SMART BRINES FOR MINIMAL SURFACE ADSORPTION IN POLYMER ENHANCED OIL RECOVERY (EOR)

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PROBLEM STATEMENT

The polymer EOR utilizes high molecular weight polymers to improve the viscosity of the displacing aqueous phase. This polymer-brine solution has a better sweep efficiency than the normal brine solution. But the polymers get adsorbed on the rock surface. Polymer adsorption on the pore surface has a negative impact and therefore needs to be minimized. Here we are investigating polymer adsorption fundamentally through QCM.

QCM-D

Upon passing the polymer solution, the sensor undergoes frequency shift (Δf) and Dissipation shift (ΔD) due to adsorption, density and viscosity effects. Polymer studied: Flopaam (40 kDa, 2000 ppm solution)

SUBSTRATES

Alumina and Silica

SALTS (1,10,100 mM)

NaCl, CaCl2.2H2O

pH: 6 and 8

ALUMINA

NaCl

pH 6

CaCl2.2H2O

pH 6

Immediate adsorption of polymers upon injection
More adsorption in the presence of Ca2+ ions and pH 8.
Adsorption mechanism can be a combination of ligand exchange and cation bridging.

SILICA

NaCl

pH 6

CaCl2.2H2O

pH 6

Drilled salt (CaCl2) on Silica

Immediate adsorption of polymers upon injection
More adsorption in the presence of Ca2+ ions and pH 8.
Adsorption mechanism is mainly via cation bridging.

CONCLUSIONS

The adsorption mechanism differs on alumina and silica
For alumina and silica in presence of monovalent salts, there is no pH dependence for adsorption.

Some factors affecting adhesion:
- Charge on the polymer
- Surface charge (charge on the clays)
- Ions present in the brine
- pH of the solution

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CONCLUSIONS

Ca2+ (divalent) ions and pH 8 combination lead to increased adsorption of Flopaam on both silica and alumina!!

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References: