Pressure Drop through Metallic Foam

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Submission: July 05, 2017; **Published:** August 22, 2017

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Mini Review

The metallic foam presents a positive impact in fluid engineering; moreover, the latter can presents also a significant pressure drop which was the aim of several studies.

Boomsma et al. [1] studied experimentally the influence of compressibility and pore scale, they found that the increasing in compressibility factor decrease the permeability, and the latter will be more sensible in front of permeability. Dukhan et al. [2] demonstrated that the pressure drop, in quadratic form, increase with increasing in pore density (PPI). They make also a new correlation that link the permeability with the inertial coefficient. We note that Guarino et al. [3] reported the same remark. The experiences of Manchin et al. [4] demonstrated that the pressure drop increase with decreasing in relative density (defined as the metallic foam density per material density).

Concerning the metal foam made from copper, the work of Xianbing et al. [5] and Gerbaux et al. [6] depict the pore density influence on the friction factor, where, the latter increase fastly in low pore density values, for constant porosity.

In the standard literature, the pressure drop is measured, generally, between the inlet and outlet of channels, using two pressure sensors. But Madani et al. [7,8] are measured the static pressure along the channel, using several pressure sensors. This method permits the elimination of inlet and outlet effects. Zhao et al. [9] compared the pressure drop of two types of materials: copper and FeCrAlY. They reported that the latter is more important in the case of copper metallic foam compared to the FeCrAlY, for the same pore density and relative density. The results of Hamadouche et al. [10] demonstrate that the insertion of aluminum metallic foam, in turbulent flow, can enhance the heat transfer coefficient with factor of 300% compared to the smooth channel. Kouidri et al. [11] characterized three metallic foam, Copper, NiFeAlCr and Inconel, with different surface roughness, their results show that the pressure drop increase from the smooth metallic foam to the rough one, they report also that the permeability changes from type of flow to another

for each metallic foam samples. The theoretical studies in these fields are rare; Fourie et al. [12] established a theoretical model based on the morphological proprieties and the hydraulic diameter of elementary representative cell. This model gives a best precision in the prediction of pressure drop during Darcy and Forchheimer regimes. Boomsma et al. [13] developed a new approach for the modelization of fluid flow through metallic foam. It emulates a periodic boundary conditions -inlet-outlet-, makes the fluid flow with a specified volumetric flow rate and adjusted inlet velocity distribution to the outlet one. The results are very close to those of experiments.

For adiabatic two phase flow, Topin et al. [14] analyzed an adiabatic two phase (air-water) flow through metallic foam samples, made from Copper and Nickel, with different pore density. This study was based on two phase multiplier. Calvo et al. [15] used the micro-tomography rayon X and radiography rayon X to characterize the hydrodynamic proprieties of liquid-gas flow, in counter-current, through metallic foam. The dynamic and static distributions of liquid quality were measured. The present literature analysis shows that, there is a significant dispersion in results; this is due, certainly, to the non-uniformed method of measure and several morphologic properties of metallic foam, which is ignored by the authors.

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