DEVELOPMENT AND CHARACTERIZATION OF MACROPOROUS CERAMIC STRUCTURES

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The Macroporous ceramic structure was produced using the polymer foam replication method. The permeability and porosity enhancement factors on Macroporous ceramic structure, fabricated using different polymer foam (Polystyrene bead) sizes and various applied pressures have been studied using pressure gradient measurement. The permeability was determined, by fitting the experimental results to the Darcy-Forchheimer equation, which provides the relationship between the pressure gradient and velocity of the air flow through the porous structure. Porosity of samples was measured by water displacement method. The average internal void diameter was obtained by fitting to the Ergun's equation, which relates the pressure gradient to the velocity of air flow, and the void size as the coefficient of first order velocity term.

First the polystyrene structure was produced under different physical conditions, to obtain different void sizes and different connectivities in the final ceramic structure (for example the polystyrene bead structures prepared with different bead sizes were subjected to different applied forces by adding a weight on the top of it for a given time). Then the prepared ceramic slurry was forced to penetrate the polystyrene structure. After drying, the polystyrene beads were removed by a burn-out operation and the ceramic material was sintered, consequently Macroporous ceramic structure was acquired.

The measured values of porosities were in the range from 0.56 to 0.80, and the sample, produced with 5 mm bead size and 1 kg of applied pressure has lowest porosity and the sample with 7 mm bead size and 1 kg of applied pressure has highest porosity. Permeability results of all prepared samples were in the range of 2.72×10^{-7} m^2 to 1.19×10^{-5} m^2. Most of the samples agree with the predictions of Darcy equation. However, the obtained results were not behaved as expected in the Ergun's equation.