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CDS Solutions

ANALYSIS INFORMATION USING ADVANCED SAMPLE HANDLING TECHNOLOGY

ANALYSIS OF POLY (VINYL CHLORIDE) BY DIRECT PYROLYSIS/FT-IR

Infrared spectroscopy of polymers is one of the most frequently used techniques for identification and characterization. Pyrolysis has often been used in conjunction with gas chromatography to obtain information about polymer samples. The combination of pyrolysis with infrared spectroscopy provides a powerful method of obtaining structural data of polymers.

Poly (vinyl chloride), (PVC), has been extensively studied by Py/GC. It has been deduced that PVC degrades via side group elimination of HCl from the polymer backbone, forming a polyene which fragments further to produce aromatics. A sample of PVC was pyrolyzed at 900° C for 20 seconds while IR scans were being taken during the pyrolysis interval. The resulting spectrum (Figure 1) shows the recognizable pattern of HCl in the gas phase. In this spectrum, both P and R branches are present and well resolved. Direct Pyrolysis/FT-IR can thus be used as a means of recognizing degradation pathways.

In a separate experiment, PVC was heated at a rate of 60° C/minute to a final temperature of 900° C (Figure 2). IR scans were taken every 45 seconds and displayed on a plot of absorbance versus time. By correlating the time with the heating rate, the temperature at which product evolution begins can be determined. In this case, the temperature of sample degradation is approximately 360° C.

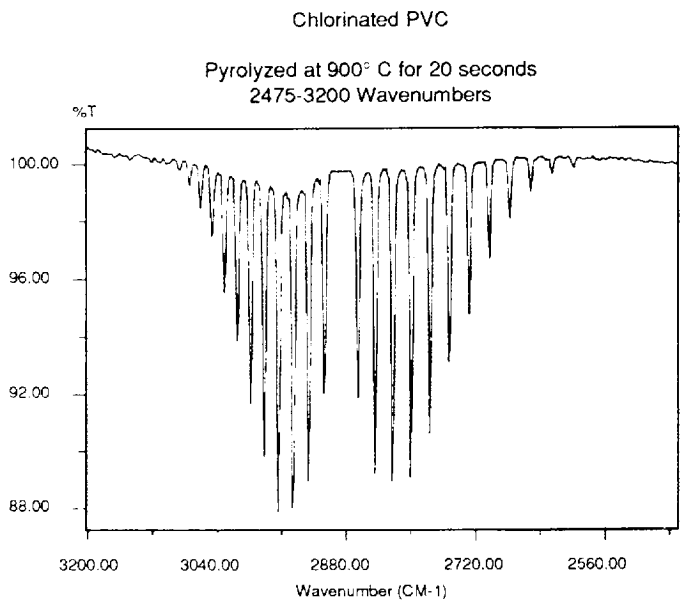

Figure 1

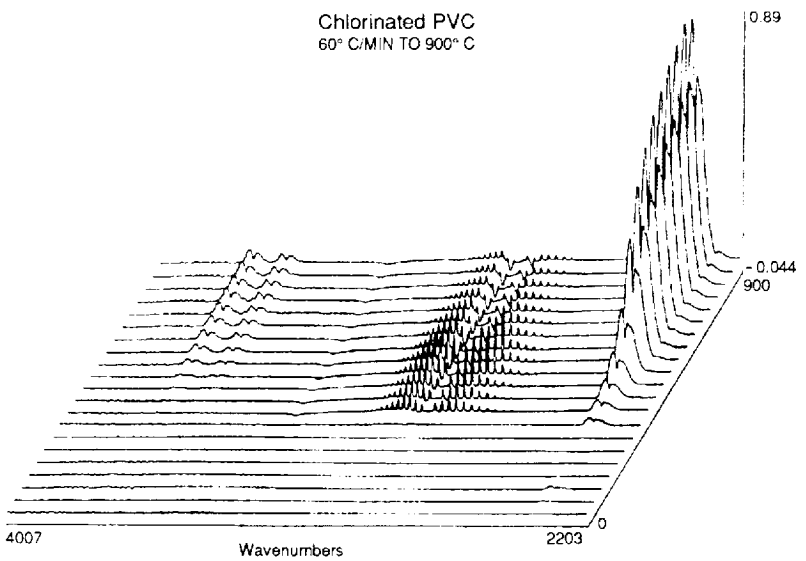

Figure 2

Pyrolysis/FT-IR can be used in the pulsed mode to allow for quick identification of polymer samples as well as in a programmed mode. The programmed mode reveals a time-resolved study of polymers as they degrade. Combining these two modes of operation gives an added dimension to FT-IR analysis of polymers.

EQUIPMENT PYROLYSIS

Pyroprobe model 1000 filament pyrolyzer, with temperatures continuously variable to 1400° C.

INTERFACE

Brill Cell for Direct Pyrolysis/FT-IR, containing ZnSe windows and sweep gas inlet ports.

DATA ACQUISITION

IBM PS2-70 with a Hewlett-Packard plotter.

For more information on this and related applications, we recommend the following readings:

J. T. Cronin and T. B. Brill, "Thermal Decomposition of Energetic Materials 26. Simultaneous Temperature Measurements of the Condensed Phase and Rapid-Scan FT-IR Spectroscopy of the Gas Phase at High Heating Rates." Appl. Spectr. 41, 1147, (1987).

J. W. Washall and T. P. Wampler, "Analytical Pyrolysis of Complex Multicomponent Samples." J. Chromatogr. Sci. 27, 144, (1989).

T. P. Wampler, "Thermometric Behavior of Polyolefins." J.A.A.P., 15, 187, (1989).

Additional literature may be obtained by contacting your CDS Instruments Representative, or by writing tc the CDS Applications Lab.

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