Operation optimization of an industrial naphtha cracking furnace

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Many researchers have studied the operation optimization of ethylene furnaces because the performance of furnaces determines the ethylene yield and it has significant effects on the total profit. However, due to the complexity of naphtha cracking reactions, previous studies for operation optimization have been limited to the ethane and propane furnaces. In this study, the optimization of naphtha furnace operation is performed using the proposed furnace and coking model. For this study, a furnace model including a radiant box and reactor coils was mechanistically formulated with free-radical cracking reactions and coke deposition reactions to obtain the model validity over a wide range of operating conditions.

Using this furnace model, the optimization of the naphtha furnace operation was performed using genetic algorithm and neural networks. In this optimization problem, a profit function was used as the objective function. Here, the decision variables were dilution steam ratio, flow rates of fired fuel and naphtha feed. The optimized operating conditions and the profit value were compared with a set of plant data during 40 days.