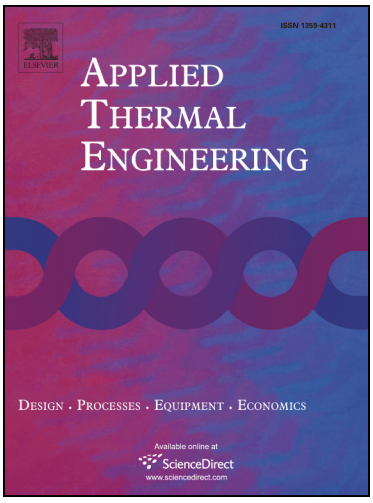

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SENSITIVITY ANALYSIS OF HEAT EXCHANGER DESIGN TO UNCERTAINTIES OF CORRELATIONS

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Abstract

Heat exchanger design procedures rely on a series of correlations to estimate heat transfer coefficients, pressure drops, costs, etc. Each correlation is characterized by uncertainties, i.e. it returns an approximate value of the variable that it aims at predicting. This paper studies how sensitive the total cost evaluation is to these uncertainties for shell-and-tube heat exchangers. A variance decomposition approach is used to calculate the total effect of each uncertain variable. Three test cases are studied for which the most influential uncertainties were found to be those on the correlations for evaluating the purchase cost and the shell side heat transfer coefficient. Probability distributions of the total cost are presented and exhibit a large variance of the total cost. The impact of the cost of energy was also investigated, which revealed that uncertainty on energy cost had a smaller total effect than that of other variables.

Keywords: heat exchanger design; sensitivity analysis; correlations; cost estimation; shell-and-tube

Nomenclature

A surface area, m^2

C_p heat capacity J kg^{-1} K

C_t Number of tube correction factor related to the tube layout pattern

D_{ctl} diameter of a circle that pass through the center of the outermost tubes, m

d_i tube inside diameter, m

$E(\ldots)$ expected value

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