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Using 3D Microimaging to Evaluate the Effect of Nutrient Flow Rate on Biofilm Growth in Porous media

Wednesday, 16 May 2018 14:00 (25 minutes)

We use microimaging to study the effects of flow rate on three-dimensional growth of biofilm in porous media. Three flow rates were investigated in model packed-bed columns, while biofilm was grown over a period of 11 days. At the end of the growth period, all columns were scanned using x-ray computed microtomography and a barium sulfate-based contrast agent to distinguish the biofilm. We used differential pressure transducer and effluent dissolved oxygen measurements to complement and validate the image-based findings. Reduction in permeability due to biofilm growth was studied using both transducer-based pressure drop measurements and image-based calculations using the Kozeny-Carman model. A combination of results from these different measurements suggest that biofilm growth was oxygen limited at the lowest flow rate, and affected by shear stresses at the highest flow rate. We hypothesize that the interplay between these two factors drives the spatial distribution and quantity of biofilm growth in the class of porous media studied here. Our approach opens the way to more systematic studies of the structure-function relationships involved in biofilm growth in porous media and the impact that such growth may have on physical properties such as hydraulic conductivity.

References

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