Pyrolysis of Polyethylene in Five Atmospheres

Application Note
Pyrolysis

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Analytical pyrolysis is generally performed in a vacuum or an inert gas, usually the carrier gas of a GC/MS. Under these conditions, the polymer is split to smaller molecules, frequently via free radical mechanisms which rapidly produce stable molecules. Polyethylene, for example, produces a series of normal alkanes, alkenes and dienes as shown in the pyrograms in Figure 1. All runs were performed in the stated atmosphere with the products collected onto a Tenax trap, then transferred and analyzed in helium by GC/MS. Changing the atmosphere to nitrogen or argon has little effect on the products made. Because the free radical reactions are so rapid, even performing the pyrolysis in hydrogen results in little if any hydrogenation of the pyrolysis products. For the intentional hydrogenation of these products, a reactor with a suitable catalyst must be used as a second step in the process.

When the pyrolysis is done in air, however, there is a noticeable oxidation of some of the products. This produces a second series of peaks, which are aldehydes and elute between the triplet peaks of the hydrocarbons. Figure 2 expands the pyrograms to show the positions of these oxidation products.

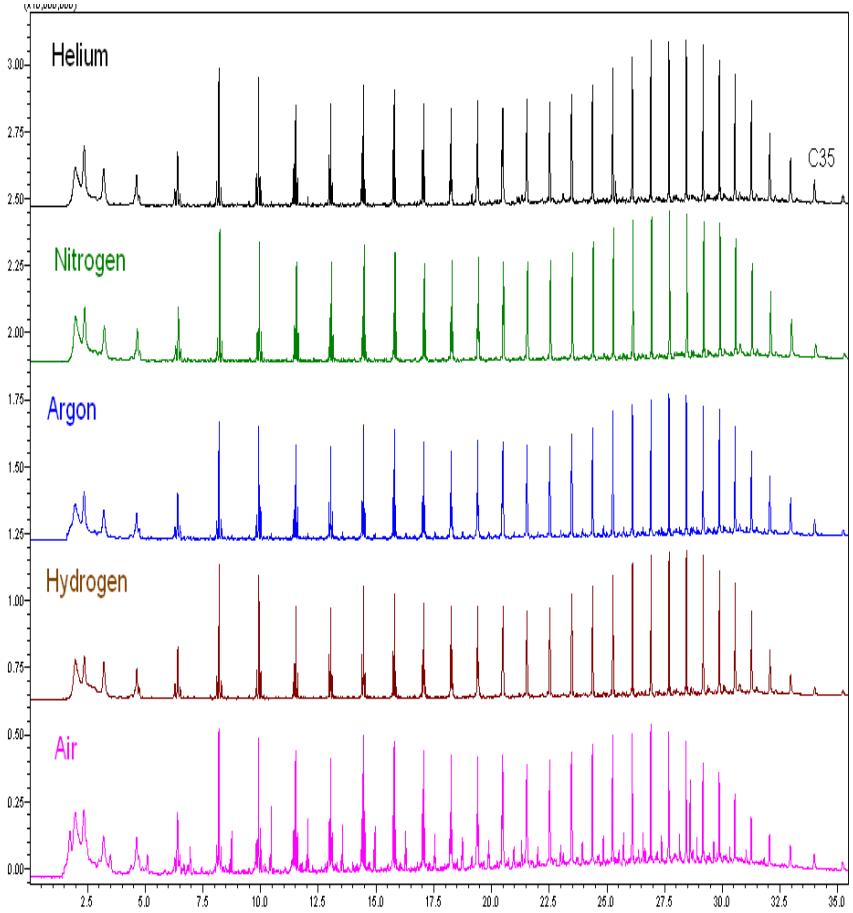

Figure 1. Pyrolysis of Polyethylene in five atmospheres, at 750°C with GC/MS analysis in helium.

Instrument Conditions

Pyroprobe

Pyrolysis:	750°C 15 seconds
Interface:	300°C for 4 minutes
Carrier flow:	30 ml/min
Trap contents:	Tenax
Trap initial:	40°C
Trap desorb:	300°C for 4 minutes

GC/MS

Column:	5% phenyl (30m x 0.25mm x 0.25μm)
Carrier:	Helium, 50:1 split
Injector:	280°C
Oven:	40°C for 2 minutes
	10°C/min to 325°C
Mass Range:	35-600 amu

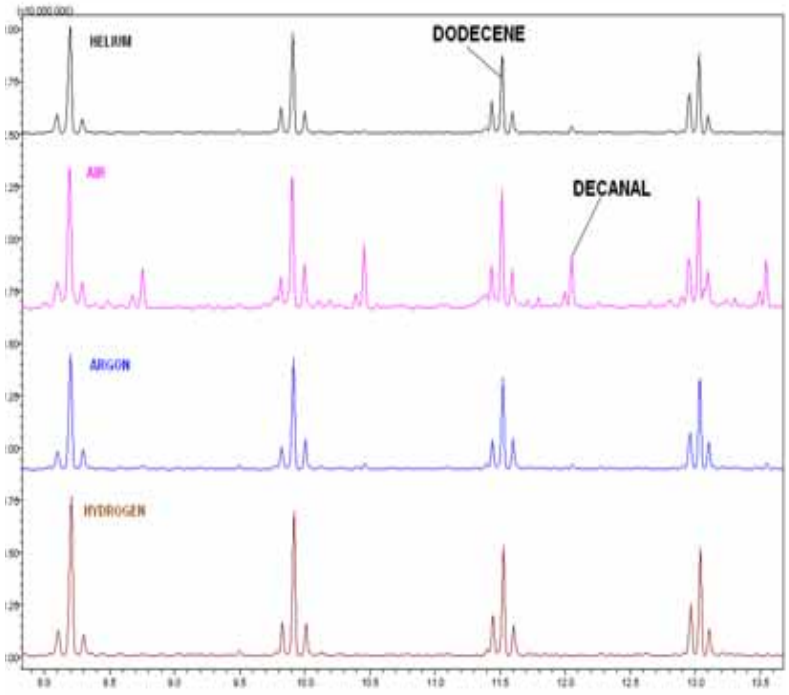

Figure 2. Expanded pyrograms showing aldehydes produced when Polyethylene is pyrolyzed in air.

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

T. P. Wampler and E. J. Levy, J. Anal.Appl. Pyrolysis, 8, (1985) 153-161.

S. Tsuge et al., J. Anal. Appl. Pyrolysis,1, (1980) 221-229.