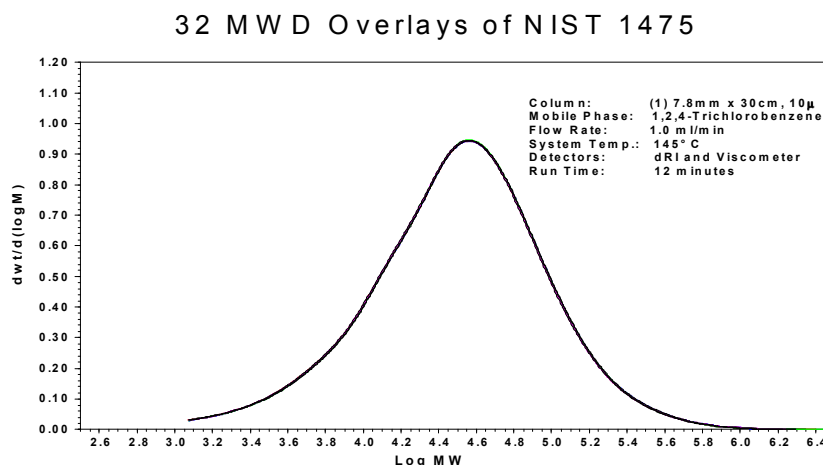


## Waters® Alliance® GPC/V 2000 System: High-Temperature, High-Speed Polyolefin Analysis

**Introduction:** Gel Permeation Chromatography is a technique that when used with the appropriate detector(s) provides an accurate molecular weight distribution of a polymer. This molecular weight distribution may be used to predict important physical properties and processing parameters for extrusion or injection molding. Since a typical GPC separation with 3 (or more) columns takes ~ 45 minutes, chemists are looking for ways to decrease analysis time and increase sample throughput. One way to do this is to use fewer (and/or shorter) columns, but historically, this has led to inaccurate and non-reproducible MW results.

**High-Temperature, High-Speed GPC Analysis:** Polyolefins have melt transition temperatures above 100°C and must be analyzed by high temperature GPC. They pose a challenge to analyze due to the high temperature requirements. Polyolefins can be analyzed on the Waters Alliance® GPC/V 2000 System using both refractive index (RI) and viscometer detection. The RI / Viscometer combination allows scientists to get accurate molecular weights and branching information, resulting in better prediction of physical properties and processing parameters. At the heart of the Alliance GPC 2000 System is the industry standard Alliance solvent manager. It provides better than 0.075% flow precision, enabling researchers to obtain excellent molecular weight reproducibility. One researcher, at a major polyolefin manufacturer, tracked molecular weight precision over a consecutive period of weeks in order to monitor manufacturing reproducibility. As shown in Figure 1 and Table 1, Alliance's advanced technology enables chemists to obtain excellent results over this extended period as indicated by the reproducible results of the well-characterized linear PE broad standard NIST 1475. This data was collected to check the accuracy and precision of the Alliance GPC/V 2000 system over a 2-week period, using only a single 7.8 mm x 30 cm mixed bed, GPC column.

**Figure 1: Overlaid chromatograms (N=32) from the analysis of NIST 1475 over a two-week period using a single GPC column on Waters Alliance GPC/V 2000**

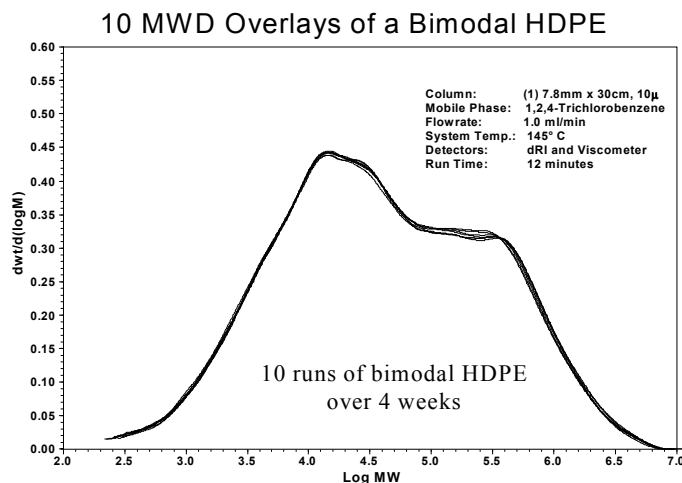


**Table 1: Molecular Weight and %RSD data from the analysis of NIST 1475 (N=32) over a two-week period using a single GPC column on Waters Alliance GPC/V 2000**

Mw	Mn	Mz	I.V. (dL/g)
58,300 (1.90%)	18,030 (2.61%)	175,920 (4.82%)	1.03 (1.50%)

Importance of Data Reduction Software: Waters Millennium<sup>®</sup> 32 GPC/V software augments the performance of the Alliance GPCV 2000 System by providing (simultaneous) viscometry data reduction. Using the universal calibration technique, accurate molecular weights, branching distributions, and intrinsic viscosity of polymers can be calculated. Figure 2 and Table 2 show the results from the analysis of a broad high density polyethylene (HDPE) standard performed by a polyolefin researcher. Note the very broad, multi-modal polymer distribution with a polydispersity value of ~28 that was calculated by Millennium<sup>32</sup> software. Figure 2 shows an overlay of 10 molecular weight distributions obtained over a four-week period, again using a single GPC column. The researcher stated that the observed molecular weight variability is mainly due to pellet-to-pellet variation, and **not** the instrument, testimonial to the remarkable reproducibility of the Waters Alliance GPC/V 2000 System.

**Figure 2: Overlaid chromatograms (N=10) from the analysis of HDPE using a single GPC column on Waters Alliance GPC/V 2000**



**Table 2: Molecular Weight and %RSD data from the analysis of HDPE (N=10) over a four-week period using a single GPC column on Waters Alliance GPC/V 2000 System**

Mw	Mn	Mz	I.V. (dL/g)
256,700 (2.58%)	9,100 (6.15%)	1,294,800 (4.3%)	2.66 (2.10%)

Summary:

- Waters Alliance GPC/V 2000 System extends the proven technology of Waters Alliance HPLC Systems into the polymer analysis lab to achieve levels of dependable reproducibility and accuracy unlike any GPC instrument ever before.