Improving Refinery Fluid Catalytic Cracking Vapor Recovery Unit Performance with Process Gas Chromatographs

Process gas chromatographs have been used since the 1950s to provide real-time compositional data to process control systems. Today, there are tens of thousands of process gas chromatographs in use throughout the process industry making the gas chromatograph the analytical workhorse for online compositional measurements. One example of how process gas chromatographs are used for improving process operations can be found in the fluid catalytic cracking vapor recovery unit in a refinery.

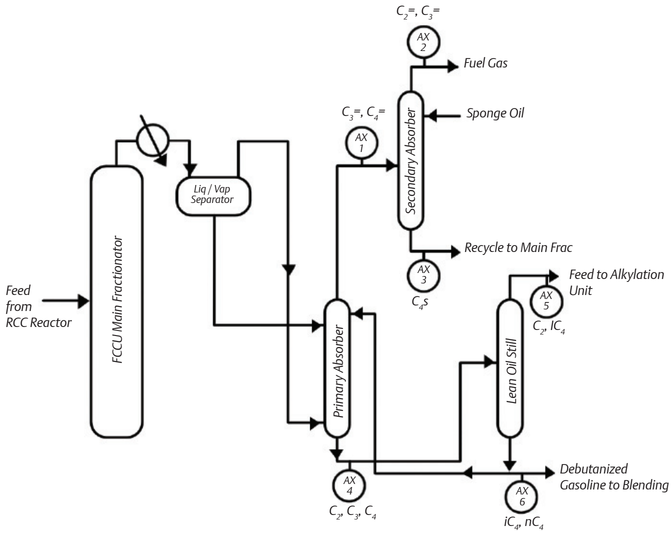
A number of processes in the refinery are devoted to improving the octane value of various petroleum streams such as within the alkylation unit. Unfortunately, the alkylation unit requires a source of butenes that is not typically found in refinery petroleum streams. One source does exist however, and that is the light gases generated by the fluid catalytic cracking (FCC) unit. So, many refineries recover butenes (and other olefins) from the light gas vapors leaving the main fractionator of the FCC unit.

The FCC Vapor Recovery Unit

The feed to the FCC vapor recovery unit is the light gas stream leaving the overhead of the main fractionator (see Figure 1). This stream is cooled enough to cause some of the components to turn to a liquid before it enters a vapor-liquid separator. The vapor and liquid enter a primary absorber at different points to create a counter-flow of liquid over the rising vapor. This is also to strip the C_3 and heavier compounds out of the vapor before it leaves the overhead of the absorber and enters the secondary absorber. The secondary absorber provides another opportunity to strip out the C_3 and heavier components from the vapor before it moves on to the fuel gas system.

The C_3 and heavier components from the primary absorber leave the bottom of the absorber and enter a lean oil still. The still separates the C_4 components rich in olefins needed for the alkylation unit from the rest of the stream. The remaining components become a debutanized gasoline fraction that can be used in the blending of gasoline.

Figure 1 - Flow Diagram of a Typical Fluid Catalytic Cracking Vapor Recovery Unit in a Refinery



Improving Fluid Catalytic Cracking Unit Performance with Process Gas Chromatographs

Several opportunities exist for process gas chromatographs to improve the fluid catalytic cracking unit's performance. The first process gas chromatograph (AX #1 in Figure 1) monitors the CO to CO_2 ratio in the flue gas leaving the top of a partial burn regenerator. This ratio is critical to regulating the temperature in the regenerator since high temperatures would damage the catalyst. For Analytical Solutions for "complete burn" regeneration processes, see Application Note CMB_ADS _Power_Optimizing_Catalyst_ Regenration_O2_Probe.

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The last two typical measurement points are the overhead and bottom streams of the lean oil still. The analyzer on the overhead stream (AX #5 in Figure 1) is to help minimize the impurities in the feed to the alkylation unit. The analyzer on the bottom stream (AX #6 in Figure 1) is to help control the amount of butanes in the gasoline stream which controls the gasoline's RVP. A summary of these applications can be seen in Figure 2.

The Emerson Solution

Emerson has a long history of providing process gas chromatographs to the refining industry. Emerson's process gas chromatographs have set the standard for online process measurement by supplying analyzers that are both robust and capable of handling the analytical requirements.

Table 1 - Summary of Process Gas Chromatograph Applications in a Typical Refinery Fluid Catalytic Cracking Vapor Recovery Unit

Analyzer #	Stream	Components Measured	Measurement Objective
1	Primary absorber overhead	C_3=, C_4=	Minimize losses of olefins
2	Fuel gas	C_2= , C_3=	Minimize losses of olefins
3	Secondary absorber bottom	C_4s	Minimize recycling of light gases
4	Primary absorber bottom	$C_2 C_3$, C_4	Minimize light gases in feed to alkylation unit
5	Lean oil still overhead	C_2s, iC_4	Reduce impurities in feed to alkylation unit
6	Lean oil still bottoms	iC_4, nC_4	Monitor Butane content to keep gasoline in RVP

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