Contribution ID: **58** Type: **Oral Presentation**

Toolchain from the creation of the mesh to the CFD simulations

Monday, 31 May 2021 09:40 (15 minutes)

The performance of many industrial applications is largely based on the quality and reliability of the guidance and support systems (high rotational speeds, low friction torque, damping capability, etc.). The subject presented here is part of an ANR project, entitled SOFITT (Saturated Open-pore Foams for Innovative Tribology in Turbomachinery) and aiming to find innovative technical solutions that break with current practices and provide high-performance support systems in terms of load capacity and damping. The project proposes a new concept of lubrication and correspondingly a new material (understood as a complex/composite material formed by the solid porous structure - compressible porous layers - and the imbibing fluid) in order to improve the quality and reliability of the guidance and supporting systems. The CFD (Computational Fluid Dynamics) simulations offer an economical solution to study the performance of this new concept of lubrication. The main objective is to understand the behavior of the porous complex structures, linked to microstructural properties of the solid material and their interactions with the fluid. 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 work proposed in this paper is a current challenge in the scientific community. The difficulty in performing CFD (Computational Fluid Dynamics) simulations in porous materials is to access the geometry of their structure. Thus, a first task is devoted to the simulation at the microscopic scale of the flow through a porous medium. The morphological structure of polyurethane foam samples is reconstructed at different levels of compression 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], [5]. A procedure allowing the passage between the microtomography measurements and the numerical models is developed. Then CFD modelling allows to study the impact of the material deformation on the pressure drop correlations [6], [7]. The numerical models are validated with experimental measurements conducted previously and presented in the reference [8].

Time Block Preference

Time Block B (14:00-17:00 CET)

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/industrial/electron-microscopy/electron-microscopy-instruments-workflow-solutions/3d-visualization-analysis-software/avizo-materials-science.html
[5] https://www.synopsys.com/simpleware.html

[6] A. Inayat, M. Klumpp, M. Lämmermann, H. Freund and W. Schwieger, Development of a new pressure drop correlation for open-cell foams based completely on theoretical grounds: Taking into account strut shape and geometric tortuosity, Chemical Engineering Journal, 287, pp. 704-719, 2016.
[7] Z. Nie, Y. Lin and Q. Tong, Numerical investigation of pressure drop and heat transfer through open cell foams with 3D Laguerre-Voronoi model, International Journal of Heat and Mass Transfert, 113, pp. 819-839, 2017.
[8] Kunik, S., Fatu, A., Bouyer, J., & Doumalin, P. (2020). Experimental and numerical study of self-sustaining fluid films generated in highly compressible porous layers imbibed with liquids. Tribology International, 106435.

Acceptance of Terms and Conditions

Click here to agree

Newsletter

Student Poster Award

Primary author: Mr ENNAZII, Alaa-eddine

Co-authors: Mr HENRY, Yann; Mr BOUYER, Jean; Mr JOLLY, Pascal; Mr DOUMALIN, Pascal; Mr FATU, Aurelian; Mr BEAUDOIN, Anthony; Mr LACAJ, Endri

Presenters: Mr ENNAZII, Alaa-eddine; Mr BEAUDOIN, Anthony

Session Classification: MS16

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