Natural and Synthetic Wax Analysis on Agilent PLgel and Gel Permeation Chromatography

Application Note

Materials Testing and Research, Polymer

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Introduction

The term wax is used to describe a wide range of materials that share a similar appearance and consistency. Typically, waxes are white or tan in color and range from soft, readily pliable materials to harder, more resistant products. Waxes are generally of two types; natural, renewable waxes such as beeswax, and crude oil products such as paraffin waxes. This note describes the analysis of a crude oil wax and a renewable wax, and contrasts the results, using gel permeation chromatography with Agilent PLgel 3 µm 100Å columns.

Analysis of Waxes

The solubility of waxes is very dependent on molecular weight. Lower molecular weight waxes are soluble in tetrahydrofuran. However, as the molecular weight increases, the wax becomes harder and more brittle, due to higher crystallinity, and more aggressive solvents, such as trichlorobenzene, may be required for dissolution.

Microcrystalline wax is a refined mixture of solid, saturated hydrocarbons, mainly branched paraffin, obtained from the heavy lubricating oil fraction of crude oil during distillation. The wax is pure white in color with characteristics that closely resemble those of natural waxes, and is used as a substitute for other waxes in laminating paper, foil, and polishes. Microcrystalline wax typically contains C30-C70 hydrocarbon chains, including paraffins.

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Beeswax is a more complex product made from the honeycomb of bees. The wax is firm and yellow in color and has been used for thousands of years, correspondingly, with a wide range of applications. The main commercial use of the wax in recent times is in the production of candles and in cosmetic formulations. Beeswax typically contains about 15% partially unsaturated hydrocarbons, 15% free fatty acids, and 70% monohydroxesters, and di- and tripolyesters.

Both waxes were analyzed in tetrahydrofuran and the chromatograms are shown in Figures 1 and 2.

Conditions

Samples	Hydrocarbon waxes
Columns	2 × Agilent PLgel 3 µm 100Å, 7.5 × 300 mm (p/n PL1110-6320)
Eluent	THF (stabilized)
Flow rate	1.0 mL/min
Inj vol	20 µL
Detector	RI
System	Agilent PL-GPC 50

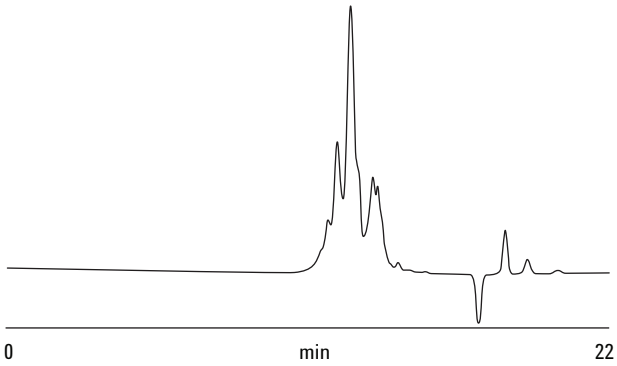

Figure 1. Chromatogram of a microcrystalline wax on an Agilent PLgel 3 µm two-column set.

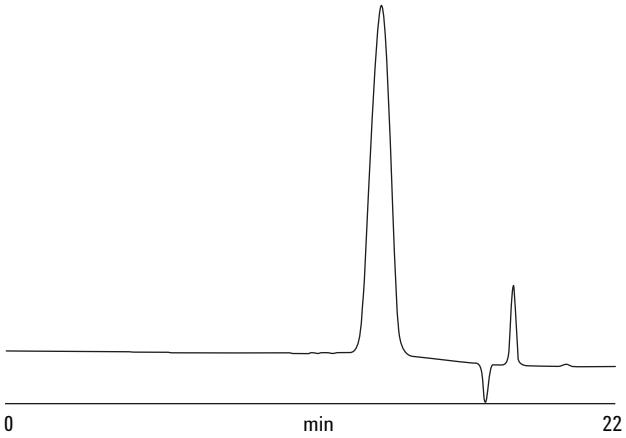

Figure 2. Chromatogram of beeswax on an Agilent PLgel 3 µm two-column set.

Conclusions

The chromatogram of the microcrystalline wax showed that a number of components could be resolved using the high efficiency columns. In comparison, the beeswax eluted as a broad polymer peak indicating that the various components had a similar size in solution. Although similar in properties, the two materials can be clearly differentiated by gel permeation chromatography.

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