CDS Analytical, Inc.

APPLICATIONS INFORMATION USING ADVANCED SAMPLE HANDLING TECHNOLOGY

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

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 pyrolysis-chromatogram (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.

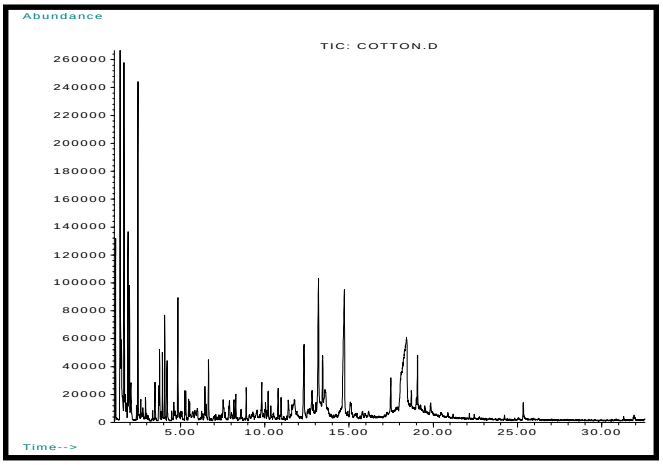

Figure 1. Pyrogram of cotton thread, pyrolyzed at 750°C.

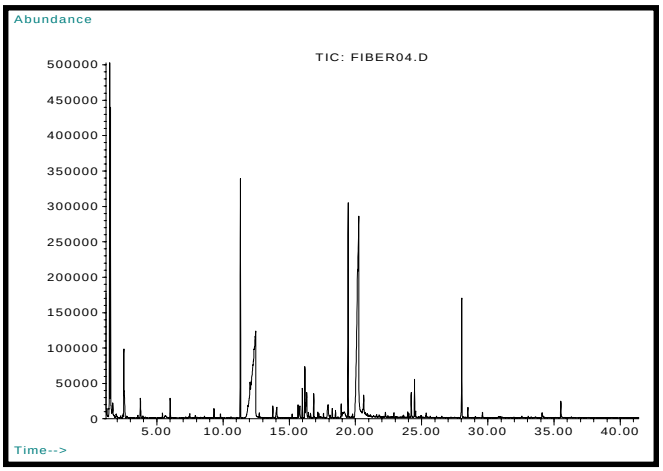

Figure 2. Pyrogram of PET pyrolyzed at 750°C.

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:

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.

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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