

Mud Logging GC

by Advanced Industrial Chemistry

Mud Logging

When drilling for gas or oil, it is common to monitor the cuttings being generated by the drill bit in a process known as mud logging. Often, mud logging also entails analysis of the evolved gases coming from the drilling mud that circulates through the well bore as the drilling proceeds. This gas analysis might be as simple as measuring the total amount of hydrocarbons being evolved from the drilling mud or it might entail monitoring individual hydrocarbons, particularly hydrocarbons below C5.

It is also desirable to measure the amount of CO₂ that is being evolved from the well head. This measurement is less about mapping the well than it is about maintaining the chemical properties of the mud being used.

Mud logging is often accomplished in a small trailer directly adjacent to the drilling rig where space is at a premium. For this reason, it is necessary to accomplish as many of the analytical applications as possible with the smallest overall analytical package. In addition, drilling rigs often move from one drilling location to another and the mud logger needs to be able to rapidly tear down at one location and re-set the instrumentation at the second location. For these reasons, it is essential to have a simple and reliable analytical package capable of being rapidly moved from one location to another in support of mud logging applications.

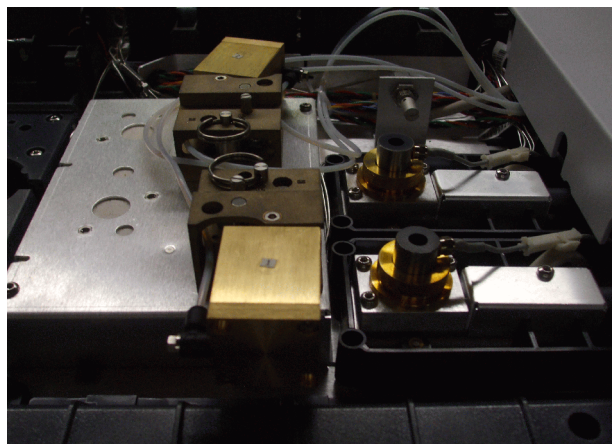
The mud logging G.C.

In order to simplify the set-up and analysis of multiple gas streams being evolved, A.I.C. built a customized Agilent 7890 gas chromatograph (G.C.) that allows the mud-logger to obtain all three of these analysis (total hydrocarbon analysis, speciated hydrocarbon analysis and CO₂ analysis) within the same 1.6 minute time frame.

This three channel system uses one gas sampling valve/column/detector configuration to analyze for the C-1 to C4 hydrocarbons with the balance of the hydrocarbons quantified as a group peak. The second channel of the G.C. is a metered connection between the sample gas coming from the sampling

pump and the second FID detector on the G.C.. This channel provides the total gas value for the gas stream coming from the drilling mud. The third channel in this configuration is another gas sampling valve/column configuration, this time using a thermal conductivity detector, to analyze CO₂ coming from the drilling mud.

Figure 1: Dual FID's on 7890 G.C. for mud logging application



The sampling panel

As noted above, one of the challenges in mud logging is the need to rapidly and efficiently tear down the analysis system, move the analysis, and re-set it in a new location. In addition, it is essential to condition the sample gas coming from the drilling rig in order to ensure that impurities do not reach the G.C. sampling valves and clog up the system. In order to accomplish these tasks, A.I.C. built a custom sampling panel which allows the mud logging personnel to quickly and easily connect the G.C. support gases and the sample gas lines. The sampling panel takes advantage of tubing dimensions and fitting selection to ensure proper connections are made to the G.C. system and to the sampling system from the drilling rig. In addition, the sampling panel has a connection for G.C. compressed air for both the FID's and for the automated gas sampling valves used on the G.C.. This air is also conditioned, in this case with a water trap and a replaceable hydrocarbon trap.

Not shown in the picture is an upstream float trap that will shut off the sampling pump if any liquid is pulled over from the drilling rig. This float prevents liquid mud from reaching any of the critical components in the mud logging G.C. system.

Figure 2: Custom sampling panel installed on mud logging G.C.



Results

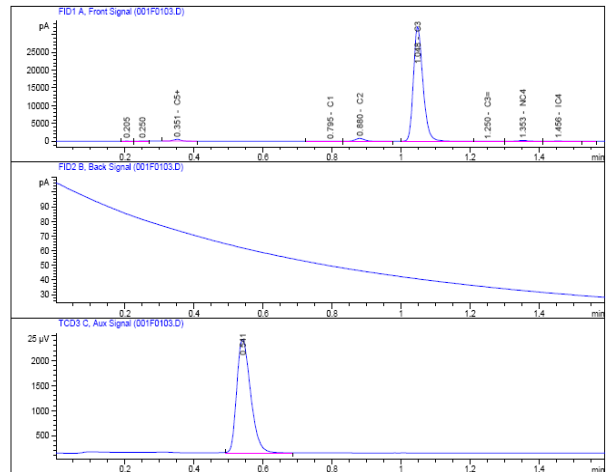
Figure 3 below shows the results of the three channel configuration to a gas challenge of propane. Propane (camp stove gas) is an easy and convenient challenge gas that allows the mud logger to test the sampling system and analytical system all the way from the drilling rig to the G.C. system.

Three channels of data are generated for every analysis. The first channel is a chromatogram of hydrocarbons with the lumped C5+ peak first, followed by the individual C1-C4 hydrocarbons. The second channel is monitoring the total hydrocarbon channel. In this channel the total signal value is calibrated against known amounts of calibration gas to provide a calibration factor which is converted to gas units in a post run macro. No chromatography is performed on this channel. Under the appropriate conditions it is possible to measure shows from as low as a few gas units all the way up to 100% methane at the instrument. The third channel is a chromatogram of predominately sampling pump air pulled from the rig.

This channel is normally predominated by the air peak in appearance except at times of high methane or CO2 shows.

Data acquisition is set up as a sequence in Chemstation with the maximum number of samples allowed in the sequence and up to 99 analysis per "sample." In this configuration, samples are injected every 1.6 minutes.

Figure 3: Data from 3 channel acquisition



Advanced Industrial Chemistry

Advanced Industrial Chemistry has developed methods and built custom G.C. systems for a number of industries including environmental, petroleum, consumer products, and research and development. With over 13 years in the gas chromatography business, A.I.C. offers the experience and the know how to meet customer needs in a cost effective manner.

A.I.C. also manufactures and sells a suite of detectors unique in the chromatographic industry. This includes a helium ionization detector (H.I.D.), and argon ionization detector (A.I.D.), a non-radioactive electron capture detector (E.C.D.), and a photoionization detector (P.I.D.)

Other Applications

Examples of other custom built GC's include:

ASTM Methods such as D3606 or D5580.

Trace gas analysis such as the measurement of fixed gases in UHP products.

Measurement of landfill gas constituents such as hydrogen, CO, CO2 and methane using the DBD HID detector.