Please fill in the name of the event you are preparing this manuscript for.	International Petroleum Technology Conference 2023 (15th IPTC)
Please fill in your 5-digit IPTC manuscript number.	IPTC-22895-Abstract
Please fill in your manuscript title.	Studing Surfactant/SmartWater Synergy Potential Starting from Ground Zero

Please fill in your author name(s) and company affiliation.

Given Name	Surname	Company
Abdulkareem	M. AlSofi	Saudi Aramco
Jinxun	Wang	Saudi Aramco
Vincent	Miralles	Solvay
David	Rousseau	IFP Energies Nouvelles
Mikel	Morvan	Solvay
Subhash	Ayirala	Saudi Aramco

Abstract

Surfactant-based chemical injection methods are among the most prominent enhanced oil recovery technologies. Synergizing the chemical flooding with a lower salinity SmartWater has potential benefits on oil recovery improvement, and our previous work has demonstrated the favorable synergetic effects on viscosity and wettability for polymer floods. In this paper, we investigate the potential synergy between SmartWater and surfactant flooding from ground zero, starting from the formulation design in two specific injection brines. Targeting for an actual carbonate case exhibiting harsh reservoir conditions, surfactant formulations were individually developed for conventional high salinity injection water and a low-salinity smartwater. A high throughput robotic platform was used to facilitate the surfactant formulation design. Four main evaluation studies were considered in the surfactant formulation design workflow, including solubility tests, phase-behaviour scans, interfacial tension (IFT) measurements, and static adsorption experiments. Later, a systematic all-inclusive laboratory workflow was used to design robust surfactant-polymer (SP) formulations. Oil displacement coreflooding experiments were finally performed using representative core samples and the two developed formulations with the conventional injection water and the low-salinity smartwater.

Results showed that the designed binary surfactant formulations, composed of olefin sulfonate (OS) and alkyl glyceryl ether sulfonate (AGES), were able to acheive ultralow interfacial tensions for both the high-salinity conventional injection water and the smartwater brines. These binary surfactant formulations showed the formation of middle phase microemulsions (Winsor Type III) in the two brines as "optimal salinity" conditions. Also, extended stability polymers were successfully screened for high temperature carbonates, including an associative polymer and an AM/AMPS (acrylamide/2-acrylamido-2-methyl propane sulfonic acid) copolymer. Single-phase displacements clearly supported the SP formulations propagation across and within the porous media. In terms of topside effects, the presence of surfactant and polymer in the brine clearly improved the separation kinetics. Nevertheless, a manageable deterioration in separated water quality was observed. The core scale oil displacement data showed that the developed SP formulations were able to produce around 60% of the remaining oil post waterflooding, and the residual oil saturation was effectively reduced to lower than 15%. Interestingly, in line with the

observed interfacial tension reductions, incremental recoveries were found to be comparable for both processes (i.e. surfactant/polymer in conventional injection water and surfactant/polymer in smartwater). A key novelty of this study is the investigatigation of the potential synergy between smartwater and surfactant-based processes from the initial step of formulation design. Through such from-scratch evaluation, we demonstrated that the synergistic benefits of smartwater with SP on oil recovery enhancement cannot be in play especially with optimal salinity surfactant formulations. The comparable SP flooding processes in terms of oil recovery performance can be designed with both high-salinity and low-salinity waters.