Simulation of heat exchanger network (HEN) and planning the optimum cleaning schedule

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Abstract

Modeling and simulation of heat exchanger networks for estimating the amount of fouling, variations in overall heat transfer coefficient, and variations in outlet temperatures of hot and cold streams has a significant effect on production analysis. In this analysis, parameters such as the exchangers' types and arrangements, their heat transfer surface areas, mass flow rates of hot and cold streams, heat transfer coefficients and variations of fouling with time are required input data. The main goal is to find the variations of the outlet temperatures of the hot and cold streams with time to plan the optimum cleaning schedule of heat exchangers that provides the minimum operational cost or maximum amount of savings.

In this paper, the simulation of heat exchanger networks is performed by choosing an asymptotic fouling function. Two main parameters in the asymptotic fouling formation model, i.e. the decay time of fouling formation (s) and the asymptotic fouling resistance (R1f) were obtained from empirical data as input parameters to the simulation relations. These data were extracted from the technical history sheets of the Khorasan Petrochemical Plant to guaranty the consistency between our model outputs and the real operating conditions.

The output results of the software program developed, including the variations with time of the outlet temperatures of the hot and cold streams, the heat transfer coefficient and the heat transfer rate in the exchangers, are presented for two case studies. Then, an objective function (operational cost) was defined, and the optimal cleaning schedule of the HEN (heat exchanger network) in the Urea and Ammonia units were found by minimizing the objective function using a numerical search method. Based on this minimization procedure, the decision was made whether a heat exchanger should be cleaned or continue to operate. The final result was the most cost effective plan for the HEN cleaning schedule. The corresponding savings by implementing the optimum cleaning schedules are reported.

Keywords: Heat exchanger network (HEN); Fouling formation; HEN cleaning schedule; Simulation of HEN

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