Analysis of Polylactide and Poly(lactide-*co*-glycolide) by GPC with Viscometry

Application Note

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Introduction

Polylactide (PLA) and copolymers with glycolic acid (PLGA) are polyesters derived from corn starch and sugar cane. Synthesized by the tin-mediated ring-opening polymerization of the dimeric acid formed from bacterial fermentation, these materials can be manufactured to reasonably high molecular weights. PLA and PLGA have received considerable attention due to their non-toxic, biocompatible and biodegradable properties. The polymers are used in a number of biomedical applications, including sutures, stents and as dialysis media. Fibers of PLA are also employed in the manufacture of upholstery and diapers.

The accurate molecular weight distributions of a sample of polylactide and of poly(lactide-*co*-glycolide) were compared by gel permeation chromatography with viscometry. Light scattering could not be used with these samples as one was a copolymer and therefore not of uniform chemistry across the molecular weight distribution. This could lead to errors in the light scattering calculations. However, the Universal Calibration technique employing a viscometer can be used with copolymers, to provide molecular weights that are independent of the standards used in the column calibration. To investigate the molecular structure of the materials they were analyzed on an integrated GPC system.

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Instrumentation

The copolymer was assessed on an Agilent PL-GPC 50 Plus with differential refractive index detector, Agilent PL-BV 400RT viscometer and Agilent PLgel 5 µm MIXED-D columns, which provide high resolution of resin and condensation polymers.

Columns:	2 x PLgel 5 µm MIXED-D, 300 x 7.5 mm (part number PL1110-6504)

Materials and Reagents

Samples:	Polylactide and poly(lactide-*co*-glycolide)
Eluent:	Tetrahydrofuran

Conditions

Flow Rate:	1 mL/min
Temperature:	40 °C

Results and Discussion

Figure 1 shows chromatograms for the polylactide. Figure 2 reveals that the samples were clearly quite different in molecular weight, the copolymer having a lower molecular weight than the homopolymer. The Mark-Houwink plot indicated that there might also be some structural differences between the homopolymer and the copolymer, with the copolymer showing a deviation to lower intrinsic viscosities as a function of molecular weight, indicating a smaller and more compact structure in solution (Figure 3).

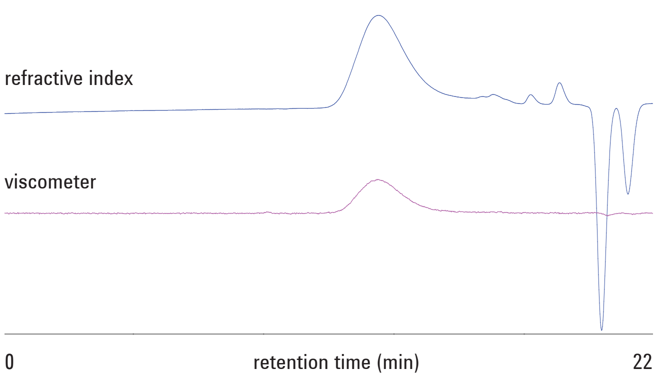

Figure 1. Chromatograms for the polylactide sample

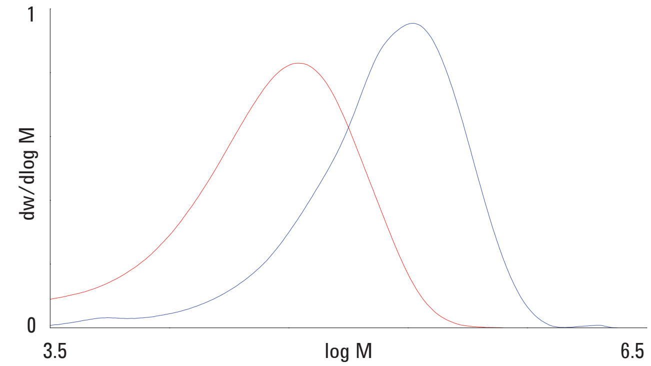

Figure 2. Overlaid molecular weight distributions for polylactide (blue) and poly(lactide-co-glycolide) (red) samples

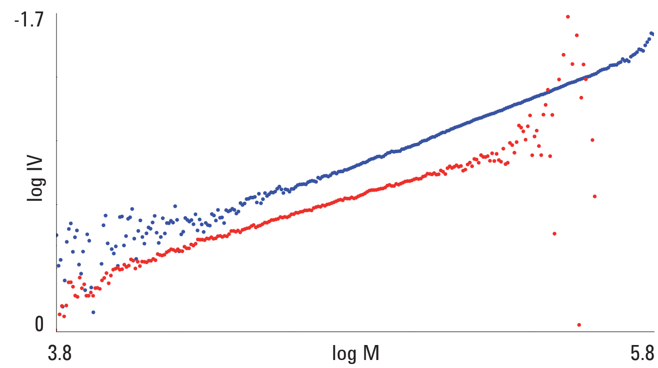

Figure 3. Overlaid Mark-Houwink plots for polylactide (blue) and poly(lactide-co-glycolide) (red) samples

Conclusion

The PL-GPC 50 Plus is a high resolution, cost effective integrated GPC system designed for operation from ambient to 50 °C. The standard system comprises precision solvent delivery, sample injection, high performance differential refractive index detection and a column oven, with fully integrated software control. When coupled with PLgel 5um MIXED-D columns and a PL-BV 400RT viscometry detector, the PL-GPC 50 Plus provides accurate molecular weight determination for all polymer types based on the Universal Calibration principle, such as polylactide and its copolymers.

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Published in UK, Aprill 30, 2015
5991-5776EN

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