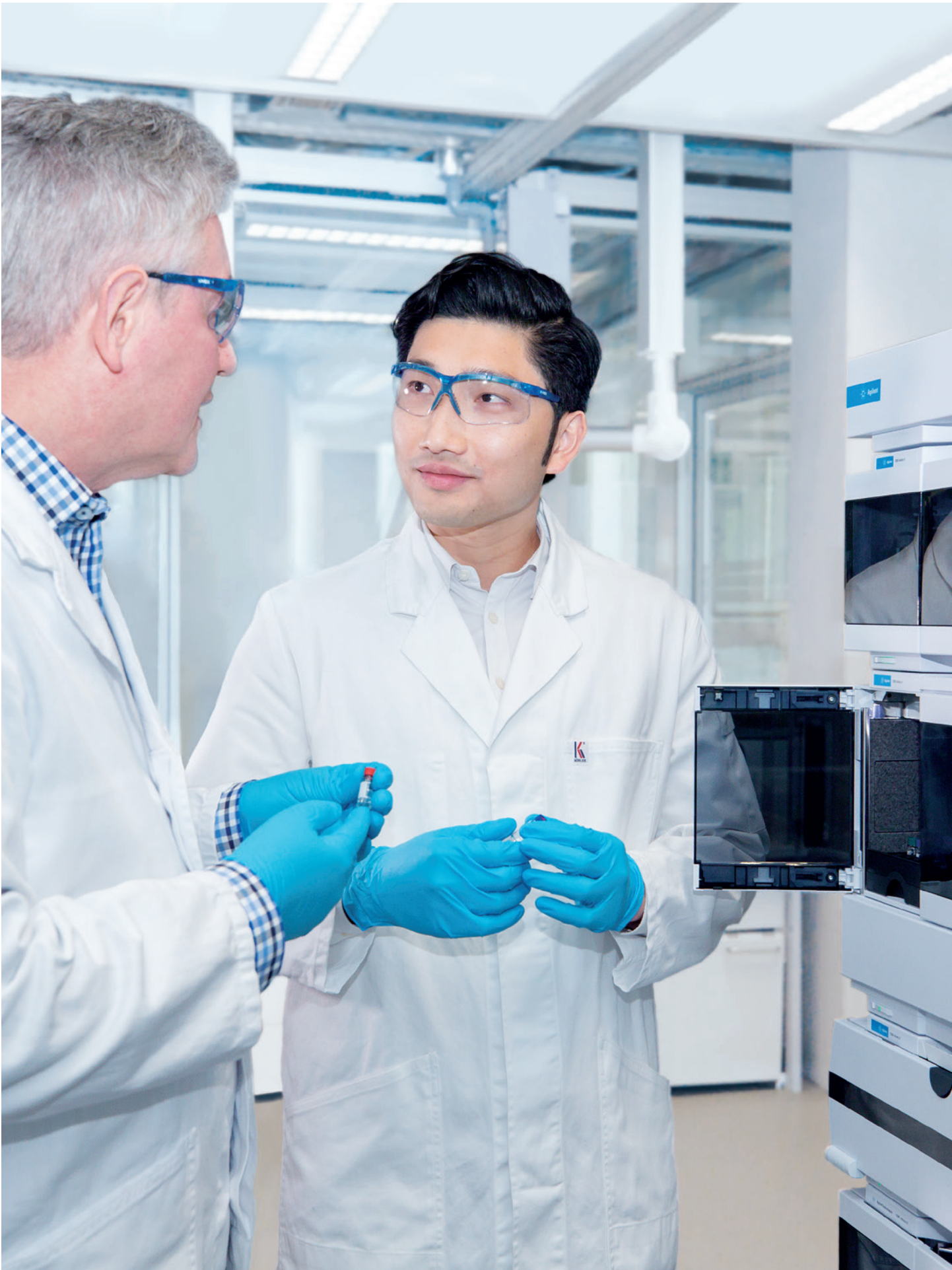


Complete Solutions for the Polymer Scientist

Agilent InfinityLab GPC/SEC Solutions





Complete Solutions for the Polymer Scientist

Agilent provides the most comprehensive portfolio of high-quality systems for gel permeation and size exclusion chromatography. No matter which type of polymer you want to characterize, we supply a complete range of market-leading, innovative instrumentation, columns, standards, and software to meet any application and budget.

Versatile and robust

Agilent solutions cover the widest range of conventional and advanced applications, spanning routine polystyrene analysis to complex engineering polymers, such as polyphenylene sulfide and polyolefins.

"We keep extending the analytical instrumentation in our laboratory with state-of-the-art Agilent GPC systems to ensure the most reliable analysis."

– **Dr. Remzi Becer**
Queen Mary University
of London

Highest performance

Our solutions deliver highest sensitivity, baseline stability, and signal-to-noise response for accurate and reproducible results. Utmost performance is maintained even when working with high temperatures or with viscous solvents, using either analytical or microscale separations.

Confidence in results

All Agilent products are designed and manufactured to the highest engineering standards. The latest developments in flow cell technology minimize band broadening to optimize GPC/SEC separations. Intuitive, easy-to-use GPC/SEC software provides accurate answers for polymer characterization.

"We have been more than satisfied with the data that has been produced and found the system to deliver highly reproducible data."

– **Cormac Duffy**
Research Chemist,
R&D Henkel Ireland Operations
and Research Ltd.

1260 Infinity II GPC/SEC System

Reproducible Molecular Weights for Routine Polymer Characterization

The Agilent 1260 Infinity II GPC/SEC System has been designed to meet the challenges you face as a polymer scientist. Each system component is optimized to deliver precise results and achieve high throughput.



1260 Infinity II GPC/SEC System

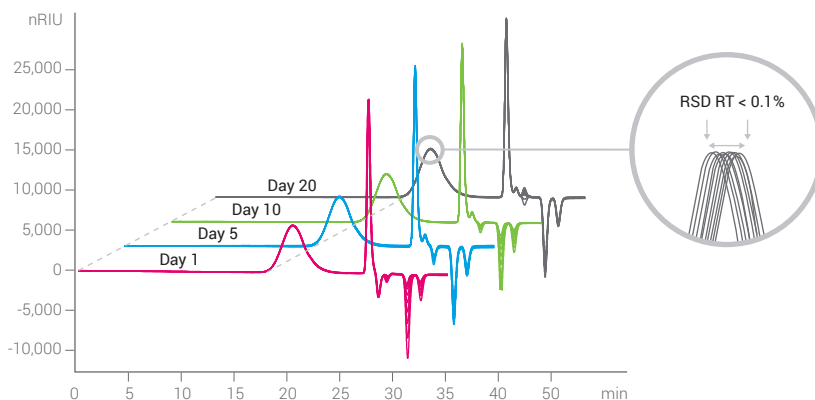
"Agilent have deservedly become my go-to partner for GPC."

— **Professor Michael Shaver,**
University of Manchester

High-precision retention times

Throughout the day and from day to day, the 1260 Infinity II GPC/SEC System provides excellent retention time reproducibility. The 1260 Infinity II Multicolumn Thermostat (MCT) ensures minimal detector noise and baseline drift.

Styrene acrylonitrile sample



This overlay of 10 consecutive runs per day over 20 days shows the remarkable day-to-day precision of retention times.

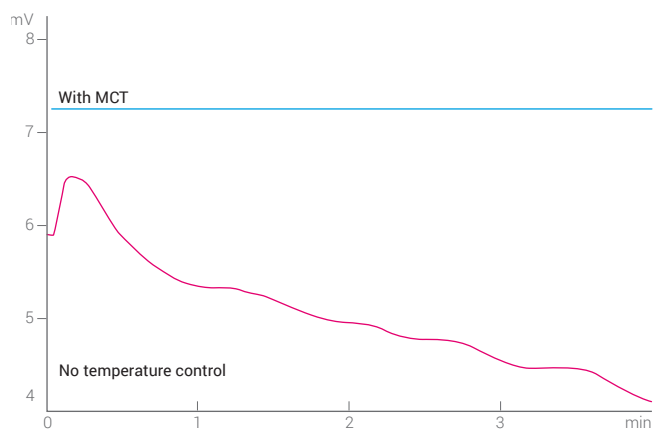


Agilent GPC/SEC columns

Agilent GPC/SEC columns and calibration kits help you to maintain the highest levels of sensitivity in polymer analysis, offering precise, reliable measurement of molecular weight distributions whether you are performing gel filtration, gel permeation, or size exclusion chromatography.

High-precision temperature control

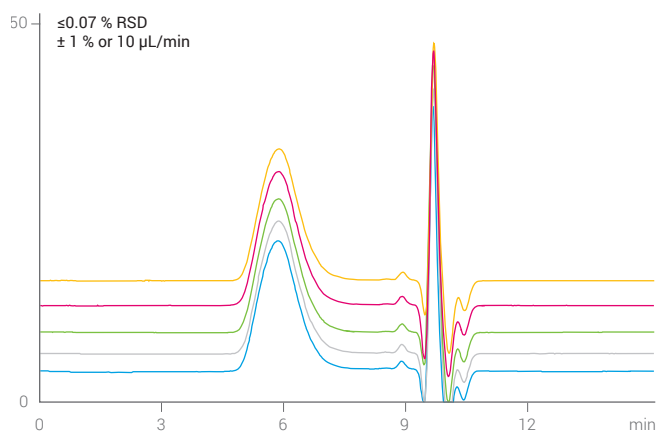
The 1260 Infinity II MCT accommodates up to four 30 cm GPC/SEC columns with high-precision temperature control to ensure the most accurate, reproducible molecular weights. Short detector equilibration times and easy peak integration ensure reliable results.



A stable baseline ensures accurate results.

High-precision flow

Variations in flow rate have the same effect as changes in temperature—retention times and therefore reproducibility are affected. The excellent flow precision of the 1260 Infinity II Isocratic Pump facilitates accuracy in analytical and preparative GPC/SEC applications.



An accurate flow rate enables reproducible results. The value quoted has been calculated from analyses performed in THF at 40 °C.

Improved Performance with Advanced Detection Techniques

GPC/SEC is the only technique that can be used to determine the molecular weight distribution of a polymer. With the Agilent 1260 Infinity II Multidetector GPC/SEC System, you can select from any combination of the following detection techniques: refractive index, light scattering, UV-Vis, and viscometry.

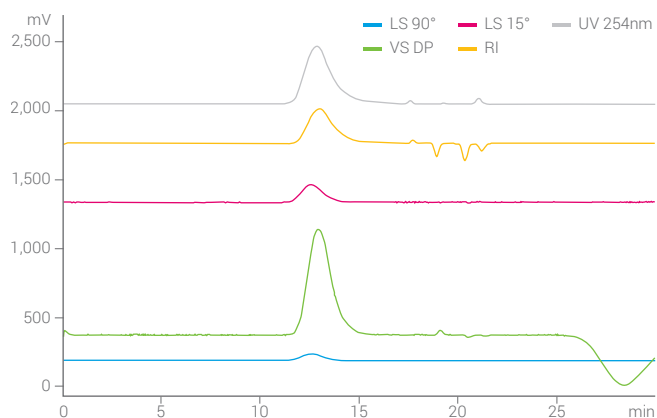
Comprehensive polymer characterization

This triple-detection approach delivers stable baselines and high signal-to-noise performance and enables determination of polymer properties that cannot be measured by conventional concentration-based detection techniques.

With the 1260 Infinity II Multidetector GPC/SEC System, you can analyze a wide range of polymers, regardless of molecular weight range or solvent. Each detector has independent temperature control to ensure high levels of precision and reproducibility from day to day.



1260 Infinity II Multidetector GPC/SEC System



Our detectors deliver stable baselines and superior signal-to-noise performance. A low-dispersion setup and a 10 μ L cell for light scattering detection results in excellent peak shapes for all signals.



Light scattering detection for absolute molecular weights

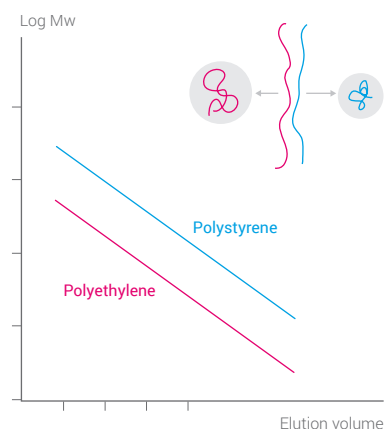
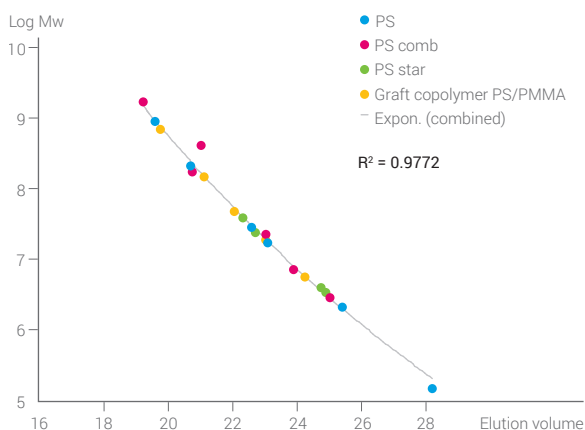
The powerful dual angle light scattering detector measures the scattering of monochromatic laser light by polymer molecules at 15° and 90° angles. Combined with data from a concentration detector, light scattering detection gives:

- Absolute molecular weights without the need for column calibration
- Accurate assessment of molecular size and radius of gyration (Rg)
- Direct determination of long-chain branching

Viscometry measurement for insights into polymer behavior

The viscometer is a robust and sensitive module that measures the viscosity of polymer molecules in solution. Using viscosity measurements with data from a concentration detector gives:

- Accurate molecular weights, regardless of the standards used to generate the column calibration
- Polymer conformation
- Mark-Houwink parameters
- Accurate branching measurements across a broad range of molecular weights

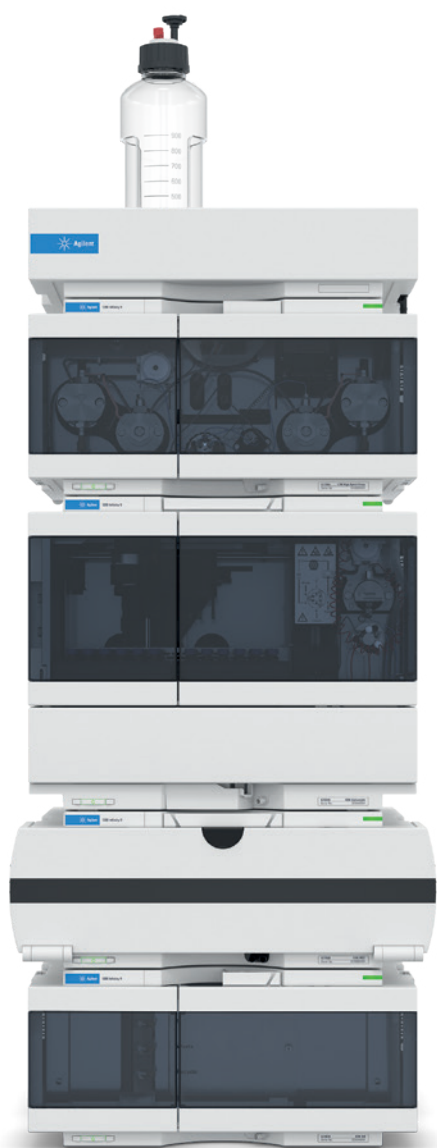


Using universal calibration (left) has clear advantages. Relative calibration (right) shows that polymers with identical molecular weights can yield different calibration curves when dissolved in solvent due to differing behavior in solution.

1290 Infinity II GPC/SEC System

All-In-One GPC/SEC

The Agilent 1290 Infinity II GPC/SEC System is capable of both analytical and microscale operation. The high-performance pump can operate at pressures up to 1300 bar. Coupling with a 2 μ L low-volume refractive index detector (RID) and 0.075 mm tubing enables microscale operation. Key benefits include shorter run times for higher sample throughput, ultralow dispersion for improved resolution, and lower solvent consumption for reduced running costs.

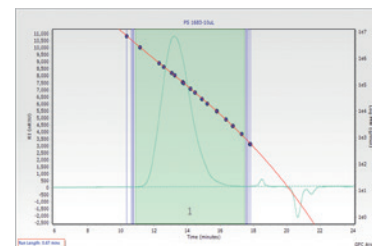
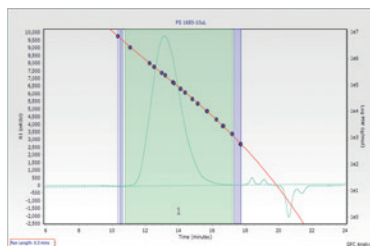


1290 Infinity II GPC/SEC System

“Our Agilent GPC systems have speeded up the development time and made cost savings on our analysis – a real boost to our company!”

– **Mr. Nigel Crabtree**,
Senior Staff Scientist
Polymers and encapsulation,
Ashland

Accurate molecular weight



Sample: polystyrene 2 mixed B,
7.5 \times 300 mm
Flow rate: 1 mL/min

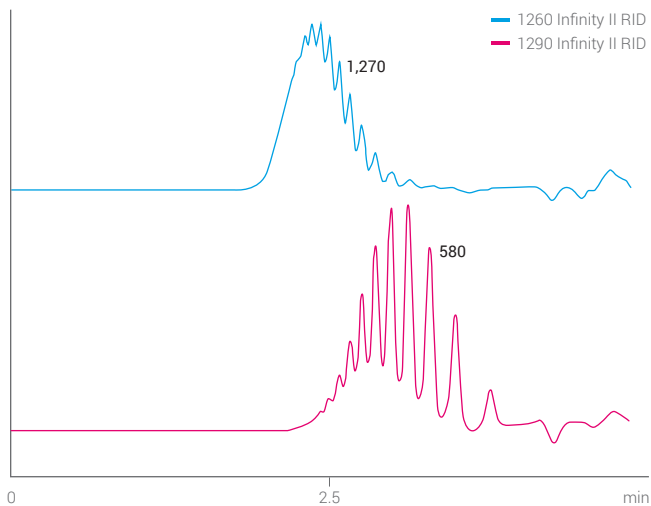
Column temperature: 30 $^{\circ}$ C
RID temperature: 35 $^{\circ}$ C
RI frequency: 18.5 Hz

	Mp	Mn	Mw	PD
Micro RID	227000	96000	274000	2.85
Conventional RID	224000	97000	270000	2.77
Ratio Values	1.01	0.99	1.01	1.03

To use the same system for both analytical and microscale work, it is important that the two different scales deliver consistent results in terms of molecular weight. A comparison of results illustrates how, even at microscale, you can be sure that molecular weights are correct and consistent.*

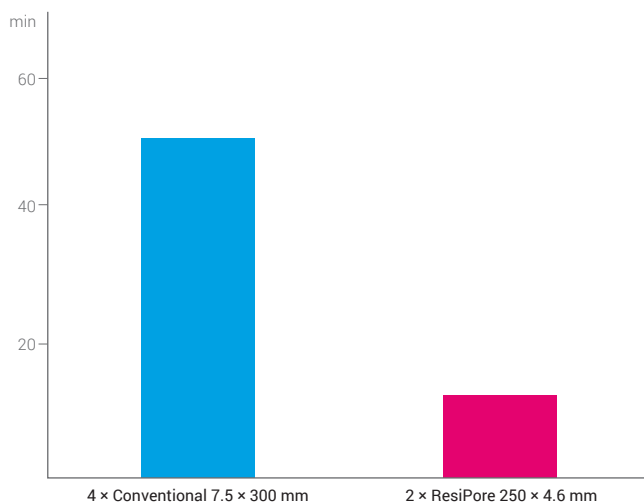
*Data courtesy of H. Eghbali et al., Analytical Science, The Dow Chemical Company

Increase resolution



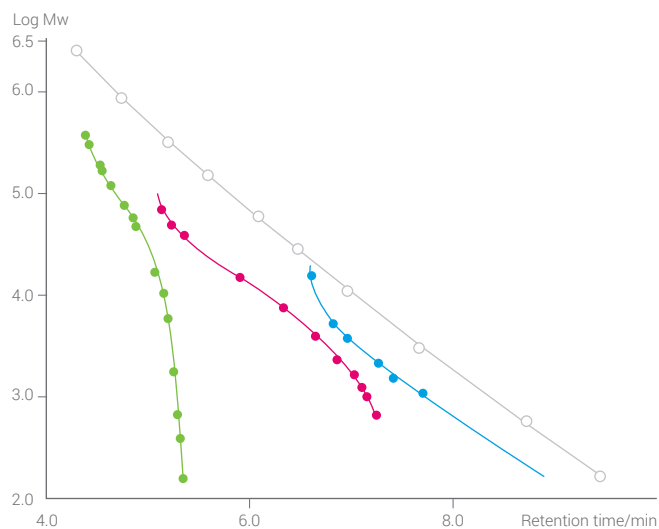
Used at microscale, the 1290 Infinity II RID has a low volume detector cell and a reduced system delay volume relative to the 1260 Infinity II RID. This ultralow dispersion gives improved resolution, with the advantages of shorter run times and increased sample throughput.

Reduce solvent consumption and run times



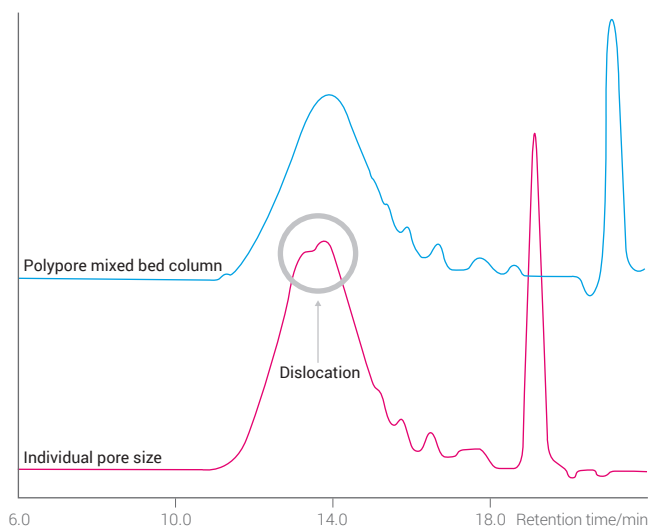
Flow rates can be increased for higher sample throughput. Using Agilent InfinityLab GPC/SEC columns with the 1290 Infinity II GPC/SEC System can reduce run times by up to 70%.

Improve calibration



Agilent InfinityLab PlusPore columns feature mixed, multiporous stationary phases. These columns enable extremely linear calibrations. When coupled with the micro RID, it is possible to achieve excellent peak shapes and very high resolution.

Retain peak shape



Serial connection of individual pore size columns, shear degradation, and adsorption to packing material can cause peak dislocations, peak tailing, and inaccurate results varying by as much as 10–20% from the true value. InfinityLab PlusPore columns can eliminate these issues.

Rapid, Easy Analysis and Reporting

Agilent offers a range of software for GPC/SEC analysis. Dedicated Agilent GPC/SEC Software and packages for Agilent OpenLab CDS and ChemStation provide the functionality required for conventional and advanced GPC/SEC.

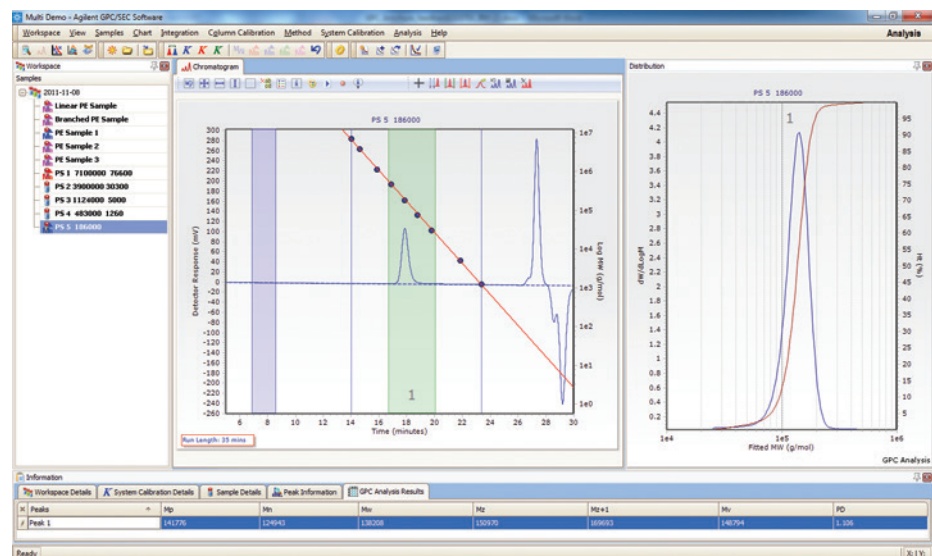
Collect and process data

The GPC/SEC Software can collect multiple data channels, including refractive index, multiple wavelength UV, and ELS, as well as advanced detector techniques such as multi-angle light scattering and viscometry. The software stores the raw data and calculated results in a single location.

The GPC/SEC Software performs all required molecular weight and branching calculations to define the size and shape of your polymer. All results are stored in a single data file for instant access to all experimental data. Traces can be easily overlaid and arranged for clear, easy-to-read reports.

“The software is excellent, with all the features required by an expert user while being accessible to the occasional user.”

– **Dr Sebastian G. Spain,**
University of Sheffield, UK



Screenshot of the Agilent GPC/SEC Software showing the chromatogram and molecular weight distribution for a polystyrene sample.

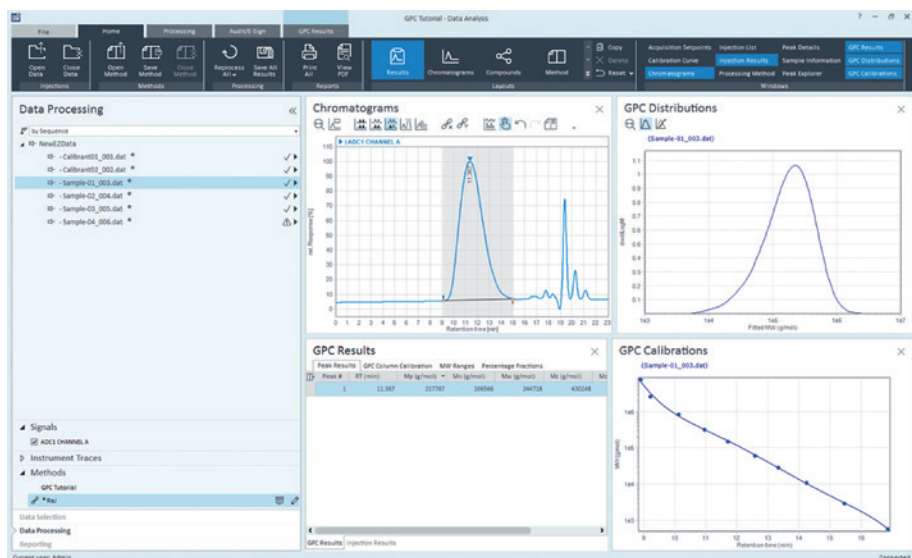
GPC/SEC software for OpenLab CDS

Agilent OpenLab CDS features a compliant, versatile software package for both HPLC and GPC/SEC. Including all the functionality of OpenLab CDS for HPLC, it is combined with a module to process the collected data using GPC/SEC calculations. The software has been designed to work with standalone workstations and client/server editions.

- Perform calculations on signals from concentration detectors (e.g., refractive index and UV)
- Generate GPC column calibrations using Narrow distribution standards or Broad Hamielec and integral methods
- Overlay data from samples, molecular weights, and distributions for comparison
- Design your own reports to fit your individual needs, or simply use one of the predefined reports from the comprehensive range

GPC software for ChemStation

Data collected with Agilent ChemStation can also be processed by using a dedicated GPC add-on software package.



Screenshot of the GPC/SEC software for OpenLab CDS showing the chromatogram and molecular weight distribution for a polystyrene sample.

1260 Infinity II High-Temperature GPC System

The Industry Standard for Routine, High-Temperature Analysis of Engineering Polymers

The Agilent 1260 Infinity II High-Temperature GPC System gives you full confidence in data integrity and operator safety. Together with a choice of optional detectors including light scattering, viscosity and ELS detection, the system can provide comprehensive characterization of the polymer to be analyzed.



Maintain sample solubility

The system is a fully integrated solution. The entire sample flow path can be heated up to 220 °C to maintain sample solubility, eliminating costly downtime due to blockages from precipitated samples.

Achieve highest-quality results

The unique design of the dual-zone autosampler ensures that your polymers are protected against degradation. The sample vial is transported to the oven for equilibration, ensuring stable baselines and reproducible results.

Benefit from ultimate flexibility

Advanced detectors based on dual-angle light scattering or viscometry give you the flexibility to use the system in a wide range of GPC/SEC applications, especially in polyolefin analysis.



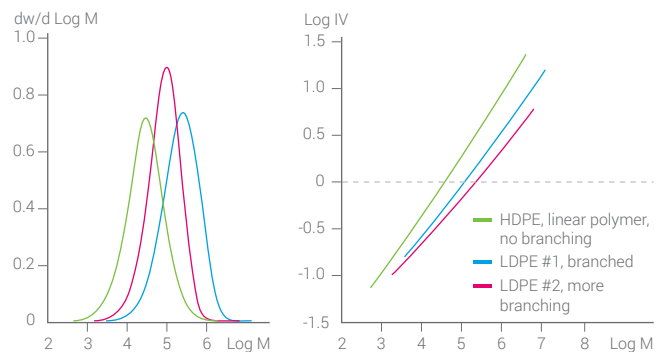
1260 Infinity II High-Temperature GPC System

“The 1260 Infinity II High-Temperature GPC is brilliantly engineered, easy to use, and consistently provides us with high-quality data.”

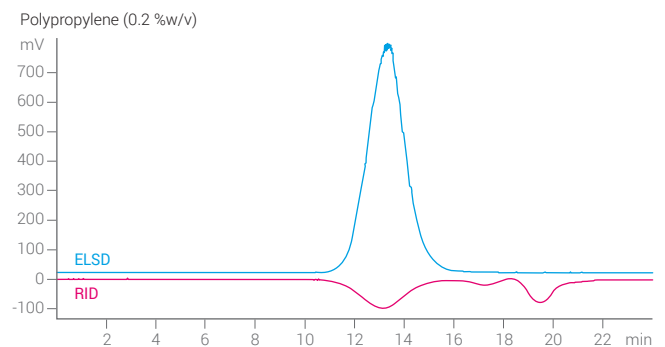
– **Dr. Daniel Lester,**
University of Warwick, UK

Sensitive high-temperature evaporative light scattering detection

The Agilent 1260 Infinity II High-Temperature ELSD brings a new dimension to polyolefin molecular weight determination, detecting low concentrations of polyolefins (polyethylene and polypropylene) at elevated temperatures in high-boiling solvents. Typically, an order of magnitude more sensitive than RID, high-temperature ELSD is ideal for polymers that require lower column loading to reduce the risks of degradation (such as ultrahigh-molecular-weight polyethylene, UHMWPE). Rapid equilibration times and excellent signal stability make selection of baselines and integration limits straightforward, improving accuracy and reproducibility of results.



Molecular weight distributions (left) and Mark-Houwink plots (right) for three different grades of polyethylene.



High-temperature ELSD can be significantly more sensitive than RID.



1260 Infinity II HT-GPC System with HT-ELSD



Agilent 1260 Infinity II High-Temperature Sample Prep System

The Ultimate Tool for Sample Preparation

The Agilent 1260 Infinity II High-Temperature Sample Prep System is designed for the dissolution and filtration of samples prior to GPC/SEC analysis, ensuring no insoluble compounds enter any part of the main system. The system combines controlled heating from 30 to 260 °C with gentle agitation at speeds from 85 to 230 rpm to avoid shearing. These features make it ideal for the preparation of a wide range of polymer types.

Everything you need for sample preparation

A wide range of accessories such as sample vials and filters are available. Correct filtering of samples prior to analysis is vital to ensure high-quality results.

Unique high-temperature filtration

A custom-built pipettor unit allows for the filtration of samples at high temperature through either stainless steel or glass fiber filters with minimal user interaction.



Agilent GPC/SEC Columns and Supplies

The Complete Solution from the Leaders in Polymer Analysis

We provide everything you need for gel permeation and size exclusion chromatography. Agilent is the only supplier to offer a comprehensive portfolio of high-quality systems for analyzing any polymer. Choose innovative instrumentation, columns, standards, and software for any application and budget.

Extensive, high-performance column portfolio

Our columns can be used with organic, aqueous, and polar solvents and cover a complete range of applications. These include high-quality PLgel, PL aquagel-OH, and PolarGel columns, along with specialist columns for specific applications.

Agilent offers a complete range of GPC/SEC columns for full characterization of synthetic and biomolecular polymers.

Highest-quality polymer standards

Polymer standards are available in a range of chemistries for calibrating GPC/SEC columns and instruments. These can be used in conventional calibration and more advanced techniques, such as the universal calibration using viscometry and light scattering.



Agilent GPC/SEC columns



Agilent polymer standards

Learn more:

www.agilent.com/chem/gpc

Buy online:

www.agilent.com/chem/store

Find an Agilent customer center

www.agilent.com/chem/contactus

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