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Measuring the changes in the pore size distribution of a soil sample during its compression using non-Newtonian fluids.

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While there are many methods available for the characterization of pore sizes of soils and other geological materials, most of them are expensive or destructive or, in fact, both. Non-Newtonian fluids have been utilized recently for that purpose, providing not only a cheaper and more accessible alternative to the classical porosimetry techniques but also a method that does not disturb the sample and can be used repeatedly. In particular, the so-called ANA method [1] derives the effective pore size distributions of the porous sample based on a set of saturated flow experiments with different shear-thinning fluids, in our case the aqueous xanthan gum solutions of different concentrations.

We will discuss a methodology to measure the progressive changes in the pore size distribution of a sample of sand that is placed in the standard triaxial test chamber and subject to a drained compression. After every compression step (i.e. after increasing the pressure level maintained in the chamber, thus further compressing the sample), a sequence of permeability measurements with fluids of different rheology is performed and the effective pore size distribution is approximated. The ANA approach is used in our case since the similar yield-stress method [2] requires using larger hydraulic gradients, which would disturb the effective stress imposed on the compressed sample.

[1] Hauswirth, S.C., Abou Najm, M.R., Miller, C.T., 2019. Characterization of the Pore Structure of Porous Media Using non-Newtonian Fluids. Water Resources Research 55, 7182–7195. https://doi.org/10.1029/2019WR025044

[2] Rodríguez de Castro, A., Agnaou, M., Ahmadi-Sénichault, A., Omari, A., 2020. Numerical porosimetry: Evaluation and comparison of yield stress fluids method, mercury intrusion porosimetry and pore network modelling approaches. Computers and Chemical Engineering 133. https://doi.org/10.1016/j.compchemeng.2019.106662

Participation

In-Person

References

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