

Optimizing your HF alkylation process with on-line acid monitoring



An important activity in the optimization of the HF alkylation process is the analysis of recirculating acid. This is normally achieved by taking off-line samples and conducting laboratory analyses on a periodic basis. There are, however, a number of problems associated with this approach.

- Sample collection and subsequent analysis of the acid is hazardous as exposure to HF acid can cause severe burns and respiratory problems.
- Conventional laboratory methods for HF, water, and especially for ASO are traditionally imprecise, making process decisions on the basis of these results difficult.
- The analysis is usually only carried out from one to five times a week - too infrequent for control purposes.
- Because the analysis takes several hours to complete, the data is often out of date when made available to the process operator or control engineer. This makes it difficult to relate process changes to HF catalyst composition.

Improve safety and optimize process control

The ABB HF Alkylation Process Acid Analyzer is an FT-NIR based process analyzer that offers a reliable solution to the problems faced by HF alkylation operators. This is achieved by the on-line analysis of the circulating acid stream

every 2 minutes, providing accurate catalyst composition in terms of HF, ASO and water content. This improves personnel safety, process control, corrosion monitoring and catalyst efficiency. A reliable, fast, on-line measurement method for HF acid has long been sought after by operators of these units.

Preconfigured and expandable

The analyzer comes pre-configured with the following measurement capabilities:

HF	80 - 100 wt%
ASO	0 - 15 wt%
Water	0 - 5 wt%

Additional measurements can be implemented using existing sample handling systems, such as monitoring the moisture content of the HF alkylation process equipment during the drying cycle at startup (0-1000 ppm).

Other HF alkylation process streams can be characterized using additional sample handling systems, including:

Stream	Properties
iC4 makeup	Purity, i/o ratio, H ₂ O
olefin feed	Purity, i/o ratio, H ₂ O
iC4 recycle	C ₃ /nC ₄ ratio
nC ₄ sidedraw	iC ₄ , C ₃ /nC ₄ ratio
alkylate	RON, RVP
propane	HF breakthrough

Excellent repeatability

The repeatabilities associated with conventional laboratory techniques for HF, ASO and water measurement are poor. This is due to problematic sampling and inherent difficulties in the analysis methods. In contrast, the results provided by the ABB HF Alkylation Process Acid Analyzer are excellent.

The lab method for ASO is particularly problematic and can commonly report a lower ASO content than is obvious from mass balance considerations. This is because the lab method can overlook light ASO due to loss of lighter components during sample handling.

Benefits of using the ABB HF Alkylation Process Acid Analyzer

- Reduced personnel exposure to HF acid
- Reduced need for off-line acid analysis
- Reduced costs associated with lab sampling
- Provides essentially real-time characterization of the acid catalyst
- Maximizes octane barrels by optimizing the quantity and quality of alkylate through real-time process control
- Reduces frequency of having to pull charge
- Detects and prevents acid runaway conditions
- Maximizes alkylate octane by safely increasing water content while mitigating corrosion
- Detects feed impurity problems with on-line ASO measurement
- Optimizes acid regeneration using on-line ASO measurement

Analyzer	Conventional Lab Methods
HF ± 0.10%	HF ± 2.7%
ASO ± 0.10%	ASO ± 5.5%
Water ± 0.03%	Water ± 0.15%

Repeatability (expressed as an absolute weight percent basis, 95% confidence limits)

The ABB HF Alkylation Process Acid Analyzer reports total ASO, including both light and heavy components. The process engineer can therefore be sure that all of the ASO has been accounted for and process decisions can now be made, with full confidence, on a real-time basis.

Remote monitoring, multiple sample points

The HF acid sample is analyzed using fiber optic cables connected to a remote sample handling system. This allows the analyzer to reside in a location outside the plant battery limits and means that the dangers of lengthy sample transport are eliminated.

The analyzer is capable of monitoring up to eight remote sample cells. This allows the system to be expanded to measure other process streams such as the acid rerun overhead by simply adding additional sample handling systems connected to the analyzer by fiber optic cables.

An analyzer developed in partnership with the refining industry

ABB began working with the Phillips Petroleum Company (now ConocoPhillips) to develop an on-line acid analysis system in 1996. Two years of testing and development on HF Alkylation pilot scale units followed. This included sample system design, metallurgy considerations and calibration model development. The analyzer was then installed, in May 1998, at the Phillips Petroleum Refinery in Sweeney, Texas, and has been running ever since.

This application is patented by ConocoPhillips, and ABB is the only vendor in the marketplace with permission to sell this technology.

Although the ABB HF Alkylation Process Acid Analyzer was primarily developed upon a ConocoPhillips alkylation process, the intrinsic nature of the FT-NIR technique means that it is also entirely applicable to UOP licensed units for the measurement of HF, ASO and water.

The ABB HF Alkylation Process Acid Analyzer is quickly becoming a standard piece of safety equipment at refineries around the world. It is not surprising that industry-leading refining companies have already adopted this analyzer as a "best practice."

ABB has been manufacturing FT-IR spectrometers and accessories since its founding in 1973. By intensive research and development activities, and through a close partnership with our clients, we have developed a unique expertise in quantitative analysis using FT-IR and FT-NIR technology. As a result, we are now the world leader in FT-IR and FT-NIR process analyzers.

Robust sample handling system designed for safety and efficiency

- A flow rate of only 20 cc/minute is required for analysis. This allows for a very low sample inventory in the system.
- An HF gas sensor can be included to detect sample leakage inside the sample cell enclosure. A beacon light is activated and the sample handling system is automatically isolated from the process if any HF gas is detected.
- In installed units, the sample handling system has remained plug-free in over six years of operation.
- All wetted parts of the sample handling system are composed of Monel, Hastelloy-C, Teflon®, Kalrez®, and sapphire. A sample handling system composed of all Hastelloy-C metallurgy for HF-wetted parts is available as an option.

Customer support and training

ABB will work in close partnership with you to develop customized solutions that meet your specific needs. We offer a wide range of customer support services, including method development, in-house and on-site personnel training, as well as start-up and after-sales service.

Contact ABB and let us help you optimize your HF Alkylation Process.

Visit us at:

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