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Research Article

Production of Zinc Bioxide from Rice Grains to Increase the Efficiency of Oil Reservoirs

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Abstract

In this study, ZnO nanoparticles were modified with rice bran. The production of modified nanoparticles due to the usage of rice bran has a high level of importance. Produced nanoparticles were evaluated by a usage of XRD and SEM analysis in order to ensure from the production quality of the nanoparticles. The images are shown uniformity of surface of synthesized organic ZnO, clearly. Afterward, the modified nanoparticles were injected into the raw petroleum in different weight percentages with respect to their properties (heavy and light petroleum). The injectection is done at a temperature range of 30°C to 150°C and operating pressures is varied between 10 bar to 300bar. The nano can improve oil recovery from reservoirs. Results show, the probability of asphaltene precipitation, making for nano light oil is 28.3% less than simple light oil. This value for nano heavy oil is 8.1%.

Keywords: Organic ZnO Nanoparticle; Asphaltene; Crude Oil; Oil Recovery; Density; Viscosity; Thermal Conductivity

Introduction

The crude oil is a natural mixture of liquid hydrocarbons that remains in liquid form both in the underground and in the reservoirs, after passing through the separators. The accumulation of hydrocarbon materials is under the surface of the earth takes place in rocks that are capable of holding and transferring fluids. These rocks are called reservoirs or tanks). The stage of crude oil transfer from the fields of production to refineries and consumption centers is difficult because of the passage of rugged routes [1]. Typically, crude oil can be transported through domestic refineries and export terminals via pipelines and crude oil shipping vessels [2]. The accumulation of hydrocarbon materials economy in the reservoir is subject to several factors. The crude oil is essentially composed of paraffinic, naphthenic and aromatic hydrocarbons. In addition, there is a small amount of sulfur compounds, nitrogen, oxygen, and a small amount of metals in crude oil. The wax sedimentation is one of the major issues and challenges in the transportation of crude oil [3]. Furthermore, some deposits with asphaltene compounds and some water and solids in the crude oil cause the pipe to close [4]. When the deposition occurs somewhere like the vertical column of the well, removing it. In addition, environmental problems require much equipment's, time and cost [5]. One of the important attributes of asphaltene is their molecular weight. Many studies have been done on the distribution of molecular weight of asphaltene. Various techniques are used to measure the molecular weight of heavy compounds [6]. The organic zinc oxide nanoparticles with rice bran shell is synthesized in this paper. Heavy and light crude oil is selected as samples. The physical properties of crude oil are investigated after mixing the nanoparticles with the two types of crude oil in this research.

Materials and Methods

Experimental equipment's

The experimental equipment's are listed below; Balloons for pouring solutions is used. The beaker for solubilization, weighting scales for females, the magnet for mixing solutions in balloons,

steamer for mixing samples and measuring temperature are used. In addition, the thermometer for measuring temperature, pipette for removal of material, heat exchanger for heat transfer, filter paper for sample straightening are used, respectively.

Results and Discussions

As is shown in the figure 1, with an increase in nanoparticles of ZnO nano oxide based on rice shell, from 1wt% to 3wt% of asphaltene precipitation decrease from 2.2% to 1.58%.

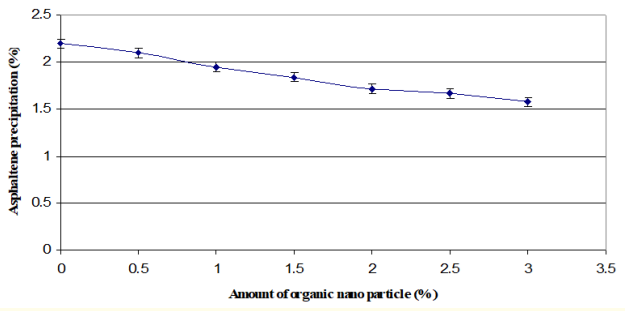

Figure 1: Asphaltene precipitation of light oil versus nano weight percentage.

The percentage of deposition of asphaltene in reservoirs depends on changes in operating pressure, temperature and oil composition. If these factors collapse, It will collapse the chemical balance in the reservoir, which will result in the formation of sedimentation, also. Experimental results illustrate the percentage of asphaltene precipitation in nano light and heavy oil is 28.3% less than simple light oil. It means, the nanoparticles can improve oil recovery from reservoirs.

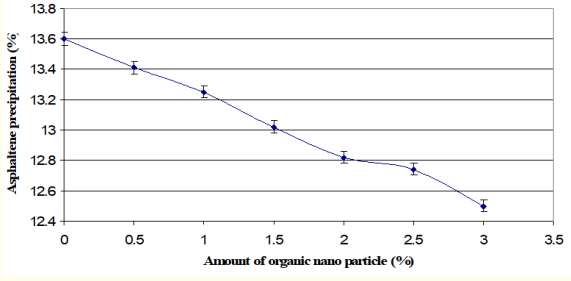

Figure 2: Asphaltene precipitation of heavy oil versus nano weight percentage.

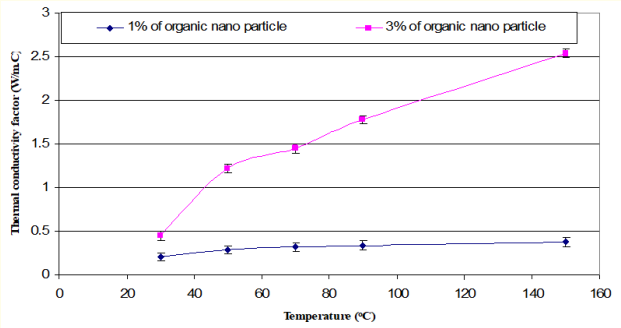

Figure 3: Thermal conductivity coefficient of light oil versus temperature.

In heavy oil, the thermodynamic equilibrium is extremely as is shown in the figure 2. In addition, the asphaltene sedimentation rate decreased by 1wt% to 3wt% of nanoparticle from 13.6% to 12.5%. In addition, the percentage of asphaltene precipitation for nano heavy oil is 8.1% less than simple heavy oil. The nanoparticles, which are mixed with text of oil can distribute the heat and this factor can decrease the viscosity and the formation of asphaltene precipitation. So, nano heavy oil passes the tube line fluently rather than simple heavy oil. Asphaltene sedimentation is one of the most important problems in the operations of crude oil transportation. Asphaltene mode near the wells can block the openings of the gaps and change the characteristics of the moisture content relative to the permeability. Therefore, the nail is reduced and in some cases. The amount of asphaltene sedimentation can cause the pipe to be close in the event of the transfer of crude oils with a higher viscosity, there is the possibility of oil gelling and flow stops which will change the behavior of crude oil. Therefore, the lack of complete information on the thermal behavior of various serial flows is necessary by the effect of the temperature of the environment around the transmission line and the overall heat transfer coefficient. The results of study, can be concluded that modified zinc oxide nanoparticles of rice bran have a high ability to distribute the heat along the crude oil. And it can be a very good nod to the problems caused by deposits in oil pipelines. In this study, significant changes were observed in the asphaltene sedimentation with the addition of this organic nanoparticles. Figure 2 shows the thermal conductivity coefficient of crude oil, which is mixed by 1wt% and 3wt% of nanoparticles.

As is shown, increasing the temperature from 30 to 150 centigrade degree with increasing the time from 15 and 40 minutes, the conductive heat transfer coefficient is increased. Since the thermal conductivity coefficient can be a function of temperature, the kinetic energy of the nanoparticle molecules increases with increasing temperature as a result, the thermal conductivity coefficient increases. According to the figure 2, with the increase of nanoparticles amount from 1wt% to 3wt%, the trend of thermal conductivity coefficient increasing is seen from 0.21 W/m.C to 0.38 W/m.C and 0.45 W/m.C to 2.54W/m.C, respectively. As the nanoparticles increase, the conductivity coefficient increases at different times and at different temperatures. Due to the zinc oxide nanoparticle is metal and the conductivity and electricity factor of metal is high. Whereas, increasing in temperature values can increase the Brownian motion and finally the interaction of nanoparticles molecules and so the thermal conductivity factor will increase. The higher thermal conductivity coefficient is desirable for heating and cooling process. Figure 3 and 4 show the variation of conductivity coefficient of light and heavy oil versus operating temperature, respectively. The figure 3 shows the thermal conductivity of heavy oil, which is blended with 1wt% and 3% of modified zinc oxide nanoparticle. According to the related diagram, with mixing of 1wt% of organic ZnO into heavy oil increasing thermal conductivity coefficient from 1.56W/m.C to 2.92W/m.C. this progressive for 3wt% of the nanoparticle is 3.68W/m.C to 6.3W/m.C.

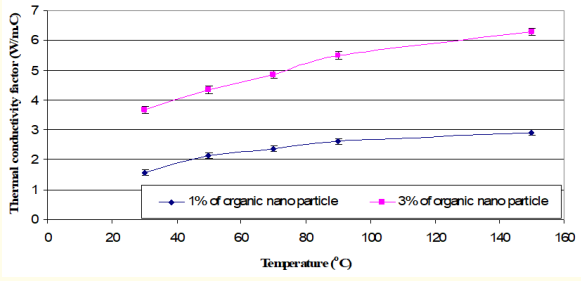

Figure 4: Thermal conductivity coefficient of heavy oil versus temperature.

It can be concluded with increasing of nanoparticles amount and temperature, the thermal conductivity coefficient has increased in different times and at different temperatures. Since the thermal conductivity coefficient can be a function of temperature, the kinetic energy and thermal uniform distribution.

Conclusion

The modified zinc oxide with desirable properties with especial procedure are synthesized in this paper. The experimental results show the physical properties of heavy and light nano oil will improve after adding the modified ZnO nanoparticles based on rice shell. The experimental results of this study show that the thermal conductivity coefficient for crude oil and the region is much lower than when added to organic zinc oxide nanoparticles. Therefore, this mechanism of increasing the thermal conductivity coefficient in oil and nanoparticles can be explained in two respects:

- First, organic zinc oxide nanoparticles have been able to increase the thermal conductivity.
- And the other is that the nanoparticle's random motion in crude oil and subsequently the thermal diffusion of the temperature distribution is flattened. So, the gradient of temperature rises between the petroleum as fluid and the wall. This subject increases the driving force and heat transfer which is occurring between petroleum pipe wall.
- The density variation in heavy oil with 1wt% and 3wt% of the nanoparticle is 80.1% and for light oil is 85.2%, approximately.
- The results show increasing percentage of thermal conductivity coefficient of light oil with 1wt% and 3wt% of organic ZnO is 44.7% and 82.3%, respectively. This increasing percentage of heavy oil is 44.6% and 41.6%, respectively.

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