Contribution ID: **433** Type: **Oral Presentation**

Analysis of Stokes-Brinkman modeling for solute/particle transport in a domain with microporous regions

Thursday, 2 June 2022 14:30 (15 minutes)

Microporosity is present in many natural porous media. It can also be an intentionally designed component in manmade porous materials. Its impact on transport depends on various factors including the properties of the microporosity, the amount and placement within the main porous structure, and the type and regime of the transport process being considered. Modeling transport with microporosity is challenging because of the differences in spatial and temporal length scales that govern the transport, and numerous methods have been studied for modeling these systems. One method that can be used for pore-scale modeling is the Stokes-Brinkman Equation, which enables direct modeling of viscous flow in the well-defined "macro"part of the pore structure, while assuming a Darcy-like flow in the microporous regions. This approach is useful if the microscale pore structure is not fully resolved or if direct modeling requires excessive computational demands. While significant research has been performed on matching boundary conditions and assigning the effective viscosity parameter for fluid flow and permeability modeling, relatively little work is published about the potential use of the Stokes-Brinkman equation for mass transport of solutes or nanoparticles.

In this work we present a micromodel design that contains macro and microporosity, and is being used for both physical and computational experiments. The problems we are studying involve two particular scenarios: changes in advected mass transport behavior due to its capture or delay in microporous regions, and the elution of mass that originates or has been captured in microporous regions. These situations are relevant in a number of practical applications.

We show solute/particle transport simulations within this domain that are being used to study physical behavior and quantify the ability of the Stokes-Brinkman equation to capture the correct solute mass transport behavior. The Stokes-Brinkman results are compared with direct numerical simulations that capture the detailed transport within both macro and microporosity. We first compare the methods for the case of fluid flow and permeability estimation, showing that traditional empirical equations (for microporosity permeability) give significant error for our particular micromodel geometry but that these errors can be reduced to essentially zero by extracting the correct microscale permeabilities from DNS and choosing an appropriate effective viscosity term. More importantly, we show that the same corrections for permeability and effective viscosity do not address the error in solute transport that is observed when comparing Stokes-Brinkman versus DNS. Additional parameter adjustments are analyzed to help determine what factors can be used to improve models of solute transport.

Acceptance of the Terms & Conditions

Click here to agree

MDPI Energies Student Poster Award

No, do not submit my presenation for the student posters award.

Country

United States

References

Time Block Preference

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

Participation

In person

Primary authors: WANG, Bin (Louisiana State University); THOMPSON, Karsten; Dr HUGHES, Richard (Louisiana State University)

Presenter: THOMPSON, Karsten

Session Classification: MS09

Track Classification: (MS09) Pore-scale modelling