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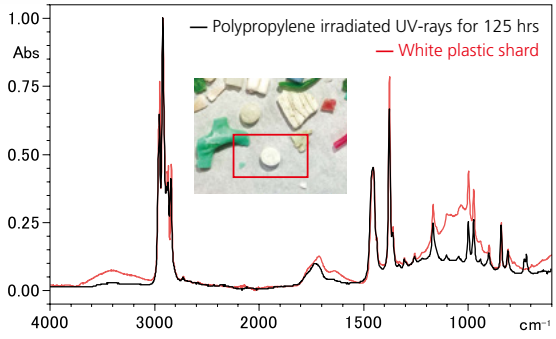
Issues in the Analysis of Microplastics

In recent years, demands for microplastics analysis have increased due to the possibility of microscopic marine plastics impacting the ecosystem.
Generally, when discriminating between plastic types, an infrared spectrum is acquired using a Fourier transform infrared spectrophotometer and then compared with the spectra for standard plastic items.
However, the shape of the infrared spectrum for a degraded plastic differs from the spectra of a standard. Accordingly, the spectrum will not match anything in commercially available plastic libraries, which makes identification and qualitative analysis difficult.

Analysis Example 1

White plastic shards from microplastic collected from a seashore were measured. Typical plastic libraries find both polypropylene and other plastics, such as polybutene, at the top, making qualitative analysis difficult. Shimadzu UV-Damaged Plastics Library finds UV-degraded polypropylene at the top.

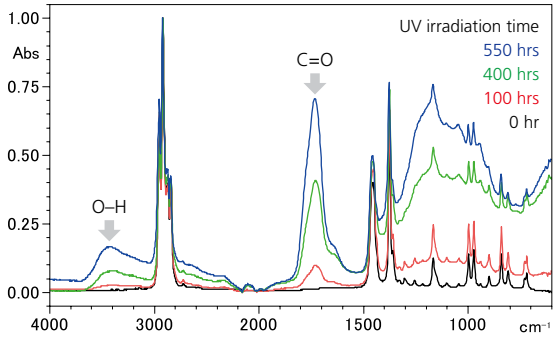


Analysis Example 2

Plastics degrade as they experience molecular cleavage and cross-linking due to thermal and solar energy.

The figure to the right shows changes to an infrared spectrum of polypropylene when irradiated with UV rays at different times.

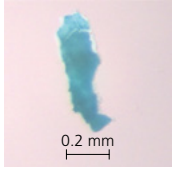
With increasing UV irradiation time, peaks of the O–H radical and C=O radical appear, which are not seen in standard polypropylene.

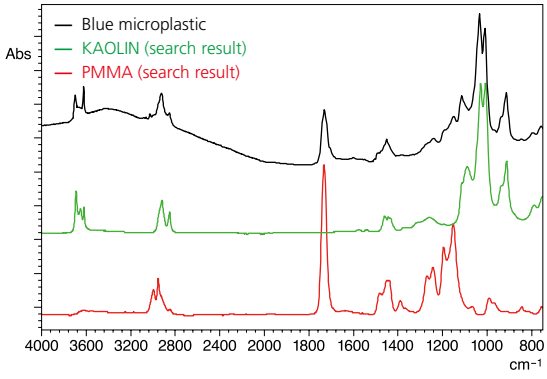


Analysis Example 3

Blue microplastics collected from Arctic cod were measured by the microscopic ATR method.

The infrared spectrum shows that the main compound was polymethyl methacrylate (PMMA) and that it contained aluminum silicate (KAOLIN) as an additive.





Fourier Transform Infrared Spectrophotometer Plastics Analysis System

Plastic Analyzer

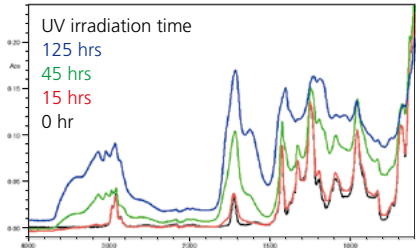
Plastic Analyzer consists of the following.

- IRSpirit™ Fourier transform infrared spectrophotometer
- QATR™-S single-reflection ATR attachment
- Plastic Analyzer method package
  1. UV-Damaged Plastics Library **2.** Thermal-Damaged Plastics Library
  3. Macro Program for IR Pilot™/Parameter File

The Plastic Analyzer method package includes FTIR spectral libraries for plastics degraded by UV rays and heat. Utilizing searches of these libraries demonstrates its effectiveness in the analysis of unknown samples that are difficult to identify with standard libraries. Examples include plastics degraded by exposure to UV rays as well as contaminants and defective items altered by heating.

UV-Damaged Plastics Library

This library includes more than 300 spectra from the UV degradation of 14 types of plastic. This proprietary Shimadzu library includes the IR spectra for plastics degraded by UV rays for the equivalent of approximately 10 years using a super accelerated weathering chamber from Iwasaki Electric Co., Ltd.

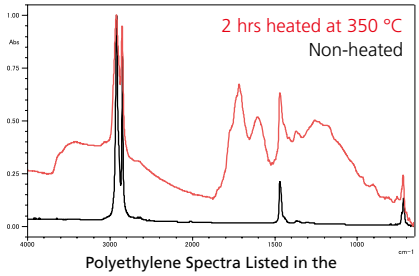


Hard PVC Spectra Listed in the UV-Damaged Plastics Library

Thermal-Damaged Plastics Library

This library includes more than 100 spectra from the degradation of 13 types of plastic heated to between 200 and 400 °C.

This proprietary Shimadzu library contains IR spectra for plastics degraded by heating, acquired through measurements at the Hamamatsu Technical Support Center at the Industrial Research Institute of Shizuoka Prefecture.



Polyethylene Spectra Listed in the Thermal-damaged Plastics Library

Microplastic Analysis for Microscopic Sizes

Fourier Transform Infrared Spectrophotometer IRTracer™-100 (left)
Infrared Microscope AIM-9000 (right)

Infrared Microscope AIM-9000

For microplastic analysis of several tens to several hundred micrometers in size, it is possible to quickly determine the plastic components and additive components by using an infrared microscope capable of qualitative analysis of organic substances and some inorganic substances.

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