Contribution ID: **227** Type: **Oral Presentation**

Absolute permeability of glass bead packs: the first principles agreement between experiment and pore-scale simulations

Thursday, 2 June 2022 13:30 (15 minutes)

We prepare two porous samples and estimate their permeabilities using experiment and simulation. After comparing experimental and simulated permeabilities, we have identified a major flaw affecting many permeability measurements with out-of-sample pressure port placement.

Each sample is composed of densely packed 500-micron glass beads obtained from different manufacturers. A special care is taken to minimize the scatter in measured permeability values, typical of standard permeability experiments. Measured permeability values are ~1% stable when varying flow rate 4-fold and fluid viscosity 2.5-fold.

Each sample is scanned in three dimensions (3D) using X-ray computed tomography (CT) for a wide range of discretization resolutions, from 3 to 65 voxels per average bead diameter. Detailed analysis of the CT scanning settings and image processing routines allowed to obtain 3D sample images free from contrast loss and CT artifacts. Hereafter, gray-scale CT images were binarized (segmented) using global segmentation threshold. For each sample, the threshold value was obtained from independently measured porosity. Such a segmentation approach avoided operator-dependency for the resulting images.

The segmented 3D images of the pore space were used to simulate Stokes flow with the two-relaxation-times lattice Boltzmann method. After performing resolution study and using extrapolation (doi:10.1063/1.5042229), we obtained ~0.1% accurate, resolution-independent permeability values. Stable experimental values and accurate simulated values demonstrated ~1% discrepancy, which is well within inaccuracies of the employed experimental equipment.

After obtaining accurate experiment–simulation agreement, we design a simple model system with out-of-sample pressure ports placement. This model system suggests the existence of a major flaw in permeability measurements, including industry standards. The flaw also affected our own permeability measurements. More details will be available in the accompanying manuscript [1] and during presentation.

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References

[1] Correct estimation of permeability using experiment and simulation. S. Khirevich, M. Yutkin, T. Patzek. Submitted.

Time Block Preference

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

Participation

In person

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