A novel technique to qualify and quantify fine microplastics in surface water by coagulation and μFTIR microscopy

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Abstract

We propose an analytical method for fine micoplastics (MP) by using μFTIR imaging, the Multivariate Curve Resolution (MCR) and the correlation analysis with their easy and quick sampling system. Coagulation was effective only for surface water samples with little suspended solids to remove matrices.

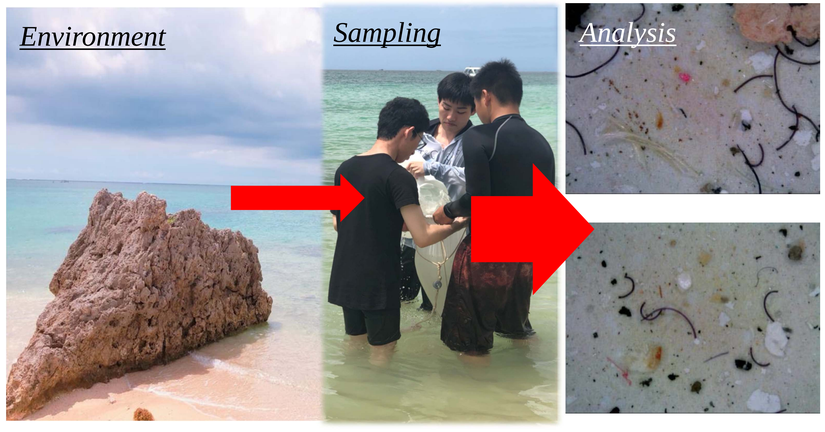

Fig. 1 Sampling and analysis of MP, especially fine MP, are difficult. Their identification by FTIR need traceability in their measurement.

Background

Fine MP (10 ~100 μm) are growing concern with large MP (>100μm) . The easy and quick sampling methods, the traceable analytical methods and the evaluation methods are needed.

Fig.2 MP on a membrane by coagulation

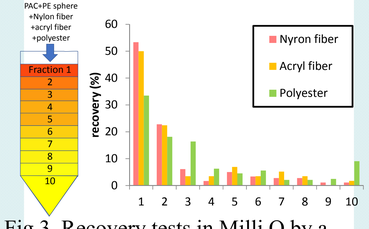

Fig.3 Recovery tests in Milli Q by a coagulation treatment

Coagulation

We tried coagulation process after NaI density separation instead of dangerous H_2O_2 oxidation. Matrices such as algae, fine solid particles, plant debris could be removed easily and quickly (Fig. 2). Recovery tests (Fig. 3) using Milli Q with 30μm polyethylene particles and 100μm nylon, polyester and acryl fibers revealed good recovery rates. But cellulose fibers (toilet paper!) trapped the added MP and settled in raw wastewater.

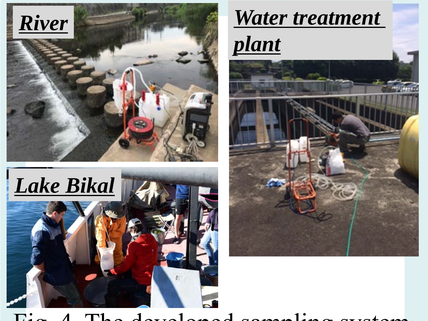

Fig. 4 The developed sampling system for 10μm MP are useful around the world.

Sampling System

Fig.4 shows a usage of a novel sampling system at various sites around the world. It takes 30 min to collect 1 m^3 of water samples.

Automatic μFTIR analysis

Fig. 5 shows an example of MP in surface water by automatic μFTIR analysis. After sampling, MP were extracted on a PTFE membrane filter (2cmφ) after H_2O_2 oxidation and NaI density separation. MP images were conducted by μFTIR (20% area/2hrs). Based on the spectrum data, MCR analysis can extract 10 major spectra. Minor spectrum can also be extracted by correlation analysis.

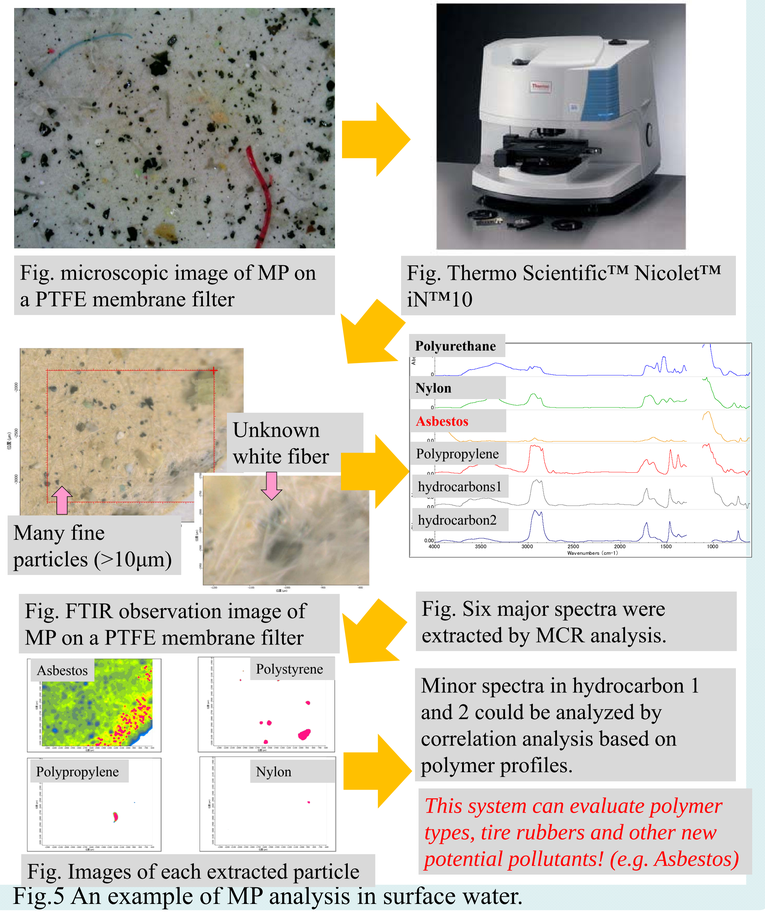

Fig.5 An example of MP analysis in surface water.