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Application News

No. A589

Spectrophotometric Analysis

Analysis of Microplastics Collected from Marine Species Using the AIM-9000 Infrared Microscope

Pollution by marine debris including microplastics has become a serious environmental problem, and scientists all over the world are exploring its status by carrying out a survey on microplastics accumulated in marine species. The effects of marine debris have spread through the food chain to marine species such as polar cod living in the Arctic Ocean and deepwater shrimp (order Amphipoda) living at depth, which should have been hard for the impact of pollution to reach. Moreover, microplastics have even been found in the polar ice.

A group of scientists from Newcastle University in the UK and Wageningen Marine Research in the Netherlands collected the stomach contents of various marine creatures to separate microplastics of approximately 100 µm in size to conduct a survey on the impact of marine debris [1]. Fig. 1 shows a picture of a marine survey.

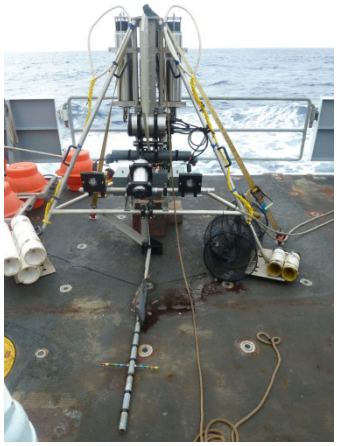

Fig. 1 Picture of a Marine Survey

This article introduces an example of analysis using an infrared microscope on microplastics collected from polar cod and deepwater shrimp.

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Pretreatment and Measurement Samples

Microplastics analysis requires scrupulous attention to prevent contamination of samples. Direct touching could attach sebum or dust and contaminate samples. Microfibers from clothing and minute particles floating in the air also need attention to avoid sample contamination.

If samples are contaminated, proteins and other residues need to be removed using an organic solvent or water. However, it should be noted that there is a possibility that the information intrinsic to the samples may be lost by using an organic solvent.

In this experiment, samples were washed with potassium hydroxide solution which removes organic substances without affecting the samples.

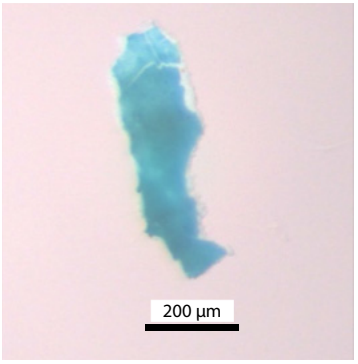

Fig. 2 Microplastic Collected from Polar Cod

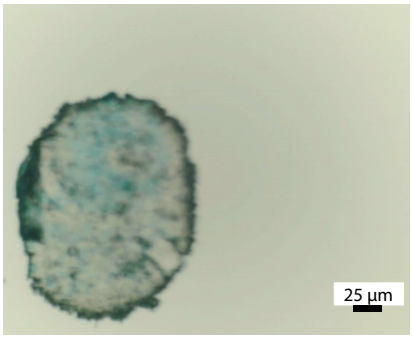

Fig. 3 Microplastic Collected from Deepwater Shrimp

Instruments Used and Measurement Conditions

An infrared microscope is suitable for observing microplastic particles in sizes from several tens to hundreds of µm. In this experiment, the IRTracer™-100 Fourier transform infrared spectrophotometer and AIM-9000 infrared microscope shown in Fig. 4 are used for analysis. The measurement conditions are listed in Table 1.

Fig. 4 IRTracer™-100 Fourier Transform Infrared Spectrophotometer and AIM-9000 Infrared Microscope

Table 1 Measurement Conditions

Instrument	:	IRTracer-100, AIM-9000
Resolution	:	8 cm^{-1}
Accumulation	:	100 times (Fig. 2), 50 times (Fig. 3)
Apodization Function	:	Happ-Genzel (Fig. 2), Sqr-Triangle (Fig. 3)
Detector	:	MCT
Aperture size	:	25 µm × 25 µm (Fig. 2) 15 µm × 15 µm (Fig. 3)

Measurement Results

The blue microplastic piece collected from polar cod shown in Fig. 2 was measured by using the microscopic ATR method, and the microplastic piece collected from deepwater shrimp shown in Fig. 3 was compressed in a diamond cell and measured by using the microscopic transmission method. The measurement results for the former are shown in Fig. 5 and those for the latter are shown in Fig. 6.

From Fig. 5, we found that the main component of the microplastic piece collected from polar cod was PMMA (polymethylmethacrylate) and that kaolin (aluminum silicate) was included as an additive. PMMA is a lightweight resin having toughness and excellent resistance to weather, water and impacts, and is therefore used for everyday items and miscellaneous goods.

From Fig. 6, we found that the main component of the microplastic piece collected from deepwater shrimp was a mixture of PE (polyethylene), $CaCO_3$ (calcium carbonate) and kaolin (aluminum silicate). PE is a common general-purpose resin used for packing materials and containers. This is often detected in microplastics.

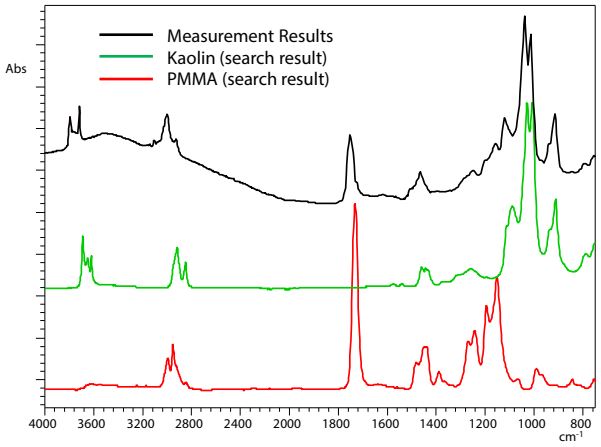

Fig. 5 Measurement Results for Microplastic Collected from Polar Cod

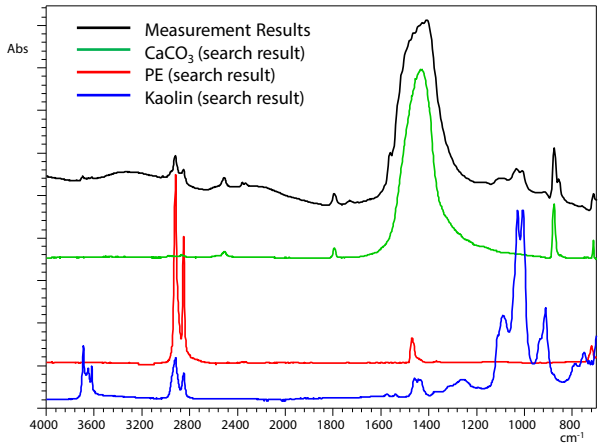

Fig. 6 Measurement Results for Microplastic Collected from Deepwater Shrimp

Conclusion

In this experiment, we analyzed microplastics collected from polar cod and deepwater shrimp. Both creatures live in an ocean area that has been considered hard for human-induced marine pollution to reach. However, the experiment revealed that they were affected by microplastics.

For analysis of microplastic particles in sizes from several tens to hundreds of µm, the resin components and additive components can be quickly determined by using an infrared microscope that enables qualitative observations of organic matter and some inorganic matter.

References
(1) In every ocean, at every depth – microfibers and microplastics Micro FTIR analysis of smallest particles from deep sea to polar ice, Susanne Kühn, Wageningen Marine Research, The Netherlands Alan Jamieson, Newcastle University, Great Britain Robert Keighley, SUK, Great Britain Marion Egelkraut-Holtus, Shimadzu Europa GmbH, Germany, SHIMADZU NEWS, 2. 2018

First Edition: Jan. 2019

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