Formulating and characterizing an oilin-water palm oil free fatty acid-based Nanoemulsions for crude oil extraction Performance

ABSTRACT

Nanoemulsion is a promising medium for chemically enhanced oil recovery (cEOR) due to its ability to reduce interfacial tension and modify the wettability of reservoir rocks. This work focuses on formulating stable oil-in-water (O/W) nanoemulsions through high-energy ultrasonication method, with oleic acid as the primary component and is stabilized with a non-ionic Tween 40 surfactant in distilled water. Systematic experimental designs, employing response surface methodology (RSM), were implemented to develop polynomial models for various responses related to the dynamic and stability properties, and crude oil extraction performance. The p-value indicator (p-value < 0.05) is utilized to assess the significance of the models and independent variables. Overall, the formulation for achieving the lowest surface tension involves 0.41 wt.% oleic acid mixed with 0.81 wt.% Tween 40 at 60 °C. Meanwhile, the highest viscosity attained with 1.0 wt.% oleic acid mixed with 1.0 wt.% Tween 40 at 30 °C. For stable nanoemulsion, the best conditions are 1.69 wt.% oleic acid, sonicated for 15 minutes at 25 °C. Additionally, an optimal condition for effective crude oil extraction is at nanoemulsion preparation with sonication time of 15 minutes and contact time of 12 hours in the immersion experiment. To this end, this work contributes valuable insights into the formulation and characterization of stable oleic acid O/W nanoemulsions for potential EOR applications. The findings enhance understanding of nanoemulsion properties and their potential as effective agents in crude oil recovery.