

Gas Chromatography

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A PerkinElmer Co-marketer

Pyrolysis of Switchgrass at Elevated Pressure

Plant materials like switchgrass, straw and wood are composed of two important biopolymers - cellulose and lignin. Cellulose is a polysaccharide made from glucose, while lignin is a complex aromatic polymer with considerable phenolic functionality. Each of these biopolymers produces characteristic pyrolysis products, with cellulose generating a series of substituted furans and levoglucosan and lignin producing phenolic products. A natural material containing both lignin and cellulose will produce both sets of products in the pyrogram.

Figure 1 shows pyrograms at low pressure (10 psi) and elevated pressure (400 psi) for a sample of switchgrass. Each run contains typical components like levoglucosan (shown in the lower run) from cellulose, and vinyl methoxyphenol (shown in the upper run) from lignin. There are considerable differences between the two runs, as shown in Figure 2, which expands the region from 5 to 8 minutes. The run performed at 400 psi now reveals more aromatic structures, including the phenol and the methyl phenols shown.

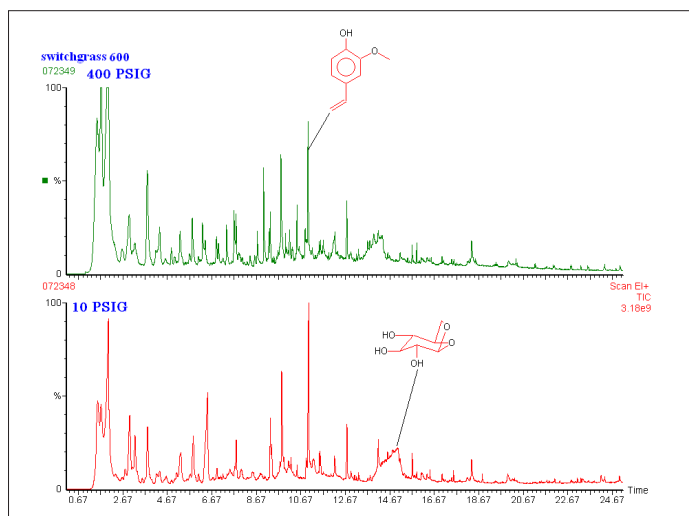


Figure 1 - Switchgrass at 600 °C, high pressure (top) and low pressure (bottom).

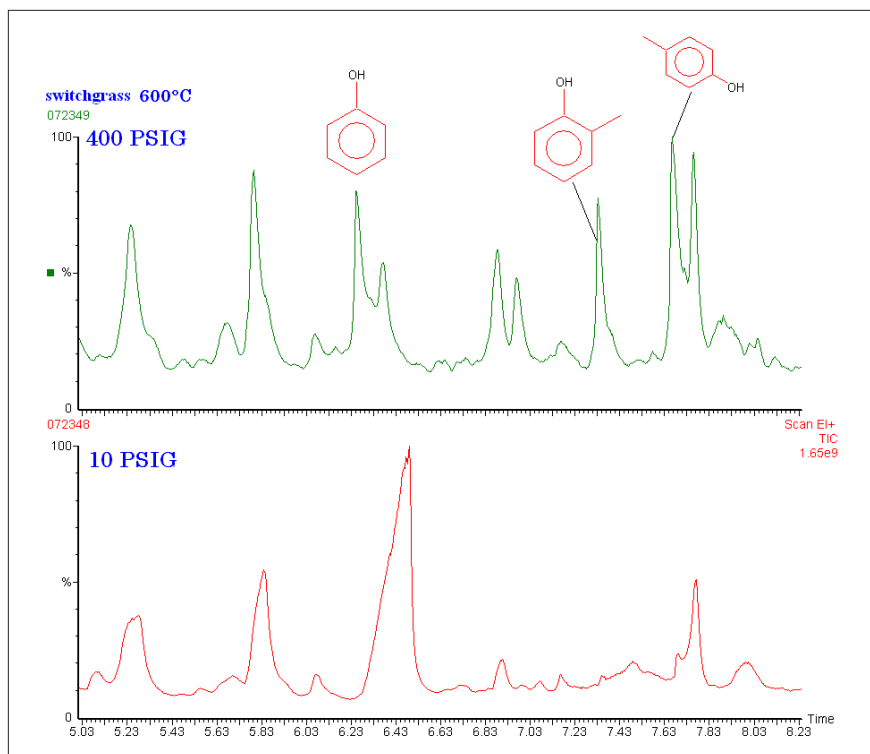


Figure 2 - High pressure (top) and low pressure (bottom), expanded.

These samples were pyrolyzed at 600 °C using a Pyroprobe 5200 in the trap mode, equipped with a back-pressure regulator. The sample chamber pressure was held at 400 psi during pyrolysis, with the pyrolysate passing first through the pressure regulator and then through the trap. The trap permits analysis at a pressure different from the GC pressure, and even in a different atmosphere (for example, air) if desired. The trapped analytes were then thermally desorbed to the gas chromatograph at normal GC inlet pressure for the analysis.

INSTRUMENT CONDITIONS

PerkinElmer Clarus® GC/MS

Column: 30 m X 0.25 mm 5% phenyl
 Carrier: Helium
 Injector: 350 °C
 Split: 100:1
 Program: 40 °C for 2 minutes, 10 °C/min to 300 °C/min
 Mass Range: m/z 35 – 600

CDS® Pyroprobe 5200 HP-R

Interface: 300 °C
 Valve Oven: 300 °C
 Transfer Line: 325 °C
 Temperature: 600 °C
 Time: 60 seconds
 Interface Time: 5 min

FOR MORE INFORMATION

Thermal transformation of pine wood components under pyrolysis/gas chromatography/mass spectrometry conditions, M. E. Arias et al., J. Anal. Appl. Pyrolysis 77 (2006) 63-67.

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