Synthesis for cascade refrigeration system in ethylene production

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Abstract

Refrigeration system occupies an important place in chemical/petrochemical process. The traditional cascade refrigeration system (CRS) used in ethylene plants contains two refrigerants, ethylene and propylene, working at multiple temperature/pressure levels. In allusion to the refrigeration cycle system of ethylene plant, energy use of this system can be analyzed by the method of Exergy analysis, and the key structural bottleneck of energy efficiency will be identified. In this study, bottleneck can be solved by optimizing the network structure, and strategies of synthesis of cascade refrigeration system of ethylene plant will be raised. The super structure was set up, including a condensing section, a compression section, and several temperature levels with expansion valves, sub-cooler, flash drums and evaporators. Based on the super structure of the refrigeration system, the mixed integer nonlinear programming (MINLP) model was established with the aim of minimizing the total annual cost (TAC). And the GAMS software was used to solve the problem and get the basic structure of the optimal refrigeration system. The final construction was obtained according to the pinch design method. This method can be applied to optimizations of refrigeration system in other industrial processes.