Investigation of anionic in place of cationic surfactants onto oil wet carbonate surfaces for improving recovery

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Abstract

This paper depicts the utilization of sodium dodecyle sulphonate (SDS) that replaces and enhances traditional use of cationic surfactant that is cetyle tri alkyl bromide (CTAB) for improving oil recovery. The SDS was assessed in Alkaline Surfactant Polymer (ASP) slugs contains regularly utilized surfactants with polymers. The impact of SDS on interfacial tension (IFT), adsorption and recovery were contrasted with that of a CTAB in these applications. The SDS was seen as good with saline solutions containing high total dissolved salts (TDS) that could be utilized in saline solutions excluding the requirement for softening and that can give preferable outcomes over traditional CTAB in frameworks where either can be utilized. The SDS has the favourable position of improved recovery with unsoftened saline solution. Their non-reactive properties make them especially appropriate for ecologically delicate applications at onland and offshore oil fields.

Key words: soften saline, adsorption, oil wet, carbonate surface, capillary number.

Introduction

In the procedure, it can be hypothesized that the alkali and SDS responds with limited quantities of esters and acids present in the solution to structure in-situ that consolidate in the infused surfactant to create concurring blends at the salt water interface [1]. The salt is additionally professed to lessen the measure of surfactant adsorption onto the formation, particularly in limestone reservoirs [2]. By expanding the pH the purpose of the limestone is surpassed and the surface becomes adversely charged. These expands the aversion between the reservoir and the adversely charged anions and in this way decreases absorption. The surfactants decrease the interfacial tension between the saline water and oil along these lines builds the capillary number.

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It is utilized to build the consistency of the injected liquid for effective profile control. The blend of it, soluble base and polymer in a procedure where leftover oil can be monetarily expelled from the reservoirs. ASP has been assessed in the research laboratories and utilized generally in the field with success [3]. There have been various other distributed lab assessments that affirm the clear capability of utilizing ASP to evacuate left out oil. Even with these critical points and the accomplishment of many field ASP ventures, the procedure isn't without certain weaknesses like the erosion and scale issues that happened during the broadened ASP flood in field. The alkali additionally has negative impacts on polymer execution and much of the time extra polymer is required to accomplish the ideal viscosity. A procedure that gives the favourable circumstances yet takes out or decreases a portion of the current uncertainty related with ASP flooding is required [4].

For the compound process, it is frequently alluring to utilize the produced liquid as the injected liquid so as to make the venture flexible and prudent [5]. Most produced liquid or accessible water sources [6]. A general dependable guideline for applying the procedure is that the cations concentration should be under 10 ppm in order to keep away from the response of the salt with the similar elements to frame insoluble scales by the flowing responses.

As a rule, the water is dealt with exchange of ions or a few other favored softening methods. The various costs (particularly for the "hard water") might be apparent as well as frequently turns into the "plug" for the venture. Besides, if water treatment equipment is manufactured furthermore, the main experiments demonstrate negative or the task to be dropped prematurely, the cost for the water treatment can't be recouped [7]. Dispensing with the water treatment process alongside the utilization of surfactants makes offshore IOR extends attainable and affordable [8].

As mentioned above prerequisites, the targets of the investigation are to discover a swap to CTAB and a procedure that provides interfacial tension improvement, is commercially possible, uses created water as the injected water without water treatment [9]. This is particularly noteworthy in optimizing and decreases the measure of surfactant required [10,11].

Materials and Methods

Conductivity of surfactants will be estimated by conductivity cell, where we can decide critical micelle concentration (CMC). CMC is the degree of proportion where micelles are shaped in polar and organic stages. Over this concentrations, further expansion of surfactants will build number or accumulation of micelles[12]. At the degree of CMC ultralow Interfacial pressure can be accomplished among oil and water.

Adsorption - A subsequent order model for the adsorption of particles onto peat particles dependent on the adsorption limit of the adsorbents with the objective of separating the energy of a second-order rate expression dependent on the adsorbent focus from models which depend on the solute concentration and represent a pseudo-second-order rate expression[13]. The linearized type of the pseudo-second-order model K_2 ($gmg^{-1}min^{-1}$) is the rate steady of the pseudo second order adsorption, q_e is the measure of quantity adsorbed on the adsorbent at balance (mg/g), and q_t is the measure of quantity adsorbed on the adsorbent whenever, t time (mg/g). K_2 ($gmg^{-1}min^{-1}$) can be determined from the slope and intercept of the plot of t/q_t against t according to equation (1).

$$t/q_t = 1/k_2q_e^2 + t/q_e \quad (1)$$

Capillary number recovery - The capillary number (N_c) is utilized to depict the powers following up on oil droplets inside a permeable media[14]. Nc is an element of the Darcy velocity(ν) applied by the portable on the trapping, the viscosity (μ) of the mobile phase, and the IFT (σ) (2) underneath shows the relationship of the Darcy velocity, viscosity and IFT to the capillary Number as equation (2).

$$N_c = \nu \mu/\sigma \quad (2)$$

A capillary number of around 10^{-6} is found after complete of the regular water and the number should be expanded by at any rate a few sets of magnitude so as to effectively oil dislodging. The Interfacial tension between the water and oil during furthermore, the water flooding ranges between the scope of 101 to 100 mN/m. The utilization of the best possible surfactants can without much of a stretch lesser than the interfacial tension to 10^{-2} mN/m or less bringing about a comparing increment in the fine number.

Results

The low concentrated SDS is chosen into the ASP slug to supplant the CTAB. In this procedure to recover the remaining oil, SDS in mix with alkali, polymers and various added substances that are commonly utilized for effective oil recovery are brought into an oil- bearing core into the inlet and the oil is recovered from outlet as shown in Fig.1

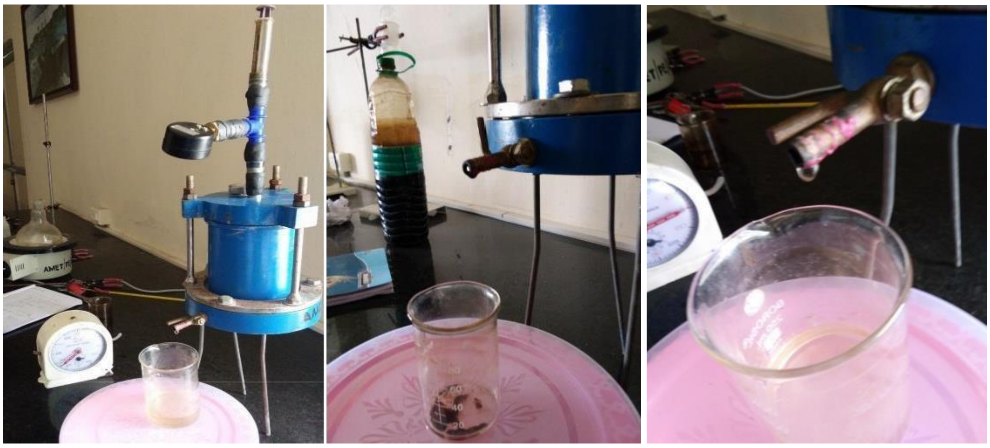

Figure 1: oil and water recovery through surfactant flooding by Permeability apparatus

The ASP procedure where CTAB is replaced with SDS will be assigned in ASP. It is desirable to include the SDS to the injected saline water previously followed by the different components. The selection of SDS of relies upon cost, accessibility and performance. The viscosity of the 0.1% PAA (polyacryl amide) in the soften and un-soften saline solutions utilizing CTAB and SDS were thought about and the information is appeared in Table 1.

Table 1. Effect of viscosity on treated water through surfactant concentration

Surfactant	Treated water	Untreated water
0.1 wt% CTAB	3.2 cp	1.5 cp
0.1 wt% SDS	9.8 cp	8.2 cp

Discussion

The viscosity was estimated at the temperature of 60°C utilizing a redwood viscometer. The information shows that polymer thickness is decreased within the sight of SDS in the treated saline solution. The thickness is further decreased and the precipitation is framed within the sight of CTAB under the unsoftened saline solution. This implies extra material is expected to take up the viscosity essential for the processing. This information appeared in Table 1 demonstrate for both surfactants, the hardness of water influences the thickness of the injected liquid. Sodium carbonate attains least viscosities in both treated and untreated saline solution. The CMC differences against oil for brine having SDS and CTAB is appeared in Fig.2. The testing arrangement was done by utilizing 0.1 wt% of the surfactant SDS and 0.1% CTAB. The saline water is utilized for liquid contained soluble alkali so as to reduce the precipitations. The remaining softened saline water is utilized for liquid so that the water soften procedure isn't required.

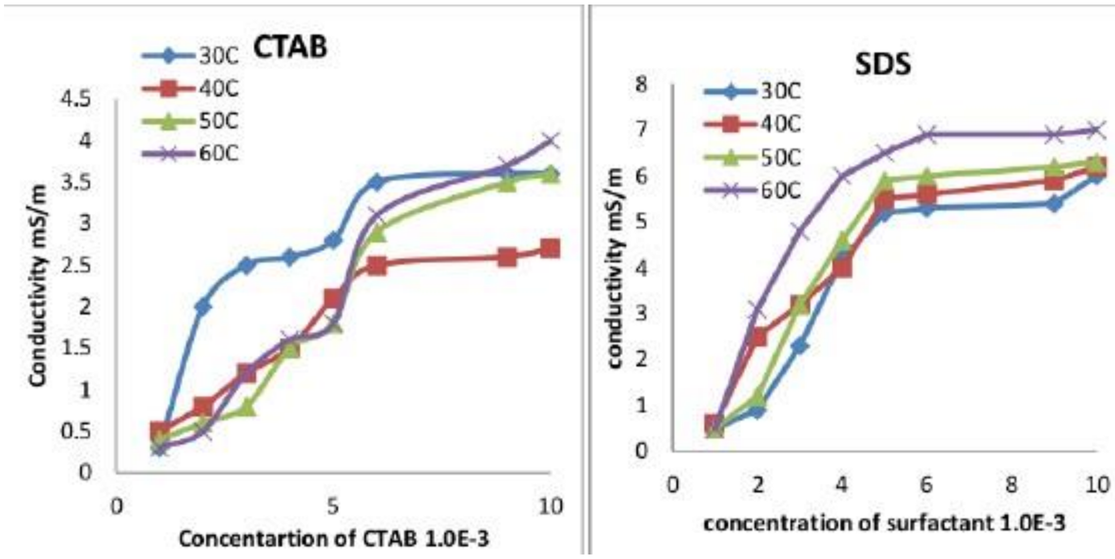

Figure 2: CMC profile for CTAB and SDS at different temperatures

For estimating the level of adsorption between SDS and CTAB, permeability apparatus was chosen. Each one has been concentrated with the unsoften saline water and alkali. Pore volume of core sample was calculated to be 33.1 cubic centimeters. Both the surfactants has been flooded to displace oil after water flooding. All the readings were observed at different fig.3.

Table 2: pseudo-second-order adsorption profiles at different temperatures

Surfactant	CTAB				SDS			
Time mins	t/q_t 30^0C	t/q_t 40^0C	t/q_t 50^0C	t/q_t 60^0C	t/q_t 30^0C	t/q_t 40^0C	t/q_t 50^0C	t/q_t 60^0C
	34.970	69.944	112.84					

q_e mg/g	49	21	32	138.24797 82	12.196 04	39.416 96	29.154 96	32.460 42
K_2 g/mg- min	0.0010 17	0.0002 51	5.8E- 05	3.77646E- 05	0.0097 53	0.0007 28	0.0021 53	0.0014 22

temperatures shown in table1. It was predicted that the adsorption on CTAB is showing maximum at 50^0C and 60^0C when compared with low concentration SDS as shown in fig.2.

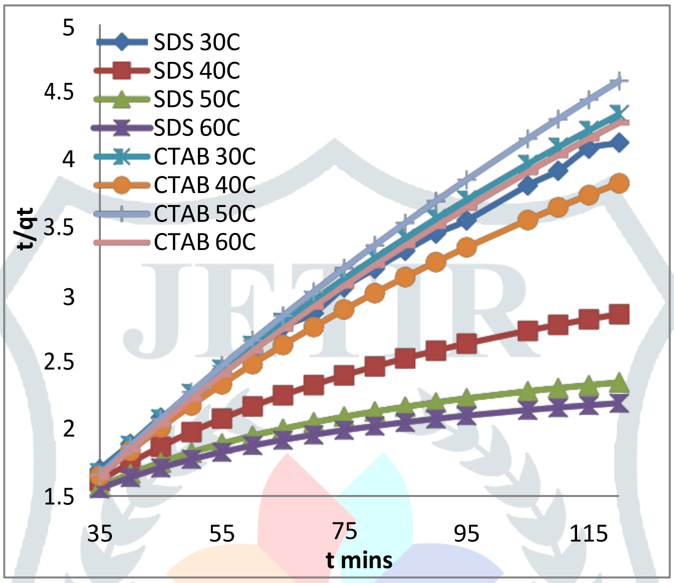

Figure 3: Adsorption of CTAB and SDS on carbonate surface

Capillary number is the measurement of Darcy's velocity and viscosity to the surface tension of a surface. And it is one among the prominent way of estimating recovery at laboratory scale. Darcy velocity can be calculated by the flow rate and cross-sectional area of the core measured in permeability apparatus. viscosity can be measured by redwood viscometer and surface tension is measured by ring tensiometer. According to fig.4 SDS and CTAB haven't shown any recovery until the capillary number is 9*1.0E-3. It indicates that both surfactants were adsorbed onto the surface and surface tension between surfactants and the core is dominating against pressure to reduce it. After that it was observed to increase recovery by both surfactants. Since the energy at surface has been diminished by the pressure generated from both surfactants to reduce surface tension. Comparatively SDS was observed to be more efficient than CTAB.

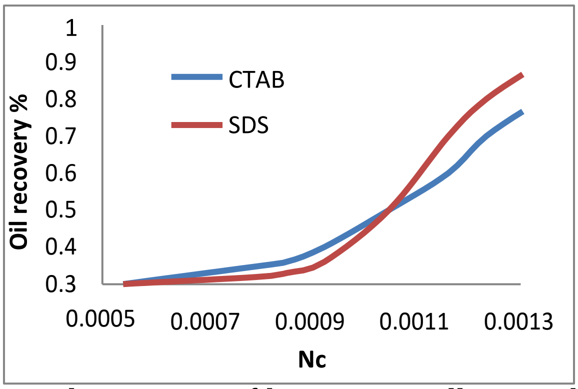

Figure 4: Oil recovery profile against capillary number

Economic analysis

In spite of the fact that the SDS is more affordable than CTAB, the amount spent on CTAB could be balanced by the investment funds in the direct up-front investments essential for treatment of water and the expense of the extra polymer needed when utilizing SDS. Besides less consumption and scale formation is coming about in diminished time for maintenance.

Conclusions

Our investigations have discovered that CTAB has high adsorption for ASP can be figured by including SDS. The SDS is utilized to decrease adsorption, complex multivalent cations, reduce the surface tension and limit the poor recovery contrasted with comparable details utilizing customary CTAB.DS is successful in acquiring low interfacial pressures when detailed into ASP slug liquids.

- It performs similarly also in soften as it does in unsoftened saline solution.
- It doesn't mix with divalent cations, for example, calcium and magnesium.
- It doesn't decrease the polymer impact in expanding its consistency of infusion liquids and enhances the polymer execution.
- As per the electro charge similarity SDS will not adsorb onto the surface of carbonates but for sandstone it will.
- Altering properties like wettability is not possible with SDS onto carbonate surfaces.
- The properties of SDS enable it to be utilized in unsoftened water in this manner decreasing the expenses of water treatment.

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