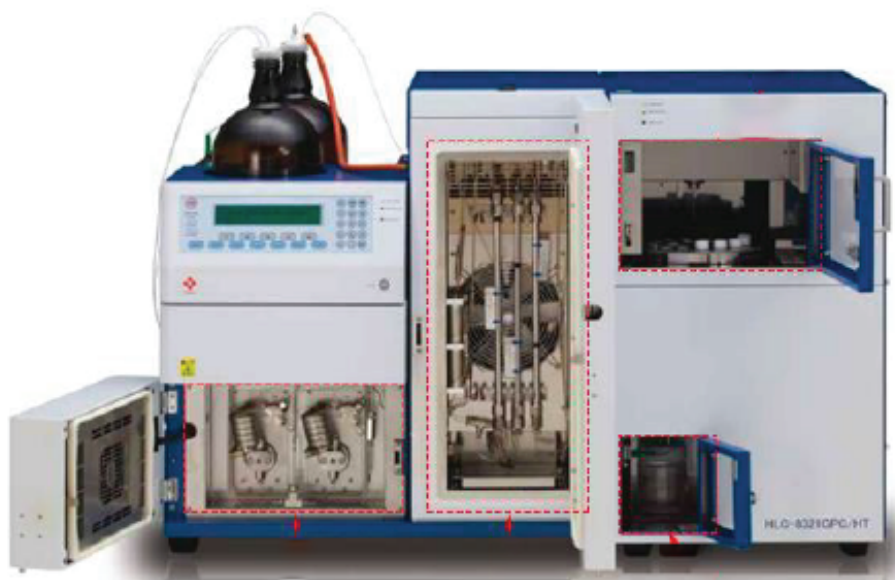


GPC Analysis Service: General

- **GPC Polymer Molecular Weight & Distribution Analysis Service**

Molecular weight is a critical factor influencing physical and chemical properties such as material strength, processability, and thermal stability. Improve your production quality and drive product innovation through our precise molecular weight analysis.

- **GPC System Components Source**

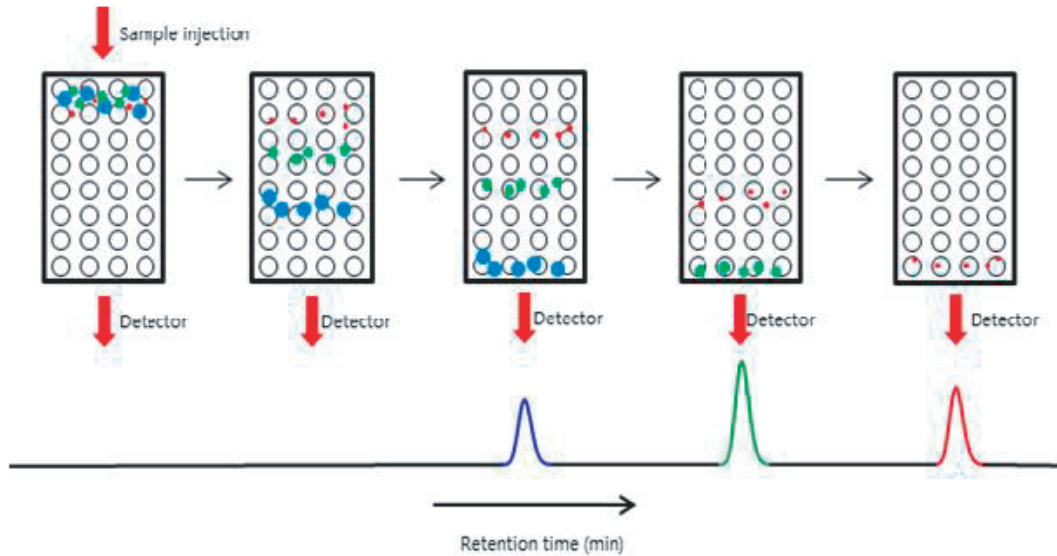


Source: EcoSEC SEC/GPC System brochure

- **Principles of GPC**

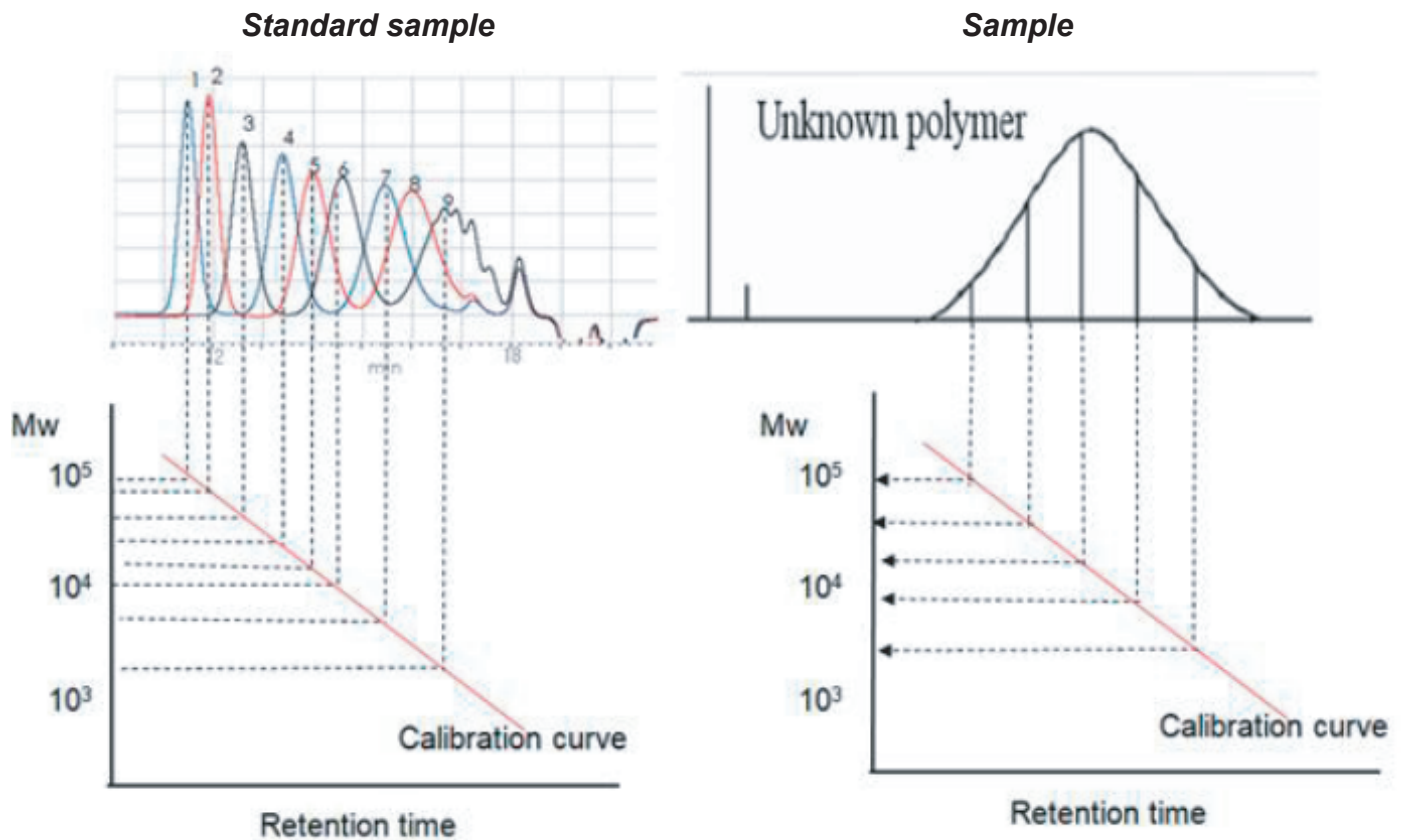
Gel Permeation Chromatography (GPC) is a separation method designed to separate polymers by molecular size by permeating a polymer solution through a column filled with cross-linked gel. In simple terms, larger molecules elute first, while smaller molecules emerge more slowly. By measuring the retention time within the column, the molecular weight of each sample can be calculated. It is also referred to as SEC (Size Exclusion Chromatography) because it separates molecules based on their size. GPC is the most common method for measuring the relative molecular weight of polymers.

- **Separation by GPC column**

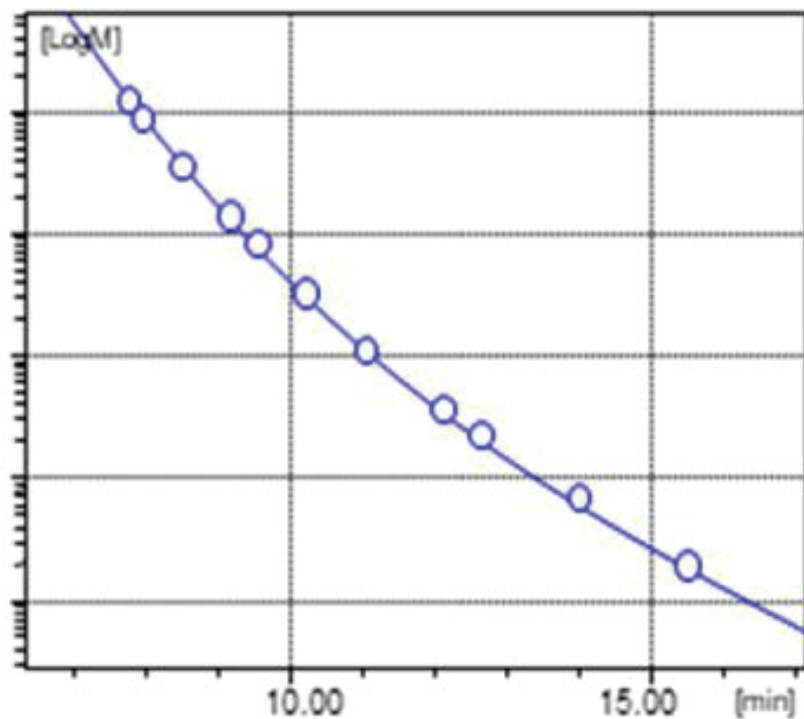
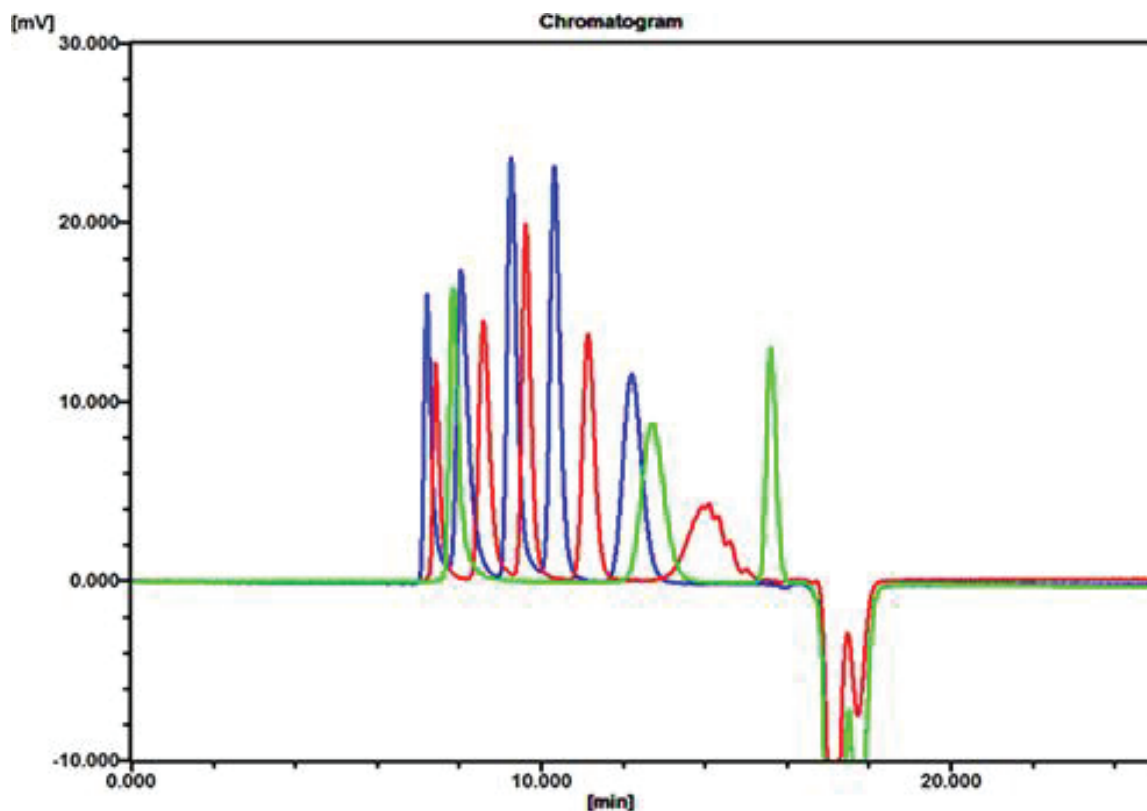


- **Standard & Sample Analysis**

GPC analysis calculates the relative average molecular weight by analyzing a test material after first analyzing a Standard Reference Material with a known molecular weight. While primarily used for single polymers, we can also analyze the molecular weight distribution of mixed products. The sample must be completely soluble in the GPC solvent for a successful analysis.

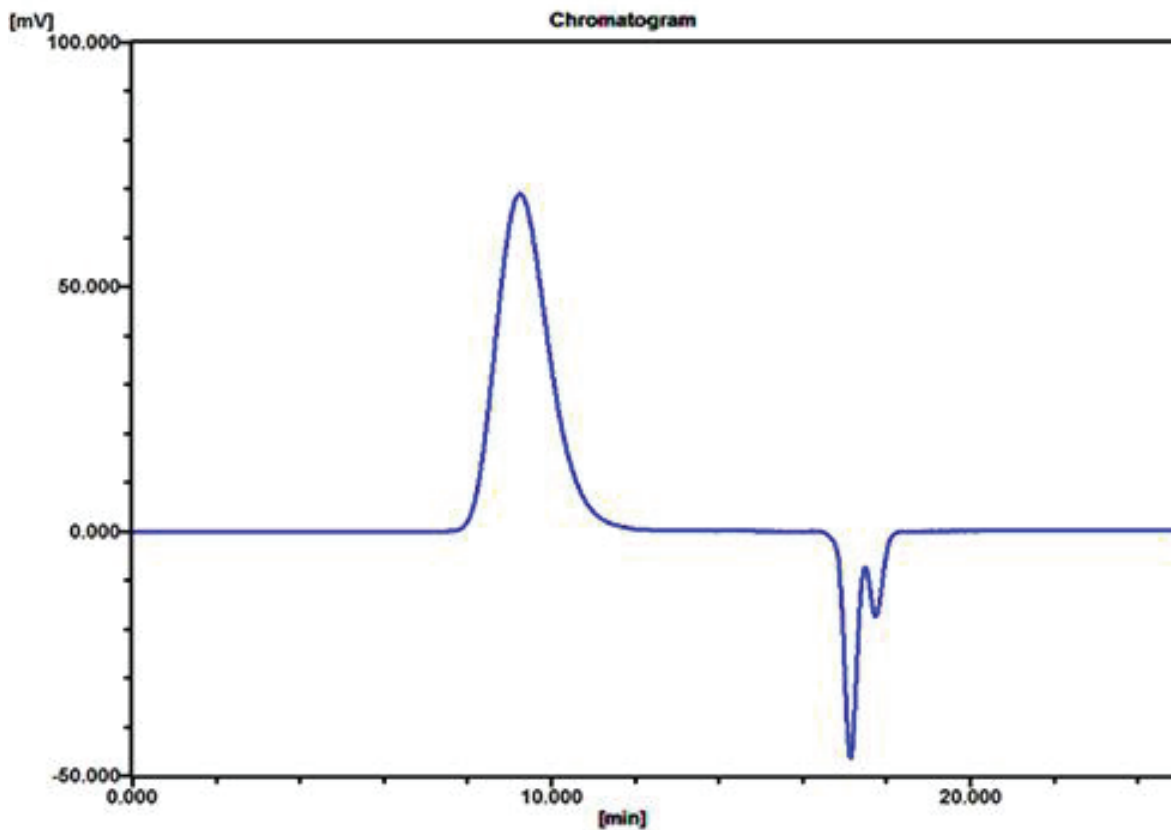


- Example Data : Polystyrene Standard Chromatogram & Calibration Curve



Time [min]	Molecular weight
7.843	1,074,000
8.042	729,500
8.590	301,600
9.267	117,700
9.625	70,500
10.320	27,800
11.147	9,570
12.207	3,090
12.727	1,920
14.100	580
15.603	162

- *Example of PVC GPC Chromatogram and Molecular Weight Analysis Results*



Mn	Mw	Mp	Mw/Mn
62,653	135,728	106,807	2.17

- Solvents & Global Standards**

Solvent	Polymer Type	Standard Material
THF	PS, PMMA, PVC, PDMS etc.	PS, PMMA, PDMS etc.
CHCl ₃	PLA, PCL, PHB etc.	PS, PLA etc.
DMF	PU, PEI, Epoxy resin etc.	PS, PMMA etc.
DMSO	Starch, Lignin etc.	PS, PMMA etc.
NMP	Polyamic acid, PVDF etc.	PS, PMMA etc.
Toluene	PDMS, Natural rubber etc.	PS, PDMS, PIB etc.
TCB	PE, PP, EVA etc.	PS, PE etc.
HFIP	PET, PBT, Nylon etc.	PMMA, PEG/PEO, PET etc.
PFP	PEEK, liquid crystal polymer etc.	PS etc.
Water	Aqueous polymers such as PEG, PVA, and PVP. Biopolymers such as collagen, proteins, DNA, and PDRN. Fillers including hyaluronic acid and CMC.	PEG/PEO, Polysaccharide, Dextran, PSS, PVP, Protein, DNA

- Testing Standards:**

Testing Standard	Details
ASTM D5296-19	Standard Test Method for Molecular Weight Averages and Molecular Weight Distribution of Polystyrene by High Performance Size-Exclusion Chromatography.
ASTM D6474-12	Standard Test Method for Determining Molecular Weight Distribution and Molecular Weight Averages of Polyolefins by High Temperature Gel Permeation Chromatography
OECD Guideline for Testing of Chemicals Test No. 118	Determination of the Number-Average Molecular Weight and the Molecular Weight Distribution of Polymers using Gel Permeation Chromatography