Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

The transient spreading flow history and liquid distribution within porous medium: a wettability study BOJAN MARKICEVIC, PALL Corp. — The interpretation of the capillary pressure at the fluid free interface as fluid potential stipulates that the wetting liquid potential is negative, and flow into porous medium is spontaneous. On the other hand, for a non-wetting flow to take place, an external force needs to be applied. Porous media are heterogeneous materials, which causes the local differences in the liquid potential and irregular liquid free interface irrespective of liquid/solid wettability. However, it is not only the capillary force that causes instabilities; even for a neutral liquid, irregularities are present due to the volumetric factor of pores of different sizes. In the present study, a neutral fluid is used as a referent value, and changes of the free interface shape for gradually increasing wetting and non-wetting interactions are determined numerically. It is shown that the interface instability is higher for the non-wetting liquid and the interface thickness is an asymmetric function of wetting angle with a minimum for the neutral fluid. Clearly, this asymmetry is influenced by pore volume, local flow resistance and capillary pressure, where for the wetting fluid, the fully saturated porous medium emerges earlier compared to its non-wetting counterpart. All three contributions lump into the changes in the flow rate, where it has been shown that by varying the external force onto the system, the interface instability can be reverted and interface stabilizes as the flow rate – and capillary number – increases. This implies that for the media whose wettability is altered, the external pressure needs to be changed in order to maintain the similar liquid distribution.

Bojan Markicevic
PALL Corp.

Date submitted: 30 Jul 2014 Electronic form version 1.4