

## Modification of oilwell cement Properties Using UH Biosurfactant

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**Abstract:** Setting time and compressive strength of oilwell cement were studied with addition of UH-biosurfactant and chemical surfactants (CTAB and SDS). It showed that 1% of UH-biosurfactant increased the electrical resistivity and the setting time to 3.67 h at 200 °F. Addition of surfactant did not significantly affect the compressive strength of the oilwell cement after 24 hours. The highest of 1584 psi was with 1% SDS addition at 200 °F.

### 1. Introduction

Oilwell cements are primarily used for sealing the annular space between the borehole walls and steel casing. Oilwell cement needs to have properties such as: low flow loss of less than 150 mL/30 min, stable suspensions and staying pumpable for enough time, harden rapidly once in place, and retaining high strength and low permeability for 15~20 years (Cowan 1993; Ramachandran 1995). Additives are normally used to modify the oilwell cement properties based on the application conditions. Surfactants have been used in oilwell cement as retarding agent, dispersing agent, and forming agent in a limited manner (Ramachandran 1995). Oilwell cementing is being used in deeper and deeper oil and gas wells and hence requiring better control of the setting and flowability properties.

### 2. Objective

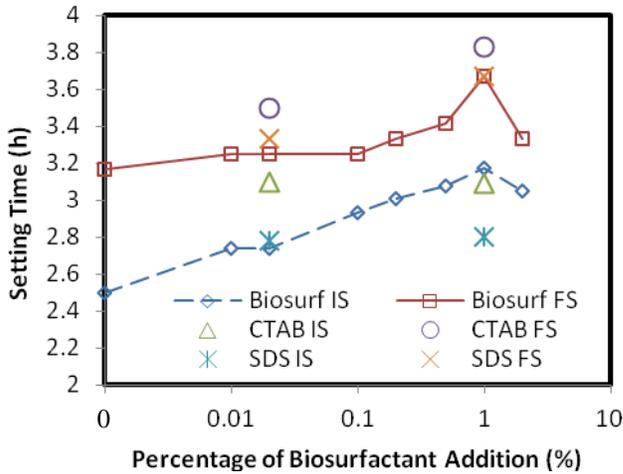
The overall objective was to investigate the effect of UH-biosurfactant on the setting and mechanical behavior of a oilwell cement.

### 3. Materials and Methods

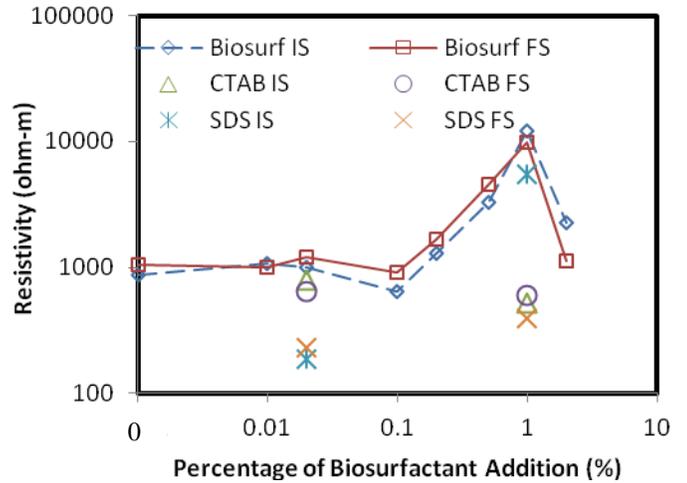
In order to investigate the effect of UH-biosurfactant on the properties of a oilwell cement (API class H-high sulfate resistant), biosurfactant with different percentage (biosurfactant to oilwell cement) of 0.01% ~ 2% was dissolved in tap water and then mixed with the oilwell cement. Setting time at 200 °F was tested using the vicat needle. Setting time of anionic surfactant SDS (sodium dodecyl sulfat) and cationic surfactant CTAB (cetyl trimethyl ammonium bromide) were also tested. The changes of the resistance of specimens were recorded during the test. The compressive strength with 1% biosurfactant addition at 200 °F and 0.02% biosurfactant addition at room temperature was tested and compared with the addition of CTAB and SDS.

### 4. Results and Discussion

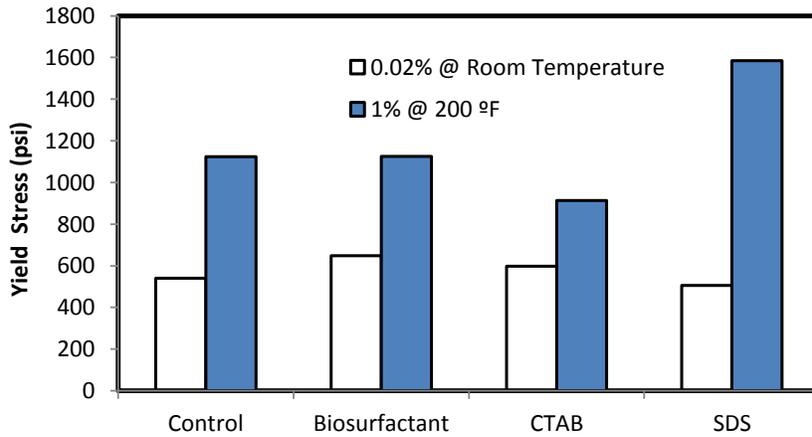
Addition of surfactants increased the setting time of the oilwell cement. Addition of 1% biosurfactant increased the final setting (FS) time and the initial setting (IS) time by 20% to 3.67 h and by 30% to 3.17 h respectively. The increase of the setting time by 0.02% and 1% biosurfactant is comparable to the increase by the same percentage of CTAB and SDS. Maximum enhanced resistivity was observed at 1% biosurfactant. The resistivity increased by 860% with the addition of 1% biosurfactant. Compared to the increase of the resistivity by biosurfactant addition, CTAB and SDS decreased the resistivity in most cases. After 24 h, 1% and 0.02% addition of surfactant did not significantly affect the yield strength of the oilwell cement at 200 °F and at room temperature respectively. The yield strength is 1.5~3.1 times higher at 200 °F with 1% surfactant addition compared to the yield strength at room temperature with 0.02% surfactant addition. The highest yield strength of 1584 psi was obtained by 1% SDS addition at 200 °F.



**Fig.1** Setting Time of Oilwell Cement with Surfactant Admixtures at 200 °F



**Fig.2** Resistivity of Oilwell Cement with Surfactant Admixtures at 200 °F



**Fig.3** Yield Strength Comparison of Oilwell Cement with Surfactant Admixtures after 24 Hours

**5. Conclusions**

Addition of the surfactants increased the setting time of the oilwell cement, while the resistivity could be increased or decreased. 1% of UH-biosurfactant can increase the final setting time to 3.67 h at 200 °F. Addition of surfactant did not significantly affect the compressive strength of the oilwell cement.

**6. Acknowledgements**

This study was supported by Center for Innovative Grouting Materials and Technology (CIGMAT) with funding from industries.

**7. References**

Cowan K.M. (1993). Surfactants: additives to improve the performance properties of cements. Society of Petroleum Engineer. SPE 25181: 317-327.  
 Ramachandran V.S. (1995). Admixtures for oilwell cements, concrete admixtures handbook. 2nd Edition. Noyes Publications. 1077-1109.