Effective Analysis of Low Chromophore Polymer Additives by HPLC with ELSD

Stephen Bullock
Polymer Laboratories, now a part of Varian, Inc.

Introduction

Evaporative light scattering detection is the preferred technique for the analysis of compounds that possess a weak or no UV chromophore. ELSD detects any compound that is less volatile than the mobile phase, and is not dependent on the optical properties of the analyte. The Varian evaporative light scattering detector is highly sensitive to a wide range of compounds and ideally suited to this application.

Polymers are part of our everyday lives, from packaging to cosmetics, and their diverse range and application are a result of the low molecular weight additives they contain. Compounds are added to polymers in order to modify their properties, and without the incorporation of these additives, some polymers would degrade, discolor or become brittle due to oxidation (eg polyethylene). A polymer can contain a host of additives in a complex blend and small differences in this mixture can dramatically affect the characteristics of the polymer. As the structure of polymers becomes increasingly complex, the need for accurate, reliable and robust analytical methods is paramount.

HPLC analysis of polymer additives has been limited by the suitability of the detection method. Many additives lack a UV chromophore and so refractive index detection has been a common choice for these types of compounds. However, RI detection is not compatible with gradient elution, so selectivity is limited and analysis times are often very long. The Varian evaporative light scattering detector is well suited to the analysis of polymer additives as it provides detection of additives regardless of their optical properties, and is gradient compatible.

Instrumentation

Column: C18 5 µm, 150 x 2.1 mm (40 °C)
Detection: Varian ELSD (neb=40 °C, evap=85 °C, gas=1.6 SLM); UV, 280 nm

Materials and Reagents

Eluent A: 0.1 % Triethylamine in water
Eluent B: ACN

Sample Preparation

Sample Concentration: 100 µg/mL

Conditions

Flow Rate: 0.4 mL/min
Injection Volume: 20 µL
Gradient: 70-100 % B in 10 min; hold 8 min

Results and Discussion

The Varian evaporative light scattering and UV detectors gave different results for the additive mixture, as shown in Figure 1. The Varian ELSD gave a good response to all five additives, whereas the UV detected only four because Erucamide does not possess a UV chromophore. This highlights the advantage of ELS detection for these types of compounds, as the response of the ELSD is not dependent on the optical characteristics of the material.

Table 1. Peak data comparison for polymer additives.

Additive	RT (min)	Peak Area (mvs^{-1})		Peak Ratio	
		2100	UV	2100	UV
Ultranox 626	11.07	909.4	181.8	0.19	0.10
Irganox® 1010	11.44	4723.8	1797.4	1.00	1.00
Ethanox 330	12.14	4087.9	2623.4	0.87	1.46
Alkanox 240	16.15	3959.5	1022.3	0.84	0.57
Erucamide	19.66	1583.9	N/D	0.34	N/D

* Normalized for Ciba Irganox® 1010 response

The mixture contained equal concentrations of each additive and the Varian ELSD gave similar responses for three of the five additives, highlighting the uniformity of response with this technique (Figure 1). The lower response of Ultranox 626 and Erucamide is possibly related to their volatility or purity. By contrast, the UV detector showed varying peak ratios and the presence of Erucamide in the sample was missed. The UV, therefore, did not accurately reflect the composition of the mixture.

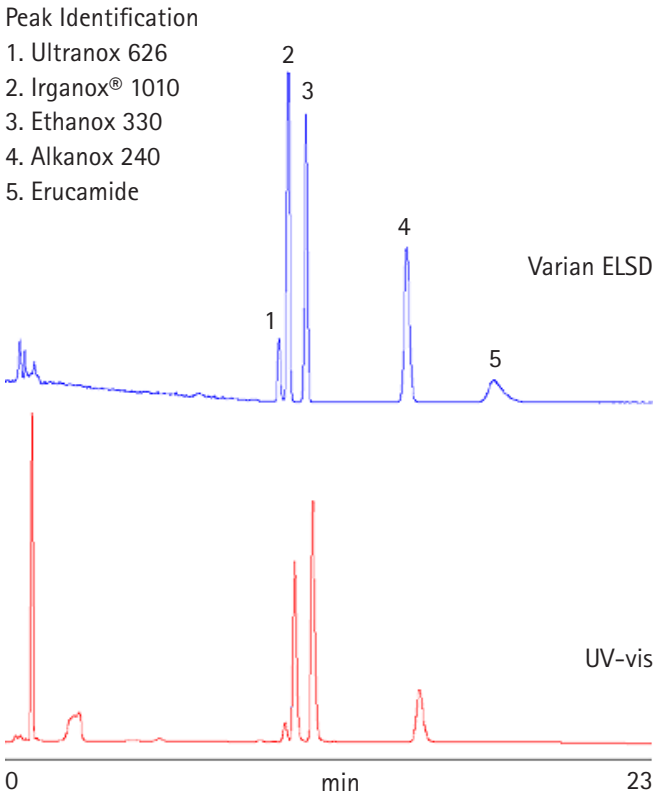

Figure 1. The superiority of the Varian ELSD over UV detection is clear in the HPLC of polymer additives.

Conclusion

The Varian evaporative light scattering detector is an ideal detector for the determination of polymer additives. The technique is compatible with gradient analysis which is required to elute complex mixtures of additives over a short time period. The Varian ELSD is universal, which provides a more representative composition of complex mixtures. When used as the primary detection method, it can detect a range of polymer additives in a single run, but it also provides an extra dimension to analysis when used in conjunction with a UV detector.

These data represent typical results. For further information, contact your local Varian Sales Office.

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Varian, Inc.
www.varianinc.com
North America: 800.926.3000 – 925.939.2400
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