Analysis of Modified Polyvinyl Alcohol by GPC Viscometry using the Agilent 390-MDS Multi Detector Suite

Application Note

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Introduction

Polyvinyl alcohol (often abbreviated as PVOH) is a water-soluble synthetic material used as an emulsifier and adhesive. PVOH can be modified by reaction of pendant –OH groups with various reagents to form new polymers with novel surfactant properties.

Gel permeation chromatography (GPC) is a well-known technique for assessing the molecular weight distribution of polymers, a property that influences many of their physical characteristics. GPC viscometry employing a viscometer in combination with a differential refractive index detector may be used to determine accurate molecular weights for polymers based on the universal calibration approach, useful for materials for which narrow standards are not available. GPC viscometry can also be used to investigate the solution behavior of modified polymers, a useful tool in the analysis of surfactant materials. This application note describes the analysis of two PVOH materials by GPC viscometry – one pure PVOH, and one that had been modified by reaction with imidazole. This second material was insoluble in water so for comparison both materials were analyzed in a polar organic solvent, dimethyl sulfoxide.

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Methods and Materials

Conditions

Sample:	Modified polyvinyl alcohols
Columns:	2 x Agilent PLgel 5 µm MIXED-C, 300 x 7.5 mm (p/n PL1110-6500)
Injection Volume:	200 µL
Eluent:	Dimethyl sulfoxide + 0.1% LiBr
Flow Rate:	1.0 mL/min
Detector Train:	390-MDS incorporating Viscometer and DRI
Detector Temp:	All detectors set at 60 °C

Results and Discussion

Figure 1 shows an example overlaid multi-detector chromatogram for the PVOH sample. The material produced fairly broad, strong signals in all the detectors, indicating the high polydispersity of the polymer.

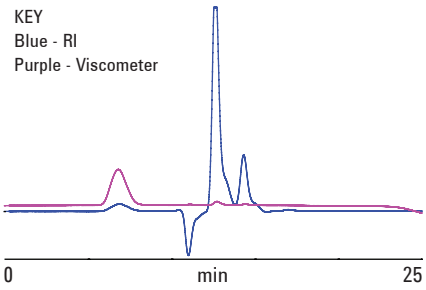

Figure 1. Overlaid multi-detector chromatogram for an example of polyvinyl alcohol

Figure 2 shows an overlay of the molecular weight distributions of the two samples under investigation. As can be seen, the PVOH samples showed an appreciable difference in molecular weight distribution, especially at high molecular weight.

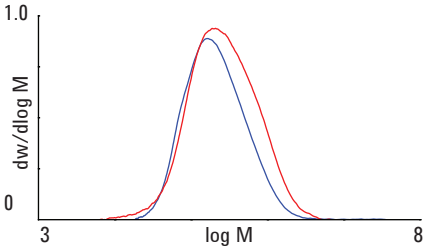

Figure 2. Overlaid multi-detector molecular weight distributions of two samples of polyvinyl alcohol

Figure 3 shows the overlaid Mark-Houwink plot of log intrinsic viscosity as a function of molecular weight. The two samples gave a very different relationship between increasing molecular weight and increasing intrinsic viscosity, indicating that the polymers were of differing sizes in solution. This resulted from the differing degrees of solvation in DMSO due to the modification of the PVOH backbone. This analysis shows that the surfactant properties of the PVOH had been significantly altered by grafting of imidazole.

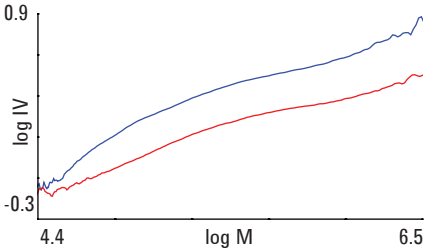

Figure 3. Overlaid Mark-Houwink plots for two samples of polyvinyl alcohol

Conclusion

The results show that the 390-MDS, combined with two PLgel 5 µm MIXED-C columns, can be used to investigate the structural and solution properties of polymers, greatly increasing the potential of GPC over using a single detector alone.

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