Using the Gas Chromatograph

Description

A 490 Micro Gas Chromatograph (GC) manufactured by Agilent Technologies was utilized in this research in order to detect gas composition for syn-gas samples generated from the gasification system as shown in Figure 1.

Figure 1: Micro 490 Gas Chromatograph

Gas chromatography is a method to achieve separation of components in gas mixtures based on retention time and to analyze the gas concentration based on peak areas. This model combines a micro-machined injector, Thermal Conductivity Detector (TCD) and a narrow-bore column for injection, separation and analysis of gas sample mixtures. There are two channels in this GC.

1. Channel 1 with the Molsieve 5A column
2. Channel 2 with the PPQ 10m column

During the analysis, Channel 1 is filled with Argon as carrier gas and Channel 2 is filled with helium. The four genie membrane filters installed are for particle and moisture removal as shown in Figure 2.

Figure 2: Genie Membrane Filters

Agilent EZChrom software is used for the instrument control, including checking GC status, reading GC configuration, setting analytical method, data acquisition, and calibration as shown in Figures 3 and 4. After the gas sample is separated into different gas components, EZChrom plots the peaks for each gas component in order of the retention time as shown in Figure 3.

The upper diagram in Figure 3 describes gas concentration in Channel 1 and the lower diagram describes gas concentration in channel 2. For the syn-gas produced from biomass gasification, the peaks of channel 1 are successively hydrogen, oxygen, nitrogen, methane, and carbon monoxide. In Channel 2, the first peak represents all gas components that go through Channel 1 and the second peak stands for the peak of carbon dioxide.

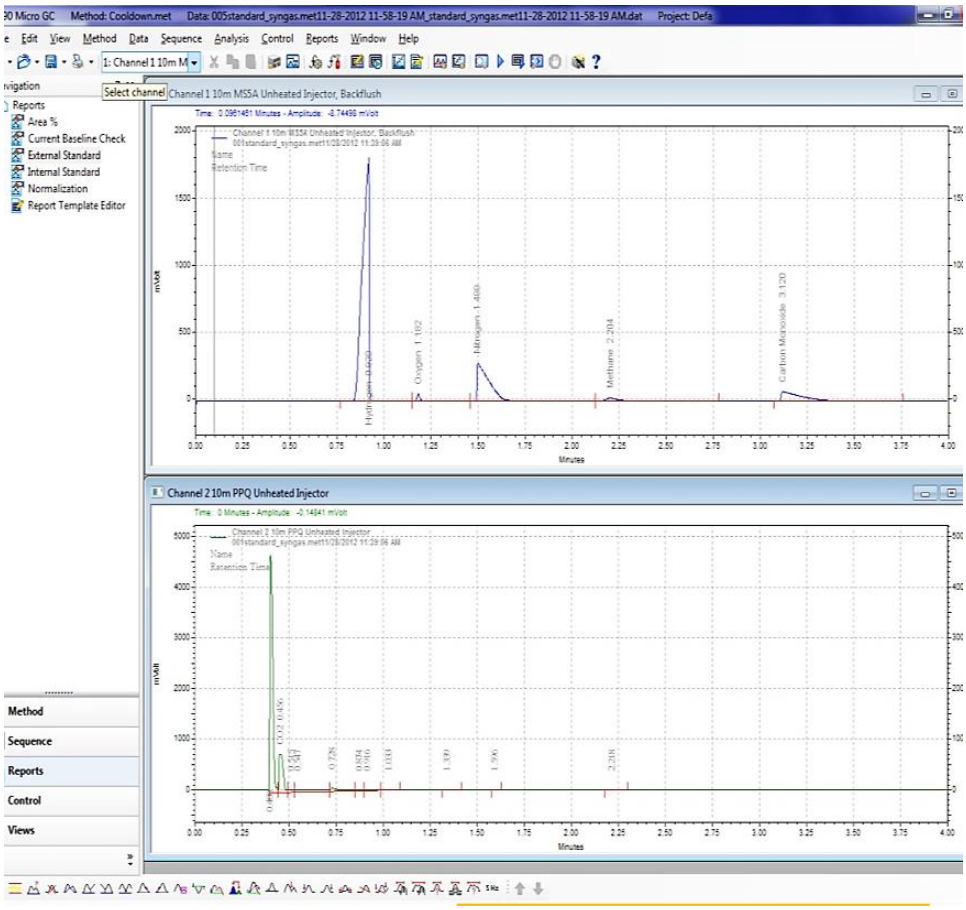

Figure 3: Interface of GC Data Acquisition with the Peak Results

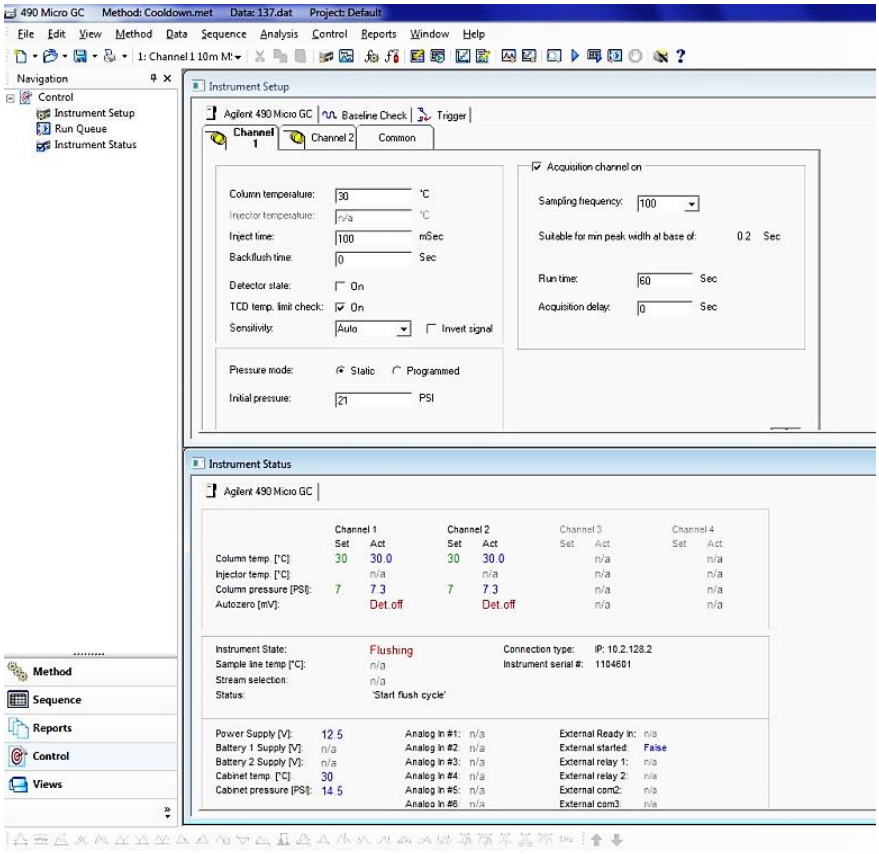

Figure 4: Interface of Instrument Status and Setup

The primary parameter settings for the bakeout, standard syn-gas and cool down methods are shown in Table 1.

Table 1: The GC Setting for Bakeout, Standard Syn-gas and Cool Down Method

	Bakeout		**Standard *syn*-gas**		**Cool down**	
	Channel 1 (Ar)	Channel 2 (He)	Channel 1 (Ar)	Channel 2 (He)	Channel 1 (Ar)	Channel 2 (He)
Column temp. (^{o}C)	180	180	90	100	30	30
Inject time (mSec)	100	100	255	255	100	100

	Bakeout		Standard *syn*-gas		Cool down	
Backflush time (Sec)	0	n/a	0	n/a	0	0
Detector state	Off	Off	On	On	Off	Off
TCD temp. limit check	On	On	On	On	On	On
Sensitivity	Auto	Auto	Auto	Auto	Auto	Auto
Invert signal	Uncheck	Uncheck	Check	Uncheck	Uncheck	Uncheck
Pressure mode	Static	Static	Static	Static	Static	Static
Initial pressure (Psi)	21	21	14	21	21	21
Acquisition channel	On	On	On	On	On	On
Sampling frequency	100	100	100	100	100	100
Run time (Sec)	60	60	240	240	60	60
Acquisition delay (Sec)	0	0	0	0	0	0

Sample gas analysis can be launched after the setting of channel temperature and pressure. Once the GC starts sampling, the sample syn-gas is delivered by the micro-machined injector with corresponding carrier gas, and then sequentially separated by the narrow-bore capillary GC columns and thermal conductivity detector in two channels. The instrument is calibrated by a concentration-known standard syn-gas. On the basis of the calibrated method, EZChrom calculates the sample gas concentration through the peak area, and generates an external standard report to show the percentage of each gas component as shown in Figure 6.

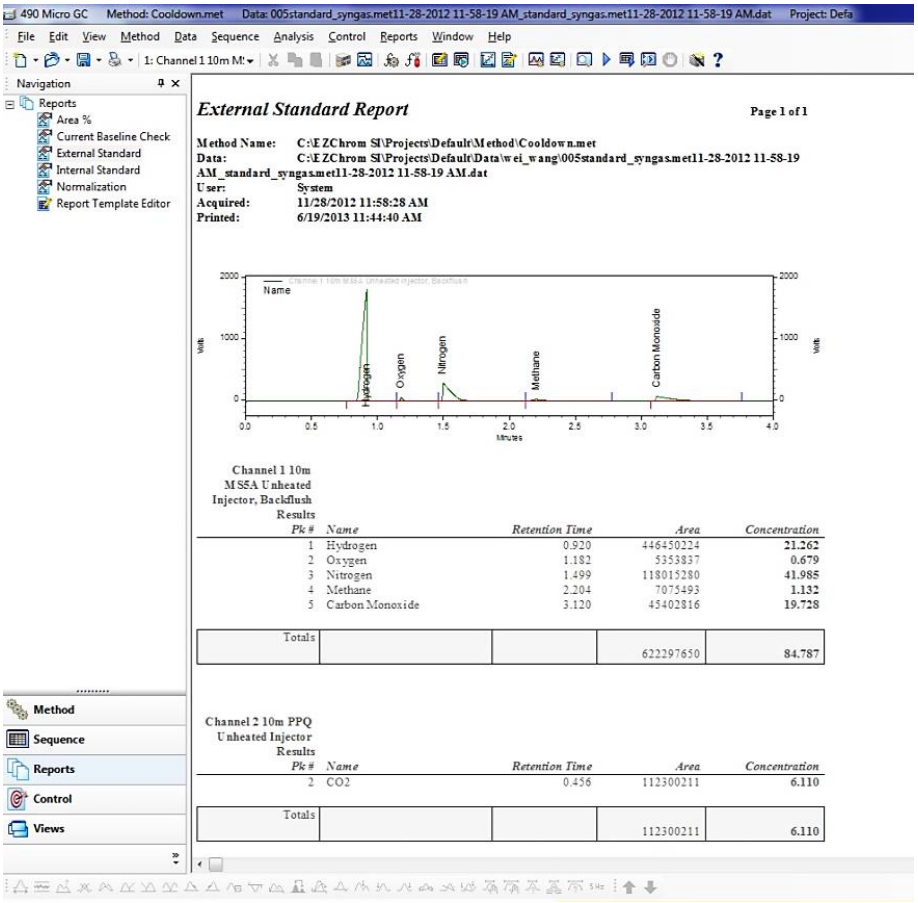

Figure 5: Interface of Sample Gas Concentration Report