Analysis of Polymethylmethacrylate (PMMA) using Gel Permeation Chromatography

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Abstract

Polymethylmethacrylates are used as homo and co-polymers for the production of safety glasses, Plexiglas and glasses for optics, cars and dishes. The mol masses vary from 120000 to 180000 g/mol. In 1988 1.5 Mio.t. were used worldwide.

The performance of PMMA depends on the molecular weight of the polymer. To ensure quality, molecular weight (MW) data has to be evaluated for each batch of polymer that is produced. Gel Permeation Chromatography is an analytical tool for the characterization of polymers which are soluble in organic solvents. The separation is based on the differences in size of the polymer molecules, and provides primary result molecular weight distribution curves. This means that molecular weight data and quantitative data are calculated after calibration with standards of known molecular weight.
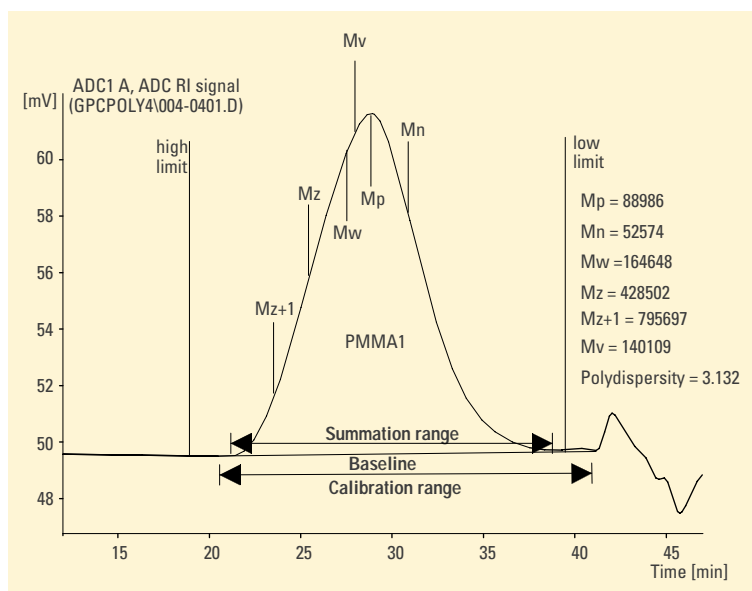
Figure 1
Standard Chromatogram

Conditions

Column
3 ˅ PSS GPC 8 ˅ 300 mm, 5 µm,
10^6, 10^5, 10^3 A
Mobile phase
Tetrahydrofurane (THF)
Flow rate
0.8 ml/min
Oven Temp
20 ºC
Injection vol 10 µl
Refractive index detector

Sample preparation
26 mg sample dissolved in 1 ml THF
Polystyrene standards from PSS were
used for narrow standard calibration

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Method Performance

Having set up the chromatographic and GPC calculation procedures including the calibration, the polymer can be analyzed and MW and MWD (molecular weight distribution) data can be calculated. After analysis of the polymer, the baseline and summation range have to be defined. The baseline points should be selected within a flat part of the graph before and after the polymer peak. The summation range should be within the calibrated range and marked either side with lines indicating the high and low limits. The start and end points of the peak need to be carefully selected.
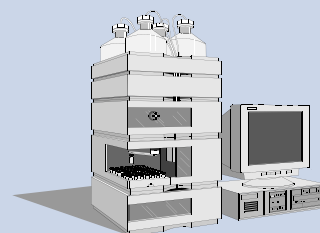
Method performance

Precision of weight average molecular weight (rsd of Mw) = < 1 %
Precision of number weight average molecular weight (rsd of Mn) = < 2 %

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