



# VARIAN

## Application Note SI-00949

### Analysis of Phenol-formaldehyde Resins by GPC and PolarGel-M

Greg Saunders

Polymer Laboratories, now a part of Varian, Inc.

#### Introduction

Phenol formaldehyde (P-F) resins are thermoplastic materials made with an excess of phenol in an acid catalyzed reaction with formaldehyde. P-F resins are commonly used as precursors to varnishes and other surface finish products.

#### GPC Analysis

PolarGel-M GPC columns are packed with low swell, macroporous copolymer beads that have a surface of balanced polarity, comprising hydrophobic and hydrophilic components. These allow PolarGel-M to be used in the analysis of high polarity polymers that are insoluble in water to give a more accurate representation of the molecular weight distribution of the polymer. If these polar polymers were to be analyzed with traditional styrene/divinyl benzene columns, interactions would cause artifacts in the peak shape and longer retention times, which would translate into apparently much lower molecular weight averages.

#### Sample Preparation

Two types of phenol-formaldehyde resin were analyzed to obtain an indication of differences in molecular weight, if any. The samples were made up in 0.2 % (w/v) DMF, with 0.1 % LiBr added to reduce sample aggregation, and injected without further treatment.

#### Conditions

Columns: 2xPolarGel-M, 300 x 7.5 mm

Eluent: DMF & 0.1 % LiBr

Flow Rate: 1.0 mL/min

Injection Volume: 100  $\mu$ L

Temperature: 50 °C

Detectors: PL-GPC 50, RI

#### Results

The superior results of the analyses are shown in the overlaid chromatograms and molecular weight distributions.

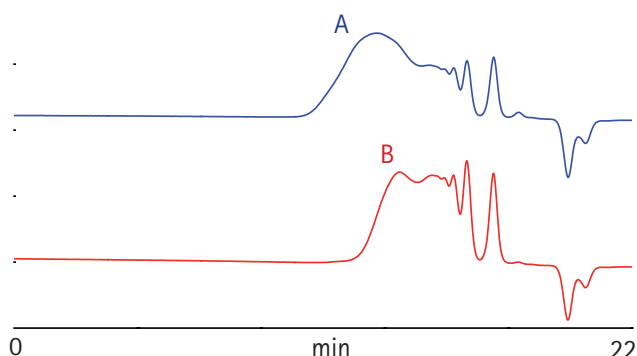


Figure 1. PolarGel-M reveals the composition of two phenol-formaldehyde resins

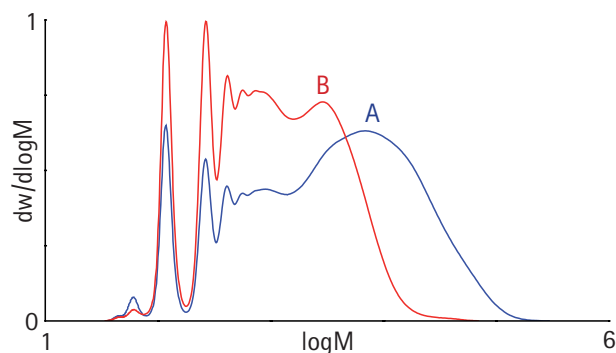


Figure 2. Overlaid molecular weight distributions of two phenol-formaldehyde resins

#### Conclusion

GPC with PolarGel-M columns allows for the artifact, interaction free calculation of the composition and molecular weight distributions of phenol-formaldehyde resins that are difficult to analyze on traditional, organic (PS/DVB) GPC columns.

*These data represent typical results.*

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North America: 800.926.3000 – 925.939.2400

Europe: *The Netherlands*: 31.118.67.1000

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