Abstract Submitted
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Diffusion in random networks[1] JUAN C. PADRINO, DUAN Z. ZHANG, Los Alamos National Laboratory — The ensemble phase averaging technique is applied to model mass transport in a porous medium. The porous material is idealized as an ensemble of random networks, where each network consists of a set of junction points representing the pores and tortuous channels connecting them. Inside a channel, fluid transport is assumed to be governed by the one-dimensional diffusion equation. Mass balance leads to an integro-differential equation for the pores mass density. Instead of attempting to solve this equation, and equivalent set of partial differential equations is derived whose solution is sought numerically. As a test problem, we consider the one-dimensional diffusion of a substance from one end to the other in a bounded domain. For a statistically homogeneous and isotropic material, results show that for relatively large times the pore mass density evolution from the new theory is significantly delayed in comparison with the solution from the classical diffusion equation. In the short-time case, when the solution evolves with time as if the domain were semi-infinite, numerical results indicate that the pore mass density becomes a function of the similarity variable $xt^{-1/4}$ rather than $xt^{-1/2}$ characteristic of classical diffusion. This result was verified analytically. Possible applications of this framework include flow in gas shales.

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