

Major Chemical Manufacturer Improves Ethylene Oxide (EO) Selectivity and Extends Catalyst Life by Implementation of DCS-Resident Advanced Process Controls (APC's) and Operator Advisory Tools

EO reactor operation presented the most bothersome control problem in this unit. Because improper reactor operation can lead to conditions in which the reactant concentrations violate explosion limits, the operators tended to run the reactor far away from optimum conditions, resulting in poor EO selectivity and excessive catalyst degradation.

Main Objective

EO operations personnel sought an improved control scheme that would ensure safe reactor operation while maximizing selectivity and extending catalyst life under widely varying process conditions. This manufacturer sought the help of MAVERICK Advanced Automation Solutions personnel to analyze the control problem and design and implement an effective solution.

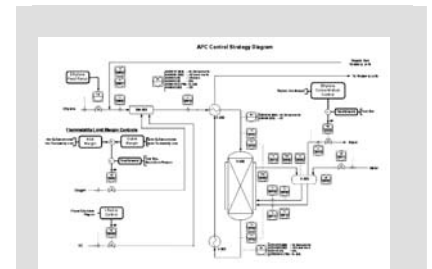
Customer Results

The controls and operator advisory tools were developed in close coordination with the senior unit operations engineer and board operator. The controls were developed in a step-wise fashion; that is, each CV/MV pair was first tested in isolation with all other variables held constant. This led to a true understanding of the characteristics and dynamics of the underlying process, allowing the further inclusion of decoupling to compensate for multivariable interactions. This coordinated MAVERICK/customer effort resulted in dramatically improved reactor operation with measurable improvements in selectivity, reduced recycle, and extended catalyst life. The project exceeded the client's expectations. The controls and tools have now been in place for several years.

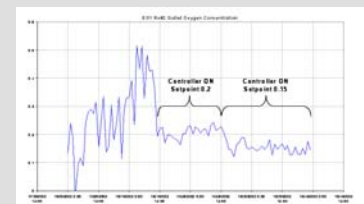
Application Description

The total solution relied on four key applications:

- ◆ **Analyzer Input Validation & Selection:** Real-time process analyzers that measure individual chemical components in the reactor feed and product streams are essential for maintaining stable and optimum reactor operation. This unit was equipped with several analyzers, some of which were redundant. One phase of the MAVERICK solution involved design and implementation of algorithms to validate each input and then choose which set of inputs to use for both closed loop control and for the operator advisory tools.
- ◆ **Inlet and Outlet O₂ Composition Control:** This is a set of constraint controls that adjust the feed O₂ flow rate to maintain either the inlet or outlet O₂ composition near, but outside of, the explosion limits, thereby maximizing reaction selectivity and allowing higher production rates, when called for.
- ◆ **Reactor Optimizer:** Trace amounts of a catalyst promoter are added to the reactor feed to maintain the optimum catalyst activity. MAVERICK first implemented an algorithm which estimates in real-time the concentration of this promoter in the reactor and then designed and implemented a control to adjust the flow of catalyst promoter to maintain its concentration at the optimum.
- ◆ **Catalyst Selectivity Visualization:** Lastly, MAVERICK designed and installed an application that gives the board operators a visual representation of how close to optimum conditions the catalyst is being operated. This provides guidance regarding adjustment of the reactor optimizer target on a day-to-day basis.



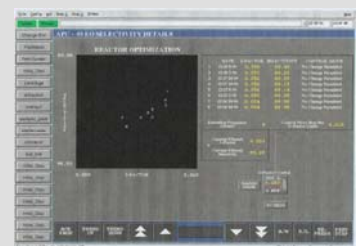
Control Strategy



Control Improvements



Analyzer Feedback



Selectivity Visualization