Fouling in Heat Exchanger Networks

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Abstract

Fouling in heat exchangers has major cost implications; especially in applications such as crude oil pre-heating. In principle, fouling can be mitigated through changes in the way a heat exchanger network is designed and operated. In crude oil fouling, the rate of fouling is dominated by the wall temperatures of the heat exchanger tubes and the shear rate at the tube wall. Prior studies have demonstrated that under certain sets of wall temperatures and tube shear rates, a threshold for fouling deposition exists, which can be used for mitigation purposes. Thus, in principle, fouling can be alleviated or stopped by adjusting conditions within individual heat exchangers. Previous research has shown that heat exchanger networks can be designed and operated to mitigate fouling by accounting for the effects of wall temperature and shear rate. Various fouling models have been suggested previously to predict fouling rate as a function of temperature and shear rate. However, all of these models have adjustable parameters that need to be fitted to experimental data. The previous approach to this has been to carry out laboratory tests in shear cells. Unfortunately, this is impractical for most applications. Each crude oil (which might be subjected to frequent changes in a given pre-heat train) needs the appropriate parameters to be fitted. Also, the relationship between the fouling in laboratory shear cells and fouling in actual heat exchangers has yet to be established. This presentation will develop an alternative approach to fitting parameters to fouling models based on actual operating equipment. The approach presented allows for data reconciliation and model fitting from operational data that allows different fouling models to be fitted simultaneously for each side of a heat exchanger. Once such parameters have been fitted, they can be used for operational optimization for fouling mitigation, including the optimization of cleaning schedules. In design and retrofit, dynamic fouling characteristics can be included in the procedure to design and retrofit so that fouling can be mitigated simultaneously through operating cycles by the systematic manipulation of operating conditions and optimisation of cleaning schedules.