Introduction

The heat exchanger network (HEN) design method is an advanced technology for energy integration in the process industries. The HEN retrofit methods can be classified into three groups: Pinch Analysis based methods, mathematical programming methods, and approaches combining both.

One of the most effective methods of the third group is the Network Pinch approach (NPA), developed for the retrofit of existing HEN [1]. In the diagnosis stage of the traditional NPA, a MILP model is used to identify the topology changes with the best potential for heat recovery. A NLP model is then used to economically optimize the selected design topology.

In this work, the standard NPA is further extended to incorporate some important practical design aspects. The modified NPA can handle complex network configurations with stream segmentation and splitting, as well as match and temperature constraints, and other design flexibility features.

The Modified Network Pinch Approach

The novel methodology includes the following practical features [2]:

- Possibility of using different minimum approach temperatures for each heat exchanger
- Management of forbidden matches and fixed temperatures
- Combining the structural modifications stage with the cost optimization stage to minimize the risk of missing cost-effective design solutions
- Flexibility in the process streams supply and target temperatures (soft targets)
- Possibility of linkage between the soft target temperature of a stream with the supply temperature of another stream
- Possibility of adding new heaters and coolers, as well as placement of process units that may cause energy losses or energy gains

New approach to deal with effluent streams such as flue gases and wastewater using environment units to balance the network

New concept called “Match Penalty” to minimize the risk that a project selected in the first steps prevents the optimal solution to be found in the following steps

Case Study

The modified NPA has been implemented in GAMS using CBC as MILP solver and CONOPT as NLP solver. The benefits of the modified approach are illustrated through a HEN retrofit of a fluid catalytic cracking unit (FCC) introduced by Al-Riyami et al. [3].

Conclusion

A novel HEN retrofit design methodology is presented based on the traditional NPA. The methodology includes newly proposed modifications by other research groups and some other new practical features. The modified NPA has been successfully tested using different literature data and also a number of real case studies.

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References