Accepted Manuscript

Oil-in-Water Nanoemulsion Stabilized by Polymeric Surfactant: Characterization and Properties Evaluation for Enhanced Oil Recovery

Narendra Kumar, Ajay Mandal

PII: S0014-3057(18)31501-5
DOI: https://doi.org/10.1016/j.eurpolymj.2018.09.058
Reference: EPJ 8631

To appear in: *European Polymer Journal*

Received Date: 8 August 2018
Revised Date: 25 September 2018
Accepted Date: 28 September 2018

Please cite this article as: Kumar, N., Mandal, A., Oil-in-Water Nanoemulsion Stabilized by Polymeric Surfactant: Characterization and Properties Evaluation for Enhanced Oil Recovery, *European Polymer Journal* (2018), doi: https://doi.org/10.1016/j.eurpolymj.2018.09.058

Oil-in-Water Nanoemulsion Stabilized by Polymeric Surfactant: Characterization and Properties Evaluation for Enhanced Oil Recovery

Narendra Kumar and Ajay Mandal*

Department of Petroleum Engineering,
Indian Institute of Technology (Indian School of Mines), Dhanbad, India-826 004
Corresponding Author: E-mail: ajay@iitism.ac.in

Abstract

Nanoemulsions are kinetically stable colloidal dispersion of oil and aqueous phase with droplet size < 200 nm, usually stabilized by a surfactant. In the present study an attempt has been made to formulate a novel type of nanoemulsion stabilized by a synthesized polymeric surfactant (polymethyl ester sulfonate, PMES), which has dual properties of reducing interfacial tension (IFT) and enhancement of viscosity. The droplet size of less than 200 nm of the dispersed oil phase in the formulated nanoemulsion, measured by dynamic light scattering (DLS) analysis and zeta potential values (ζ) of less than -30 mV, indicate its high kinetic stability. Stable viscosity values with shear thinning and shear thickening nature in wide temperature (30−70°C) range denoted enhanced thermal stability with improved mobility and displacement efficiency of nanoemulsions. The stability and viscosity of the nanoemulsion is further improved by incorporation of silica nanoparticles (NPs). Cryo-TEM micrographs unveil the stabilizing mechanism, interaction of oil droplets with polymer branching of PMES surfactant and silica NPs. Viscoelastic behavior investigated by Oscillatory method shows that the dynamic moduli, storage (G′) and loss (G″) of nanoemulsions follow the Maxwell model for viscoelastic materials. Specific frequency (SF) or cross over point of G′ and G″ denote the transition between viscous and elastic phases. A shift in SF position by variation in salinity, temperature and NPs concentration change the viscoelastic property of nanoemulsions.

Keywords: Nanoemulsions, polymeric surfactant, viscosity and viscoelastic properties, Maxwell model, Enhanced oil recovery

Introduction

The perpetual decline in oil production has raised a need to improve the oil recovery by development of new technologies to recover the un-swept areas of the reservoir. Enhanced oil recovery (EOR) technique comprising approaches of thermal, miscible-immiscible, chemical