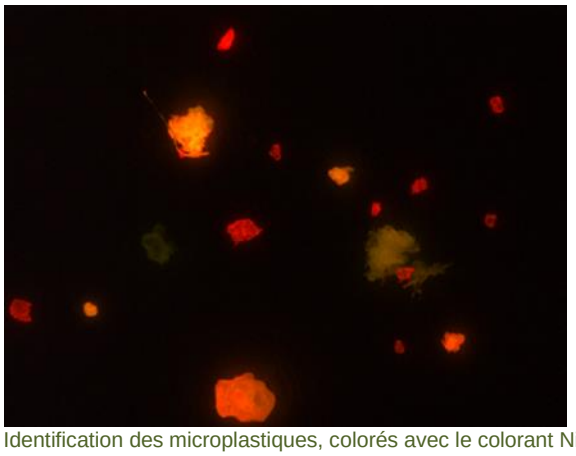

Fig. 1. Identification des microplastiques, colorés avec le colorant Nil Red.

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LINKS

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