Success Story

Honeywell

Marathon Ashland Achieves Record-Setting Throughput for FCC

"The FCC unit began setting new record throughput rates. This means a lot for the bottom line and our 2005 STP performance. The recent changes in unit performance can be attributed to teamwork in deploying a fancy mathematical model-based advanced control program."

Marathon Ashland Petroleum LLC, Catlettsburg Refinery Newsletter, May 27, 2005

Benefits

A large-scale model predictive controller using Honeywell's Profit Controller software was recently commissioned on a Fluidized Catalytic Cracking (FCC) unit at the Marathon Ashland Petroleum Catlettsburg Refinery in Catlettsburg, Kentucky.

Based on analysis of operating data, the feed rate to the FCC unit has been increased by some 5 percent. The higher unit throughput has been accomplished at a higher reactor severity resulting in higher conversion and increased gasoline yields. The model-based controllers also helped to improve and stabilize the main fractionator and gas plant operations. Product yields and qualities are being controlled more closely to specification and the stripper is being operated closer to its limits as evidenced by the presence of C2 in the stripper bottoms product. An online C2 analyzer for the stripper bottoms was instrumental to operating the stripper closer to its operating limits.

Keys to the project's success include the collaborative effort between refinery personnel and Honeywell's expert Advanced Process Control (APC) engineers, Honeywell's Profit® Controller, based on Honeywell's patented Robust Multivariable Predictive Control Technology (RMPCT), and strong support from the Catlettsburg operating and management staff from start to finish.

Challenge

The scope of the FCC advanced control project at the Marathon Ashland Catlettsburg Refinery was focused on improving unit economics and unit performance. The project was to provide advanced control functions to optimize the value of feed, products and operating cost, subject to quality targets or limits, and unit operating constraints.

The project included the combination of three interacting processes under a common control strategy. The gas con (stripper and debutanizer) was combined with the reactor/regenerator and main fractionator into one Profit Controller application. The primary objectives for the advanced control implementation on the reactor and regenerator were to operate the unit safely while pushing the unit severity to constraints with an optimum combination of unit operating parameters. The primary objectives of the main fractionator column advanced control implementation were to maintain target product qualities and to maximize product value subject to constraints. Finally, the primary objectives of the advanced control implementation on the gas plant were to maintain target product qualities and to maximize product value subject to constraints.

The following supporting and inferred calculations were included in the project:

- Naphtha end point
- LCO 90 percent point
- Gasoline RVP or C4-
- Debutanizer overhead C5+
- Stripper bottoms C2
- C3/C4 splitter overhead C4

Inferred properties were developed and implemented with the use of Honeywell's Profit Sensor Pro modeling package.

Solution

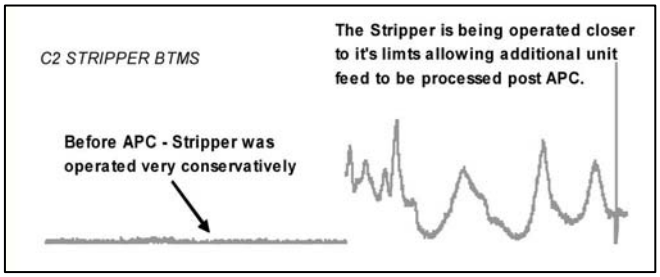
The main objectives for the FCC advanced control application were to maximize the feed rate, maximize the conversion, minimize the unit pressure and maximize naphtha 98 percent. The implementation of the APC strategy reduced the variability in the product quality, maximized LCO 90 percent, and improved and stabilized unit operations, particularly for the gas con stripper.

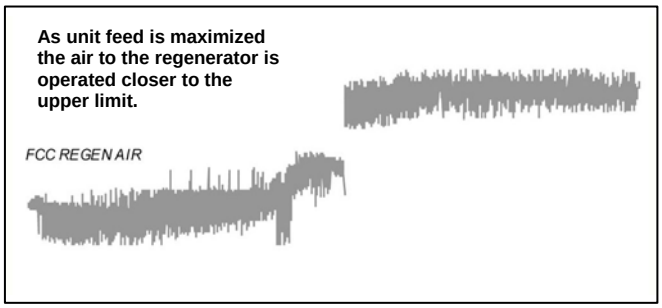
FCC units provide significant advanced control benefits because of the large product upgrades, expensive operating costs and difficult multivariable interactions. Profit Controllers are used in these applications for online control and economic optimization. This advanced algorithm minimizes tuning requirements and maintains good control under changing conditions and model error.

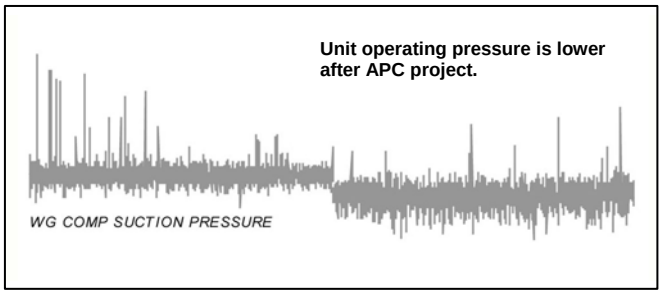
Model identification is available in the Windows environment. These reactor/regenerator controls can be dynamically integrated with the FCC main fractionator and gas concentration unit controls by using an upper-level Profit Optimizer, which also uses RMPCT algorithms. These controls also are applicable to resid on cracking (RCC) units. In addition, Profit Bridge can be used in conjunction with rigorous kinetic models to update reactor yield gains when significant feed quality or economic changes are present.

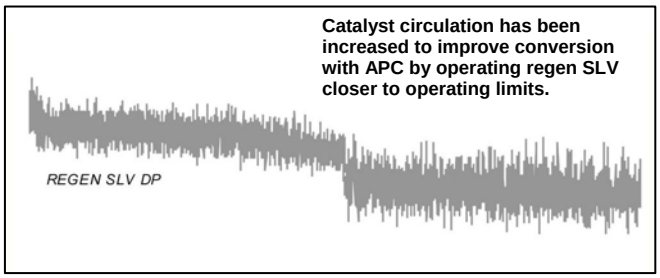
Strategy. The Profit Controller built-in optimizer is configured for reactor product value optimization and/or feed maximization. Nonlinear control and optimization are provided when Profit Bridge is used to update the reactor yield gains.

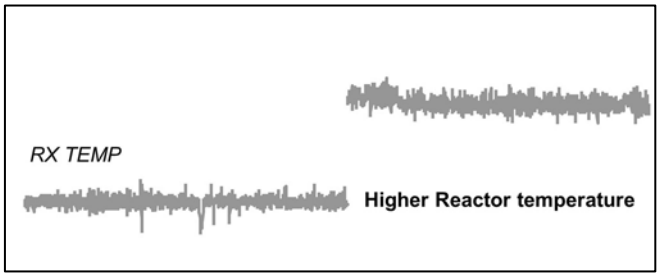
Regenerator carbon balance, reaction severity and throughput are controlled by adjusting feed and combustion air rates, regenerator and reactor pressures, the catalyst cooler and riser temperature to maximize production of higher value products within operating limits. The controls utilize measured or predicted product rates and calculated catalyst flow.











Controlled variables may include:

- Flue gas %O2
- Regenerator dense phase
- Flue gas %CO temperature

Constraints considered may include:

- Regenerator temperatures
- Reactor/regenerator delta-pressure
- Catalyst-to-oil ratio
- Conversion
- Slide valve limits
- Catalyst cooler duty
- Slide valve differential pressures
- Main fractionator lower tray temperature
- Main fractionator level
- Wet gas compressor suction pressure

Conversion. Catalyst flow and product yield calculations are based on operating conditions with feedback from measured values. These calculations are performed using standard toolkits that provide a user-friendly collection of configurable programs. The toolkit calculations may be based on a rigorous kinetic model. A rigorous kinetic model may also be used to determine optimum operating targets for online optimization.

Economics. Based on numerous process surveys, typical benefits range from 4¢/bbl to 40¢/bbl of fresh feed and up to a 5 percent increase in throughput with typical payback from 6 to 12 months.

Commercial installations. Controls have been implemented on 67 FCC and RCC units. Rigorous online model optimization has been implemented on more than 10 units.

For More Information
To learn more about Profit Controller, visit www.honeywell.com/ps or contact your Honeywell account manager.

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