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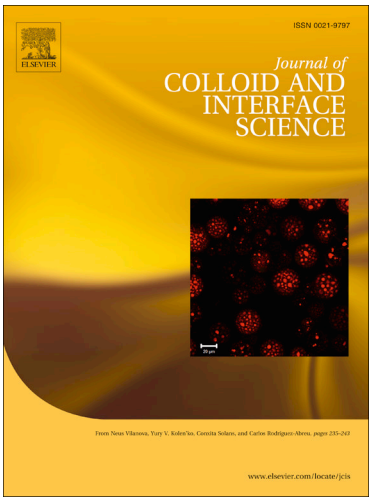

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The application of Pulse Field Gradient (PFG) NMR methods to characterize the efficiency of separation of water-in-crude oil emulsions

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Abstract

Demulsification of water-in-crude oil emulsions is an essential and sometimes challenging procedure for crude oil processing facilities. Pulse field gradient (PFG) NMR techniques are known to monitor the dynamics of emulsion separation. This method has limitations that restrict its application to some crude oils. A comprehensive methodology applicable to all types of crude oil regardless of its viscosity, without assumptions, and providing a large number of data with fast measurements, is proposed in this paper. The coalescence and sedimentation of unstable emulsions was observed through simultaneous measurements of the evolution of the brine profile and droplet size distribution (DSD). Measurements of emulsions after stabilization, with and without the contribution of the free water layer, revealed the residual emulsified water quantity and location in the sample. A new, faster approach to separate the oil and water overlapping T_2 relaxation signals was demonstrated on real water-in-crude oil emulsions, using the root mean square displacement (RMSD) measured with the spoiler recovery and a loop of 13-interval pulsed field gradient stimulated echo (PFGSTE) oneshot sequences. The residual water within the crude oils after separation was determined and used to quantify the efficiency of the demulsifier used.

Key-words: crude oil, water-in-oil emulsions, pulse field gradient (PFG) NMR, brine profile, droplet size distribution, low-field NMR, demulsification, root mean square displacement (RMSD), 13-interval pulsed field gradient stimulated echo (PFGSTE), and oneshot sequence