Application Brief

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Characterization of Polypropylene Recyclates with GPC/SEC

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Abstract

Molar mass analysis of polypropylene (PP) recyclates was achieved using a set of Agilent POLEFIN columns with 1,2,4-trichlorobenzene at 160 °C with high-temperature GPC/SEC.

Introduction

The polyolefin PP is one of the most common macromolecules on the polymer market. It is used widely in packing, for containers and housings, but also in automotive interiors and further applications.[1]

Recycling of polyolefins has recently become more prominent. In particular, the comparison of new and recycled polyolefin material is likely to become more common. The macroscopic behavior of recycled PP compared to conventional PP needs to be understood, and so characterization with GPC/SEC is essential.

GPC/SEC analysis of PP requires high-temperature GPC/SEC for characterization, since it is only soluble at elevated temperatures (for example, 1,2,4-trichlorobenzene is a typical mobile phase, which is used at 160 °C).

GPC/SEC is normally used for analysis of molar mass distribution and to determine structural properties such as in copolymer analysis. However, the behavior of material, which is based on recyclates, depends not only on molar mass, but also on structure, potential impurities, and content of antioxidants.

Experimental

Table 1. Instrument and sample conditions.

	Conditions
Pump	Isocratic pump Flow rate: 1 mL/min Mobile phase: 1,2,4-trichlorobenzene
Injection System	Autosampler Injection volume: 200 µL
Columns	Set of POLEFIN columns: POLEFIN 10 µm precolumn, 8 × 50 mm (p/n POA080510) POLEFIN 10 µm linear XL, 8 × 300 mm (p/n POA083010LXL) POLEFIN 10 µm linear XL, 8 × 300 mm (p/n POA083010LXL) POLEFIN 10 µm linear XL, 8 × 300 mm (p/n POA083010LXL)
Temperature	160 °C
Sample Concentration	3 mg/mL
Calibration	Agilent ReadyCal-Kit Polystyrene for high-temperature applications (p/n PSS-PSKITR1HT/PSS-PSKITR10HT)
Detectors	Infrared (IR) detector
Software	Agilent WinGPC

Results and discussion

A set of three POLEFIN 10 µm columns in combination with a POLEFIN 10 µm guard column was used to analyze the molar mass distribution of recycled PP. The recyclate-based material was also compared to a corresponding new PP material without recycled compounds. In Figure 1, a comparison of the molar mass distribution of the two materials is shown. The given molar masses are based on calibration with polystyrene reference materials and not absolute PP values.

The conventional PP material as well as the recyclate-based PP were prepared as three individual samples. All injections were in good agreement and showed high reproducibility.

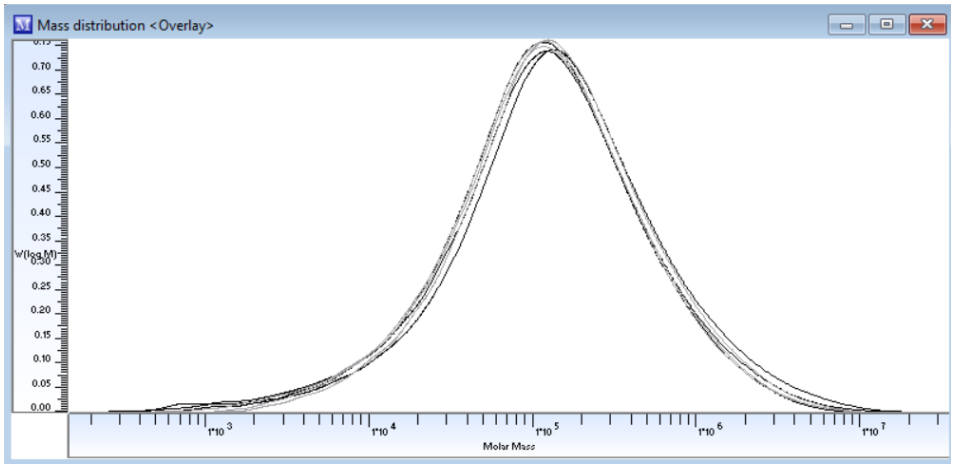

Figure 1. Comparison of the molecular weight distribution (based on calibration with PS reference materials) of each of the three samples of new PP (gray lines) and recycled PP (black lines).

Conclusion

Polypropylene recyclate-based material was successfully analyzed using high-temperature GPC/SEC at 160 °C with a set of POLEFIN columns and TCB as the mobile phase. The comparison between conventional PP and recycled PP did not exhibit a significant difference in molar mass distribution.

Reference

1. Mark, J. E. Polymer Data Handbook; Oxford University Press, Inc., **1999**.

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