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Harnessing the complex behaviour of ultra-dense and viscous treatment fluids as a strategy for aquifer remediation

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Abstract This paper examines the possibility of harnessing variable density flow and other processes in the delivery of $KMnO_4$. Specifically, we examined remediating chlorinated solvents as plumes in contaminated aquifers using a semi-passive barrier approach. It is necessary to predict how solutions behave once they are injected into the aquifer. Flow and transport are investigated through experimental and modelling studies. The experimental work of Schincariol and Schwartz is modelled using a finite element code MITSU3D. Simulations revealed that lenses with different permeability enhance mixing and relatively low permeability lenses have the potential to sequester the dense fluids. MITSU3D code is adjusted to simulate the variable density flow of viscous silicate solutions. Fingering in such a heterogeneous system appears to be relatively unimportant. Other possibilities for sequestering $KMnO_4$ at the site of emplacement include increasing the viscosity and forming gels. Dilute silicate solutions can turn into gel through time when they are mixed with dilute bicarbonate solutions. With the addition of permanganate, this gel can act as a slow-release material.

Key words variable density flow; silicate solutions; MITSU3D; time-delayed gelling; slow release material