Pyrolysis-GC/MS of Clothing Fibers - Cotton and Polyester Poly(ethylene terephthalate)

Application Note
Fibers

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Although clothing may be made from a wide variety of fibers, both natural (such as wool and silk) and synthetic (such as nylons and acrylics), cotton, polyester, and blends of these two are popular and important materials in the textile industry. Cotton fibers are essentially cellulose, and poly (ethylene terephthalate) (PET) is the polyester used almost exclusively in polyester clothing.

Because cellulose and PET are chemically quite different, analysis of these two polymers by pyrolysis-gas chromatography is a simple task. When a material, especially a polymer which is too large a molecule to be analyzed by GC, is pyrolyzed, it breaks apart into smaller molecules which retain the chemical information of the original polymer. These smaller molecules may be analyzed by GC, producing a pattern of the peaks representing diagnostic fragments of the parent material. Figure 1 shows a pyrolysischromatogram (pyrogram) generated from a piece of cotton thread heated to 750°C for 15 seconds. When cellulose degrades thermally, it produces water and carbon dioxide, and many other organic materials, including aldehydes and ketones. PET, on the other hand, degrades to produce aromatics, including benzene, benzoic acid, and oligomeric fragments of the polymer. Figure 2 shows a pyrogram of a PET clothing thread, in which benzoic acid elutes at about 11 minutes. Blends of cotton and polyester would show the peaks seen in both Figures 1 and 2 in the same pyrogram, since each polymer degrades essentially independently.

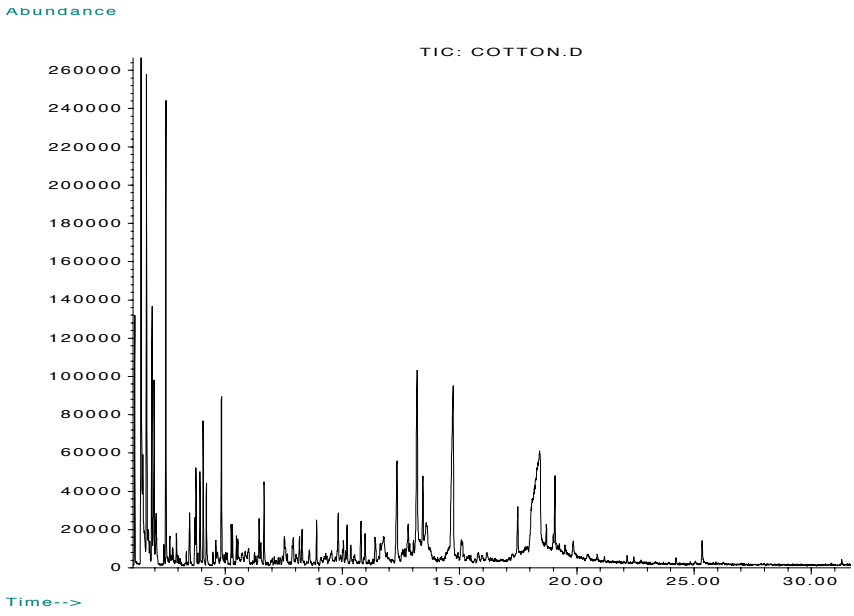

Figure 1. Pyrogram of cotton thread pyrolyzed at 750°C.

Instrument Conditions

Pyroprobe Autosampler

Pyrolysis Setpoint:	750°C 15s
Valve Oven:	300°C

GC/MS

Column:	5% phenyl (30m x 0.25mm x .25μm)
Carrier:	Helium, 75:1 split
Injector:	300°C
Oven:	40°C for 2 min
	8°C/min to 290°C for 10 min

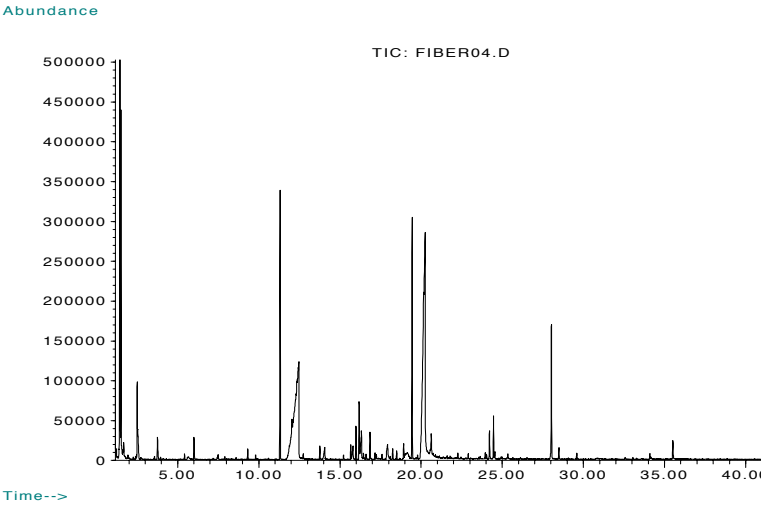

Figure 2. Pyrogram of PET pyrolyzed at 750°C.

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

H. Ohtani and S. Tsuge, Degradation
Mechanisms of Condensation Polymers
in Applied Pyrolysis Handbook,
T. Wampler (Ed.) Marcel Dekker,
N.Y., publisher.

D. Radlein, J. Piskorz and D. Scott,
Fast Pyrolysis of Natural Polysaccharides
as a Potential Industrial Process,
JAAP, 19, (1991) 41.