SEMINÁRIOS do departamento de MATEMÁTICA

Título

Foam-Assisted Surfactant Flooding

Palestrante

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Resumo

Foam-Assisted Surfactant Flooding (FASF) is a novel enhanced oil recovery (EOR) method combining the reduction of oil-water (o/w) interfacial tension (IFT) to ultra-low values and foaming of a gas drive for mobility control. We present a detailed laboratory study at reservoir conditions and a numerical analysis on the FASF. The stability of two specially selected surfactants in the vicinity of original injection water, i.e. sea water was assessed at 90°C. The phase behaviour of the crude oil-surfactant-brine systems and the ability of the two selected surfactants to generate stable foam in bulk were studied in presence and in absence of crude oil. The phase behaviour and bulk tests resulted in the formulations of the surfactant slug and drive foaming solutions. The slug solution aims for oil mobilisation by lowering of the o/w IFT and the drive formulation is required for gas foaming for mobility control. CT scanned core-flood experiments were conducted in Bentheimer sandstone cores initially brought to residual oil by water flooding. Oil mobilisation was obtained by injecting a surfactant slug at either under-optimum (o/w IFT of 10-2 mN/m) or optimum (o/w IFT of 10-3 mN/m) salinity conditions. At both salinities the injected surfactant slug yielded the formation of an oil bank. The oil bank is unstable due to dominant gravitational forces. Optimum salinity surfactant slug was notably more effective at reducing residual oil to waterflood (81 % reduction) compared to the under-optimum salinity slug (30% reduction). After oil mobilisation, drive foam was either generated in-situ by co-injection with nitrogen gas or was pre-generated ex-situ and then injected to displace mobilised

oil. It was found that, at optimum salinity, FASF yielded an ultimate recovery factor of $40 \pm 5\%$ of the oil in place (OIP) after water flooding whereas under-optimum salinity FASF showed a recovery of $35 \pm 7\%$ of OIP after water flooding. Experiments have shown that the presence of crude oil is detrimental to in-situ foam generation and stability. Pre-generated drive foam increased its ultimate oil recovery by 13% of the OIP after water flooding compared to in-situ foam generation at optimum salinity. We show that model and experiments match rather well.

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