CFD simulation and experimental validation of tortuosity effects on heat transfer of packed beds loaded by multi-lobe particles

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Abstract

~~In t~~This paper investigated ~~,~~ the heat transfer of multi-lobe particles in a packed bed ~~had been investigated~~ numerically and experimentally. In the numerical analysis, continuity, motion and energy equations were solved and heat transfer coefficient was calculated. Finite element method (FEM) was used to solve partial equations using FEMLAB2.3 software. In the experimental work, two different arrangements of structured beds ~~had~~ were ~~been~~ examined. The results ~~showed~~ indicated that the two beds with the same porosity had different particle-to-fluid Nusselt numbers which could be caused by tortuosity differences. Moreover, the comparison of local Nusselt number with previous empirical correlations ~~showed~~ revealed that ~~lack~~ neglecting ~~of~~ tortuosity ~~consideration made~~caused correlations to be unable to predict the experimental Nusselt number. Therefore, a modified correlation ~~had been~~was proposed according to the CFD results, which reduced the error between 4-8 % by considering the tortuosity effects.

Keywords: Experimental, Computational Fluid Dynamics (CFD), multi-lobe particles, heat and mass transfer analogy, tortuosity.

1. Introduction

Packed beds are widely used in industrial applications because of their low cost, ease of use, etc. ~~Having the~~A large surface area ~~to~~ volume ratio~~,~~ is the basic characteristic of Multi-