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

Application Note

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Introduction

Polyvinyl butyral (PVB) is a resin prepared from polyvinyl alcohol by reaction with butyraldehyde. PVB is an important material that has a wide range of uses in applications that require strong binding, optical clarity, excellent surface adhesion, toughness and flexibility. The most well-known application of PVB is in laminated safety glass, for example, in the windscreens of vehicles. In such products, PVB is used as an interface layer between two sheets of toughened glass. The interface layer absorbs the energy of impacts, binding broken shards of glass together and distributing the force of the impact over a wide area. The use of laminated glass has greatly reduced injuries resulting from automobile accidents. As it is the viscoelastic properties of PVB that contribute to its performance in glass laminates, the molecular weight distribution of the material must be closely monitored to ensure optimum performance.

Gel permeation chromatography (GPC) with triple detection, employing a light scattering detector and viscometer, may be used to determine accurate molecular weights for polymers such as PVB. Three PVB materials were analyzed using these techniques, one of which did not perform as expected in application testing.

Methods and Materials

Conditions

Samples:	Polyvinyl butyrals
Columns:	2 x Agilent PLgel 5 µm MIXED-C, 300 x 7.5 mm (p/n PL1110-6500)
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 example overlaid multi-detector chromatogram for a sample of PVB. All of the samples exhibited strong signals that were fairly broad in all the detectors, indicating the high polydispersity of the materials.

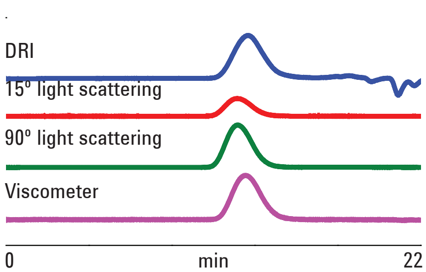

Figure 1. Overlaid multi-detector chromatogram for an example of polyvinyl butyral

Figure 2 is an overlay of the molecular weight distributions of three PVBs. 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 in the high molecular weight region where there was less material present than the other samples. This change was thought to be responsible for the change in the performance of the material in comparison to the other polymers.

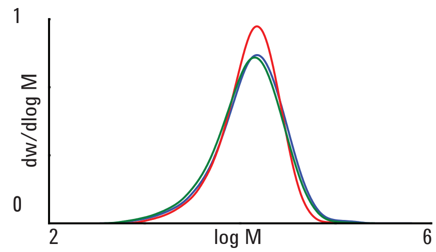

Figure 2. Overlaid triple detector molecular weight distributions of three polyvinyl butyrals

Figure 3 shows the overlaid Mark-Houwink plot of log intrinsic viscosity as a function of molecular weight. All of the samples had a similar relationship between increasing molecular weight and increasing intrinsic viscosity, indicating that the PVBs were of a comparable structure. Therefore, the difference in molecular weight observed was as a result of the synthesis methods rather than any changes to the nature of the polymers themselves.

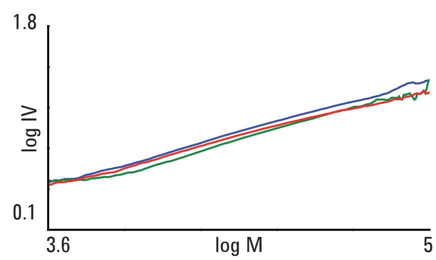

Figure 3. Overlaid Mark-Houwink plots for three samples of polyvinyl butyral

Conclusion

GPC is a well-known technique for assessing polymer molecular weight distribution, a parameter that influences many of their physical properties such as the toughness of polyvinyl butyral interface layers in laminated glass. The 390-MDS is designed for such applications using organic solvents. The 390-MDS can be linked with any liquid chromatography system to a provide a powerful tool for GPC.

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