Analysis of Polybutadiene by GPC Triple Detection with the Agilent 390-MDS Multi Detector Suite

Application Note

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Introduction

Polybutadiene is an elastomer – a polymer that exhibits elasticity. Elasticity is the ability to deform under external stress but return to the original form after removal of the stress. Polybutadiene is a synthetic rubber manufactured from the monomer 1,3-butadiene. Polybutadiene exhibits 80% recovery after stress, one of the highest values of a synthetic material. It is commonly used to coat electronic assemblies due to its extremely high electrical resistivity. Polybutadiene displays a high wear resistance, low heat build-up after repeated flexing and a low rolling resistance, making it suitable for applications such as tires. It is often used in combination with other materials to produce rubber blends with differing properties.

The 390-MDS offers triple detection GPC by employing a light scattering detector and a viscometer in combination with a differential refractive index detector, to determine accurate molecular weights for polymers for which narrow standards are not available, such as polybutadiene.

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Methods and Materials

Conditions

Samples:	Polybutadienes
Columns:	2 x Agilent PLgel 5 µm MIXED-C, 300 x 7.5 mm (p/n PL11110-6500)
Injection Volume:	100 µL
Eluent:	THF (stabilized)
Flow Rate:	1.0 mL/min
Detector Train:	390-MDS incorporating Agilent 390 Dual angle light scattering, Viscometer and DRI options
Detector Temp:	All detectors set at 40 °C

Results and Discussion

Figure 1 shows an overlaid multi-detector chromatogram for a sample of polybutadiene. The polymer delivered strong, fairly broad signals in all the detectors, indicating the high polydispersity of the materials.

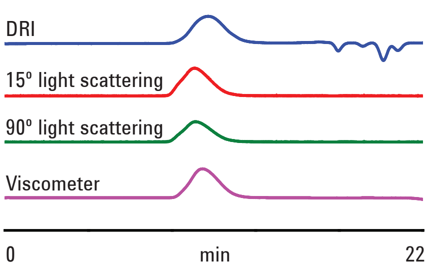

Figure 1. Overlaid multi-detector chromatogram for a sample of polybutadiene

Figure 2 is an overlay of the molecular weight distributions of the three polybutadiene samples. Two of the samples displayed similar molecular weights with only slight differences across the distributions. However, the third sample showed an appreciable difference in molecular weight distribution, especially at high molecular weight where there was slight exclusion of the sample. This change was thought to be responsible for the difficulty in processing this material.

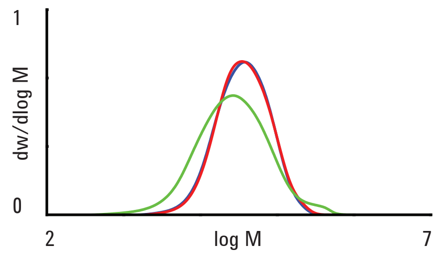

Figure 2. Overlaid triple detector molecular weight distributions of three samples of polybutadiene

Figure 3 shows the overlaid Mark-Houwink plot of log intrinsic viscosity as a function of molecular weight. All of the samples gave the same relationship between increasing log intrinsic viscosity and increasing log molecular weight. This indicates that the polymers were structurally identical and, therefore, that the difference in molecular weight observed was as a result of the synthesis methods employed rather than any changes to the nature of the polymers themselves.

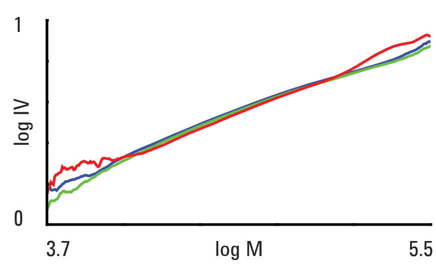

Figure 3. Overlaid Mark-Houwink plots for three polybutadiene samples

Conclusion

Triple detection GPC revealed that samples of polybutadiene were structurally similar and that differences in molecular weight resulted from the synthesis method rather than any changes to the nature of the polymers.

The triple detection 390-MDS when combined with the use of PLgel columns provides a powerful system for the characterization of polybutadienes.

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