Accurate Determination of the MWD of Polyacrylic Acid

Application Note

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Introduction

Polyacrylic acid is a biodegradable water soluble polymer with numerous industrial applications, including as a super adsorbent (eg in disposable nappies), in water treatment as a metal ion scavenger and in the treatment of metal surfaces prior to coating. The molecular weight distribution (MWD) of this material is an important parameter, as it strongly affects its end use properties. Aqueous SEC is an ideal analytical tool for the measurement of the MWD of polyacrylic acid. Since polyacrylic acid is a polyelectrolyte, care must be taken in selecting the appropriate SEC conditions. In the method described below, a buffered mobile phase with a high electrolyte content was used to minimize non-size exclusion effects. Agilent PL aquagel-OH MIXED 8 µm columns were selected to provide good resolution over a wide molecular weight range. Column calibration was achieved using Agilent EasiVial PEG/PEO standards see Figure 1. EasiVials provide a rapid and convenient means of constructing an aqueous SEC column calibration curve over a wide molecular weight range (typically 100 to 1,200,000 g/mol). Each vial contains a mixture of four individual, highly characterized, narrow dispersity standards. The amount of each individual standard is carefully controlled during manufacture, allowing their use in SEC-viscometry, which requires accurate concentrations. Refractive index chromatograms obtained from each EasiVial PEO are shown in Figure 2.

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Conditions

Samples:	Polyacrylic acid, approx 0.2 % w/v; EasiVial PEG/PEO standards at 0.1-0.5 mg/mL
Columns:	2 x PL aquagel-OH MIXED-H 8 µm, 300 x 7.5 mm
r PL1149-6800)	
Eluent:	0.2 M $NaNO_3$ + 0.01 M NaH_2PO_4 adjusted to pH 7
Flow Rate:	1.0 mL/min
Injection Volume:	200 µL
Detection:	RI

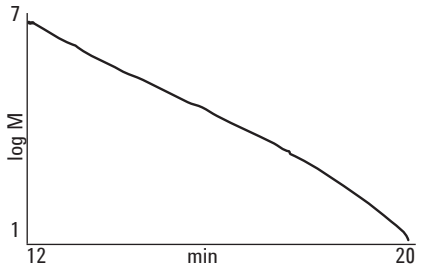

Figure 1. Calibration of PL aquagel-OH MIXED 8 µm column using EasiVial standards

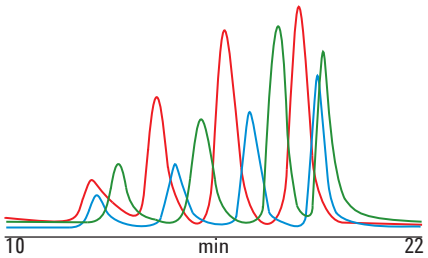

Figure 2. RI chromatograms from EasiVial PEOs

Results and Discussion

Three polyacrylic acid samples (A, B and C) were chromatographed and their corresponding molecular weight distribution compared (Figure 3).

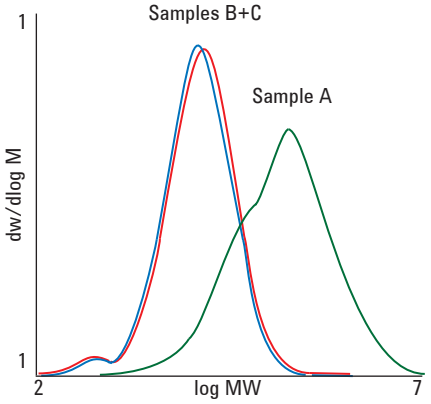

Figure 3. Comparison of three polyacrylic acids

Sample	Mn (g/mol)	Mw (g/mol)	PD
A	33,450	89,430	2.67
B	7990	14,930	1.87
C	7880	13,490	1.71

Sample A had a significantly higher molecular weight distribution compared to Samples B and C, which were similar. Consequently, Sample A was expected to possess significantly different rheological properties compared to the other two samples. Closer examination showed that Sample A was significantly more viscous than Samples B and C, which were similar. In addition, the MWD of Sample A was bi-modal, which suggests that it may be a blend of more than one component.

Conclusion

Size exclusion chromatography using PL aquagel-OH MIXED 8 µm columns calibrated with EasiVial standards accurately identified molecular weight distributions of polyacrylic acids. These differences were corroborated through visual examination of the samples' bulk viscosity.

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