Pyrolysis of Switchgrass at Elevated Pressure

Application Note
Energy

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Plant materials like switchgrass, straw and wood are comprised 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 making 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 and elevated pressure (400 psi) for a sample of switchgrass. Each run contains typical components like levoglucosan (shown in lower run) from cellulose, and the vinyl methoxyphenol (shown in the upper run) from lignin. There are considerable differences in 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 phenol and the methyl phenols shown.

These samples were pyrolyzed at 600°C using a Pyroprobe in trap mode, equipped with a back-pressure regulator. The sample chamber pressure was held at 400 psi during pyrolysis, with the pyrolysate passing through the pressure regulator and then through a trap. The trap permits analysis at a pressure different from the GC pressure, and even 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

Pyroprobe

Interface:	300°C 5 minutes
Pyrolysis	600°C
Valve Oven:	300°C
Transfer Line:	325°C
Trap Desorb:	300°C 5 minutes
Back Press:	400psi

GC/MS

Column:	5% phenyl (30m x 0.25mm)
Carrier:	Helium, 50:1 split
Injector:	350°C
Oven:	40°C for 2 minutes
	10°C/min to 300°C
Mass Range:	35-600 amu

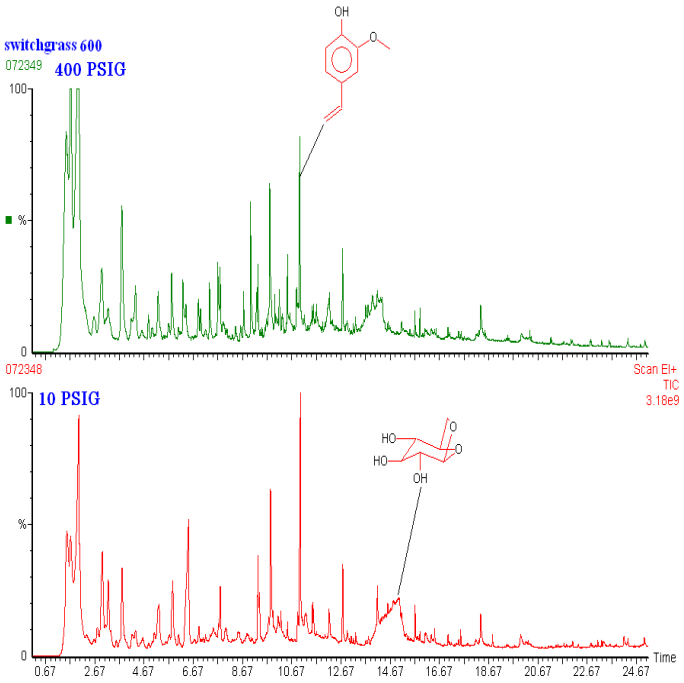

Figure 1. Switchgrass at 600°C, High pressure (top) and low pressure (bottom).

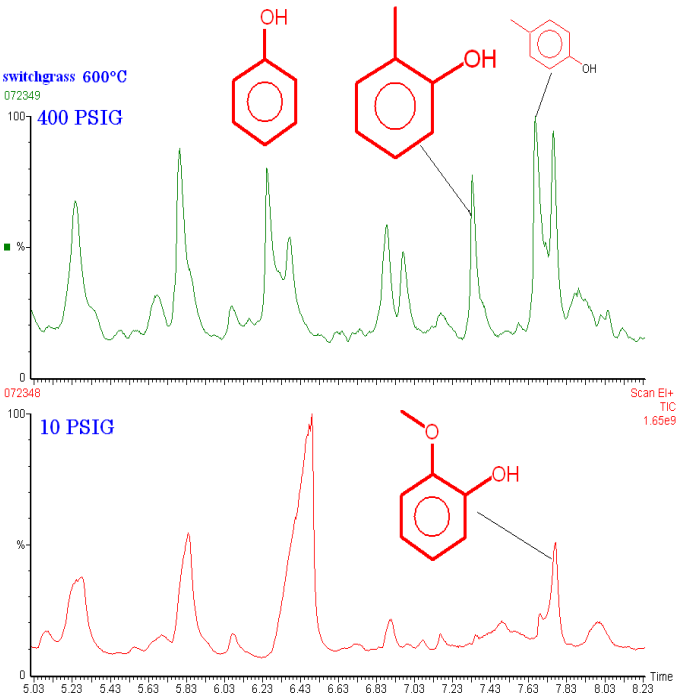

Figure 2. High pressure (top) and low pressue (bottom), expanded.

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

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.