Abstract

This thesis exploits a new method for refineries to make most efficient use of hydrogen. Hydrogen is an important utility in the production of clean fuels such as low-sulfur gasoline and diesel. On the other hand, hydrogen is produced as a side product in some processes. Therefore, a hydrogen network is formed in every refinery whose duty is to prepare hydrogen needs of all consumers. The methodology is based upon mathematical optimization of the superstructure of hydrogen network and maximizes the amount of hydrogen recovered across a site. The techniques account fully for pressure constraints as well as the existing equipment and are suited for revamping real, industrial systems. The optimum placement of new equipment such as compressors and purification units is also considered. The methods are illustrated with two industrial case studies, where both operating cost savings and minimum total cost objectives are achieved. The approach in this thesis can account for economic issues such as payback time and capital budgets.

The resulting formulation is an MINLP model which can be solved by conventional methods considering some simplifying assumptions. Otherwise these methods are not suitable to solve this problem. In this thesis an Ant Colony algorithm is proposed for conquering the nonlinear combinatorial problem arising from superstructure model. To ensure all the constraints are satisfied, an adaptive feasible bound for each variable is defined to limit the search space. Adaptation of these bounds is executed by the suggested bound updating rule. Finally, the capability of the proposed algorithm is demonstrated through a case study.

Key words: Refinery, Hydrogen Network, Optimization, MINLP model, Ant Colony Optimization(ACO)