Contribution ID: **206** Type: **Poster**

Semi-analytically derived flow-rate/pressure drop relationships for the flow of yield stress fluids through rectilinear pipes of non-circular cross-sections.

Tuesday, 15 May 2018 17:15 (15 minutes)

For the study of yield stress fluids flow in porous media, the complex pore-scale structure has been extensively idealized as bundles of capillaries. A bundle of rectilinear capillaries of circular cross-section has been used over the past decade for the development of a new method of pore-size distribution (PSD) characterization based on the injection of a yield stress fluid. The main idea of this method, considered as an alternative to the mercury injection porosimetry, is that since those fluids cannot flow below a certain stress threshold, by measuring the evolution of the flow rate versus the pressure drop across a rock sample, its PSD can be retrieved through some "inversion"procedure. The numerical inversion techniques allowing to derive the PSD from experimental data and the experimental feasibility of this innovative and non toxic technique have been presented in recent works (e.g. Rodríguez de Castro et al., 2014). In order to be more representative of real pore cross sections, the flow rate/pressure drop relationship has been further investigated using detailed numerical simulations in bundles of capillaries with square or triangular cross-sections (Malvault et al, 2017).
In this study we propose a set of semi-empirical formulas that relate flow rate and pressure drop for yield stress fluids flowing in rectilinear capillaries of square, triangular, and rectangular cross sections. This approach is based on two main notions: the Critical Bingham number beyond which a yield stress fluid cannot flow anymore in a pipe of a given cross section; and a Shape Factor, whose physical meaning is the deviation of the considered shape of cross section (square, triangular, rectangular), from the ideal circular one.
This approach was initially proposed by Saramito and Roquet (2001) for the case of Bingham fluids flowing in pipes of square cross section. By following the same reasoning, a generalization for the flow of Herschel-Bulkley fluids in pipes of square, rectangular and triangular cross sections is developed.
The results obtained using the semi-analytical formulas developed in this work are shown to be in very good agreement with those derived from detailed numerical simulations. They can therefore be used for modeling flow in bundles of capillaries in a much more efficient and rapid manner.

References

Malvault, G., Ahmadi, A., Omari, A., Numerical Simulation of Yield Stress Fluid Flow in Capillary Bundles: Influence of the Form and the Axial Variation in the Cross Section, TiPM, DOI 10.1007/s11242-017-0919-8, 16p, (2017).

Rodriguez de Castro, A., Omari, A., Ahmadi, A. et Bruneau, D, Towards a new method of porosimetry: principles and experiments. TiPM, 101, 349-364. (2014).

Saramito, P. & Roquet, N., An adaptive finite element method for viscoplastic fluid flows in pipes, Comp. Meth. Appl. Mech. Eng. 190 (40/41) 5391–5412 (2001).

Acceptance of Terms and Conditions

Click here to agree

Primary authors: Prof. AHMADI-SENICHAULT, Azita (Professor, University of Bordeaux-FRANCE); Prof. OMARI, Abdelaziz (Professor, University of Bordeaux-FRANCE); MACKAYA, Terence Emery (PhD Candidate, I2M-TREFLE, ENSAM-Talence, FRANCE)

Presenter: Prof. AHMADI-SENICHAULT, Azita (Professor, University of Bordeaux-FRANCE)

Session Classification: Poster 2

Track Classification: MS 1.17: Flow of Non-Newtonian and Complex Fluids Through Porous Media