Computational Modeling of Flows at Pore Scale with Application to Study Properties of Landfills Isolations

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Abstract: Waste disposal sites create a risk of pollutants to infiltrate into the groundwater flow system and spread out across large areas. Therefore constructing efficient sealing barriers belongs to a class of crucial problems in environmental engineering. Isolating layers consist of mixtures of soils, mainly sands and clays.

Upscaling from pore- to core scale [1] is applied to study properties of isolating layers in function of compositions of soil mixtures. Elements of the computational procedure are the following: (i) voxel-based pore scale geometry of a mixture obtained by the X-ray computed microtomography, (ii) numerical model which is based on Finite Volume discretization of the Navier-Stokes equations within ANSYS/Fluent software, and (iii) upscaling to derive core scale parameters of a sample, which is permeability in this case.

Dealing with realistic geometries is a challenging task due to sizes and complex shapes of computational grids. We discuss attempts to reduce sizes of computational problems, what is most often obtained at a price of data resolution deterioration.

As a complement to computations we compare computed effective permeabilities with experimentally measured values.

We also present an application of simple statistical models to modify geometries at pore scale what provides another approach to study mechanisms of permeability losses.

[1] M. Peszyńska, A. Trykozko: *Pore-to-core simulations of flow with large velocities using continuum models and imaging data*, Computational Geosciences, Vol. 17, nr 4, (2013), 623-645.

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