Styrene/Isoprene Block Copolymers with Agilent PLgel MIXED-D and GPC/SEC

Application Note

Materials Testing and Research, Polymers

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Introduction

Unlike random copolymers where two or more monomers are included in a polymer chain in a statistically random manner, block copolymers contain isolated blocks of what are essentially homopolymers linked at one or more terminal positions. This regulated structure produces materials with novel properties not observed in random copolymer analogues, typically associated with phase behaviour at interfaces. Such copolymers have been exploited for their surfactant characteristics and for their propensity to form isolated domains in thin films. The simplest block copolymers are AB diblocks consisting of two chains of different polymers (A and B) joined at one terminal. Triblock polymers contain three separate polymer chains connected in series, typically composed of two (ABA triblocks) or three (ABC) different types of polymer chain. Producing block copolymers from blocks with widely differing chemistries results in materials with very unusual properties.

A family of block copolymers of styrene (S) and isoprene (I) have been developed for their excellent adhesive properties. In these materials, SI diblock and SIS triblock copolymers are blended to give a product with the required viscosity and modulus for particular applications.

Gel permeation chromatography (GPC) can be used to estimate the relative proportion of the two components in an SI/SIS product.

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Analysis of Styrene/Isoprene Block Copolymers

In this example, the relative styrene chain lengths in the diblock and triblock materials are the same and so the diblock will have a reduced molecular weight and therefore size in solution compared to the triblock.

Using high efficiency GPC columns, the two components can be resolved based on this size difference. Figure 1 shows a chromatogram of a commercial SI/SIS blended product. The SI and SIS components have been resolved allowing quantification to take place. In this case, the SI content is approximately 42%, typical of a material that finds application in reducing the modulus of polyolefins.

Sample	Styrene isoprene block copolymer blend
Columns	2 × Agilent PLgel 5 µm MIXED-D, 300 × 7.5 mm (p/n PL1110-6504)
Eluent	THF (stabilized)
Flow rate	1.0 mL/min
Inj Vol	100 µL
Detector	RI
System	Agilent PL-GPC 50

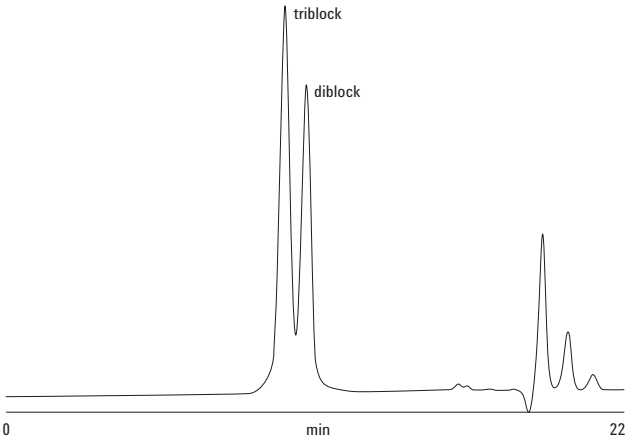

Figure 1. Chromatogram of a styrene isoprene di- and triblock copolymer blend on an Agilent PLgel 5 µm MIXED-D, column.

Conclusions

High efficiency Agilent PLgel MIXED-D columns resolve components of an isoprene/styrene block copolymer based on their size in solution. This allows quantification to take place. Typically, an increase in the proportion of diblock in the blend reduces the viscosity and modulus of the product, a feature that is particularly suited to pressure-sensitive label applications, for example. In this case, the styrene/isoprene content is approximately 42%, typical of a material used to reduce the modulus of polyolefins.

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