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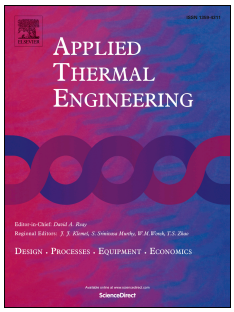

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Optimisation of Fin Selection and Thermal Design of Counter-current Plate-fin Heat Exchangers

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Abstract

A major challenge in designing optimal multi-stream plate-fin heat exchangers is the large number of combinations of standardised fin geometries for various fin types to choose from, which adds discrete aspects to an already complicated design problem. In this work, a new design algorithm is proposed to address this issue. By treating basic fin geometries such as plate spacing, fin pitch, fin length and fin thickness as continuous variables for all the fin types, different fin types are characterised based on the work published by different researchers. Then by taking into account thermal hydraulic performance of different fin types, optimal fin types and their corresponding design parameters can be obtained simultaneously by minimising the total volume of heat exchanger. The design parameters can be rounded to the nearest standardised fin parts for a feasible design. A case study with a comparison of published results is carried out to demonstrate the effectiveness of the method.

Key words: plate-fin heat exchanger design optimisation

Nomenclature

A total heat transfer area of one side, m^2
A_c free flow area of one side, m^2
A_{fr} total heat exchanger front area, m^2
b plate spacing, m
b_{st} standardised plate spacing, m
c fin pitch, m
c_{st} standardised fin pitch, m
c_p heat capacity, J/kg K
d_h hydraulic diameter, m
e wavy fin amplitude, m
ER relative difference
f friction factor
f_s ratio of secondary surface area to total surface area for heat transfer
h heat transfer coefficient, $W/m^2 K$
i interest rate
j Colburn factor

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