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FORGE**

PROCESS SOLUTIONS

Bharat Petroleum Improves Quality,
Increases Yields, Cuts Costs with
Honeywell Forge Advanced Process Control

Case Study

"Honeywell Forge Advanced Process control's Multivariable Controller and Soft Sensors Enabled BPCL to Improve Profitability through Increased Production, Reduced Operating Costs, Increased Energy Efficiency and Improved Product Quality"

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BACKGROUND

Bharat Petroleum Corporation Limited's (BPCL) Mumbai Refinery is one of the most versatile and productive refineries in India. The refinery processes about 12 Million Metric Tons in 61 different types of crude making it one of the most flexible refineries in India. In 2011 BPCL embarked upon an aggressive Refinery Modernization Project and optimization of the Diesel Hydro- DeSulfurization Unit and Hydrogen Generation Unit (DHDS/HGU), both of which involved the implementation of Advanced Process Control (APC) strategies. Multiple operating units were included in the modernization project including Crude Distillation, Vacuum Distillation, Naphtha Stabilizer, Hydrogen Generation, Hydrocracker Unit (HCU), and Lube Oil Separation.

CHALLENGE

Petroleum refinery processes are interactive in nature, and precise control is needed as product properties and process conditions change. Profitability in terms of feed throughput and preferential product optimization is also

subject to multiple constraints. Some of the requirements of BPCL included:

- Increasing the throughput of the crude unit and hydrocracker unit.
- Improving the stability of column profiles
- Maintaining reformer Steam -to- Carbon ratio and temperature profile
- Maintaining first and second stage reactor temperature profiles
- Maximizing production of Liquefied Petroleum Gas (LPG) and heavy diesel

Controlling conversion in the hydrocracker was another challenge as LOBS feedstock quality and quantity is dependent on it, and there is a large dead time between the hydrocracker unit's first stage reactor and final waxy yield in LOBS.

The crude distillation column is designed for hot reflux and overhead condensation takes place in two phases. This makes the column pressure and reflux drum level control particularly challenging and is a pre-requisite for smooth functioning of APC. The pressure control becomes very critical in the event of water ingress

or a change in crude quality. The hydrocracking process depends on the quality of the feedstock and the relative rates of two competing reactions -

hydrogenation and cracking - which are non-linear. Prevention of hydrogen venting turned out to be another challenging task.

SOLUTION

The Honeywell Advanced Process Control's Multivariable Controller and Soft Sensors. Honeywell engineering services were deployed by BPCL to design, implement and maintain multiple input/output (MIMO) advanced process control applications in various refinery units. These included Crude Distillation, Vacuum Distillation, Naphtha Stabilizer, Hydrogen Generation, Hydrocracker, and Lube Oil Separation. Based on the patented Robust Multivariable Predictive Control Technology (RMPCT), Profit Controller and Profit Sensor Pro are part of the Honeywell Profit Suite for Advanced Control and Optimization.

In addition to conventional advanced control strategies for maximizing feed throughput and product quality, additional areas of improvement were explored to optimize the processes using RMPCT and Soft Sensors inferential technology. Some examples include:

- Using Soft Sensors, light and heavy kerosene and aviation turbine fuel property inferential were developed.
- A crude oil density analyzer feedback was used in crude column control models for better prediction in crude change scenario.
- An inferential for vacuum residue penetration index was developed for monitoring the same during bituminous crude processing.
- In hydrocracker, viscosity index and percentage un-converted oil predictions were developed to suite the LOBS feed requirements.

- Viscosity analyzers were used for waxy and de-waxed product maximization.
- Furnace pass balances were implemented at crude unit and LOBS where multiple-pass furnaces are used. The pass balance applications are combined with upstream column level control and furnace outlet temperature optimization strategies.
- Dynamic product sulfur inferential was done as part of the DHDS APC project for optimization. Based on the high accuracy of prediction of the inferential, the same has been also

used in solving blending use case. Honeywell Forge Advanced Process Control's Multivariable Controller and Soft sensor combination provides significant process control and optimization benefits by increasing throughput, product yields and product quality in highly interactive industrial processes. In addition, users benefit from greater flexibility in operations and in meeting their process control needs while maintaining robust and safe control. The Advanced Process Control Project at BPCL, Mumbai has improved the dynamic control of the DHDS units

and achieved monetary benefits. These results were accomplished through joint efforts of the BPCL and Honeywell project and engineering teams. The inputs and innovations delivered by the BPCL operational and technical teams were instrumental in overcoming the challenges. Following the engineering and installation of the advanced control systems Honeywell provided comprehensive training, commissioning and startup services that resulted in a successful and timely project conclusion.

RESULTS

The Honeywell Forge Advanced Process Control solution and Advanced Process Control strategies have resulted in tangible and intangible benefits to the refinery as summarized below.

Diesel Hydro-Desulfurization / Hydrogen Generation Units

- Reduced variation in Methane Slippage

- Higher Optimization in Reformer due to reformer Skin Temp inferential
- Reduced Variation in Product Diesel Sulfur resulted in reduction in Fuel Gas requirement in Feed Heater.
- Steam Reduction in Diesel Stripper due to reduction in Product Diesel Flash (Inferential) variation

BPCL documented an overall reduction in both fuel gas usage and steam usage that resulted in significant financial benefits to the operation.

Refinery Modernization Project

Implementation of APC strategies and Honeywell Forge Advanced Process Control resulted in significant reduction in variations in key parameters.

In addition, cost reductions were realized in the Crude, HGU, HCU and Lubricating Oil Base Stock (LOBS) units as audited by BPCL and Honeywell.

For more information

To learn more about Honeywell Forge Advanced Process Control, visit our website hwl.co/advancedprocesscontrol or contact your Honeywell account manager

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