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Synergetic Effect of Nano-Particle Synthesized from the Bran of Rice with Petroleum for Enhancing Crude Oil Physical Properties

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ABSTRACT

This study modified zinc oxide nanoparticles using rice bran. Rice bran is crucial for zinc oxide nanoparticle production. Finally, XRD and SEM investigations verified nanoparticle production quality. Photos showed the synthesized organic zinc oxide nano-particles' surface uniformity. Afterwards, medium and light crud oils were treated with customized nanoparticles at varying weight percentages. At pressures from 10 to 300 bar, injection was done at 30-150 C. Adding rice bran to the adhesion force of light or medium crud oil molecules modified organic zinc oxide nanoparticles. Both the light and medium crud oil samples showed a rise in thermal conductivity from 0.19 to 2.45 W/m C and 1.61 to 6.45 W/m C, respectively, as the working temperature was raised. Findings showed that asphaltene precipitation % fell as crud oil API grew. Nano-light and medium crud oil had more asphaltene precipitation than basic light and medium crud oil. Nanoparticles improved reservoir crud oil recovery. Compared to normal light crud oil, light crud oil nanoparticles reduce asphaltene precipitation by 28.3%. Compared to simple medium crud oil, this is an 8.1% increase.

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1. INTRODUCTION

The natural combination of liquid hydrocarbons called crud oil remains in a liquid state within the underground and the reservoirs after it passes through the separators. Petroleum compounds are most commonly found in rocks that can retain and transfer fluids, which are located deep within the Earth. These rocks are often referred to as reservoirs or tanks. According to [1], the process of transporting crud oil from production regions to refineries and consumption centers is complicated by uneven paths. From regional refineries to export ports, crud oil is often transported via pipelines and crud oil ships [2]. How quickly hydrocarbons accumulate in the reservoir is affected by a number of variables. Crud oil contains essential hydrocarbons such as aromatic, paraffinic, and naphthenic hydrocarbons. Nitrogen, oxygen, sulfur compounds, and a few metals are also present in crud oil, although to much smaller amounts. According to [3], [4], wax sedimentation is a significant problem that arises during the transportation of crud oil. In addition, clogs can form in pipelines due to asphaltene compound deposits, crud oil particles, and water [5]. The answer to deposition that happens in a well's vertical column is to remove it. Furthermore, environmental issues necessitate substantial resources [6]. Its molecular weight is an essential property of asphaltene. The asphaltene molecular weight distribution has been the subject of a great deal of research. The molecular weight of medium substances has been measured using several techniques [7]. Light absorption viscometers and osmotic vapour pressure meters are examples of these methods. According to [8], these processes typically yield asphaltene with an average molecular weight from different types of crud oils. One example of an equilibrium thermodynamic phenomenon is the solubility or suspension of asphaltene particles in crud oil [9].
Additionally, it has been modelled using the thermodynamic equilibrium. Any change to effective components can lead to the accumulation of aggregation phenomena and the elimination of suspension [10]. According to [11], [12],

asphalting particles will inevitably settle to the bottom. In addition, the refining sector takes crud oil and uses hydrocarbon separation and conversion procedures to make a variety of commercial petroleum products. Furthermore, nanotechnology is among the novel approaches that have recently made their way into the petroleum sector [3], [4]. There might be huge shifts in the many oil and gas industries brought about by the novel nanotechnology. As previously mentioned, crud oil is the name for heavy or medium oil, and it does not flow readily. Heavy and medium oils, bitumen, and unconventional oil reserves are believed to surpass 6 trillion barrels, according to recent studies. According to [9], [10], this quantity accounts for over 70% of the world's energy resources that come from fossil fuels. Despite this science's brief tenure in the oil business, it has improved and facilitated oil extraction in multiple ways, such as by lowering surface tension, altering wettability, and decreasing viscosity. Lots of people have looked into oil and its byproducts, such as ways to make it sweeter, the physical characteristics of medium oil components, how to evaluate oil extraction methods, how sedimentation works, and how to stop or lessen the precipitation of heavy compounds, particularly asphaltene (Simonsen et al. 2018). As a result of its electrical properties, excellent thermal conductivity, adequate resistance to ultraviolet radiation, and strong coating strength,medium dielectric constant, and high refractive index, mineral ZnO nano-particles are expensive to use nowadays [11], [12]. In order to improve the qualities of synthetic fluids like oil, researchers currently are using scientific methods that involve adding nano-particles to fluids at low volumetric concentrations [13]. Nanosilicates' remarkable sensitivity to nano-particle size is one of its most distinctive characteristics. To better remove heavy molecules, smart fluids can alter the wettability, tensile strength, and gel strength, among other properties. Because their hydrocarbon chains are too lengthy to dissolve in water or any basic fluid, molecules with more than 14 carbons in their chain are known as insoluble surfactants in water. According to [14], nano-surfactants are materials whose dimensions fall within the range of less than 100 nm. A material's activity is proportional to its size and activity level, according to study. According to [15], reservoir rock's characteristics can be altered by utilising certain nano-particles. The main goal of utilising surfactants to enhance heavy molecule removal is to decrease surface tension, which in turn corrects the reservoir's wettability and lowers the oil's viscosity. Nevertheless, a significant portion of these substances are either absorbed during the early stages of development or have the opposite impact on wettability. However, improving harvests is the goal of lowering capillary pressure and raising formation permeability [16]. The use of nano-surfactants improves fluid flow by lowering the capillary pressure in the tank's refractory, according to the research. The reason behind this is that these materials' active surface area and capacity to permeate cavities are much enhanced when their dimensions are in the nanoscale range [17].The term "nano-fluid" refers to a mixture of base fluid and nano-particles, or particles with an average size less than 100 nm. The base fluid could be anything from oil to water to gas. To enhance water flooding recovery, nano-fluids are often created by dispersing different types of nano-particles in water or brine [18], [19]. Metal oxide has a lesser heat capacity compared to organic and other tiny molecules. Some studies have shown that organic compounds, including mineral oils, require more energy to be heated than metals and metal oxides [14]. The mineral oil used is of a lighter viscosity than the usual, in order to allow convection currents to flow more easily. Convection currents, which are ideal for heat transmission, thrive under the conditions found in a transformer tank and heat transfer cell,and the lesser viscosity of mineral oil makes this possible [20], [21]. Among the nanoparticles, zinc oxide is the most reactive. In order to remove hydrogen sulphide from sour fuels, zinc oxide nanoparticles have found extensive use in petrol and oil refineries. Consequently, our investigation utilised this particular form of nano particle. Nanoparticles of zinc oxide are also unstable and poisonous when used in large quantities. Consequently, in order to alter the structure, zinc oxide nanoparticles were combined with rice bran, an organic component. Also, rice bran's active surface as an absorbent can be enhanced by combining zinc oxide nanoparticles with it. We are working quickly to implement this method as soon as possible. The producer in question will see widespread use in the industrial sector [22], [23]. Synthesis of zinc oxide nanoparticles using rice bran is detailed in this work. Two types of crud oils, light and medium, were chosen for the feed sample. After combining the two crud oils with the zinc oxide nanoparticles, their physical characteristics were studied.

2. MATERIALS AND METHODS

Tools for Scientific Investigation Here is a list of the experimental equipment that was used: Various tools were utilised for this experiment, including flasks for solution pouring, beakers for solubilisation, magnets for solution mixing within the flasks, and a steamer for sample mixing and temperature measurement. Also utilised were a pipette for material removal and a thermometer for temperature measurement. To raise the temperature of the sample, the heating system was turned on. A hydrometer was also employed to measure the specific gravity. Additionally, materials were tested at temperatures other than ambient using the cooling and heating tubs. The separation of heavy substances was accomplished using filtration machinery. This study made use of X-ray and ultrasonic equipment made in the Netherlands. Scanning electron microscopy using Hitachi, Antoine, and Soxhlet devices allowed us to measure the amount of asphaltene. Finally, the effects of operating pressure and temperature on density and viscosity were evaluated, and experimental studies were carried out to determine the significance of asphaltene precipitation and thermal conductivity as factors influencing the fluidity of oil in pipelines.

2.1. Solutions preparation

In this investigation, the following material was utilised: A solution containing 2 weight percent acetic acid (99.9% yield), 45 weight percent sodium hydroxide (99% yield), 15 weight percent zinc acetate dehydrate (99.5% yield), 1 gramme of rice bran, 1 gramme of ordinary heptane, and 1 gramme of distilled water (88% yield). The Merck Company supplied us with all of these chemicals. Light crud oil from the Al ahdab reservoir and medium crud oil from the Badrah reservoir were the feed samples used in this investigation.

2.2 Organic Zinc Oxide nanoparticle synthesis

According to [14], the zinc oxide nanoparticles were created using a chemical deposition process. So, 2 millilitres of acetic acid was transferred to a beaker using a pipette for the first solution. Then, using a graduated cylinder, 98 millilitres of distilled water was added to the same beaker. The researchers in this work employed acetic vinegar to break the connections between the particles. The acetic acid solution was then supplemented with 1 gramme of rice bran. A magnet mixer was used to mix this solution for 30 minutes. Afterwards, the solution was subjected to an ultrasonic device operating at 30 C and 150 W for a duration of 10 minutes. Filtration of the resulting solution followed. Lastly, the particles that were created were rinsed with ethanol and double-distilled water, in that order. To make sure the rice bran precipitate was clean, we washed it [24]. The second solution was made up of a 15 weight percent solution of zinc acetate dihydrate. The solution was transferred to a flask in 30 ml when it had become clear. Salt hydroxide (45 weight percent) makes up the third solution. Thirty millilitres of the clear solution was transferred to the second solution flask after preparation. The last step was to combine the filtrate from the first solution with the zinc acetate and sodium hydroxide solution, using the leftover particles on the paper. We used a magnet mixer to combine the resulting solution, and then we heated it in an oil bath to 70 degrees Celsius for four hours. A thermometer was used to regulate the temperature during the trials. The solution was then mixed for 12 hours after the temperature was turned off. The resulting solution was subjected to a 10-minute ultrasonic treatment at 150 watts. The process concluded with filtering the solution and then drying the precipitates in an oven set at 50 C for 12 hours. To confirm the synthesis of zinc oxide nanoparticles, pictures were acquired from the precipitates using optical, X-ray, and scanning electron microscopy techniques.

2.3. Assessed factors

The physical conditions of two regions were compared in this study using crud oil samples. Oil from Al-Ahdab field in Iraq's Wasit governorate was the initial candidate. The field is located in the western part of the country. And Badrah oil field, located in Wasit governorate, about 160 km to the southeast of Baghdad, the capital of Iraq, was the source of the second crud oil to be chosen. This study experimentally assessed the viscosity and density of crud oil in pipeline following injection of organic zinc oxide nanoparticles, two essential features of this fuel. Further, experimental investigation was conducted to determine the impact of nanoparticles amount on asphaltene thermal conductivity and precipitation. Finally, analysis and interpretation of the results were carried out.

3. RESULT AND DISCUSSIONS

3.1. Optical images results

Optic pictures of organic zinc oxide nanoparticles modified with rice bran are shown in Fig. 1. Fig. 2a and 2b show the oil optic before and after adding organic zinc oxide nanoparticles modified with rice bran, respectively. Fig. 2 clearly shows the oil surface's homogeneity and shape.

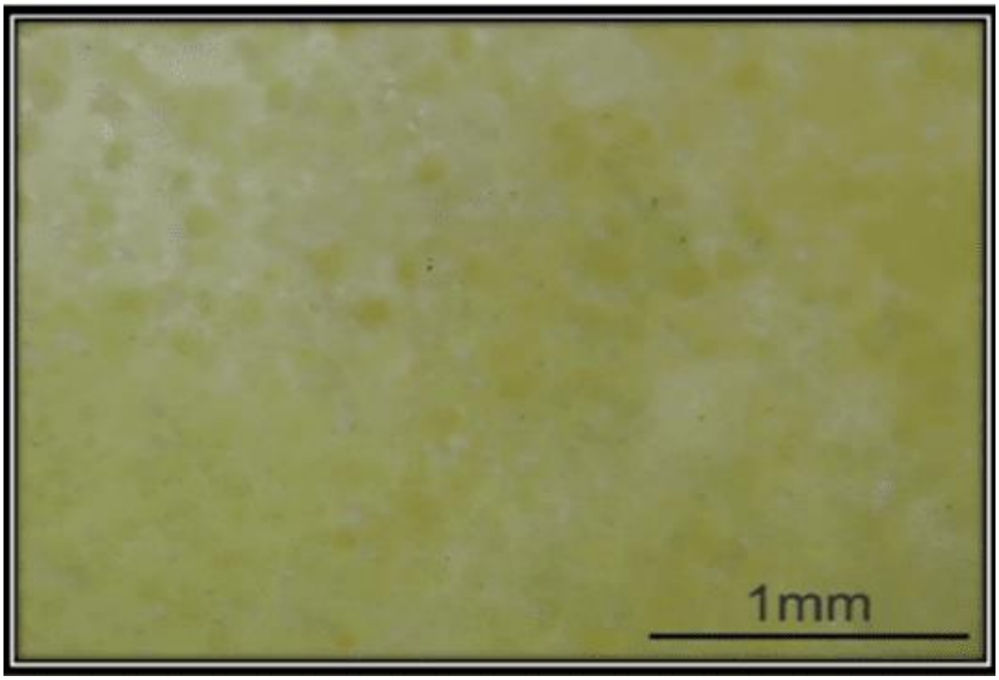

Figure 1. Optic picture of Zinc oxide nano-particles.

3.2. X-ray Analysis

The Bragg equation can be used to determine the particle layer gap. Hence, the Bragg's law was used to determine the layer distance between the zinc oxide nanoparticles. We can see this relationship in Eq. 1.

$$n\lambda = 2\text{d}\sin(\emptyset) \quad (1)$$

where d is distance between Zinc oxide adjacent layers, ∅ diffraction angle ,and λ is X-ray beam wavelength. Eq. 2 is derived from the Braggs equation to derive d.

$$d = \lambda/2\sin(\emptyset) \quad (2)$$

Each mineral has its own distinct set of d-spacing, so converting diffraction peaks to d-spacing is one way to identify them [15]. A common method for doing this is to compare the d-spacings to some kind of standard reference pattern. The major peak has a 2∅angle, as shown by the sample analytical results, since organic material (rice bran) was added. In Fig. 3, the peak's deviation angle is smaller than 2 degrees. Based on Fig. 3 (shown with bran as the organic foundation) and Fig. 2a (shown without the organic base), it is clear that the synthesised zinc oxide nanoparticles are of high quality. Fig. 3 shows the XRD pattern of the synthesised zinc oxide nanoparticles, which shows the hexagonal wurtzite structure's distinctive peaks. The results from the experiment are in agreement with what the JCPDS has determined. There is good shape and form to the XRD peaks. The lattice planes (100), (002), (101), (110), (103), (112), and (201), respectively, correlate to the 2h values of 17.79, 27.421, 29.252, 32.51, 35.602, 41.962, 48.961, and 51.79 that show the strongest XRD peaks.

3.3. Scanning electron microscopy analysis

The zinc oxide nanoparticles that were altered by rice bran are shown in Fig. 4 as photographic images. Scanning electron microscopy Fig. 4 (magnification 10,000 x) shows that the surface is uniformly covered by most particles. Nanoparticles of synthesised zinc oxide have a granular form and an average size of 35 nanometres. Its purity level is 99%. The synthesis process determines the purity. Investigating the synthesised zinc oxide nanoparticles using scanning electron microscopy and energy-dispersive X-ray spectroscopy reveals that the organic rice bran is distributed correctly as the zinc oxide nanoparticle matrix. The specimen's uniform surface and evenly distributed

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nanoparticles, as observed in the given forms, are results of using a sonicator and a mechanical stirrer. Also, by capturing optical photographs, the diameters of the synthesised zinc oxide nanoparticles could be easily quantified.

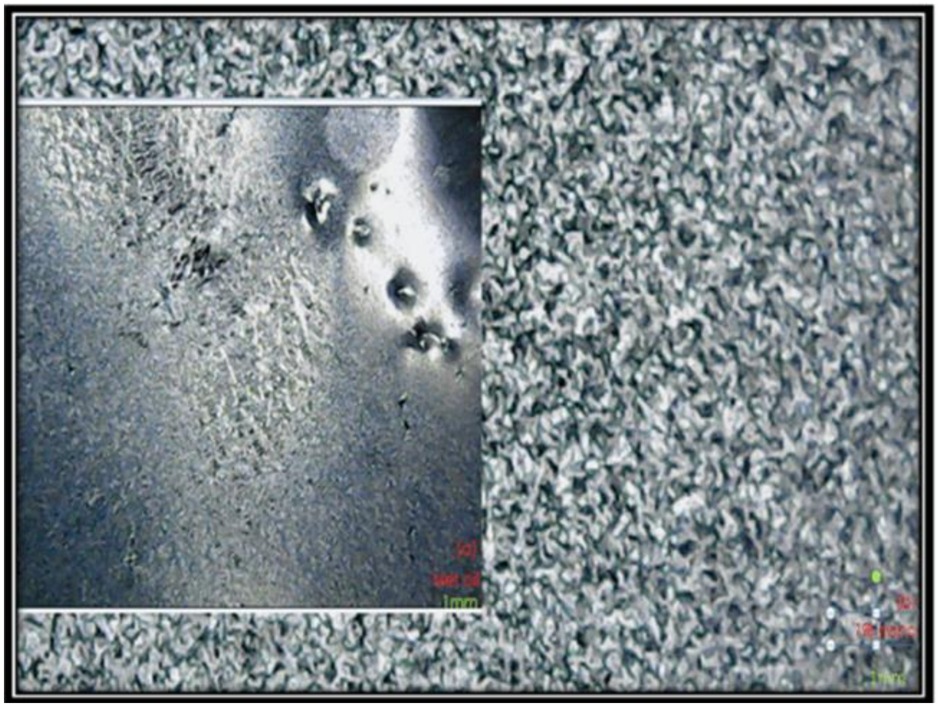

Figure 2. Optic picture for a) crud oil without nanoparticles b) with nanoparticles.

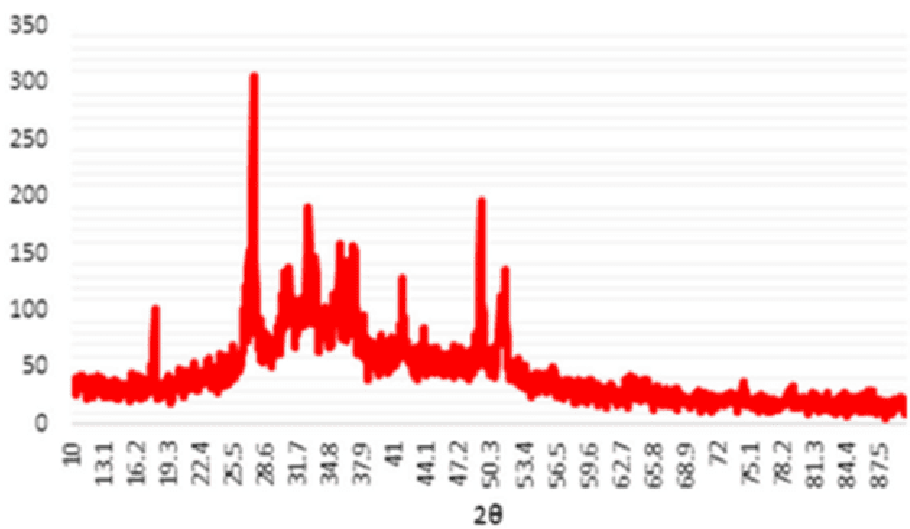

Figure 3. X-ray spectrum for synthesized zinc oxide nanoparticles.

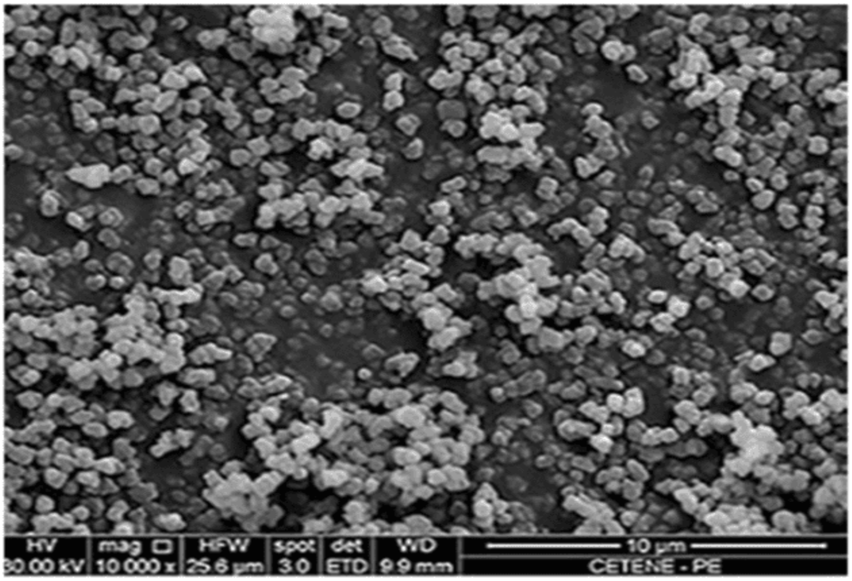

Figure 4. SEM of synthesized organic zinc oxide nanoparticles.

3.4. Analysis of nano-oil and simple oil density and viscosity

Furthermore, this investigation assesses not one but two distinct varieties of crud oil. The application programming interfaces (APIs) of illumination are displayed in Table 1.

Table 1. Specification of the API index of crud oil samples.

Samples	API
Al ahdab	39.28(Light)
Badrah	26.85(medium)

The Al ahdab region yields light crud oils, while the Badrah region yields medium crud oils. This section delves into the impact of factors like operational temperature and pressure. These elements are fundamental in modifying crud oil's viscosity, a physical property. The investigated operating temperatures ranged from 30 to 150 degrees Celsius. The operational pressure range that was examined was 10 to 300 bars. The correlation between pressure and viscosity was demonstrated by the experimental findings. When it comes to temperature and viscosity, the correlation is negative. The correlation for crud oil devoid of nanoparticles, or plain crud oil, is illustrated in Fig. 5. [25] found that oil molecules compress when operational pressure increases. Therefore, as a limiting agent, viscosity rises as pressure goes up. Additionally, as pressure rises, [26] found that as oil molecules move, their kinetic energy and the distance between them both increase. These arguments are shown in Fig. 5. One and three weight percent of zinc oxide nanoparticles in light crud oil affects its viscosity, as seen in Fig. 6. Oil with 1 weight percent and 3 weight percent of zinc oxide nanoparticles is shown in Fig. 6, along with the relationship between operating parameters and viscosity. The experimental data shows that crud oil with a 1 weight percent concentration has a viscosity ranging from 2.5 to 5.08 mPa s. According to the findings, the molecules of both crud oil and nanoparticles are compressed when the oil is subjected to pressure. Therefore, as the pressure increases, the viscosity also increases and this findings agree with [27], [28] studies.

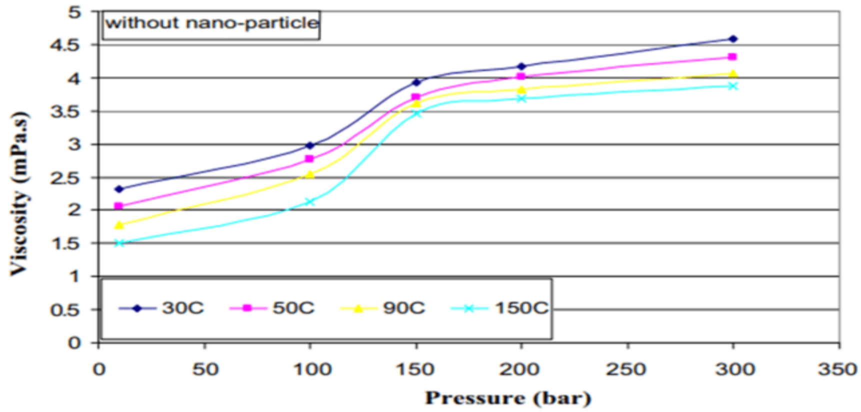

Figure 5. Light crud oil's viscosity changes under pressure in the absence of zinc oxide nanoparticles.

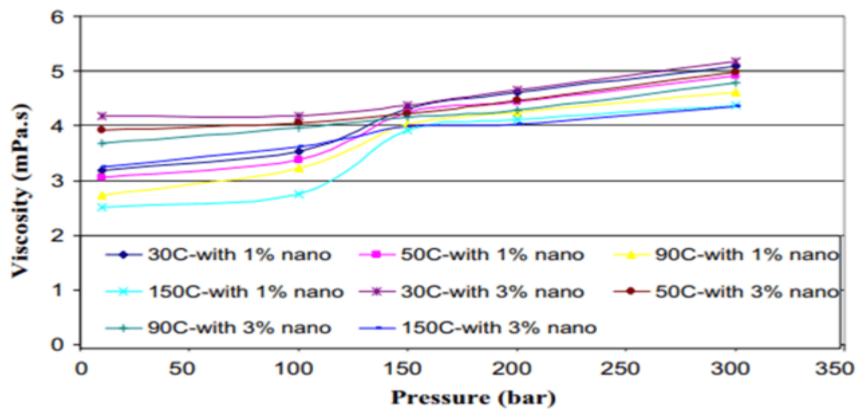

Figure 6. Changes in viscosity with respect to pressure for light crud oil with 1 wt% and 3 wt% zinc oxide nanoparticles.

But when the temperature was raised from 30 to 150 C, the molecules were able to move farther apart, which improved their molecular activity and, in turn, reduced the viscosity. Zinc oxide nanoparticles combined with crud oil have an effect on viscosity, as shown in Figure 6. In addition, chemical interactions can be formed when zinc oxide nanoparticles and crud oil mix [29]. The crud oil's fluidity is impacted by these linkages. Also, light crud oil with 3 weight percent zinc oxide nanoparticles exhibits changes in viscosity at various pressures (Fig. 6). Zinc oxide nanoparticles really improved the viscosity, according to the findings. Fig. 7 shows that, without nanoparticles, the density of light crud oil varies [30]. According to the findings, the density increases as the pressure increases. Temperature increases can also make crud oil denser [31]. Alternatively, Fig. 8 displays the density fluctuation at different pressures of light crud oil containing 1 wt% and 3 wt% zinc oxide nanoparticles. The data show that the density increases as the pressure increases from 10 bar to 300 bar because there are more molecules per unit volume. As the amount of density increases, the relationship between pressure and density approaches linearity. For 1 wt% light crud oil, the density ranges from 0.81 to 5.3 kg/m3, while for 3 wt% it ranges from 0.93 to 6.12 kg/m3. Figures 7 and 8 illustrate experimental data that show that the gas solubility in crud oil (Rs) decreases with increasing temperature at constant pressure, and that crud oil's density increases as a final result. Hence, under various operating conditions, the solubility ratio plays a significant role in determining density.

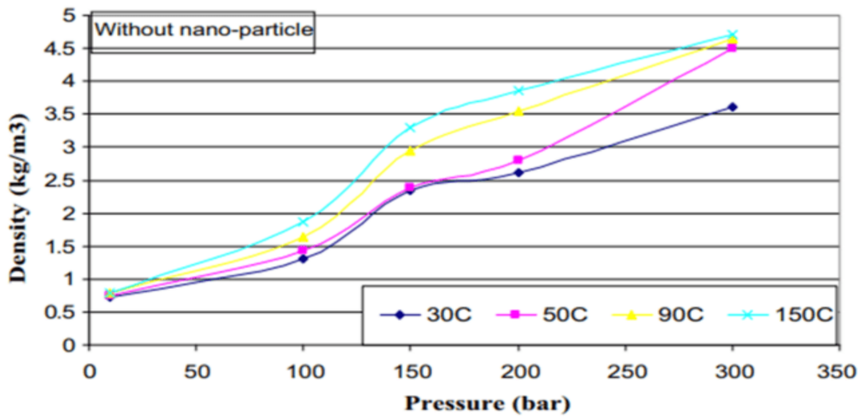

Figure 7. The pressure-dependent density variation of light crud oil devoid of organic zinc oxide nanoparticles.

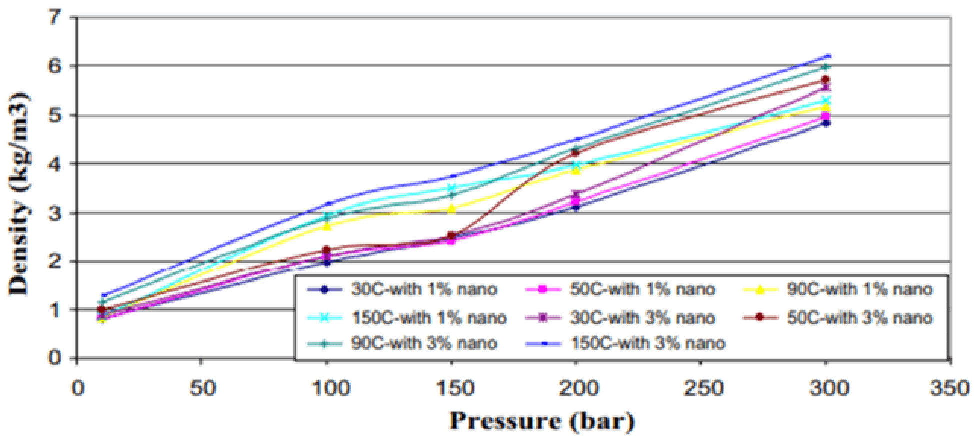

Figure 8. Light crud oil density changes with pressure when treated with 1 and 3 weight percent zinc oxide nanoparticles.

The graph in Fig. 9 displays the relationship between pressure and the viscosity of crud oil. We measured these values at temperatures of 30, 50, 90, and 150 degrees Celsius. So, at 30 degrees Celsius, the viscosity reaches its peak. From 10 to 300 bar, the viscosity ranges from 14.19 to 44.8 mPa s. Fig. 9 displays the behaviour of medium simple crud oil. As seen in Figure 9, the intermolecular force has a direct correlation to the intermolecular tensile strength. The results demonstrate a positive correlation between viscosity and pressure. Temperatures of 30, 50, 90, and 150 degrees Celsius are used in these tests. Fig. 10 shows that the viscosity can be effectively changed by increasing the concentration of organic zinc oxide nanoparticles. Medium crud oil's viscosity will rise when the concentration of organic zinc oxide nanoparticles rises. But because heavier oil contains denser molecules, this rise is less than that of light crud oil. Zinc oxide nanoparticles have a stronger adhesive force when combined with thick oil molecules than with lighter crud oil molecules. Consequently, medium crud oil has a wider viscosity variation range than light crud oil. Without zinc oxide nanoparticles, the density of medium crud oil varies between 0.92 and 11.78 kg/m3 throughout pressure ranges of 10 to 300 bar. Fig. 11 illustrates this correlation. From 30 to 150 degrees Celsius is the temperature range used in the studies. Figure 12 contrasts this, showing the pressure-dependent density fluctuation of medium crud oil containing 1 wt% and 3 wt% zinc oxide nanoparticles. Median crud oil with 1 wt% and 3 wt% zinc oxide nanoparticles changes in density as a result of variations in pressure and temperature. The positive correlation between pressure and density was further verified by experimental results. Extending the pressure from 10 to 300 bars increases the number of molecules per unit volume, as seen in Fig. 12. Fig.12 shows a temperature range of 30 to 150 degrees Celsius.

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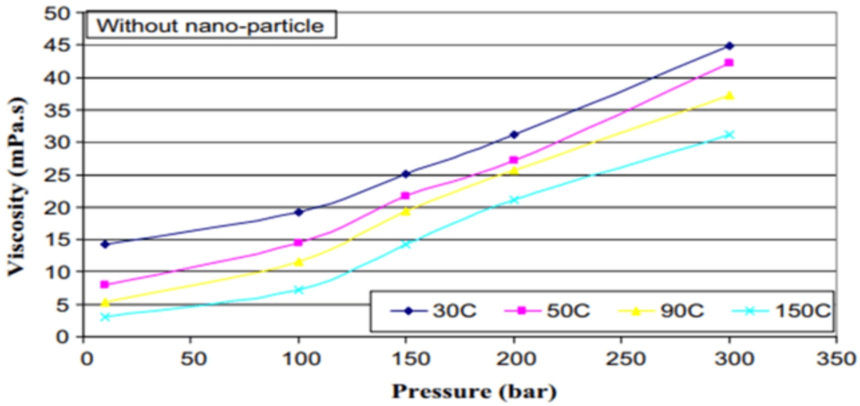

Figure 9. The pressure-dependent viscosity curve of medium crud oil devoid of organic zinc oxide nanoparticles.

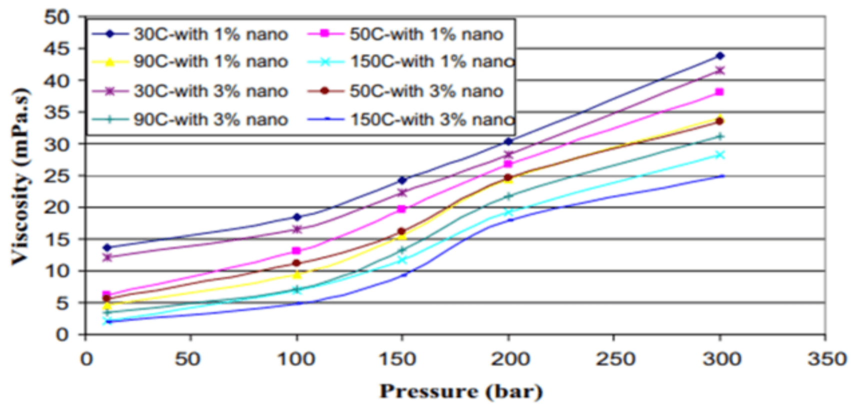

Figure 10. The pressure-dependent viscosity profile of medium crud oil with 1% and 3% zinc oxide nanoparticles added.

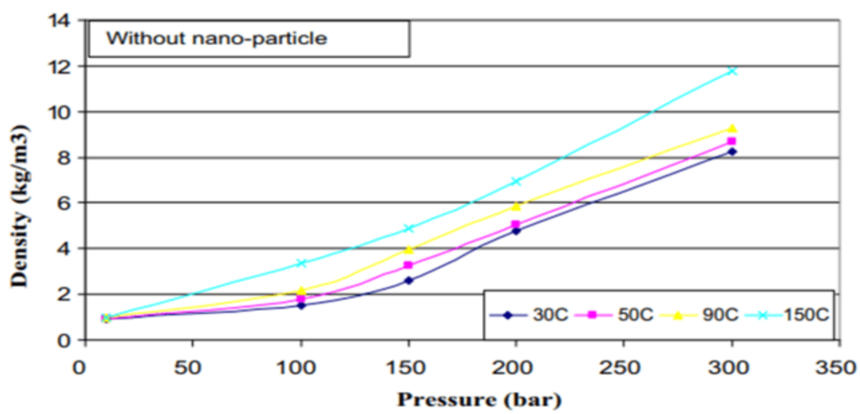

Figure 11. The pressure-dependent density variation of medium crud oil devoid of zinc oxide nanoparticles.

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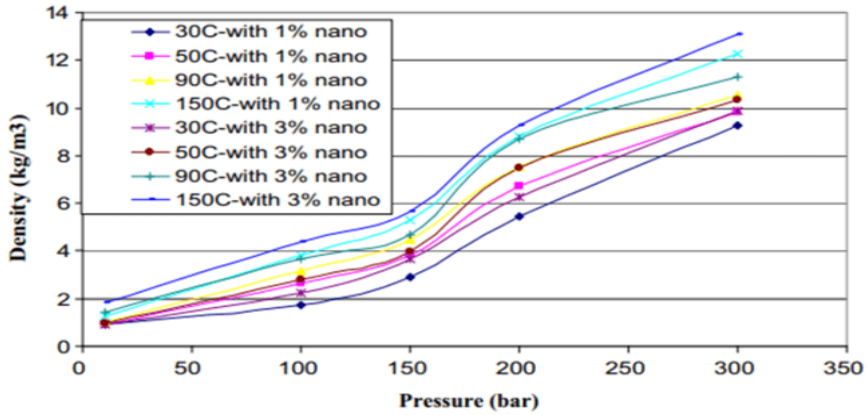

Figure 12. Medium crud oil's density changes with pressure when treated with 1 weight percent and 3 weight percent zinc oxide nanoparticles.

3.5. Examination of the precipitation of asphaltene

Crud oil with and without 0.5%, 1%, 1.5%, 2%, 2.5%, and 3% zinc oxide nanoparticles are shown in Figures 13 and 14, respectively, to illustrate the change in asphaltene precipitation. These results show that the asphaltene precipitation drops about 2.2 to 1.58% when the nano-weight percentage goes up from 0.0 to 3 wt%. Variations in temperature, pressure, and oil content determine the asphaltene deposition percentage in reservoirs. Crud oil wells can experience fouling formation as one of their difficulties. Fouling can be formed depending on the operating conditions and the content of the crud oil. In a number of crud oil wells, asphaltene precipitation is a major issue. Research has shown that compared to light crud oil devoid of zinc oxide nanoparticles, light crud oil containing these particles reduces the amount of asphaltene precipitation. Zinc oxide nanoparticles enhance oil recovery from reservoirs, according to the research. In medium crud oil, the thermodynamic equilibrium is rather extreme (Fig. 14). From 13.6% to 12.5%, the asphaltene sedimentation rate was reduced. In addition, compared to simple medium crud oil, nano-medium crud oil has a lower percentage of asphaltene precipitation. As a result of the heat distribution properties of the zinc oxide nanoparticles in crud oil, the precipitation of asphaltene can be reduced. As a result, pipelines can accommodate nano-medium crud oil with greater ease than medium crud oil. Among the most significant issues in transporting crud oil is asphaltene sedimentation [32]. Asphaltene mode close to wells can alter moisture content relative to permeability properties by blocking gap openings. The pipe can become blocked while transporting crud oils with a higher viscosity due to the amount of asphaltene sedimentation [33]. So, it appears that the difficulties produced by deposits in oil pipelines can be adequately addressed by using zinc oxide nanoparticles of rice bran, which have a great ability to transport heat along the crud oil.

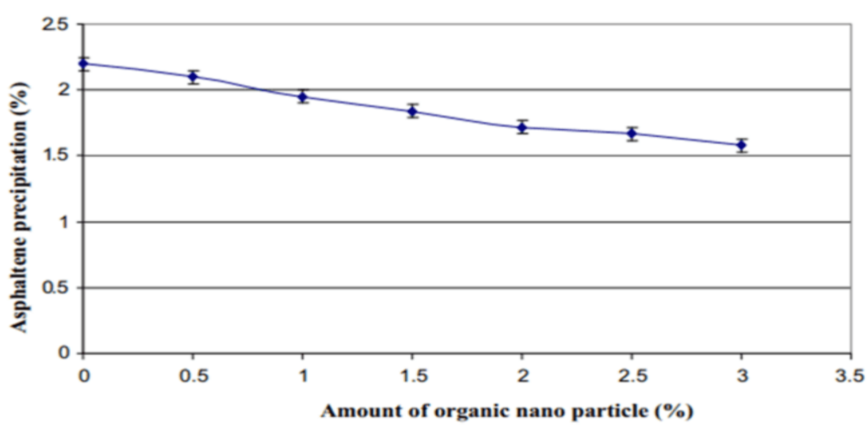

Figure 13. Precipitation of asphaltene from light crud oil varies with different percentages of zinc oxide nanoparticles.

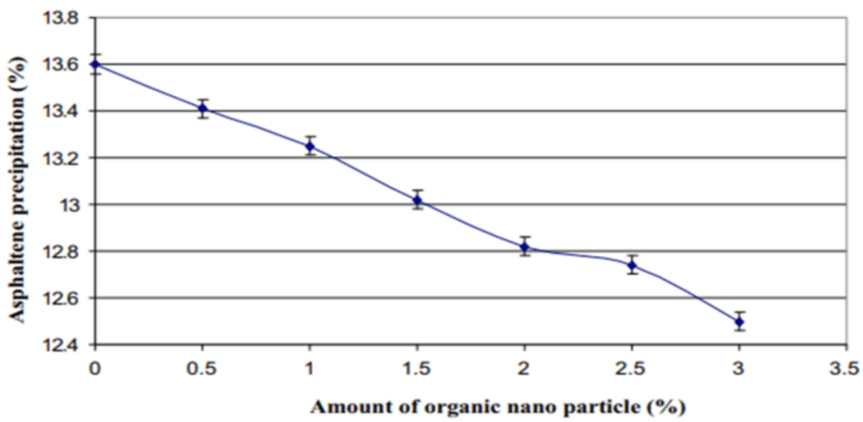

Figure 14. Changes in medium crud oil's asphaltene precipitation according to the weight % of zinc oxide nanoparticles.

3.6. Thermal conductivity coefficient analysis

The thermal conductivity factor of light crude oil that has been blended with zinc oxide nanoparticles at various weight percentages is depicted in Fig. 15. According to Fig. 15, the conductive heat transfer factor will increase if the temperature is raised from 30 to 15 degrees Celsius and the time period is extended from 15 to forty minutes. Increasing the temperature causes the kinetic energy of nanoparticles to increase, which in turn causes an increase in the thermal conductivity factor, as stated by [25]. According to Figure 15, the thermal conductivity factor has a tendency to increase from 0.21 to 0.38 W/m C and from 0.45 to 2.54 W/m C, respectively, when the weight percent of zinc oxide nanoparticles increases from 1% to 3%. This is shown in the graph. As a result of the high conductivity and electrical properties of the metals, the conductivity factor of zinc oxide nanoparticles shows an upward trend at varying temperatures and times. Brownian motion and, by extension, contact between zinc oxide nanoparticles may be amplified when the temperature is raised, however. According to [34], [35], the heat conductivity factor will increase as a result of this. When carrying out operations, such as heating and cooling, it is preferable to have a thermal conductivity factor that is higher. For light crude oil and medium crude oil, respectively, the temperature-dependent conductivity factor change is depicted in Figures 15 and 16, respectively. Thermal conductivity of medium crude oil that has been added with zinc oxide nanoparticles at weight percentages of 1 and 3 is depicted in Fig. 16. The thermal conductivity factor of medium crude oil is increased from 1.56-2.92 W/m C as a consequence of the addition of 1% organic zinc oxide nanoparticles. Using medium crude oil that contains 3% zinc oxide nanoparticles, the temperature has raised from 3.68 to 6.3 W/m C. The thermal conductivity factor, which is a measure of the relationship between the concentration of zinc oxide nanoparticles and the temperature, is shown to rise at varying times and temperatures. The thermal conductivity factor, which is dependent on temperature, kinetic energy, and thermal uniform distribution, has the potential to influence the flow of crude oil via pipelines, as stated by [36], [37]. Following the addition of zinc oxide nanoparticles at concentrations of 1% and 3% to light crude oil, the thermal conductivity factor rose by 44.7% and 82.3%, respectively, as demonstrated by the results of the tests. 41.6 and 44.6 percent are the percentages that correlate to the bigger amounts for medium crude oil. As a result, the increased oil recovery in the crude oil wells is supported by the improved thermal conductivity parameters.

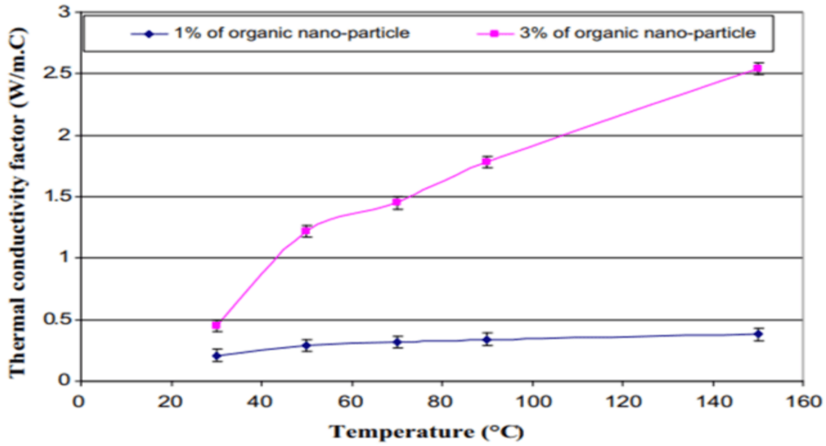

Figure 15. The relationship between temperature and the thermal conductivity factor of light crud oil.

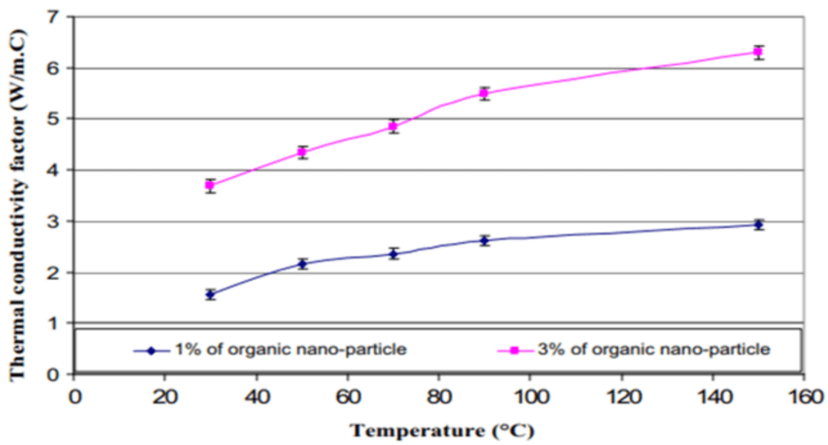

Figure 16. The relationship between temperature and the medium crud oil's thermal conductivity factor.

4. CONCLUSION

Ecological shocks are the source of environmental issues. Rice bran was used as the basis for the synthesis of zinc oxide nanoparticles in this work. Zinc oxide nanoparticles with suitable characteristics were synthesised using rice bran, a specific producer in this paper. The findings of the experiment demonstrated that adding rice bran manufactured with zinc oxide nanoparticles improves the physical characteristics of medium and light crud oil. Moreover, the addition of zinc oxide nanoparticles to crud oil significantly lowers its thermal conductivity factor. In contrast to variables like particle size, the erratic mobility of zinc oxide nanoparticles that results in thermal emissions makes it inappropriate to take into account the slip rates between them and crud oil. Because of this thermal release, the temperature gradient between the wall and crud oil slows down and the temperature distribution is flattened. This leads to an increase in heat transfer between the wall and crud oil. There are multiple explanations for the mechanism causing the thermal conductivity factor of zinc oxide nanoparticles and crud oil to increase.

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