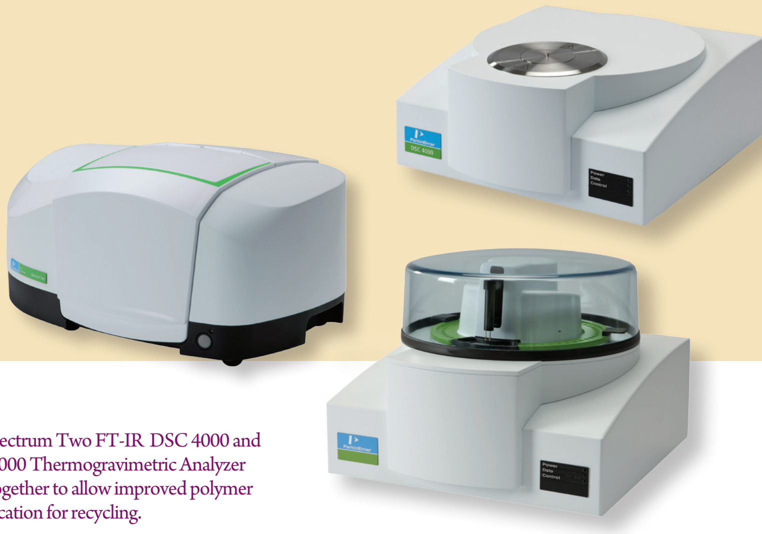
PRODUCT NOTE

Thermal Analysis
FT-IR Spectrometry



The Spectrum Two FT-IR DSC 4000 and TGA 4000 Thermogravimetric Analyzer work together to allow improved polymer identification for recycling.

Polymer Recycling Pack

Polymer recycling is a growing industry, as many bottles and containers that were once destined for landfills are now being recycled into new products. Because polymers tend to be mutually immiscible, it is important that something identified as polyethylene terephthalate (PET) or polyethylene (PE) really be that polymer and not polycarbonate (PC) or polystyrene (PS). The chemical identification of the polymer can be done easily using the Spectrum Two™ Fourier Transform Infrared (FT-IR) and Universal Attenuated Total Reflectance (UATR) accessory as shown in Figure 1.

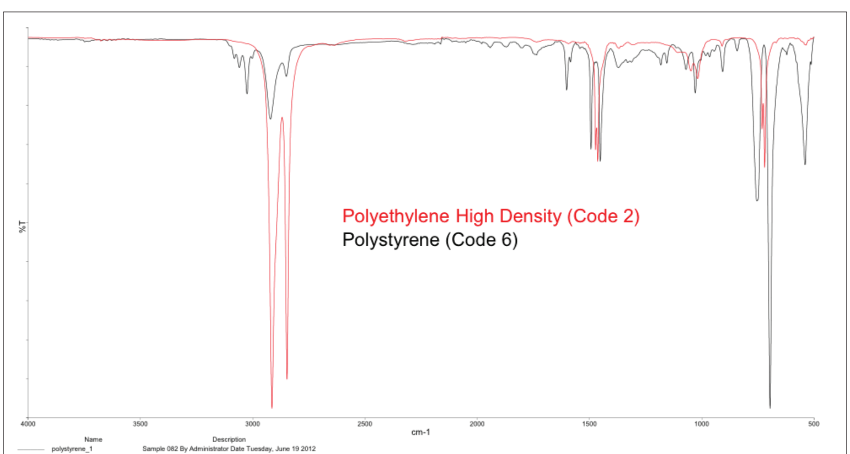


Figure 1. Overlay of PE and PS spectra in the FT-IR . FT-IR is a fast and accurate way to detect chemical differences in polymers.

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Spectroscopic chemical identification alone is not always adequate to determine the classification of a polymer sample. Grades 2 and 4 are chemically the same polymer, polyethylene. As a result they have similar FT-IR spectra. As Figure 2 shows, the spectra of Grade 2 High Density Polyethylene (HDPE) and Grade 4 Low Density Polyethylene (LDPE) are similar. Differential Scanning Calorimetry (DSC) measurements of low density and high density polyethylene. Figure 3, clearly demonstrate the differences between the polyolefin grades. DSC can identify not only the correct form of polymer, but it can also determine when a finished product contains a physical mixture of polymers. An example of such is provided with multilayer thin films. When measured with a DSC, it is easy to determine the identity of the constituents and, in some cases, their concentrations (Figure 4). In this example, it was determined that the weight percent of HDPE in the thin film was between 12-14%.

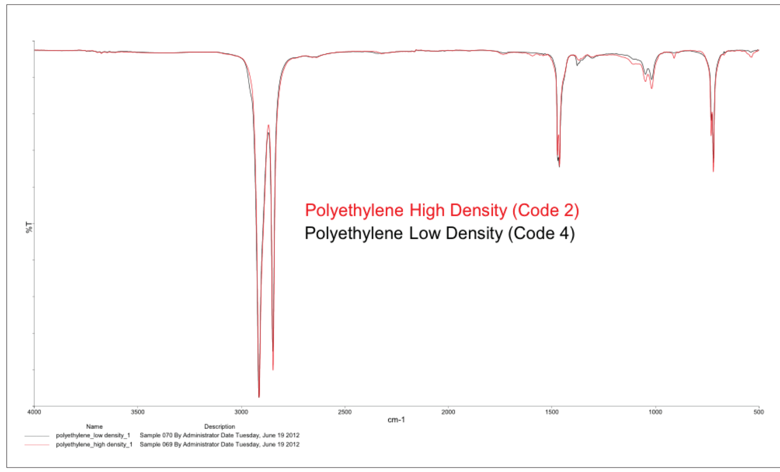

Figure 2. Overlaying Code 2 and 4, both polyethylenes, show the identical spectrum in the FT-IR. Other methods are needed to see the differences.

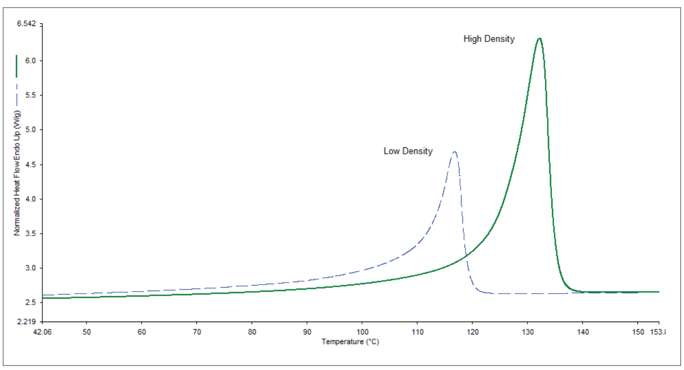

Figure 3. Grades 2 and 4 in the DSC show strong differences.

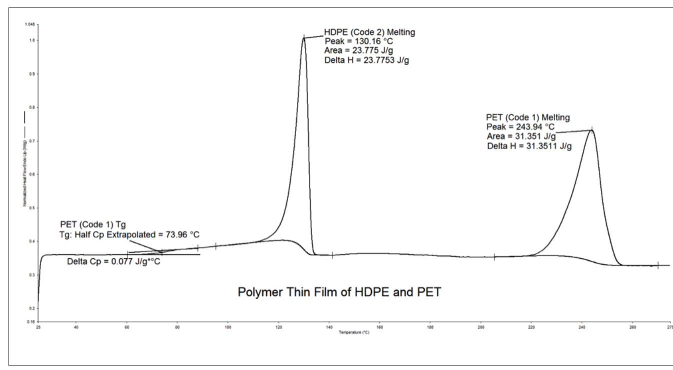

Figure 4. Thin film analysis by DSC, detecting the presence of two polymers within the sample.

In addition to these concerns, the amount of fillers used in materials, such as glass fibers, calcium carbonate, talc, etc., can be detected using Thermogravimetric Analysis (TGA). Within the compendium library, files are provided to demonstrate how one can use TGA to determine the amount of filler in a polymer (Figure 5).

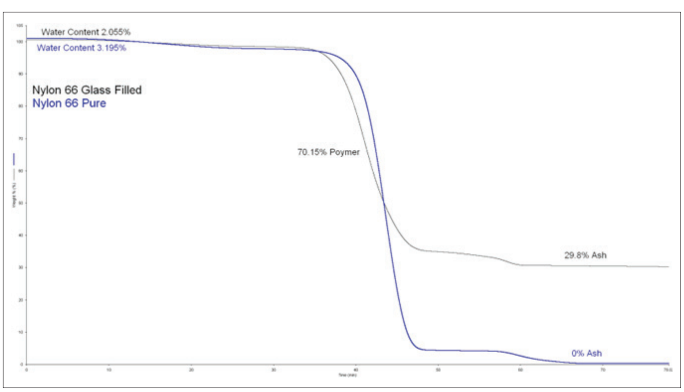

Figure 5. Detecting a filler in nylon

The Polymer Recycling Resource Pack consists of a polymer compendium that addresses how to identify the various grades or codes used in recycling as well as common problems encountered, and three libraries of data files. One library for each of the techniques discussed above is supplied: FT-IR, DSC, and TGA. Working from the compendium, one can first chemically identify the material and then get more precise information on the quality or state of the material. In addition, the compendium also addresses common problems and difficulties with the interpretation of data relevant to the recycling industry.

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