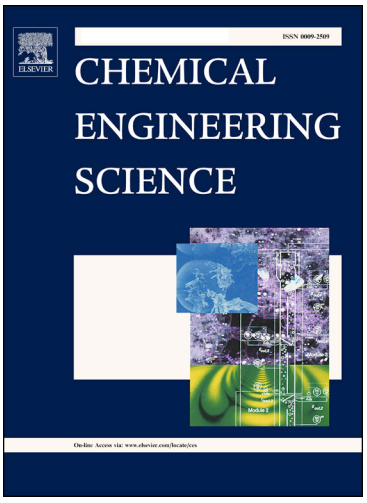

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Colloidal-suspension flows with delayed fines detachment: Analytical model & laboratory study

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Abstract
The effects of confinement and electrostatic interactions on the ion diffusion in the particle-rock contact area yields a delay in particle detachment during low-salinity water injection in porous media. The objective of the work is laboratory and mathematical modelling of the effects of delayed particle detachment on colloid-suspension transport in porous media. We present the governing system for single-phase particulate flow accounting for non-equilibrium fines detachment. The exact solution for one-dimensional flow with varying salinity is derived. Laboratory coreflood tests on low-salinity water injection are performed. The measured breakthrough fine particle concentration and pressure drop across the core are matched by the analytical model with high accuracy. Introduction of delay in the model removes the concentration shocks present in the instant fines detachment model as fines detach continuously throughout the injection period.

Keywords
Porous media; Colloids; Suspension; Analytical model; Laboratory coreflood; Particle detachment

Nomenclature

C	Dimensionless suspended particle concentration [-]
c	Suspended particle concentration [-]
C_{acc}	Accumulated suspended particle concentration [-]
D	Slope of characteristic line [-]
F_d	Drag force $[M][L]^{-1}[T]^{-2}$
F_e	Electrostatic force $[M][L]^{-1}[T]^{-2}$
J	Impedance [-]
k_0	Initial core permeability $[L]^2$
l_d	Drag lever arm [L]
l_n	Normal lever arm [L]
P	Dimensionless fluid pressure [-]
p	Fluid pressure $[M][T]^{-2}[L]$
q_0	Initial injection rate $[L]^3[T]^{-1}$
R^2	Coefficient of determination [-]
S_a	Dimensionless attached particle concentration [-]
S_s	Dimensionless strained particle concentration [-]
T	Dimensionless elapsed time [-]
t	Elapsed time [T]
T_0	Dimensionless elapsed time (initial condition) [-]
U	Fluid velocity $[L][T]^{-1}$
U_p	Particle velocity $[L][T]^{-1}$
X	Dimensionless distance from the core inlet [-]
x	Distance from the core inlet [L]
X_0	Dimensionless distance from core inlet (initial condition) [-]