SECCO Maximizes EBSM Unit Profitability with Honeywell’s Optimization Solution

“The APC and optimization solution significantly stabilizes process operation and, by improving operational performance, has achieved remarkable profits.”

-- SECCO EBSM Unit APC and Optimization Performance Report

Benefits

Shanghai SECCO Petrochemical Company Limited (SECCO), founded by China Petroleum and Chemical Corporation (Sinopec Corp.), Shanghai Petrochemical Company Limited (SPC) and BP East China Investment Company Limited, was looking to maximize profitability by improving production capacity and operation efficiency of their recently commissioned ethyl-benzene/styrene monomer (EBSM) plant. The implementation of an advanced control and optimization solution with Honeywell led to the following benefits:

- Increased Styrene Monomer yield by 0.2%
- Increased production capacity when required
- Improved operational efficiency through more stable control
- Improved product quality control

Background

In 2005, Shanghai SECCO PC Ltd. started up a new EBSM unit in Caojing, Shanghai with a production capacity of 500,000 tes per year. SECCO recognized that the styrene market in Asia is very competitive and decided to quickly implement an advanced control and optimization solution to help achieve increased production capacity through stable operation at high rate and at a lower energy cost. They chose Honeywell to implement this project because of Honeywell’s cost effective approach to dynamic optimization and their strong local presence.

Challenges

The Ethyl-benzene (EB) Unit uses the Lummus/UOP EBOne Process which involves the alkylation of benzene with ethylene to yield a mixture of alkylated benzenes and un-reacted benzene. This mixture is distilled to recover ethyl-benzene, while higher alkylated benzenes go through a transalkylation step to form additional ethyl-benzene. Un-reacted benzene is recycled while the ethyl-benzene product is sent to the dehydrogenation section of the styrene unit. Styrene monomer (SM) is produced from the dehydrogenation of ethyl-benzene into styrene and hydrogen. The endothermic dehydrogenation reaction produces side products that are separated in a downstream distillation train from the styrene monomer. Recycle streams within both the EB and SM units, as well as the connections between the units make this process highly interactive. Therefore any improvements in operational stability and production profitability must employ both local advanced control strategies and broader optimization solutions.

SECCO Plant
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Solution

Honeywell proposed a unique combination of model predictive control and integrated dynamic optimization to cover the EB and SM units. Honeywell’s Profit Controller and Profit Optimizer technologies were used to implement the solution. The implementation involved:

- One EB Unit Profit Controller including the alkylation/transalkylation reaction area and the EB distillation area
- One Dehydrogenation Unit Profit Controller including the dehydrogenation area and Steam Superheater
- One SM Unit Profit Controller including the reactor effluent cooling, the offgas compressor and the Dehydrogenated Mixture (DM) distillation area
- The EB/SM Profit Optimizer covering each of the three Profit Controller applications

The EB Unit controller maximizes ethylene feed to the unit subject to reactor constraints. It also maximizes ethyl-benzene yield while controlling purity of recycle benzene and ethyl-benzene in the downstream distillation area.

The Dehydrogenation Unit Controller maximizes feed to the dehydrogenation reactor subject to constraints such as Delta P across the reactor while maintaining constant EB conversion. The controller also minimizes energy consumption in the steam superheater.

The SM Unit controller maximizes the recovery of styrene from the dehydrogenation mixture by controlling key qualities in the EB/SM Splitter, EB Recovery column, the Styrene column and the Thin Film Evaporator.

The Profit Optimizer covers all the three controllers designed for this unit and optimizes the whole EBSM plant. It coordinates the operations in each of the controllers under its umbrella through bridge models and maximizes profitability while handling plant-wide constraints.

Results

The Advanced Control and Optimization project took approximately 12 months to complete. It incorporated a comprehensive execution plan based upon six sigma methodologies. A layered approach included improving the regulatory controls, implementing key inferential quality and control calculations and designing linked multivariable controllers for use within a global dynamic optimizer.

SECCO were able to show significant improvement in EB unit stability, by improved control of the EB unit feed as well as tighter control around the alkylation reactor outlet temperatures. This has increased the effective capacity of this unit.

In addition improved quality control around the styrene monomer distillation section has resulted in increased product recovery by maximizing separation in the EB/SM Splitter. (Figure 2).

More Information

For more information about Honeywell advanced control and optimization solutions, visit www.honeywell.com/ps or contact your Honeywell account manager.

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