Effect of Graphene Oxide nanoparticles on a heavy oilfield: Interfacial tension, wettability and oil displacement studies

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Abstract

Nanotechnology has emerged as a pivotal player in the hydrocarbon industry, with graphene oxide nanoparticles garnering attention for their unique properties and their incorporation into enhanced oil recovery studies. Despite their promise, there is a notable dearth of core flooding experiments exploring the efficacy of graphene oxide (GO) nanoparticles. This study delves into the exploration, exploitation, and evaluation of GO nanoparticles, focusing on their performance in altering interfacial properties amidst varying electrolyte concentrations representative of field brine. Specifically, salinity levels of 300 ppm, 600 ppm, and 900 ppm were examined, alongside pH assessments within the range of 4, 6, and 8. The concentration of graphene oxide was systematically varied at 0.03 wt%, 0.06 wt%, and 0.09 wt%. Additionally, the wettability behavior of the nanofluid at the oil/sand interface was scrutinized through contact angle and Amott Harvey evaluation. Experimental findings revealed that the adsorption of GO on the sandstone surface transformed its wettability from strongly crude oil-wet to intermediate crude oil-wettability. Remarkably, under conditions of 900 ppm formation brine, 8 pH solution, and 0.09 wt% nanoparticle concentration, the Graphene oxide nanofluid exhibited superior performance across diverse electrolyte concentrations. Notably, heavy oil displacement tests in sandstone cores demonstrated a 7% incremental oil recovery with Graphene oxide nanofluid compared to conventional waterflooding. This study elucidates the potential of graphene oxide in advancing enhanced oil recovery strategies.

References

[1] H. Radnia, A.M. Rashidi, A.R. Solaimany-Nazar, M.M. Eskandari, M. Jalilian, A novel nano-fluid based on sulfonated graphene for enhanced oil recovery. J. Mol. Liq. 271, 795e806 (2018). https://doi.org/10.1016/j.molliq.2018.09.070

[2] Gómez-Delgado, J.L., Rodriguez-Molina, J.J., Perez-Angulo, J.C. et al. Evaluation of the wettability alteration on sandstone rock by graphene oxide adsorption. emergent mater. (2023). https://doi.org/10.1007/s42247-023-00596-8

[3] S. Das, A. Katiyar, N. Rohilla, R.T. Bonnecaze, Q.A. Nguyen, Methodology for chemical formulation for wettability alteration induced water imbibition in carbonate reservoirs. J. Petrol. Sci. Eng. 198, 108136 (2021). https://doi.org/10.1016/j.petrol.2020.108136

Figures

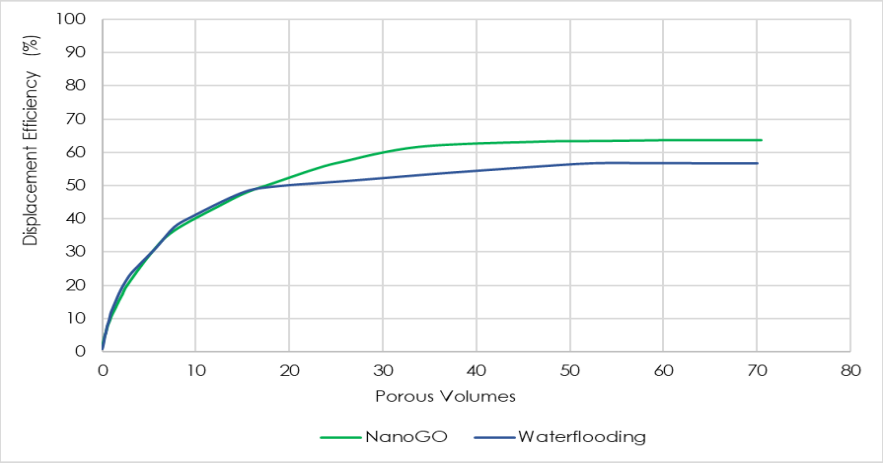

Figure 1: Microscopic displacement efficiency