Research topics

Fouling in Heat Exchanger Networks

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Abstract

Fouling of heat exchanges leads to significant costs in the process industries. Fouling causes decay in the heat transfer effectiveness and an increase in the pressure drop through the affected heat exchangers. This most often leads to increased energy consumption. Whilst cleaning of heat exchangers can restore their performance, the costs incurred between cleans can be significant. This project has developed ways to mitigate the fouling in heat exchanger networks. Interactions within heat exchanger networks are exploited, with changes in process conditions and cleaning schedules being optimised simultaneously.

Project description

Fouling is a broadly spread problem; it is present in almost any industry that uses heat transfer equipment in its processes. The main consequences of fouling are the decay in the heat transfer effectiveness and the increase in the pressure drop through the affected heat exchangers. The cost associated with this problem is enormous. It has been estimated that the expenditure relating to fouling represent 0.25% of the Gross National Product (GNP) in the industrialised countries, which in 1992 was equivalent to US$ 45 billions per year.

An extensively used method to mitigate fouling in heat exchanges is the cleaning of fouled heat transfer surfaces in order to restore its thermal and hydraulic performance. Several methods have been proposed to find the optimal cleaning schedule of heat exchanger networks prone to fouling. The existing approaches are based on mathematical programming, leading to optimization problems that require a large amount of time and resources to be solved. A major shortcoming of these fouling mitigation techniques is that fouling is accepted as an unavoidable problem and no effort is made to try to avoid its occurrence.

In this work, a new strategy for mitigation of fouling in heat exchanger networks is presented. It is based on the fact that the propensity of some types of fouling may be reduced through the proper selection of the operating conditions. The proposed method combines the optimisation of the operating conditions with the scheduling of cleaning task in an integral fouling mitigation technique. The application of the method in complex heat exchanger networks, such as crude oil preheat trains, is demonstrated. The results show that the new approach is superior when compared to the traditional mitigation techniques.