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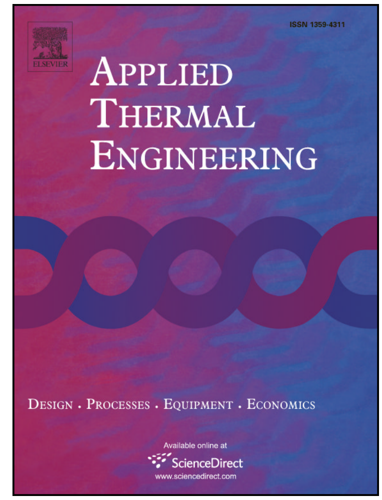

Research Paper

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Numerical Study on Polydisperse Particle Deposition in a Compact Heat Exchanger

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Abstract

In this paper, the effect of particle size on deposition in a compact heat exchanger is investigated numerically. The effect of flow velocity and particle mass on the deposition for different particle size is also studied and discussed. Particle motions are simulated using the Lagrangian approach and discrete particle model (DPM). The deposition is modeled applying user defined function (DEFINE_DPM_EROSION). Flow simulation is performed using the Eulerian approach by solving Reynolds-Averaged Navier-Stokes (RANS) equations. Turbulence is simulated with the Realizable k-epsilon model applying the Discrete Random Walk (DRW) model to account turbulent velocity fluctuations. Also, enhanced wall treatment is used with turbulence model. A computational study is done on a 3D five fin channels of a compact heat exchanger. The air flow is entered from upstream with velocity over a range from 1 m/s to 5 m/s and six polydisperse particles groups with various diameters from 1 μm to 1500 μm, are introduced into the computational domain. The results show that most of the particles deposited on the front of channels and also on the first, second and last edges of fin channels. Besides, deposition ratio increased with the increase of particle diameter, up to a maximum value, and then it decreased. The effect of injecting small particles with larger size particles is also studied, and their results showed an increase in particle deposition. Results show that velocity increase can promote or hinder particle deposition.

Keywords

Compact heat exchanger, CFD analysis, DPM, Particle deposition, Polydisperse, Pressure drop

Nomenclature

C_c	Cunningham correction	v'	Turbulent fluctuation in *y* direction (m/s)
d	Diameter (m)	w'	Turbulent fluctuation in *z* direction (m/s)
d_{ij}	the deformation tensor	U_p	Particle velocity (m/s)
e_r	Coefficient of restitution	V	Volume (m^3)
$\vec{g}$	gravitational acceleration (m/s^2)	v_{rel}	The relative velocity of particle-fluid (m/s)
k	turbulent kinetic energy (J/kg)	X	Position (m)