Analysis of Poly(styrene/butadiene) Copolymers by Conventional Gel Permeation Chromatography on the Agilent PL-GPC 50

Application Note

Materials Testing & Research

Author

Graham Cleaver
Agilent Technologies, Inc.

Introduction

A poly(styrene/butadiene) block copolymer (SBR) mimics many of the properties of natural rubber and has applications in a wide variety of industrial areas. The characteristics are provided by the hard polystyrene chains being surrounded by a network of rubbery polybutadiene, which provides strength and flexibility over a large temperature range. The copolymer is a thermoplastic elastomer and therefore can easily be used in manufacturing by injection moulding, or blended into an existing product to increase elasticity or impart toughness. The molecular weight distribution is critical, as any homopolymer will significantly affect the resultant end properties.

Verified for Agilent
1260 Infinity
GPC/SEC System

Agilent Technologies

Methods and Materials

Conditions

Columns:	2 × Agilent PLgel 5 µm MIXED-C, 7.5 × 300 mm (part number PL1110-6500)
Eluent:	Tetrahydrofuran (250 ppm BHT)
Flow Rate:	1.0 mL/min
Sample Concentration:	2.0 mg/mL
Injection Volume:	100 µL
Temperature:	40 °C
Calibration Standards:	Agilent Polystyrene EasiVial
Detection:	PL-GPC 50 Integrated GPC/SEC System, DRI

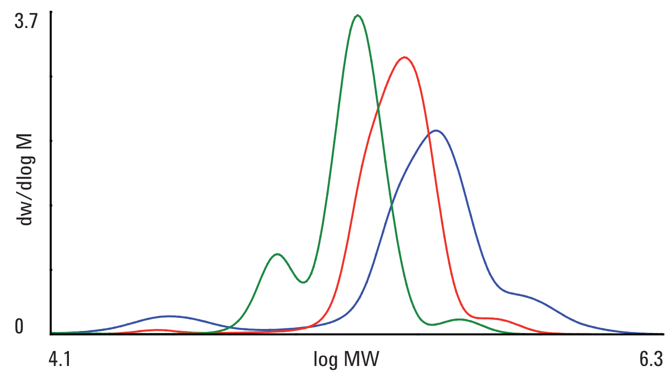

Figure 2. Overlaid molecular weight distributions for the poly(styrene/butadiene) samples

Results and Discussion

Chromatograms for three poly(styrene/butadiene) block copolymer samples are shown in Figure 1. Figure 2 reveals the copolymer overlaid molecular weight distributions.

Each peak eluted as a relatively narrow main peak indicative of ionic polymerization. The molecular weights of the components of the samples were different, due to a change to the synthesis conditions employed. The main peak of each sample was the block copolymer. However, one of the samples also contained a smaller peak eluting after the main peak, indicating the presence of homopolymer at lower molecular weight. Evidence of high molecular weight termination products is provided by the small peaks eluting before the main peak. The presence of these peaks is a result of imperfections in the polymerization processes used to manufacture the materials.

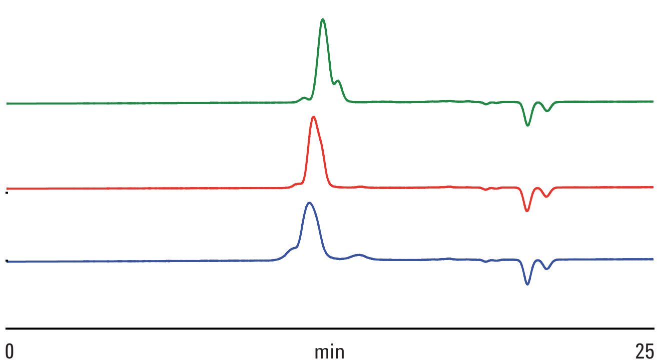

Figure 1. Chromatograms for three samples of poly(styrene/butadiene) – each sample eluted as a multi-modal distribution of relatively sharp peaks

Conclusion

Three samples of poly(styrene/butadiene) were analyzed by conventional gel permeation chromatography on the Agilent PL-GPC 50 Integrated GPC/SEC System. Distinct differences were observed arising from presence of homopolymers, along with the anticipated copolymer. This application note demonstrates how GPC may be used to assess the products of complex synthesis reactions to gain mechanistic insights into polymerization processes.

www.agilent.com/chem

Published in USA, April 30, 2015

5991-5832EN

Agilent Technologies