Particle-Fluid Heat Transfer Close to the Bed Wall: CFD Simulation and Experimental Study of Particle Shape Influence on the Formation of Hot Zones

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Abstract

~~In this paper,~~This paper investigated the heat transfer of a wall-affected non-spherical particle ~~affected by wall was investigated~~ both numerically and experimentally. In the numerical section, three-dimensional finite element method was used to solve the partial equations using FEMLAB version 2.3. In the experimental section, the axial flow over a single naphthalene particle with a tube to particle diameter ratio (N) ranging ~~from~~ within 4.5-6.7 was examined and the Nusselt number was calculated by heat and mass transfer analogy. The effects of tube wall, particle shape, and the particle rotation angle were tested on the formation of hot zones ~~were tested~~ in detail. The results indicated that the wall effect can be ignored when particle-tube wall distance per particle diameter ~~is~~ was greater than 0.143 ($y_c/Dp \geq 0.143$). Internal holes did not play an important role in reducing the hot zones. The minimum hot zones were observed for tri-lobe particle at the axial rotation angle of zero when the particle leant against the wall tangentially. The predicted results were well congruent with the experimental results. The results obtained by this study can be ~~practical to discover~~applied to discovering more about the hot spots and obtain a better catalyst particle for packed bed reactors.

Keywords: Cylindrical, Tri-Lobe Catalyst particle, Heat Transfer, Packed Bed, Computational Fluid Dynamics (CFD), Wall Effects, Hot Zones.