



# Analysis of Polycarbonate using Gel Permeation Chromatography

Angelika  
Gratzfeld-Huesgen

Polymer  
/chemical industry

## Abstract

Polycarbonate is chemically a polyester of carbonic acid and aliphatic or aromatic hydroxy compounds that it is used for the production of cabinets, housings, packing boxes, light transparent roofs, noise protection walls, inside paneling and microwave compatible dishes. In 1989, 470000 tons were used worldwide, with the mol masses varying from 10000 to 200000 g/mol.

To ensure the highest quality, molecular weight (MW) data has to be evaluated for each batch of produced polymer. Gel Permeation Chromatography is an analytical tool used to characterize polymers which are soluble in organic solvents.

## Method Performance

Figure 1 shows the signal traces of four different batches of polycarbonates. The differences in MW data for each of these four batches is shown in table 1. For one polycarbonate, MW data was determined by absolute methods. This data was used for a broad standard calibration.

The following explains the different calibration types.

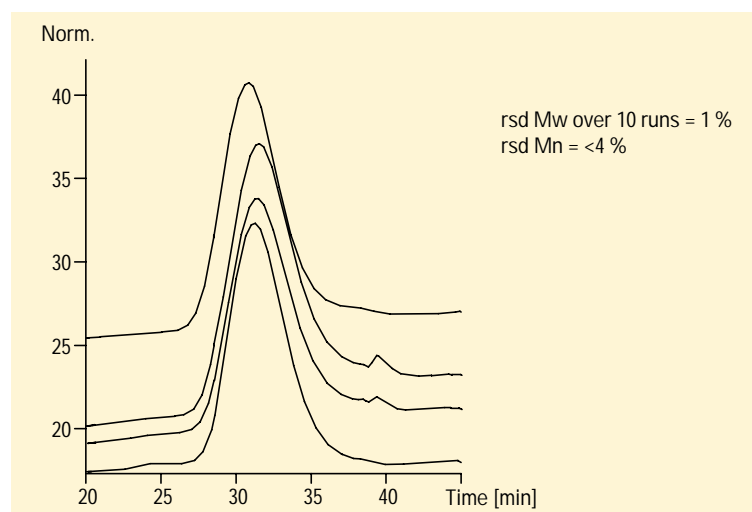


Figure 1  
Molecular weight data analysis of four different polycarbonates

## Conditions

**Column** 3 ~ PSS GPC, 8 ~ 300 mm, 5  $\mu$ m, 10<sup>6</sup>, 10<sup>5</sup>, 10<sup>3</sup> A

**Mobile phase** Tetrahydrofurane (THF)

**Flow rate** 0.8 ml/min

**Oven Temp** 20 °C

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

**UV DAD** 254/100 nm

**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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The accuracy of MW data, is measured by conformity with data measured compared with absolute methods, and is mainly influenced by the calibration procedure used.

In an ideal situation narrow standards are available for the polymer of interest, however this is normally not true. In many cases where organic solvents are used narrow polystyrene standards are used for calibration. This means that the accuracy is often poor. This is seen when you look at the comparison with absolute MW from light scattering or viscometer measurements. A solution for this is to use the broad standard calibration, where a polymer of the same chemical structure and known Mw and Mn data is used as calibration compound (see figure 2). In this case broad standard calibration with a chemically identical polymer with known Mw and Mn would provide the best conformity.

On the software side, care should be taken in selecting the right calibration curve fit. Baseline setting and summation start and end points should be selected correctly.

Narrow standard calibration		Broad standard calibration	
Mw	Mn	Mw	Mn
44096	17996	30000	12000
33306	10709	22604	6697
34494	10787	23616	7176
38556	16446	26602	10547

Table 1  
Molecular weight analysis of four different polycarbonates

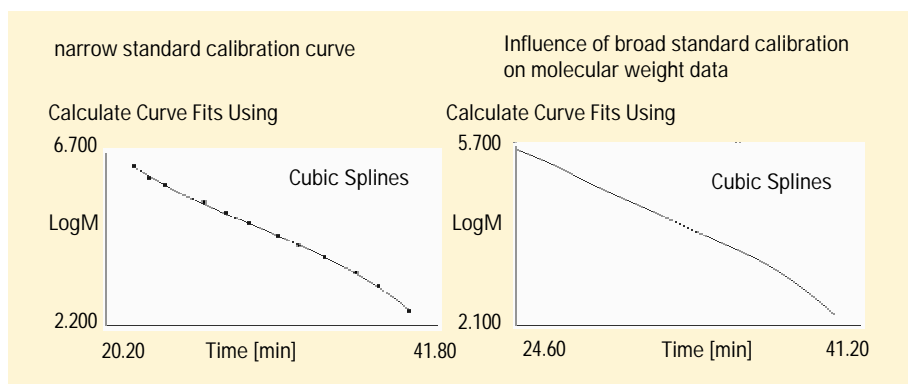


Figure 2  
Influence of calibration on molecular weight data

## Method performance

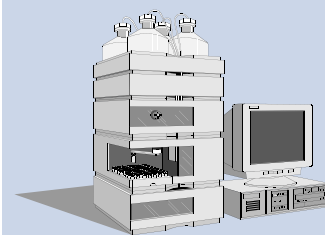
Precision of weight: average molecular weight (rsd of Mw) = < 1 %

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

## 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



Angelika Gratzfeld-Huesgen is application chemist at Agilent Technologies, Waldbronn, Germany.

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