Numerical study of forced convective heat transfer in grille-sphere composite packed bed with Taguchi-CFD method

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Abstract

In the present paper, a grille is inserted into the packed bed to construct a grille-sphere composite packed bed with small grill-sphere packed channels inside, which would be helpful to improve the flow homogeneity and heat transfer performance inside. The tube to particle diameter ratio of the packed bed is relatively large, while the tube to particle diameter ratio of the grill-sphere packed channel is relatively small. Due to the effect of grille on the porosity, the pressure drop and heat transfer characteristics in the grille-sphere packed channels are significant. Furthermore, the Taguchi-CFD method is used to study the grille effects in detail, including grille thermal conductivity, grille thickness and tube to particle diameter ratio of the channel. It is found that, the effect of the tube to particle diameter ratio (N) would be the most significant, while the effects of grille thermal conductivity and grille thickness would be relatively small. Therefore, the tube to particle diameter ratio is considered as the main factor for an optimum design in grille-particle composite packed bed.