An inter-olefins plant optimization using Machine learning and Linear Programming techniques

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Abstract

With the increasing market competitiveness and feedstock uncertainity, it is crucial for industries to integrate and utilities their assests in a best possible manner. SABIC's ethylene plants in the Kingdom are interconnected via complex network system allowing for exchange of feed, intermediate and product streams. Such integration provides opportunity for inter-plant/site optimization to maximize overall profitability of our ethylene and derivatives businesses.

An unsteady feedstock and reliability issues usually results into suboptimal utilization of the assests and having a tool which can distribute and optimize the feedstock with optimal operations for each plant will greatly improve site-wide yield & production. It can also address challenges related to feed allocation changes, plant slow-downs/shut-downs etc. Using a fundamental first principle yield model along with LP techniques makes achieving such integration too complex and hard to achieve, especially because of the multivariate non-linearity of ethylene furnaces, and requires high computational time and space.

Our approach hence is to develop a surrogate phenomenological yield models using Artificial Neural Network integrated in Aspen plus flowsheet and optimize using a non linear SQP solver. Statistical software package, JMP, is used to Generate Training data set with Space filling design DOE. This methodology using Machine learning approach reduces the simulation time and enhance model robutness.

In this paper, we present our structured methodology to develop surrogate yield model of ethylene furnaces and demonstrates its application for inter-cracker plant/site revenue optimization, including feedstock planning, furnace optimization and re-routing of cracker intermediate streams. Such optimization has the potential of ~1% improvement of ethylene plants gross profits.