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Application Note SI-02024

Analysis of Carboxymethyl Cellulose via GPC Viscometry

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Introduction

Carboxymethyl cellulose (CMC) is a derivative of cellulose with carboxymethyl groups (-CH_2COOH) attached at some of the hydroxyl groups that typically make up the cellulose backbone. The general structure is shown in Figure 1.

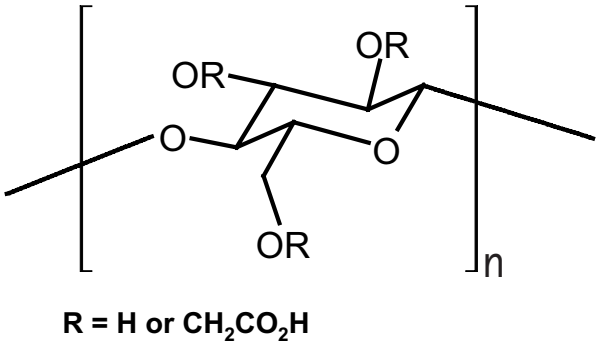

Figure 1. General structure of the CMC monomeric repeat unit.

Carboxymethyl cellulose has useful material properties such as high solution viscosity. This coupled with the low toxicity and non-allergenic nature of the material results in its widespread use within the food science arena. In addition, CMC is also used in many wide ranging final end user products, such as toothpaste, eye drops and water based paints.

Materials and Methods

Analysis of CMC materials can easily be achieved by gel permeation chromatography (GPC) with high efficiency PL aquagel-OH 30 8 µm (300 x 7.5 mm) columns and the PL-GPC 50 Plus integrated GPC/SEC system equipped with RI and viscometry detection.

The CMC sample was prepared at 0.2% (w/v) in 0.2M $NaNO_3$, 0.01M NaH_2PO_4, pH 7 buffer solution and allowed to dissolve at room temperature overnight. It was injected without further treatment.

Sample: Carboxymethyl Cellulose
Column: PL aquagel-OH 30 8 µm (300 x 7.5 mm)
Eluent: 0.2M $NaNO_3$, 0.01M NaH_2PO_4, pH 7
Flow Rate: 1.0 mL/min
Inj Vol: 100 µL
Sample Conc: 2.0 mg/mL
Temp: Ambient
Calibrants: PEG/PEO EasiVial™
Detector: PL-GPC 50 Plus (Differential Refractive Index + Viscometer)

Results

Figure 2 shows the dual detector chromatogram for the CMC sample. Figure 3 shows the molecular weight distribution calculated via the Universal calibration, a technique utilizing the viscometer to determine molecular weights independent of the chemistry of the polymer calibrations employed. Figure 4 shows the Mark-Houwink plot generated from the viscometry data, the curvature can provide information about the structural or chemical homogeneity as a function of molecular weight.

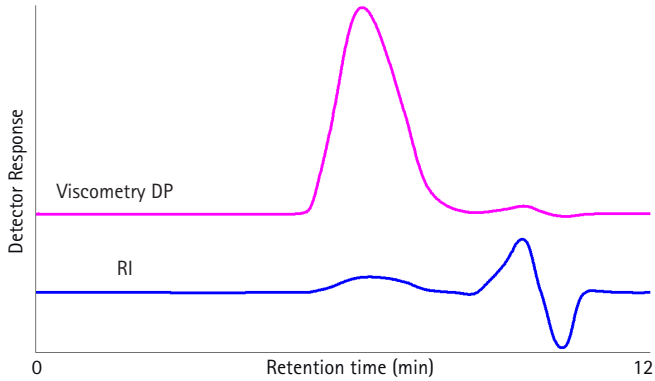

Figure 2. RI/Viscometry raw data chromatograms obtained from the carboxymethyl cellulose sample.

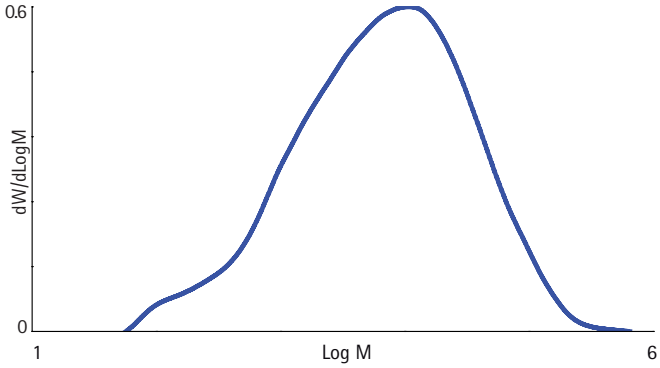

Figure 3. Molecular weight distributions obtained from the carboxymethyl cellulose sample.

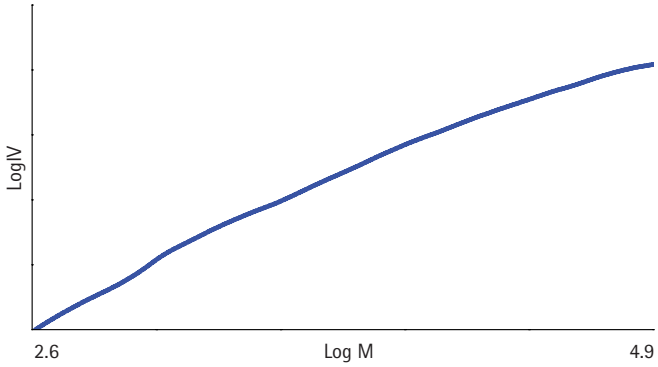

Figure 4. Mark-Houwink plot obtained from the carboxymethyl cellulose sample.

Conclusion

A sample of carboxymethyl cellulose was successfully analyzed using a Varian GPC system comprising a PL aquagel-OH column and PL-GPC 50 Plus instrument, incorporating refractive index and viscometry detection.

These data represent typical results.
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