

The Effect of Varying Injection Volumes of Surfactant and Polymer on Oil Recovery

Bo Hyun Chon, Sung Bum Jang

INHA University, Incheon 402-751, Korea
bochon@inha.ac.kr

Abstract

Surfactant-polymer flooding, a kind of chemical flooding to produce residual oil after waterflood, is designed to increase additional oil recovery from the reservoir. In this study, a laboratory surfactant-polymer flooding experiment was performed to investigate the effect of injection volume of each solution on the oil recovery. A series of surfactant-polymer flooding experiments have been performed to find the optimal recovery efficiency condition. When a surfactant and polymer combination is injected progressively into the reservoir through injection wells the slug moves towards the production well by water drive. In these processes, several interactions between the surfactant and reservoir fluids (crude oil, brine, etc.) such as the creation of a microemulsion phase, adsorption to the rock, wettability alteration, and reduction of interfacial tension occur because of the injection [1,2]. The surfactant helps oil recovery through oil solubilization and mobilization. The injection of a surfactant lowers the interfacial tension between crude oil and formation water and decreases the capillary forces inside the pore. The surfactant is dissolved in either water or oil at the reservoir to form a microemulsion, which forms an oil bank [3]. The formation of an oil bank and subsequent maintenance of sweep efficiency and pressure gradient by injection of a polymer and chase water increase the oil recovery significantly [4-6]. The polymer controls water-oil mobility ratio to achieve a favorable value such that the injected fluid does not bypass the displaced fluid. By adding polymer to water, the viscosity of water is increased and aqueous phase permeability is decreased. The reduction of water mobility improves the displacement conditions for increasing the oil recovery. The phase behavior test was carried out to observe the conditions required to generate a microemulsion system between surfactant and crude oil. A combination of a 2.5 wt% surfactant solution with 1.5 wt% of salinity was found to be optimal for injection experiments. In the surfactant-polymer flooding test, approximately 0.6 pore volume (PV) of slug was injected into the core. The injected volumes of the surfactant and polymer were varied in each test. The oil recovery after water flooding by the surfactant-polymer injection ranged from 13.6% to 28.6%. The highest oil recovery of 28.6% was obtained by injecting 0.1 PV of surfactant and 0.5 PV of polymer.

Acknowledgement

The authors thank the financial support by the Ministry of Trade, Industry and Energy (MOTIE) for the Korea Energy and Mineral Resources Engineering Program and the Special Education Program for Offshore Plant for this project.

References

- [1] A. Seetherpalli, B. Adibhatla, K. K. Mohanty, "Wettability Alteration during Surfactant Flooding of Carbonate Reservoirs", The SPE/DOE 14th Symposium on Improved Oil Recovery (2004).
- [2] L.L. Schramm, Surfactants: Fundamentals and Applications in the Petroleum Industry, Cambridge University Press, Publications, New York (2000).
- [3] S. Abhijit, O. Keka, S. Ashis, M. Ajay, Adv. Pet. Explor. Dev., 2, 13 (2011).
- [4] D.O. Shah, R.S. Schechter, Improved Oil Recovery by Surfactant and Polymer Flooding, Academic Press Inc., Publications, New York (1997).
- [5] A. M. Michels, R. S. Djojoseparto, H. Haas, R. B. Mattern, P. B. van der Weg, W. M. Schulte, SPE Reserv. Eng., 11, 189 (1996).

[6] T. Austd, J. Milter, "Spontaneous Imbibition of Water into Low Permeable Chalk at Different Wettabilities Using Surfactant", SPE International Symposium on Oilfield Chemistry, Houston (1997).

Figures

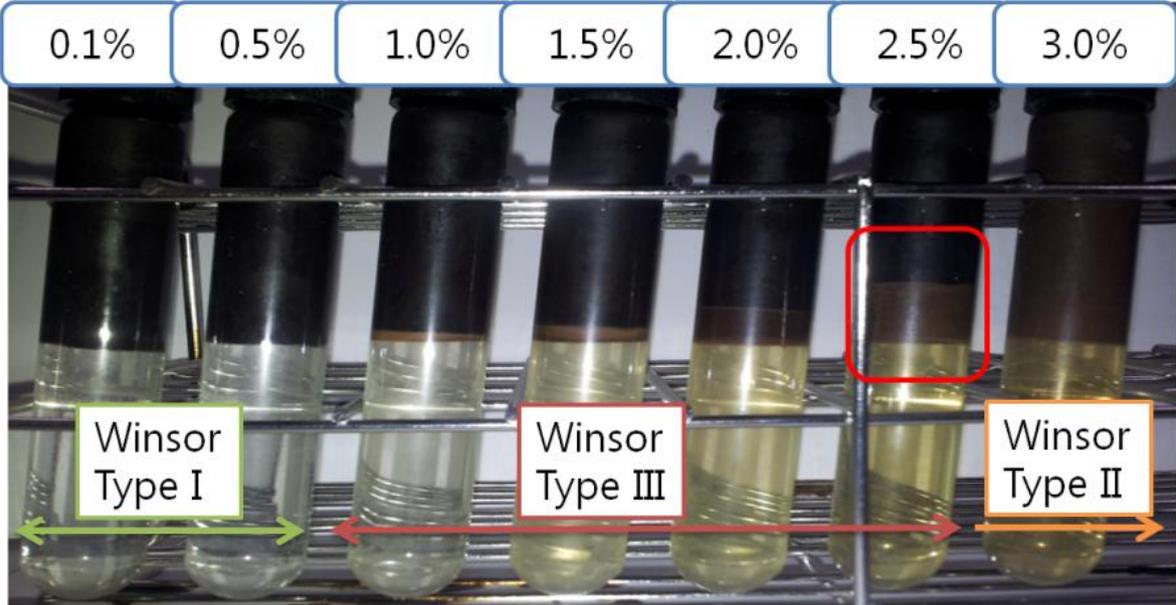


Fig. 1. The effect of surfactant concentration on the phase behavior at 60 °C. The solutions consisted of 0.1, 0.5, 1.0, 1.5, 2.0, 2.5, and 3.0 wt% dodecyl alkyl sulfate and VGH crude oil.

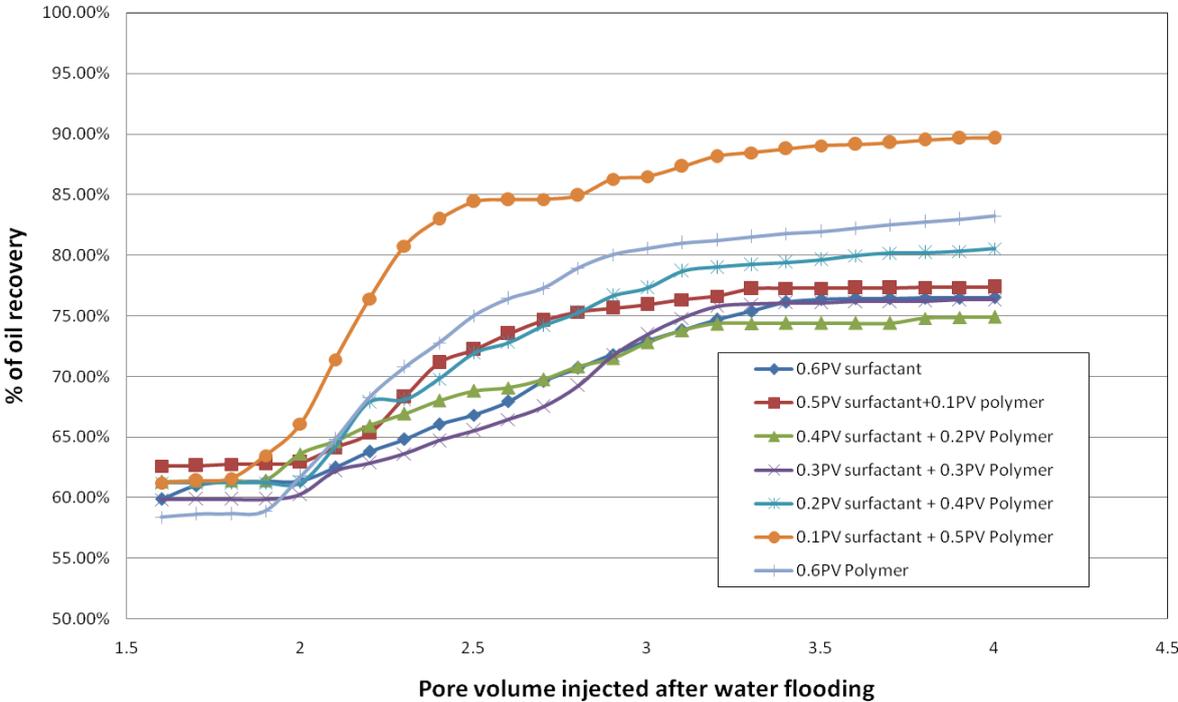


Fig. 2. Production performance of surfactant-polymer flooding after water flooding.