Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Electrokinetic Fingering In Hele-Shaw Cells MOHAMMAD MIRZADEH, MARTIN BAZANT, Department of Chemical Engineering, MIT — Large scale flow problems in porous media, such as those encountered in underground oil reservoirs, are typically described by the Darcys law. However, it is well known that many underground rock formations contain surface groups and minerals that dissociate in the presence of water. Convection of these charges by the pressure driven flow can then set up streaming current and streaming potential that affects the flow. Furthermore, electric fields that are often used to enhance oil recovery, e.g. by reducing the oil's viscosity through electro-thermal heating, drive electro-osmotic flows that could set up very large pressure in small pores. The full description of fluid flow thus requires a solution to the fully coupled electrokinetic problem. In their seminal work, Saffman and Taylor showed that the moving interface between two immiscible fluids in a porous medium becomes unstable if pushed by the low-viscosity fluid. Here we report on the role of electrokinetic phenomena on stability of these viscous fronts in Hele-Shaw cells by using analytic as well as numerical approaches. Interestingly, we find that the instability could be suppressed if the right physical conditions are met or otherwise enhanced, leading to greater mixing of two fluids.

Mohammad Mirzadeh
Department of Chemical Engineering, MIT

Date submitted: 11 Jul 2016 Electronic form version 1.4