CDS solutions

APPLICATIONS INFORMATION USING ADVANCED SAMPLE HANDLING TECHNOLOGY

Analysis of Gases Produced from the Pyrolysis of Biomass

Most biomass contains both cellulose and lignin, and when pyrolyzed using a capillary GC/MS produces a pyrogram like the one shown in Figure 1. This is a sample derived from pine wood, and the pyrolysis products include compounds from cellulose, like acetic acid and levoglucosan, and phenolics from the lignin such as methoxy phenol and vanillin (see Table 1 on the back).

Both cellulose and lignin produce fixed gases, including methane, carbon monoxide and water, which are difficult to analyze using capillary GC for several reasons. First, they may co-elute as the first peak, making specific identification difficult. Secondly, the masses for such small molecules may not be unique. Mass 28 could indicate nitrogen, carbon monoxide or ethylene. In addition, if a trapping system is being used, to facilitate slow heating, use of a reactor or heating in a reactive atmosphere, the fixed gasses are likely to pass thorugh the trap and be vented instead of being transferred to the GC.

In this analysis, a sample loop was placed after the sorbent trap, which collects the larger pyrolysis products, so that the fixed gases could be collected and transferred to a second GC with a packed column and thermal conductivity detector (TCD). Once the gases are inside the loop, a valve is rotated to flush them to the inlet of the packed column, producing the chromatogram shown in Figure 2. In this way, the effect on the production of these gases caused by changing parameters such as temperature or heating rate can be evaluated.

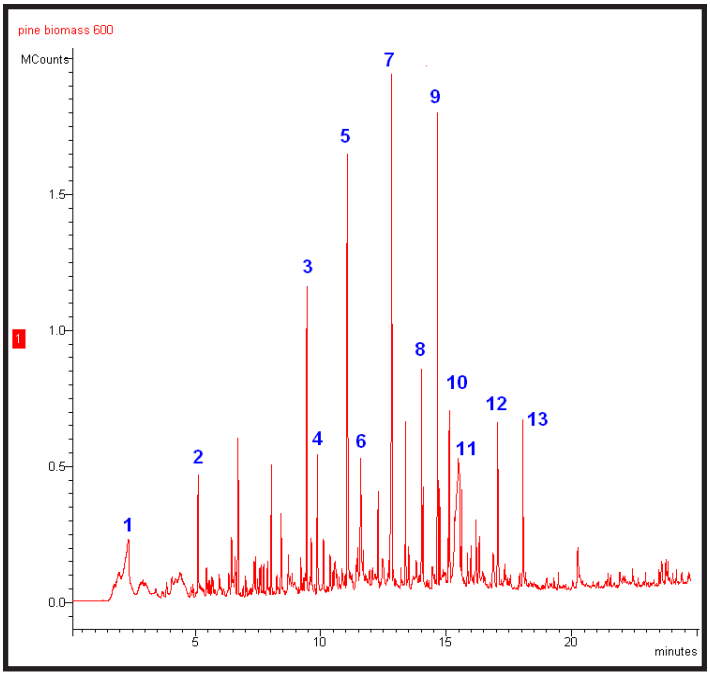

Figure 1. Py-GC/MS of pine wood biomass at 600°C.

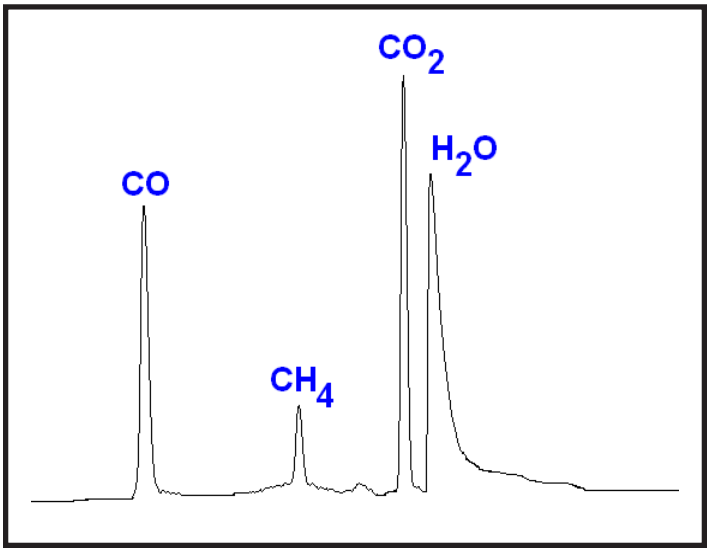

Figure 2. Packed column-TCD analysis of gases from pyrolysis of pine biomass.

ANALYTICAL PARAMETERS

PYROLYSIS

Pyroprobe 5200

Interface:	325°C
Ramp:	10°C/mS
Temperature:	600°C
Time:	15 seconds

CAPILLARY GC/MS

Carrier:	He
Column:	5% Phenyl methyl silicone 30 m x 0.25 mm
Split:	50:1
Program:	40°C for 2 minutes 10°C/minute 300°C for 5 minutes

PACKED COLUMN GC/TCD

Column:	Carboxen 1000, 60/80 mesh 1/4" x 9'
Carrier:	He
Flow:	30 ml/min
Program:	50°C for 4 minutes 30°C/minute 230°C for 8 minutes

TABLE 1

1 Acetic acid
2 Furfural
3 Phenol, 2-methoxy-
4 Levoglucosenone
5 Phenol, 2-methoxy-4-methyl-
6 2-Furancarboxaldehyde, 5-(hydroxymethyl)-
7 2-Methoxy-4-vinylphenol
8 Vanillin
9 Phenol, 2-methoxy-4-(1-propenyl)-, (E)-
10 Ethanone, 1-(4-hydroxy-3-methoxyphenyl)-
11 1,6-Anhydro-á-D-glucopyranose (levoglucosan)
12 Methyl-(2-hydoxy-3-ethoxy-benzyl)ether
13 4-Hydroxy-2-methoxycinnamaldehyde

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

A. A. Boateng, H. G. Jung and P. R. Adler, *Pyrolysis of energy crops including alfalfa stems reed canarygrass and eastern gamagrass,* Fuel 85 (2006) 2450.

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.

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