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Review article

Review on demulsification techniques for oil/water emulsion: Comparison of recyclable and irretrievable approaches

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ABSTRACT

Since the establishment of the first global refinery in 1856, crude oil has remained one of the most lucrative natural resources worldwide. However, during the extraction process from reservoirs, crude oil gets contaminated with sediments, water, and other impurities. The presence of pressure, shear forces, and surface-active compounds in crude oil leads to the formation of unwanted oil/water emulsions. These emulsions can take the form of water-in-oil (W/O) emulsions, where water droplets disperse continuously in crude oil, or oil-in-water (O/W) emulsions, where crude oil droplets are suspended in water. To prevent the spread of water and inorganic salts, these emulsions need to be treated and eliminated. In existing literature, different demulsification procedures have shown varying outcomes in effectively treating oil/water emulsions. The observed discrepancies have been attributed to various factors such as temperature, salinity, pH, droplet size, and emulsifier concentrations. It is crucial to identify the most effective demulsification approach for oil/water separation while adhering to environmental regulations and minimizing costs for the petroleum sector. Therefore, this study aims to explore and review recent advancements in two popular demulsification techniques: chemical demulsification and magnetic nanoparticles-based (MNP) demulsification. The advantages and disadvantages of each technique are assessed, with the magnetic approach emerging as the most promising due to its desirable efficiency and compliance with environmental and economic concerns. The findings of this report are expected to have a significant impact on the overall process of separating oil and water, benefiting the oil and gas industry, as well as other relevant sectors in achieving the circular economy.

1. Introduction

For over a century, crude oil has been the primary energy source driving the global economy, existing in the form of hydrocarbons (Adam et al., 2020; Hassan et al., 2021, 2022a, 2022b, 2023). Due to rapid population growth, our world has become excessively reliant on energy reserves for both domestic and industrial needs, leading to an estimated 50% increase in global energy consumption by 2050 (Adam et al., 2020). In reservoirs, crude oil coexists with water and rocks, and the presence of these physical entities affects the mobility of the oil (Hassan et al., 2022c). Various approaches have been employed to improve oil mobility by reducing the strong forces between oil and water, such as

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