Influence of the porosity and pore size on permeability of ceramic wick structures

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Permeability is a key parameter in applications which require flow of fluids through a porous structure. The goal of this study is to manufacture ceramic wick structures with different pore size and porosities and to analyze its influence on the structure permeability. Different pore sizes and porosities were obtained by slip-casting mullite/Al_2O_3 slurries with different grinding times. Porosity was determined by Archimedes principle and pore size was determined by capillary extrusion. The darcyan and non-darcyan permeabilities were experimentally obtained by gaseous permeametry. A mathematical simulation of the permeability constants was carried out using the Ergun model and the results were compared with the experimental data. Porosity values in the varying from 48 to 59% and pores sizes in range of 1,1 and 4,0 μm were obtained. Darcyan constant, k_1, in order of 10^{-14} m^2 and non-darcyan constant, k_2, in order of 10^{-10} m were determined. The mathematical simulation revealed that the darcyan constants exhibited the same order of magnitude of the experimental data, while the non-darcyan constants differed by up to three orders of magnitude. This fact could be associated with the tortuosity of the flow path, which was not taken into account in the model. The obtained results show that for the prediction of pressure drop through the porous media an evaluation of both permeability constants is required.

Keywords: Permeability, slip casting, wick structures, .

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[1]M.D.M. Innocentini, V.R. Salvini, A. Macedo, V.C. Pandolfelli, Prediction of ceramic foams permeability using Ergun's equation. Materials. Research, São Carlos. V. 2, n. 4, 1999

[2]M.D.M. Innocentini, A.R.F. Pardo, V.R. Salvini, V.C. Pandolfelli, How accurate is darcy's law for refractories, American Ceramic Society Bulletin. v. 78, n. 11, 64-68p. 1999a.

[3]M.D.M. Innocentini, A.R.F. Pardo, V.C. Pandolfelli, Influence of air compressibility on the permeability evaluation of refractory castables. Journal of American Ceramic Society. v. 83, n. 6, 1536-1538 p. 2000.

[4]M.D.M. Innocentini, V.C. Pandolfelli, Permeability of porous ceramics considering the Klinkenberg and inertial effects. Journal of the American Ceramic Society. v. 84, n. 5, p. 941-944, 2000

[5] E.A. Moreira, M.D.M. Innocentini, V.R. Salvini, V.C. Pandolfelli, J.R. Coury, Permeability of cellular ceramics, In: XXVII ENEMP, Campos do Jordão, SP, 2001

[6] E.G. Reimbrecht, Fabricação, caracterização geométrica e determinação de propriedades hidráulicas de elementos porosos para uso em bombas capilares. 2004. 135p.

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[7] A. Jena, K. Gupta, Liquid Extrusion Techniques for Pore structure evaluation of Nonwowens, International Nonwovens Journal, pp. 45-53, 2003.

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