

Evaluation of Produced Water Treatment Using Advanced Oxidation Processes and Sodium Ferrate(VI)

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Abstract : Oil and gas exploration is an essential activity for modern society, although the supply of its global demand has caused enough damage to the environment, mainly due to produced water generation, which is an effluent associated with the oil and gas produced during oil extraction. It is the aim of this study to evaluate the treatment of produced water, in order to reduce its oils and greases content (OG), by using flotation as a pre-treatment, combined with oxidation for the remaining organic load degradation. Thus, there has been tested Advanced Oxidation Process (AOP) using both Fenton and photo-Fenton reactions, as well as a chemical oxidation treatment using sodium ferrate(VI), Na_2FeO_4 , as a strong oxidant. All the studies were carried out using real samples of produced water from petroleum industry. The oxidation process using ferrate(VI) ion was studied based on factorial experimental designs. The factorial design was used in order to study how the variables pH, temperature and concentration of Na_2FeO_4 influences the O&G levels. For the treatment using ferrate(VI) ion, the results showed that the best operating point is obtained when the temperature is 28 °C, pH 3, and a 2000 mg.L⁻¹ solution of Na_2FeO_4 is used. This experiment has achieved a final O&G level of 4.7 mg.L⁻¹, which means 94% percentage removal efficiency of oils and greases. Comparing Fenton and photo-Fenton processes, it was observed that the Fenton reaction did not provide good reduction of O&G (around 20% only). On the other hand, a degradation of approximately 80.5% of oil and grease was obtained after a period of seven hours of treatment using photo-Fenton process, which indicates that the best process combination has occurred between the flotation and the photo-Fenton reaction using solar radiation, with an overall removal efficiency of O&G of approximately 89%.

Keywords : advanced oxidation process, ferrate (VI) ion, oils and greases removal, produced water treatment

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