Pore scale transport of miscible and immiscible fluids in porous media

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Abstract
The separation of harmful or valuable substances entrapped in porous media has applications in processes such as enhanced oil recovery, diffusion in tissue, and aquifer remediation. In this study the motion and removal rate of immiscible and miscible solutions have been analyzed to gain understanding of solvent effectiveness as it is diluted due to diffusion or mixing within porous materials. The extraction of oil using water, a surfactant solution of 4% CTAB in water, and a foam produced form the surfactant solution is observed using two dimensional flows between parallel slides containing cylindrical obstacles. The fluid motion is visualized. The foam proved to be the most effective solution at removing oil. The formation of large air bubble during foam propagation indicated that foam is not capable of holding its structure. The dissolution of two miscible fluids (glycerol and water) is visualized in square and round capillary tubes of various diameters. The capillaries are filled with solute before being immersed in a bath in which the solute concentration within the solvent is increased. The observation of the miscible liquid--liquid interfaces in a tube help us quantify the effective diffusion process.

Keywords
Porous media, Microfluidics, Liquid-liquid interface