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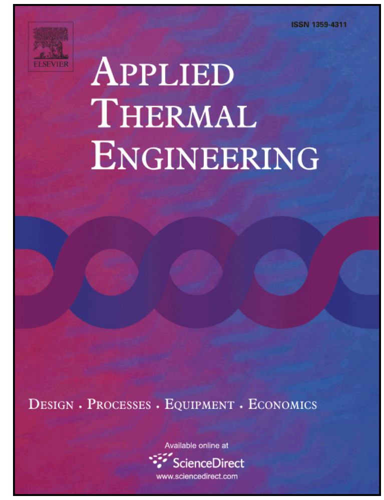

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Optimization investigation on configuration parameters of spiral-wound heat exchanger using Genetic Aggregation response surface and Multi-Objective Genetic Algorithm

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Abstract: Based on the method combining Genetic Aggregation response surface and Multi-Objective Genetic Algorithm, the effects of configuration parameters of spiral-wound heat exchanger (SWHE) on flow and heat transfer characteristics were numerically studied. The results show that the shell-side pressure drop of the spiral-wound heat exchanger decreases with the increase of layer pitch, winding angle and tube pitch, respectively. The shell-side heat transfer coefficient of the spiral-wound heat exchanger decreases with the increase of layer pitch and increases with the external diameter of tube. The shell-side heat transfer coefficient increases firstly with the increase of the winding angle and then decreases. The sensitivity analysis also shows that the shell-side flow and heat transfer characteristics are mainly affected by the winding angle. Under the working condition, the pressure drop and heat transfer coefficient are both negatively correlated with the layer pitch. And the winding angle is negatively correlated with the pressure drop, but positively correlated with the heat transfer coefficient. Three optimal configurations were obtained by the Multi-Object Genetic Algorithm based on Genetic Aggregation response surface. Compared with the original configuration, the average heat transfer coefficient of improved ones is enhanced by 2.93%, while the average pressure drop is reduced by 40.27%. The results are of great significance for the design of spiral-wound heat exchanger.

Keywords: Spiral-wound heat exchanger; Structural parameters; Genetic Aggregation; Multi-Objective Genetic Algorithm

NOMENCLATURE

A	heat transfer area	q	heat flux, W/m^2
B	layer Spacing, mm	x,y,z	Coordinate, mm
C_p	specific heat, J/kg K		
D_t	external diameter of tubes, mm	***Greek symbols***	
l	tube pitch, mm	ε	turbulent energy dissipation
Nu	Nusselt number	μ	dynamic viscosity, Pa s
ΔP	pressure drop	ρ	density, kg/m^3
P_{in}	pressure of shell inlet	λ	thermal conductivity, W/m K
P_{out}	pressure of shell outlet	θ	winging Angle, °
Pr	Prandtl number	κ	Turbulent kinetic energy
u	velocity, m/s		
Re	Reynolds number	***Subscripts***	
K	heat transfer coefficient, W/m^2 K	in	inlet
Δt_m	log-mean temperature difference, K	out	out

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