Selecting the Correct Agilent PLgel Column for Polyolefin Analysis with GPC/SEC

Technical Overview

Introduction

Polyolefins range from low molecular weight hydrocarbon waxes to ultra high molecular weight rigid plastics. The molecular weight distribution of polyolefins is directly related to physical properties such as toughness, melt viscosity and crystallinity. Gel permeation chromatography (GPC) is widely accepted as the preferred technique to fully characterize the molecular weight distribution of polyolefins.

The selection of a column set for the analysis of a polyolefin is dependent on the molecular weight range of the sample. Low molecular weight samples can be analyzed using high efficiency, relatively low pore size columns. Higher molecular weight materials require large particle size media to minimize shear effects, with a wide pore size distribution.

Figures 1 to 4 show typical data for four different polyolefin samples, all obtained with Agilent PLgel columns and the Agilent PL-GPC 220 high temperature GPC instrument.

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Conditions for Figure 1

Samples	Linear hydrocarbons
Columns	2 × Agilent PLgel 3 µm 100Å, 7.5 × 300 mm (p/n PL1110-6320)
Eluent	TCB
Flow rate	0.8 mL/min
Inj vol	20 µL
Temp	145 °C
System	Agilent PL-GPC 220

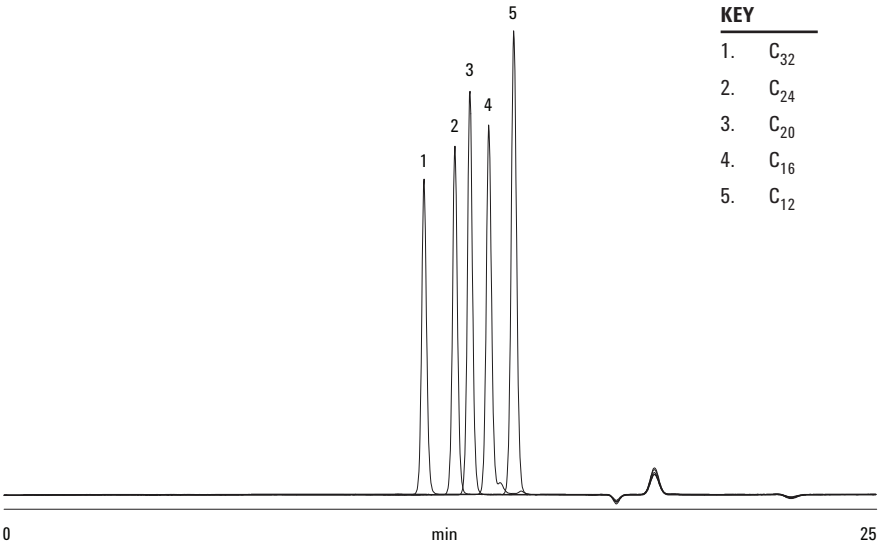

Figure 1. Separation of a selection of low molecular weight linear hydrocarbons on two Agilent PLgel 3 µm 100Å columns.

Conditions for Figure 2

Sample	Hydrocarbon wax
Columns	2 × Agilent PLgel 5 µm MIXED-D, 7.5 × 300 mm (p/n PL1110-6504)
Eluent	TCB
Flow rate	1.0 mL/min
Inj vol	100 µL
Temp	160 °C
System	PL-GPC 220

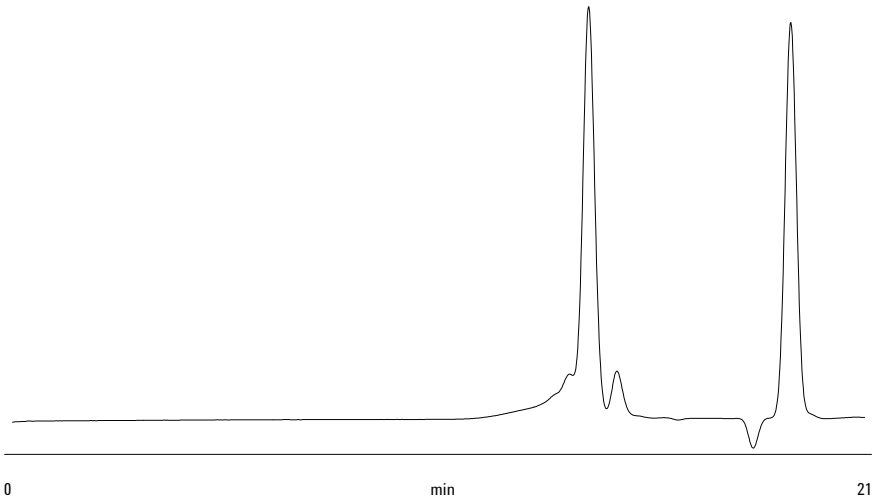

Figure 2. The chromatogram of a relatively low molecular weight hydrocarbon wax produced on two Agilent PLgel 5 µm MIXED-D columns.

A molecular weight distribution of an intermediate molecular weight polyethylene analyzed using three Agilent PLgel 10 µm MIXED-B columns is shown in Figure 3.

Conditions for Figure 3

Sample	Polyethylene
Columns	3 × Agilent PLgel 10 µm MIXED-B, 7.5 × 300 mm (p/n PL1110-6100)
Eluent	TCB
Flow rate	1.0 mL/min
Inj vol	200 µL
Temp	160 °C
System	PL-GPC 220

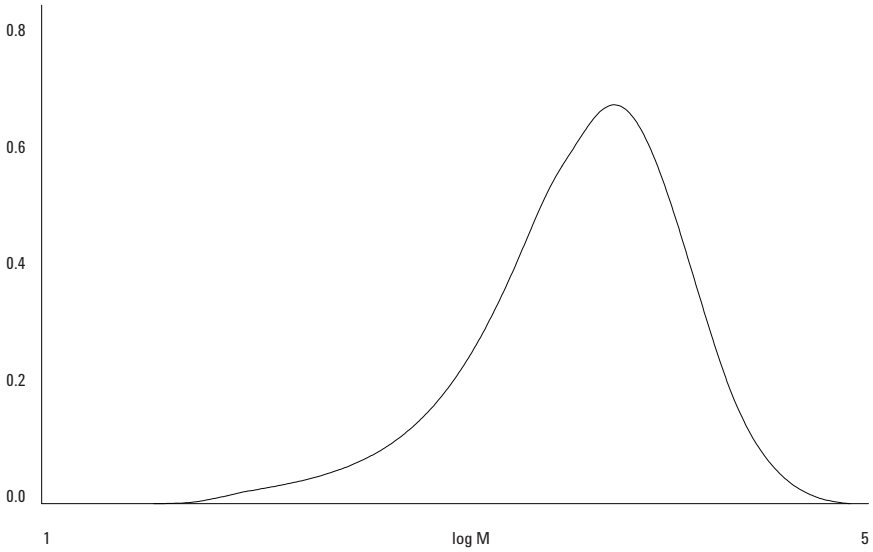

Figure 3. The chromatogram of a relatively low molecular weight hydrocarbon wax on an Agilent PLgel 10 µm MIXED-B two-column set.

Conditions for Figure 4

Sample	Polyethylene
Columns	4 × Agilent PLgel 20 µm MIXED-A, 7.5 × 300 mm (p/n PL1110-6200)
Eluent	TCB
Flow rate	1.0 mL/min
Inj vol	200 µL
Temp	160 °C
System	PL-GPC 220

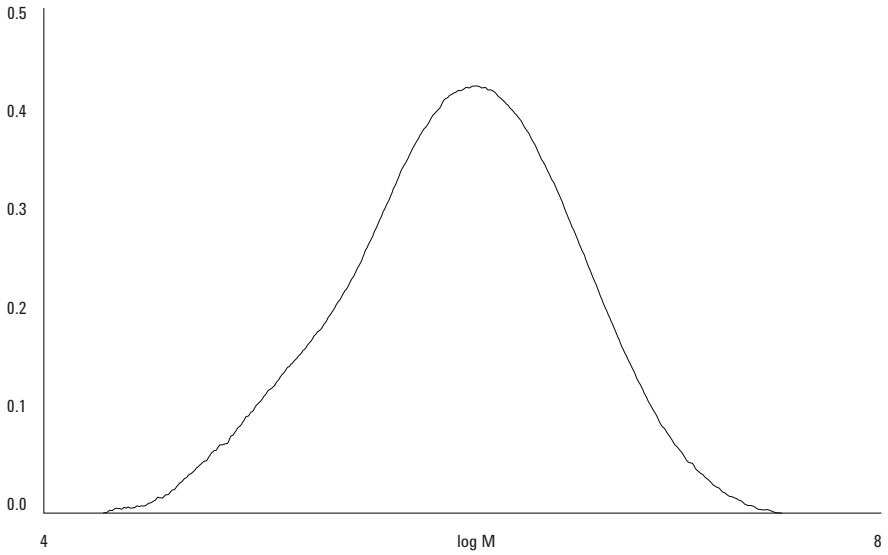

Figure 4. A molecular weight distribution of an ultra high molecular weight polyethylene analyzed using four Agilent PLgel 20 µm MIXED-A columns.

The molecular weight operating ranges and efficiencies for the columns are summarized in Table 1.

Table 1. Operating Ranges and Conditions for the PLgel Columns Used to Analyze Four Polyolefins

Agilent column	MW operating range	Efficiency (plates/m)
PLgel 3 µm 100Å	Up to 4,000	> 100,000
PLgel 5 µm MIXED-D	200–400,000	> 50,000
PLgel 10 µm MIXED-B	500–10,000,000	> 35,000
PLgel 20 µm MIXED-A	2,000–40,000,000	> 17,000

These applications illustrate the diversity of polyolefin samples and indicate the flexibility of the PLgel series of columns in addressing the analysis of such samples.

GPC/SEC Columns and Calibrants from Agilent

An alternative column choice for polyolefins is Agilent OligoPore, which exhibits significantly increased pore volumes compared to conventional low pore size GPC columns, for higher resolution in the oligomeric region.

Agilent offers a comprehensive portfolio of GPC/SEC columns and calibrants for high-performance separations based on molecular size in solution. Agilent delivers leading solutions for characterizing and separating polymers by GPC/SEC, and manufactures all components for accurate polymer analysis.

Look at the Agilent Literature Library on www.agilent.com/chem/gpc-sec for a comprehensive range of application notes and technical overviews to help you get the best from your Agilent GPC/SEC columns and instruments.

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