



HAL
open science

Numerical analysis of axial compression impact on the hydrodynamics of open-cell foams

Alla-Eddine Ennazii, Anthony Beaudoin, Aurelian Fatu

► To cite this version:

Alla-Eddine Ennazii, Anthony Beaudoin, Aurelian Fatu. Numerical analysis of axial compression impact on the hydrodynamics of open-cell foams. 15th annual international conference on porous media, interpore, May 2023, Edingbourg, United Kingdom. ⟨hal-04316208⟩

HAL Id: hal-04316208

<https://univ-poitiers.hal.science/hal-04316208v1>

Submitted on 16 Dec 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

InterPore2023



Rapport sur les résumés tmpM7ztO2.png

Abstract ID : 373

Numerical analysis of axial compression impact on the hydrodynamics of open-cell foams

Contenu

eX-Poro-HydroDynamique lubrication (or XPHD lubrication) presents a different scientific approach to dealing with tribological problems. It's an innovative inter- and multidisciplinary research topic which offers a promising sliding solution for various applications, such as bearings, thrust bearings, various guide components, etc. Its applications in both biological systems, and industrial systems : soft porous squeeze damping or soft porous lubrication are very broad and important. XPHD lubrication is a lubrication mechanism of biomimetic inspiration which features an additional parameter to the system "the porous media". It consists of self-sustained fluid films generated within compressible porous layers (CPL) imbibed with liquids in replacement for using the fluid film only as in the classic lubrication system. Soft and porous structures imbibed with liquids generate a high load support under compression, the load support is generated through the resistance to flow inside the porous material. During compression, the resistance to flow and load support increase, the greater the compression level, the lower the porosity and corresponding permeability. The main objective of this work is to understand the behavior of the fluid flow inside the porous structures when subjected to axial compression stress. In the scientific literature, the works studying the flow in compressible materials are essentially experimental because of their very complex geometrical shape [1], [2], [3], the CFD (Computational Fluid Dynamics) simulations offer an economical solution to study the performance of this new concept of lubrication. To create the geometry, the morphological structure of foam samples is reconstructed at different levels of compression rates from 3D X-ray microtomography. This is achieved by using a commercial software (Avizo) that allows to process 3D images and create FE/CFD models suitable for numerical analysis [4]. The numerical simulations of flows will be performed with the solvers icoFoam and simpleFoam of the OpenFOAM [5] framework for steady-state incompressible laminar and turbulent flows, making it possible to study different fluids and porous materials. The performed simulations were made with an open-pore polyurethane foam with 96% porosity using five compression rates for creating the different geometries. For the fluid we used water and a hydraulic oil ISO VG 46 to see the impact of the viscosity on the flow. The analysis of the simulations shows the impact of the solid compression on different parameters, such as the decrease in permeability as function of the compression rate, the anisotropy of the flow within the compressible structure and the actual increase in the tortuosity generated by the compression of the solid and the variation of the porosity.

References

- [1] S. Dasa, S. Sneijdersa, N.G. Deenb and J.A.M. Kuipersa, Drag and heat transfer closures for realistic numerically generated random open-cell solid foams using an immersed boundary method, *Chemical Engineering Science*, 183, pp. 260-274, 2018.
- [2] M. Bracconi, M. Ambrosetti, M. Maestri, G. Groppi and E. Tronconi, A systematic procedure for the virtual reconstruction of open-cell foams, *Chemical Engineering Journal*, 315, pp. 608-620, 2017.
- [3] M. Bracconi, M. Ambrosetti, M. Maestri, G. Groppi and E. Tronconi, A fundamental analysis of the influence of the geometrical properties on the effective thermal conductivity of open-cell

foams, Chemical Engineering & Processing: Process Intensification, 129, pp. 181-189, 2018

[4] <https://www.thermofisher.com/fr/fr/home/electron-microscopy/products/software-em-3d-vis/avizo-software.html>

[5] <https://www.openfoam.com/>

Participation

In-Person

Country

France

Energy Transition Focused Abstracts

MDPI Energies Student Poster Award

No, do not submit my presentation for the student posters award.

Acceptance of the Terms & Conditions

[Click here to agree](#)

Auteur principal: ENNAZII, Alaa-eddine

Co-auteurs: BEAUDOIN, Anthony (Université de Poitiers); FATU, Aurelian

Orateur: ENNAZII, Alaa-eddine

Track Classification: MS16 - (MS16) Fluid Interactions with Thin Porous Media

Type de contribution: Poster Presentation

Submitted by **ENNAZII, Alaa-eddine** on **Monday 12 December 2022**