Low saline water-alkaline-surfactant/alternated/CO2 flooding in Reservoir Cores

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Abstract

The discovery of new oil reserves has steadily declining over the years, so increasing the recovery factors from the oil fields is the only logical way to meet the growing demands. With this objective the different enhanced oil recovery (EOR) methods are designed. It has been observed that oil recovery by water flooding is influenced by the salinity and composition of injected water. Although low saline waterflooding (LSW) has the potential to recover additional oil, its recovery is less compared to chemical and gas EOR methods. The purpose of this study is to investigate the EOR potential of the novel low saline wateralkaline-surfactant/alternated/CO2 (LSWASG) method in an oilfield of Assam, India. Reservoir cores and crude oils from an Upper Assam depleted oilfield were analysed for their characterization and for preparing the synthetic formation brine (SFB). Chemical formulations that will best recover crude oil were next screened based on interfacial tension (IFT) measurements. Finally, lab-scale core flooding experiments were conducted to evaluate the oil recovery potential of the proposed method. From the coreflooding experiments, it was observed that secondary waterflooding of crude oil saturated core plugs resulted in recovery of about 33% oil initially in place (OIIP). Additional oil recovery by low saline waterflooding in the tertiary mode was 4.8 % OIIP. However, the oil recovery with LSW combined with the selected formulation (0.5 wt% SDS + 1 wt% Na2CO3) with and without alternated CO2 gas injection increased to 19.34% and 22.57% OIIP respectively. Higher oil recovery by the synergic combination of LSW, chemicals and CO2 gas, highlighted the EOR potential of the novel LSWASG process in the Assam oilfield producing medium gravity crudes

Generally, injecting carbon dioxide (CO2) into oil reservoirs is an effective enhanced oil recovery (EOR) technique that improves oil recovery, but injecting CO2 alone can be compromised by problems, such as early breakthrough, viscous fingering, and gravity override. The base CO2 injection method was improved by water-alternating-gas (WAG) injection with formation water (FW) and with low-salinity (LS) water (LSW), with LSW WAG achieving greater recovery than WAG with FW.This study investigates various combinations of standard waterflooding (with FW); flooding with nonmiscible gaseous CO2; WAG with CO2 and FW and/or LSW; foam flooding by adding a surfactant with CO2; adding an alkaline treatment step; and finally adding an LSW spacer between the alkaline step and the foam. These various EOR combinations were tested on Bartlesville sandstone cores (ϕ of approximately 12%, K of approximately 20 md) saturated with a heavy oil diluted slightly with 10% heptane for workability. The ultimate outcome from this work is a “recipe” of EOR methods in combination that uses alkaline, LSW, surfactant, and CO2 steps to achieve recovery of more than 63% of the oil originally in place (OOIP) in coreflooding tests.Combining CO2 injection with surfactant [sodium dodecyl sulfonate (SDS)] to produce a foam resulted in better recovery than the WAG methods. Adding alkaline as a leading step appeared to precipitate the surfactant and lower recovery somewhat. Adding an LSW spacer between the alkaline treatment and the foam resulted in a dramatic increase in recovery. The various cases of alkaline + LSW spacer + surfactant + CO2 (each with various concentrations of alkaline and surfactant) achieved an average improvement of 7.71% of OOIP over the identical case(s) without the LSW spacer. The synergistic effect of the LSW spacer was remarkable.

Biography:

Chinmoy Dutta is a M.Tech student specialized in Petroleum Exploration & Production Department under Dibrugarh University, India. His interested area of research is Enhanced oil recovery of Petroleum. In 2017 He published an paper titled "Phase behavior study for Chemically Enhanced water flooding" international journal IJESM, Volume 6, Issue 7, November 2017. He also presented two paper in oral presentation in two different international conferences. This approach is responsive to surfactant and alkali flooding in EOR analyzed with the Low saline brine.

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