Experimental Studies on Evaporative Drying and Salt Deposition in Porous Media Using Micromodels

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We employed pore scale visualization to investigate evaporative drying and the associated salt deposition of brine in porous media at different wetting conditions, using a 2.5D etched-silicon/glass micromodel based on a thin section of a carbonate rock.

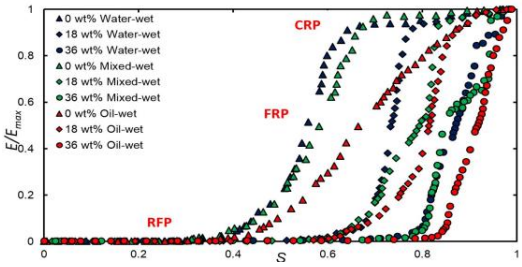

Figure 1. Evaporation rate as a function of liquid saturation for DI-water, 18 wt% Brine, and 36 wt% NaCl brine.

Discussion of Results

For DI-water, we observed the three classical periods of evaporation: the constant rate period (CRP) in which liquid remains connected to the matrix surface, the falling rate period (FRP) and the receding front period (RFP), in which the capillary connection is broken and water transport becomes dominated by vapour diffusion. The length of the water CRP was much shorter for a uniformly oil wet model but mixed wettability made little difference to the drying process.

For brine systems at all wetting conditions, the dry area became linear with the square root of time after a short CRP. However, this is unlikely to be due to capillary disconnection from the surface of the matrix as is usually the case for DI-water, as the salt crystals continued to be deposited almost preferentially in the channel above the matrix. We propose that this behaviour is due to a combination of salt deposition in the vertical channel and at the matrix surface greatly impeding hydraulic connectivity to the evaporating surface as well as the high viscosity of the saturated brine increasing the viscous resistance to flow.