GPC Analysis is Ideal for Characterizing PVC

Application Note

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Introduction

Poly(vinyl) chloride is a thermoplastic widely encountered in everyday life. It is light, non-flammable, robust and durable. PVC is permeable, does not deteriorate, is easy to maintain and its physical and mechanical characteristics make it ideal for many different uses. PVC application areas include the toiletry, food, water and car industries.

Unplasticized PVC has a high melt viscosity leading to some difficulties in processing. The finished product is also too brittle for many applications. In order to overcome these problems, it is routine to incorporate additives to the PVC. In addition to acting as impact modifiers, a number of polymeric additives may be considered as processing aids. Such materials are primarily included to ensure more uniform flow and hence improve surface finish. The properties of the final material are dependent on the molecular weight distribution of the PVC and the type and level of the added plasticizers. The analysis of the compounded material is, therefore, of primary importance, and GPC is the ideal analytical tool for its characterization. With their linear resolving capability over a wide molecular weight range, Agilent PLgel MIXED columns provide resolution of both polymer and additives, particularly with the high efficiency 5 µm particle size columns.

Three different grades of PVC tubing containing different plasticizers were analyzed by GPC using a column set comprising three PLgel 5 µm MIXED-C columns.

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Conditions

Columns: 3 x PLgel 5 µm MIXED-C, 300 x 7.5 mm (p/n PL1110-6500)
Eluent: THF (stabilized)
Flow Rate: 1.0 mL/min
Detection: RI

Results and Discussion

Sample 1 contained an aliphatic plasticizer, while Sample 2 contained an aromatic plasticizer. Sample 3 contained both. The common peak eluting at approximately 29 minutes was due to toluene, which was included in the samples for flow rate correction.

All three samples displayed a broad peak at the same retention time, which was due to the PVC (approx 17 min), but also displayed other peaks with varying retention times which were attributed to the different plasticizers (Figure 1). Polystyrene standards and the resultant calibration is illustrated in Figure 2.

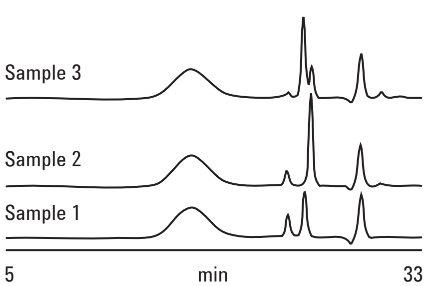

Figure 1. Overlaid raw data chromatograms for three PVC samples

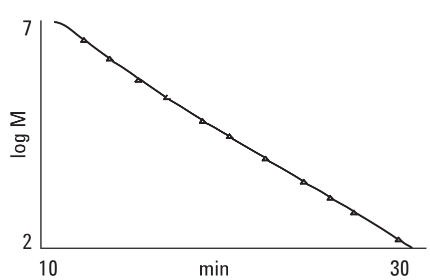

Figure 2. Calibration curve derived from polystyrene standards

Conclusion

GPC using PLgel MIXED-C columns permits the determination not only of the molecular weight distribution of PVC samples, but also the identification and quantification of their plasticizers.

PLgel 5 µm MIXED-C columns are designed for rapid polymer analysis. With its linear calibration up to 2 million MW, this is the column of choice for highest resolution and accuracy in molecular weight distribution analyses. Rapid solvent change capability, excellent temperature stability and the high resolution of the PLgel 5 µm MIXED-C also provide ideal versatility for the R&D laboratory.

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Published in UK, September 2, 2010
SI-01824

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