Contribution ID: **690** Type: **Oral Presentation**

Injectivity Decline by Nanoparticles in High Permeability Sandstone Rock

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Water injection and production is key to many industrial applications including hydrocarbon recovery, geothermal energy exploitation and ground water resource management. To comply with water quality requirements and environmental regulations, water is thoroughly treated and filtered before injection into the subsurface. Even after such extensive treatment, sub-micron solid particles remain suspended in the water. During injection, these particles are transported in the water and filtered by the porous structure, eventually plugging the formation and resulting in significant injectivity decline or even the clogging of the formation.
Injectivity decline studies reported in the literature thus far have focused on the filtration of particles in the micron range, especially from 1 to 5 microns. They have established is that severe injectivity decline arises from internal filtration and, after a certain transition time, the formation of an external filter. Attempts to apply this physical concept to the injectivity decline due the retention of nano-sized particles have so far been fruitless due to a large extent to the lack reliable experimental data. This experimental study aims to fill that gap.
We report very well controlled laboratory experiments where ultra-filtered injection water is mimicked by water with dispersed spherical silica nanoparticles of about 140 nm diameter. The stability of nanoparticle colloid is investigated by varying nanoparticle concentration, brine compositions and pH. Their apparent hydrodynamic size and zeta potential show a range of salinity and pH where nanoparticles remain dispersed and within the expected size range. Then, core-flood experiments were conducted on Bentheimer sandstone. Pressure drop measurements along the core and influent/effluent analysis were used to analyse the transport and retention of nanoparticles in the cores. Experimental results show that stable injectivity is reached, along with a good propagation of the nanoparticles through the permeable core with no external filter cake formation, provided the pH and salinity of the injected fluid are kept within the stability range found in bulk. The injectivity decline show three different stages, which were matched using a 1D deep filtration model. The model includes three retention mechanisms: surface deposition, plugging and entrainment, and the simulations were found to be in very good agreement with the experimental results.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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