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Mixing of Crude Oil with Organic ZnO Nano-Particles from Rice Bran to Improve Physical Properties of Crude Oil: A Novel Agent for Enhanced Oil Recovery

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In this study, ZnO nanoparticles were modified with rice bran. Synthesis and production of ZnO nanoparticles is highly important due to the use of rice bran. In addition, XRD and SEM analyses were used to ensure the production quality of the nano-particles. The images clearly showed surface uniformity of the synthesized organic ZnO nano-particles. Afterward, the modified nano-particles were injected into crude oil in different weight percentages according to their properties (heavy and light crude oil). The injection was done at a temperature range of 30–150 °C with operating pressures varying from 10 bar to 300 bar. The adhesion force created between heavy or light crude oil molecules and organic ZnO nanoparticles was modified with rice bran. Furthermore, an increase in the operating temperature increased the thermal conductivity of oil samples from 0.21 to 2.54 W/m °C for the light crude oil sample and 1.56–6.3 W/m °C for the heavy crude oil sample. The results showed that the percentage of the asphaltene precipitation decreased with the increased API of the crude oil. In addition, the percentage of asphaltene precipitation for nano-light and heavy crude oil was considerably better than the simple light and heavy crude oil samples, respectively. The nano-particles improved the crude oil recovery from reservoirs. The results indicate that the probability of asphaltene precipitation in the case of light crude oil nanoparticles is less than the simple light crude oil by 28.3%. This is 8.1% for the heavy crude oil compared to the simple heavy crude oil.

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