



Contribution ID: 727

Type: **Poster (+) Presentation**

## Does the imaging domain size matter in modeling the permeability of bioclogged porous media inside a microfluidic channel with evolving biofilms?

Wednesday, 2 June 2021 16:00 (1 hour)

This study integrates mathematical modeling and microfluidic experiments to study the impacts of imaging domain size on determining the permeability of porous media with evolving biofilm ratios. *E. coli* biofilms were grown to three biofilm ratios: low (2.7%), intermediate (17.6%), and high (55.2%) inside a microfluidic channel packed with a single layer of glass beads. Two-dimensional biofilm geometries in the porous space were extracted by digitizing confocal images. The permeability of the bioclogged porous media was estimated by solving the Navier-Stokes equations for flow in the pore spaces and a Forchheimer-corrected version of the Brinkman equation for flow inside biofilms using COMSOL. To evaluate the effect of modeling domain sizes on the estimation of the permeability, we simulated water flow in the bioclogged porous media using three smaller domain sizes (i.e., 1.5 mm × 1.5 mm, 2.5 mm × 2.5 mm, and 3.5 mm × 3.5 mm), in addition to the original domain size of 5 mm × 5.6 mm. We randomly selected five different porous medium areas for each domain size to conduct the simulation. In these simulations, biofilm porosity was assumed to be constant (0.6), and a range of biofilm permeability, including 10<sup>-9</sup> m<sup>2</sup>, 10<sup>-12</sup> m<sup>2</sup>, 10<sup>-15</sup> m<sup>2</sup>, and impermeable, was considered. We found that the modeling domain size was very important to estimate the permeability of bioclogged porous media, particularly when the biofilm ratio was low. Although the size of the modeling domain was found to be essential in estimating the permeability of lower biofilm levels, smaller domain sizes can be acceptable when biofilm structures are well developed.

### Time Block Preference

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

### References

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**Session Classification:** Poster +

**Track Classification:** (MS11) Microfluidics in porous systems