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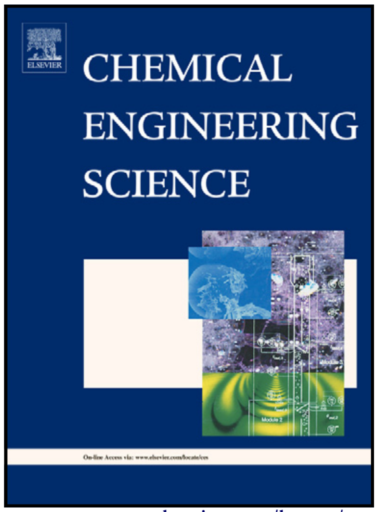

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Pressure drop in flow across ceramic foams - a numerical and experimental study

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Abstract

The unique properties of ceramic foams make them well suited to a range of applications in science and engineering such as heat transfer, reaction catalysis, flow stabilization, and filtration. Consequently, a detailed understanding of the transport properties (i.e. permeability, pressure drop) of these foams is essential. This paper presents the results of both numerical and experimental investigations of the morphology and pressure drop in 10ppi (pores per inch), 20ppi and 30ppi ceramic foam specimens with porosity in the range of 75 to 79%. The numerical simulations were carried out using a GPU implementation of the three-dimensional, multiple-relaxation-time lattice Boltzmann method (MRT-LBM) on geometries of up to 360 million nodes in size. The experiments were undertaken using a water channel. Foam morphology (porosity and specific surface area) was studied on post-processed, computed tomography (CT) images, and the sensitivity of these results to CT image thresholding was also investigated. Comparison of the numerical and experimental data for pressure drop exhibited very good agreement. Additionally, the results of this study were verified against other researchers' data and correlations, with varying outcomes.

Keywords: ceramic foam, pressure drop, lattice Boltzmann method, Darcy-Forchheimer equation, anisotropy, specific surface area, pore-scale simulation

1. Introduction

The industrial importance of materials with open porosity structures in the form of ceramic or metallic foams has grown in recent years. These materials exhibit specific properties such as high specific surface area, high porosity, low density, favourable mechanical, thermal and corrosion resistance. Thus they are well suited to serve as compact heat exchangers, reaction catalyst support, flow stabilizers or filters (Twigg and Richardson, 2007). This results in an increased need for *a priori* knowledge of their hydrodynamic

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