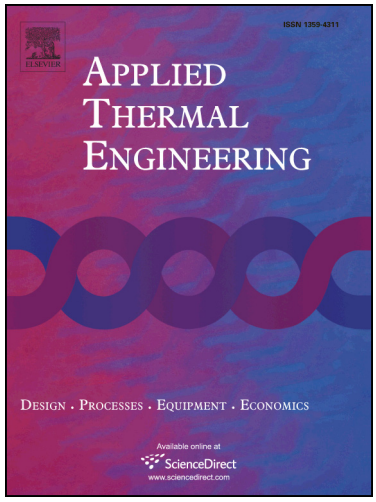

Research Paper

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Shape Optimization of Welded Plate Heat Exchangers Based on Grey Correlation Theory

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Abstract: This paper focuses on shape optimization and heat transfer analysis of a Welded Plate Heat Exchanger (WPHE) with straight gas channels and corrugated water channels. Three influential factors (long axis, short axis and plate spacing) were selected as the initial variables to carry out CFD (Computational Fluid Dynamics) simulation. The influences of various factors on heat transfer characteristics were analyzed using the grey correlation theory, then the optimal parameters of WPHE were discovered by increasing the data density for further study. To verify the correctness of the results, a test platform was built based on the optimal parameters. The error of the two study methods was less than 10%, compared with the CFD simulation results.

Keywords: Welded plate heat exchanger; Grey correlation theory; Computational fluid dynamics

1. Introduction

The temperature of industrial exhaust gas is usually controlled at 100-180°C, due to the low heat transfer efficiency of traditional heat exchangers and dew point corrosion. Such a high exhaust temperature not only wastes a lot of energy, but also causes serious environmental problems [1, 2]. Waste heat recovery relates to a series of heat conduction processes, and the performance of the heat exchanger directly determines the efficiency of recovery systems. At present, the traditional heat exchanger used for energy recovery systems has great limitations. A rotary heat exchanger with low efficiency causes fluid mixing and pollution problems. The traditional tubular heat exchanger has the disadvantages of a non-compact structure, low heat transfer efficiency and a large occupation area. The finned tube heat exchanger has the problem that the fin root and the outer surface of the tube easily loosen at the welded or detachment point, resulting in increased heat resistance and decreased heat transfer efficiency. Non-condensable gas produced by the chemical reaction of the working fluid and the steel shell may shorten its life and influence the heat transfer efficiency of the heat pipe exchanger [3, 4]. The pressure limit of the detachable heat exchanger is less than 2.5MPa and the temperature is no more than 260°C, because of the sealing gasket, while the maximum pressure range of the WPHE (Welded Plate Heat Exchanger) reaches 20MPa and the temperature range is 200-900°C, thanks to the plate being sealed by welding [5]. The WPHE combines the

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