ABB MEASUREMENT & ANALYTICS | APPLICATION NOTE

Optimize refinery hydrotreating & catalytic reforming

Using fast on-line simulated distillation GCs PGC5009 fast gas chromatograph

The advantage of on-line fast simulated distillation.

Measurement made easy

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Industry | Refining
Improve your control strategies.

The challenge

Improving profitability requires refiners to reduce the impact of market price volatility and product environmental compliance requirements by adopting better control strategies. Better control strategies enable refiners to handle a wide range of feedstocks while maintaining smooth operations and intermediate product qualities, both key to sustainable margins and reliable operation. Most traditional process and lab gas chromatographs as well as D86 distillation devices do not provide the required fast and reliable measurement feedback due to long cycle times and poor repeatability.

The ABB PGC5009 fast on-line gas chromatograph answers the challenge by providing superior process chromatography for simulate distillation in less than 5 minutes. Fast, accurate and repeatable measurement results mean highly effective process control with paybacks measured in weeks and profits measured in millions.

The case

The major product of refineries is fuel for spark ignition engines. Small increments in the profit margin by improving operations is significant because of the large volumes produced. Intermediate streams from the initial crude oil distillation are used to provide feed to process units.

Catalytic reforming is a major conversion process in petroleum refinery and petrochemical industries. The process converts low octane naphthas into higher octane reformate products for gasoline blending and aromatic rich reformate for aromatic production. Hydrotreating is an important step to remove unwanted sulfur from streams that are used as feeds to some refinery units. Catalytic reforming and isomerization are examples of refining processes that require low sulfur feeds. The catalyst in these processes are platinum based and sulfur compounds are catalyst poisons. Controlling the feed distillation properties enable control on not only the product properties but also the monitoring of the sulfur compounds. Intermediate streams used to feed hydrotreater do not have a uniform amount of sulfur compounds across their boiling point range as well as the sulfur compounds in the stream may not be equally easy to remove in a hydrotreater. These stream properties lead to developing effective control strategies that are strictly connected to refining margins. In addition to advanced control strategies, enabling better control is also a primary factor, which aims to maintain stream and/or product properties during upset conditions and during changes in feeds and changing to different products.

The fast SIM DIS process gas chromatograph

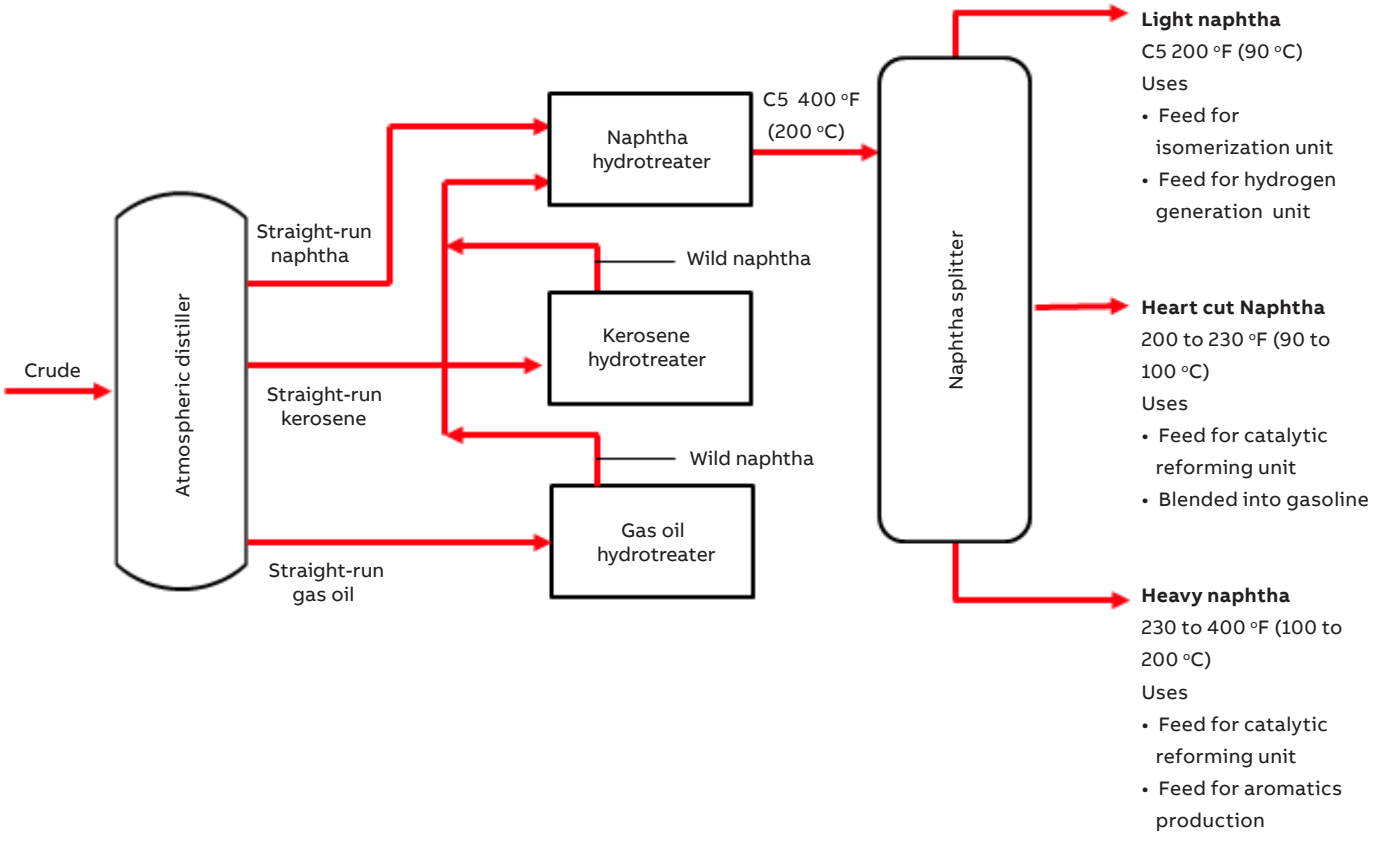
Fast cycle times, set between 3 to 4 minutes

The strategy
Control of the stream's boiling range is needed to maintain feed and product specifications as well as exclude sulfur compounds that are difficult to remove as to maximize efficiency. For units such as catalytic reformers, assuring a low sulfur feed from the naphtha hydrotreatment is essential to maintaining high unit conversion and acceptable catalyst activity. In addition, depending on the type of product to be made, distillation control is essential to monitoring the amount of benzene and/or other aromatics in the product to meet regulatory specifications. As the market changes, a reforming unit can improve profitability by shifting the product made between feeds for a chemical plant or fuel blending component. At the heart of this strategy is good distillation control for the catalytic reformer feed, at the atmospheric distillation tower and for the reformer product, at the naphtha splitter.

The past
Traditional D-86 physical distillation process analyzers and on-line simulated distillation (SIMDIS) have been applied to determine the boiling point distribution for process streams ranging from gasoline components to diesel base stocks. Unfortunately, the conventional technologies are not fast enough to update readings as needed for effective feedback / feedforward control. Depending on stream composition, cycle time can be 35 minutes or longer.

The solution
The The PGC5009 has a patented design, which allows users to obtain a complete stream distillation profile, from the initial boiling point (IBP) to the final boiling point (FBP), including the intermediate points, providing data correlated to ASTM 3710 and ASTM 2887 and with cycle time respectively of 240 and 180 seconds. The fast output of the technique allows the users to extract a much higher and accurate information from a stream compared to traditional technologies.

Feeds to naphta hydrotreater unit and naphtha splitter



The benefits
Allowing for instance the exclusion of hard to desulfurize compounds from the feed, the hydrodesulfurization units can run under less severe conditions, which can extend catalyst life and run length. The refiner benefits from applying the PGC5009 in control strategies that extract the most economic benefit from existing assets. In addition, some hydrotreated streams can in principle be separated as to hydrotreat only the portion that contains the sulfur bearing components. This approach is only applicable when the refiner has excellent cut point measurement and control. The benefit is the ability to increase hydrofiner capacity, by not treating the portion of the feed that does not have the sulfur, effectively reducing the flows needed in the hydrofiner.

Process streams such as the fluid catalytic cracker naphtha can also benefit from the same strategy, where the sulfur compounds are concentrated within a narrower boiling range than the boiling range of the stream.

Other important applications include the ability to better control unit product specifications during events such as a heavy rain that affects distillation tower heat balance or a change in feed and/or product specifications. Feedforward control can minimize the impact of feed changes by adjusting unit variables to new set points in anticipation of the change.

The separation of components and products in a refinery is mostly done by distillation columns. To maintain profitability it is important to have good distillation control, which is only possible by using analyzers that quickly respond to compositional changes. The PGC5009 uniquely provides the fast and repeatable measurements needed to implement tight control strategies that improve margins.

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The PGC5009 fast gas chromatograph

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