CDS Analytical, Inc.

APPLICATIONS INFORMATION USING ADVANCED SAMPLE HANDLING TECHNOLOGY

Pyrolysis-GC of High and Low Density Polyethylene

Polyethylene, whether high density (HDPE) or low density (LDPE) is essentially a very long hydrocarbon molecule. Pyrolysis of PE produces shorter hydrocarbons, mostly normal alkanes, alkenes and dienes, which may be analyzed by gas chromatography, producing a pyrogram like that shown in Figure 1. The recurring pattern of triplet peaks show these paraffins and olefins for a wide distribution of chain lengths, and each triplet contains one more carbon than the triplet which eluted just before it. For example, the large peak at 10 minutes is normal 1-decene, marked C_{10} in Figure 1.

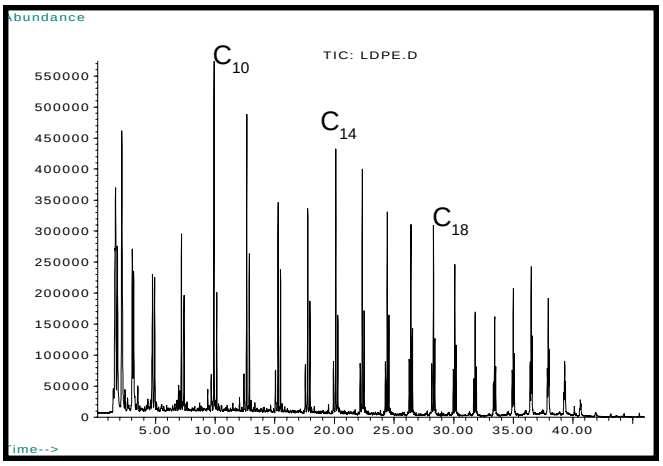

Figure 1. Pyrolysis of low density polyethylene at 750°C.

A major difference between HDPE and LDPE is the increased amount of branching found in LDPE. When a polyethylene molecule is not purely linear, the hydrocarbons produced during pyrolysis retain this structure, and the resulting pyrolysate includes branched hydrocarbons in addition to the normal olefins and paraffins. These branched compounds elute between the triplets of the normal compounds, as shown in Figure 2. Here the region between decene and tetradecene has been expanded to show the branched materials eluting between the normal hydrocarbons, and it is clear that the degree of branching, and thus the kinds and amounts of non-linear hydrocarbons is substantially greater for the LDPE.

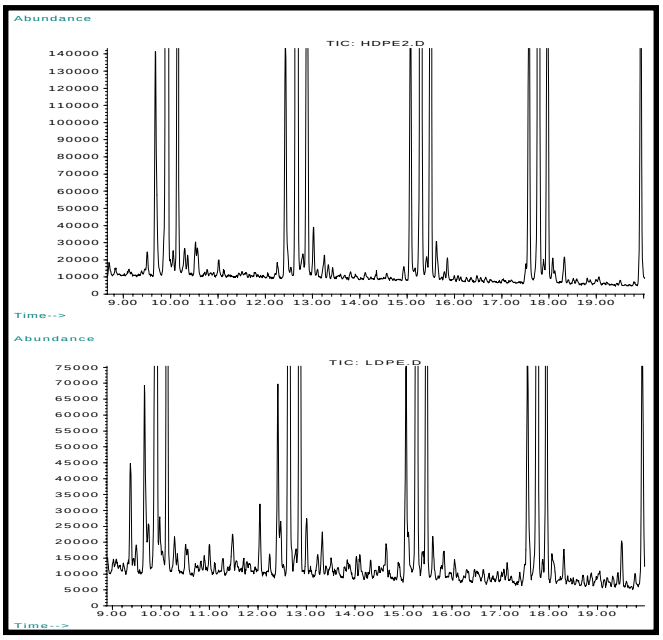

Figure 2. Partial pyrograms of high density (top) and low density (bottom) polyethylene

Equipment

All samples were pyrolyzed using a CDS Model 2500 Pyrolysis Autosampler interfaced to a Hewlett-Packard 6890 gas chromatograph with a mass selective detector.

Pyrolysis

Interface oven:	300°C
Ramp:	10°C/ms
Temperature:	750°C
Time:	15 seconds
Clean:	1000°C for 10 seconds

Chromatography

Carrier:	He
Column:	HP-5
	30 m x 0.25 mm
Split:	75:1
Initial temperature:	40°C for 2 minutes
Ramp:	8°C/minute
Final temperature:	290°C for 10 minutes

FOR MORE INFORMATION CONCERNING THIS APPLICATION, WE RECOMMEND THE FOLLOWING READING:

S. Tsuge, and H. Ohtani, *Microstructures of Polyolefins*, in Applied Pyrolysis Handbook, T. Wampler, (Ed)., Marcel Dekker, N.Y., Publisher

S. Tsuge, Y. Sugimura and T. Nagaya, *Structural Characterization of Polyolefins by Pyrolysis-Hydrogenation Glass Capillary Gas Chromatography*, JAAP, 1 (1980) 221.

T. Wampler, *Thermometric Behavior of Polyolefins*, JAAP, 15 (1989) 187.

Additional literature on this and related applications may be obtained by contacting your local CDS Analytical representative, or directly from CDS at the address below.

CDS Analytical, Inc.

CDS Analytical, Inc. has been a leader in the design and manufacture of laboratory instruments for sample preparation and analysis since 1969. We are dedicated to providing the best possible instruments for both research and routine analysis. Well known in the field of pyrolysis, CDS manufactures the Pyroprobe® 1000 and 2000 for the introduction and analysis of solid materials by GC, MS and FT-IR. CDS offers a complete line of dynamic headspace instruments for the analysis of volatile organic compounds in environmental, pharmaceutical and food applications, as well as custom systems for complex, multicomponent materials investigation. Our customers, their requirements and applications are important to us. To help meet your needs, we offer a wide range of analytical information and the services of our applications laboratory. If you would like additional information, please contact us at the address below, or call us at 1 800 541 6593.

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