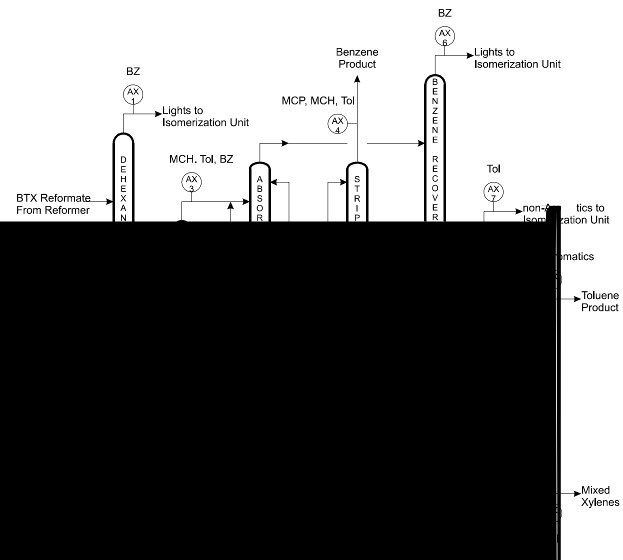
Improving Refinery Aromatics Separation Unit Performance With Process Gas Chromatographs



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 on-line compositional measurements. One example of how process gas chromatographs are used for improving process [redacted] th[redacted] first [redacted] xylenes[redacted] The seco[redacted] aromatics ga[redacted] Environmental [redacted] requirements. Fo[redacted] is to separate the va[redacted] product streams rather t[redacted]

[redacted]tics

The Aromatics Separation [redacted]

The reformate product stream from [redacted] unit is the feed to the aromatics sepa[redacted] shown in Figure 1, reformate typically e[redacted] dehexanizer tower that removes the light p[redacted] compounds in the reformate. The compounds [redacted] removed are predominately C_5 and C_6 paraffins t[redacted] then sent to the isomerization unit for further proces[redacted] The bottom stream from the dehexanizer then goes to [redacted] the benzene tower.

At the benzene tower, the benzene and lighter components are sent to an absorber-stripper section that separates the benzene from the lighter components. Any light compounds that leave the absorber are sent to a benzene recovery tower where one last attempt is made to recover benzene from the stream. The light compounds eventually leave the top of the benzene recovery tower and go to the isomerization unit. The benzene product stream exits the top of the stripper column.

While the benzene is being purified, the stream leaving the bottom of the benzene tower enters a different set of absorber-stripper columns to separate the non-aromatic [redacted]s [redacted]luene [redacted]r any [redacted]atics [redacted]ve to [redacted]ght run [redacted]tower [redacted]eavier [redacted]

Impro[redacted]Gas Chroma[redacted]

A number of o[redacted]s chromatographs [redacted]on unit performance. [redacted]g the performance of the [redacted] overhead stream, a proce[redacted]AX #1 in Figure 1) monitors any be[redacted] minimize the loss of aromatics. A second process gas chromatograph (AX #2 in Figure 1) monitors the bottom stream for methylcyclopentane (MCP) and benzene. The control system calculates the MCP-to-benzene ratio to control the amount of MCP in the final benzene product.

A third process gas chromatograph (AX #3 in Figure 1) monitors the overhead streams in the benzene tower. This overhead stream is monitored for other impurities that could end up in the benzene product stream by measuring the methylcyclohexane (MCH), toluene and benzene. The MCH and toluene is ratiod to the benzene level to control how much of these impurities end up in the benzene product.

The final benzene product is monitored with a process gas chromatograph (AX #4 in Figure 1) to verify the product purity by measuring the MCP, MCH and toluene. To insure that the maximum amount of benzene is recovered as product, a process gas chromatograph (AX #5 in Figure 1) measures for benzene concentrations in the overhead streams of the benzene recovery tower.

The bottom streams of the benzene tower are monitored using a process gas chromatograph (AX #6 in Figure 1) for the benzene to toluene ratio to control the amount of benzene that would end up as impurity in the final toluene product stream. Another gas chromatograph (AX #7 in Figure 1) monitors the actual toluene product for common impurities such as benzene and C_8+ aromatics. There is also a process gas chromatograph (AX #8) on the toluene recovery tower overhead to minimize the loss of toluene into the non-aromatics.

Finally, there is often a gas chromatograph (AX #9 in Figure 1) on the mixed xylene stream to minimize the loss of toluene.

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 on-line process measurement by supplying analyzers that are both robust and capable of handling the analytical requirements.

Analyzer #	Stream	Components Measured	Measurement Objective
1	Dehexanizer overhead	BZ	Minimize losses of benzene
2	Dehexanizer bottoms	MCP, BZ	Provide MCP-to-BZ ratio to control MCP in benzene product
3	Benzene tower overhead	MCH, BZ, Tol	Provide MCH+Tol to benzene ratio to control impurities in benzene product.
4	Benzene product	MCP, MCH, Tol	Monitor benzene product purity
5	Benzene recovery overhead	BZ	Minimize losses of benzene
6	Benzene tower bottoms	BZ, Tol	Provide BZ-to-Tol ratio to control BZ in toluene product
7	Toluene product	BZ, C_8 Arom.	Monitor toluene product purity
8	Toluene recovery overhead	Tol	Minimize losses of toluene
9	Mixed xylenes product	Mixed Xylenes	Minimize losses of toluene

Legend:
BZ = Benzene
Tol = Toluene
MCP = MethylCycloPentane
MCH = MethylCycloHexane
C_8 Arom = C_8 Aromatics

Figure 2 - Summary of Process Gas Chromatograph Applications in a Typical Refinery Aromatics Separation Unit

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