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A homogenized model for flow and transport through porous media LUCY C. AUTON, University of Oxford, UK, SATYAJIT PRAMANIK, Indian Institute of Technology Gandhinagar, India; University of Oxford, UK, MOHIT P. DALWADI, CHRIS W. MACMINN, IAN M. GRIFFITHS, University of Oxford, UK — The major challenge in flow through porous media is to better understand the link between pore-scale microstructure and macroscale flow and transport. For idealized microstructures, the mathematical framework of homogenization theory can be used for this purpose. Here, we consider a 2D microstructure comprising an array of circular posts, the size and spacing of which can vary arbitrarily in the streamwise direction. We use homogenization theory to develop effective continuum equations for macroscale flow and transport that are characterized by the local porosity, an effective local anisotropic flow permeability, and an effective local anisotropic solute diffusivity. These macroscale properties depend nontrivially on both degrees of microstructural geometric freedom (post size and spacing). We take advantage of this dependence to compare scenarios where the same porosity field is constructed with different combinations of post size and spacing. For example, we consider scenarios where the porosity is spatially uniform but the permeability and diffusivity are not. Our results may be useful in the design of filters, or for studying the impact of deformation on transport in soft porous media.

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