



# Analysis of Polystyrene using Gel Permeation Chromatography

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## Abstract

Polystyrene is used as homo-, co-polymers, thermoplastic elastomers and foamed polystyrene (EPS) for the production of cabinets, housings, furniture, packing boxes and food packaging material. In 1988 7.1 million tons were used worldwide. The mol masses vary from 170000 to 1000000 g/mol.

Polystyrene has been around since 1839, but the current macromolecular structure of the molecules was discovered a lot later in 1920 by Staudinger. The first industrial product based on polystyrene was introduced in 1930, then in 1950, the first foamed polystyrene product was made commercially available. This was called styropor.

Since then the usage of this plastic has increased drastically and nowadays when used as co-polymer its application range is almost universal. To ensure the highest quality, molecular weight (MW) data have to be evaluated for each batch of produced polymer. Gel Permeation Chromatography (GPC) is an analytical tool used to characterize polymers which are soluble in organic solvents.

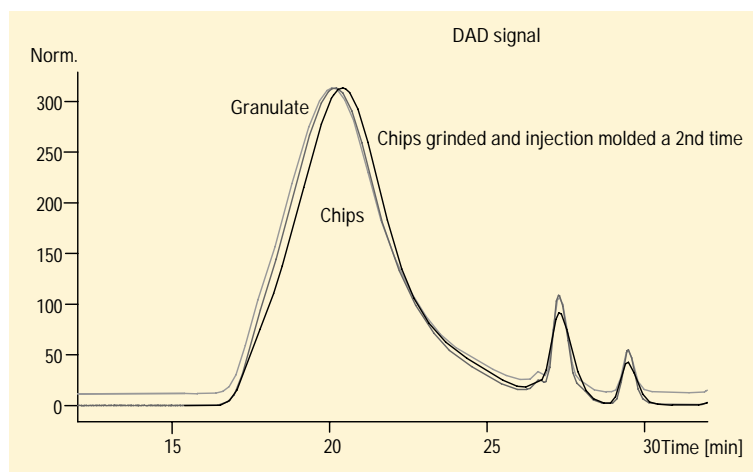


Figure 1  
Different processed polystyrenes

## Conditions

### Column

3 ~ PLgel mixed-B, 7.5 ~ 300 mm, 5  $\mu$ m

### Mobile phase

Tetrahydrofurane (THF)

**Flow rate** 1 ml/min

**Oven Temp** 20 °C

**Injection vol** 10  $\mu$ l

**Refractive index detector**

### Sample preparation

Sample dissolved in 1 ml THF

Polystyrene standards from PSS were used for narrow standard calibration



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## Method Performance

Figure 1 shows the signal traces of different treated polystyrenes. A granulate was used to produce colorless chips. These chips were grinded and injection molded a second time. The influence of these production procedures on the MW data are shown in table 1.

### Method performance

Precision of weight: average molecular weight (rsd of Mw) = < 1 %

Precision of number weight: average molecular weight (rsd of Mn) = < 2 %

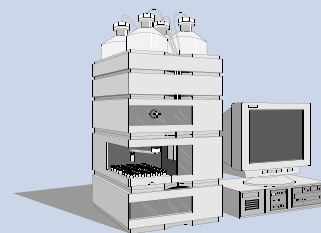
MW data	Granulate	Chips	Chips, grinded and injection molded a second time
Mp	109776	87563	103049
Mn	59152	49062	55036
Mw	159590	133565	149385
Polydispersity	2.698	2.722	2.714
Mz	327846	297500	311084
Mz + 1	545718	539583	533941
Mv	141380	117205	132243

Table 1  
Molecular weight data

## Equipment

### Agilent 1100 Series:

- isocratic pump
  - degasser (recommended)
  - autosampler
  - thermostatted column compartment
  - diode array detector and/or HP 1047A refractive index detector
- Agilent ChemStation + software + polymer labs GPC software



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Released 06/97  
Publication Number 5965-9048E



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