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Investigation of Viscosity Variations for Heavy, Light and Medium Crude Oil as Basic Fluid of Well

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Abstract

Finding the properties of crude oil after addition of nano particle is considered in this work. The experiments are held to investigate the effect of nano particles on the physical properties of two kinds of heavy crude oil (API =21.45), medium crude oil (API=27.9) and light crude oil (API= 32.95). The ferric oxide nano particle decreases the viscosity of oil sample B about 11.4%, averagely comparing with the viscosity of oil sample B without the nano. Also, the empirical results illustrate the variation of temperature from 50°C to 90°C for medium crude oil (Sample C). The experimental results show, the decreasing in viscosity values for nano and simple medium oil. The obtained results show the trend of viscosity for nano oil is severely than simple oil. The average decreasing in the viscosity values are measured as 12.9% comparing with the viscosity of simple oil. All of the obtained results show the nano particles can improve the heat transfer rate in the text of crude oil. So, the trends of all of the experimental graphs are decreasing.

Keywords

Heavy Hydrocarbons, Crude Oil, Temperature, Nano, Viscosity, Well

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1. Introduction

Development in technologies, progress in inventions and life style improvements are dependent on available sources of energy [1, 2]. Researchers have been focused on new sources of energy to solve energy crisis for recent 100 years [3, 4]. Solar energy, wind energy, sea wave's energy, nuclear energy, electrochemical reactions (fuel cells) and other types of energy resources have been presented as replacement of fossil fuel energy resources [5, 6]. Oil and gas resources are so valuable reserves which are limited in some regions; especially these are centered in Middle East [7]. Even if, in spite of all progresses in processes which explore, refine and use the fossil fuels, many environmental emissions are made [8-11]. So, inappropriate use of these valuable resources may one of the reasons of created problems [12, 13]. The heating value of oil and gas are high, the mechanism of energy releasing from oil and gas is easier, cheaper and so applicable comparing with nuclear energy, solar energy and the others. Solar energy and wind energy are also regional limited. Solar cells are so expensive, needs special equipment for house hold application, low efficiency, needs periodic maintenance to remove dust or any other pollutants on solar cells which decreases the amount of isolation rate [14]. Application of solar cells doesn't show high efficiency in some countries in Middle East even with high enough solar power, because of heavy dust. Many factors indicate that initialization of fossil fuels is inevitable [15]. So, finding both efficient processes related on oil and gas industry with lower wastes and pollutants and also applicable techniques related on new

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types of energy have been considered [16].

Gas sweetening processes are so important in gas refinery procedure to remove acid gasses, prevent corrosion in equipment, air pollution, and healthy problems and to increase heating value of gas fuel [17]. The H_2S solvent removal process is a known, available and feasible technique.

This primer is divided into a Crude Oil section and a Refining section. The former covers the basics of crude oil chemistry and transport and can be skipped by anyone who is familiar with the subject matter or is not familiar and does not care to become so. The latter section focuses more on the original motivation of this project: to try to identify and quantify potential chokepoints in the oil refining process. Crude oil consists of a mixture of hydrocarbons, chains of carbon atoms bonded to each other and to hydrogen atoms, with the major stipulation being that each carbon can form four bonds and each hydrogen can form one bond. (See examples in Figure 1.) The properties of the resulting molecules are defined mainly by the arrangement of atoms, known as the form, and the number of carbon atoms, referred to as the size or weight. The complexity of a hydrocarbon's form increases greatly as the size increases. The different end products such as gasoline, diesel, and jet fuel, are composed of different weight portions, or *fractions*, of a hydrocarbon mixture. Let's look specifically at gasoline. Gasoline is composed of a mixture of hydrocarbons that are mostly between four and twelve carbons in length. These "useful" hydrocarbons are contained in a mixture of hydrocarbons that contain between one and several hundred carbons. To separate the gasoline fraction from the others, refiners take advantage of boiling point differences between fractions. As a rule, the heavier (i.e. higher number of carbons) the molecule, the higher its boiling point. In pure substances such as water, the entire solution will boil at one defined boiling point.

However, studies on finding new combination of solvent removal with other methods to make the sweetening process more efficient are required. In this investigation, the effect of nano particles in the novel process for precipitation of heavy hydrocarbons and recovery value percentage are presented.

2. Materials and Method

Energy resources are becoming increasingly important to humankind as population growth places increasingly greater demands on Earth's natural resources. Our increased population size also has spurred the growth of both technological development and industrial production, and this growth has in turn created an increased demand for energy supplies. The development of modern societies has spurred a shift in the use of energy resources from wood to coal to oil and, to a certain extent, uranium. The use of each of these energy sources produces environmental costs; these costs are incurred during harvesting, transporting, and the actual process of releasing the energy contained within each of these materials.

Three samples of crude oil are used in this experimental work. The ten gr of nano ferric oxide is added into 1 kg oil using ultrasonic method. The recovery of heavy oil from sand beds is investigated in this work, experimentally. Same sand beds are provided and set in the experimental vessel one by one for each light oil, medium oil and heavy oil with and without nano particles, separately. The sand bed is weighted before the experiment. The oil stream passed through the bed at the same conditions. The sand bed is weighted after passing the oil. The vessel, is heated till the amounts of oil recovery are leveled out at different temperatures.

3. Results and Discussion

Properties of crude oil are important in refinement processes in refineries. Investigations have been focused on separation methods which lead to the refined oil with acceptable quality. Addition of ferric oxide particles in three kinds of heavy, medium and light oil samples is investigated and viscosity and recovery values percentage of the oils are surveyed.

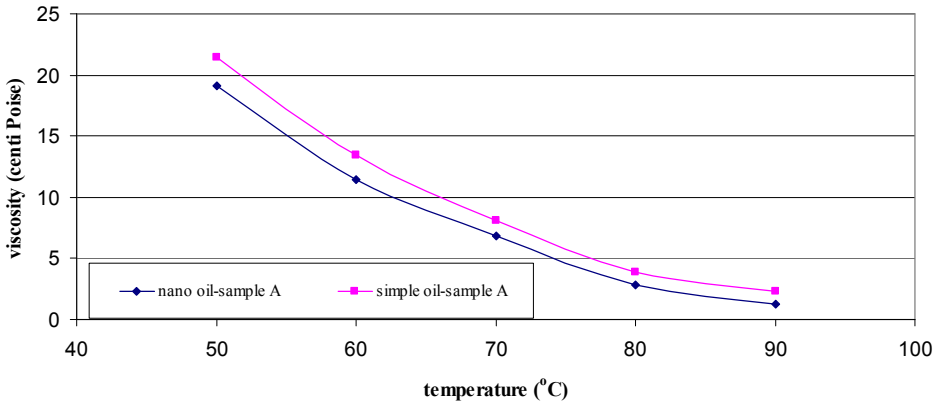

Figure 1. Viscosity versus temperature of sample A with and without nano particle.

The Figure 1 shows the effect of nanoparticles in variations of oil viscosity for sample A, with various temperatures. Results show the increase in temperature from 50°C to 90°C decreases the amount of viscosity. Nano particle decreases 13.9% the viscosity of nano oil relative to viscosity of simple oil, averagely.

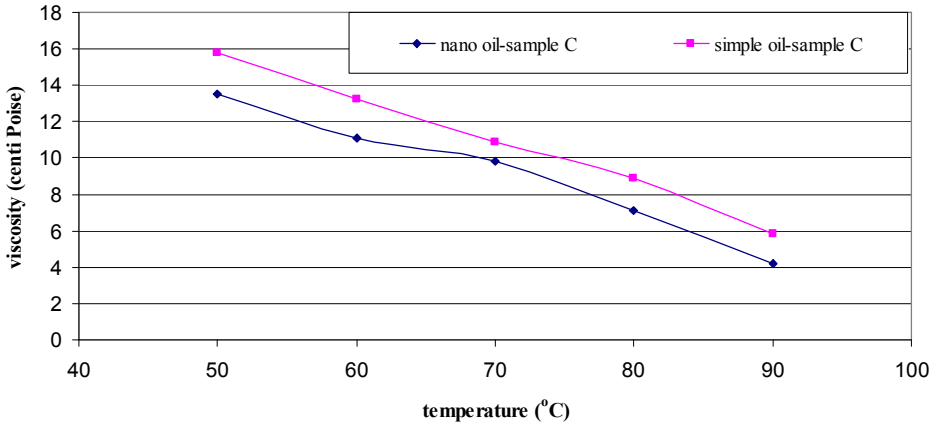

Figure 2. Viscosity versus temperature of sample C with and without nano particle.

The Figure 2 shows the variation of temperature from 50°C to 90°C for medium crude oil. The experimental results show, the decreasing in viscosity values for nano and simple medium oil. The obtained results show the trend of viscosity for nano oil is severely than simple oil. The average decreasing in the viscosity values are measured as 12.9% comparing with the viscosity of simple oil.

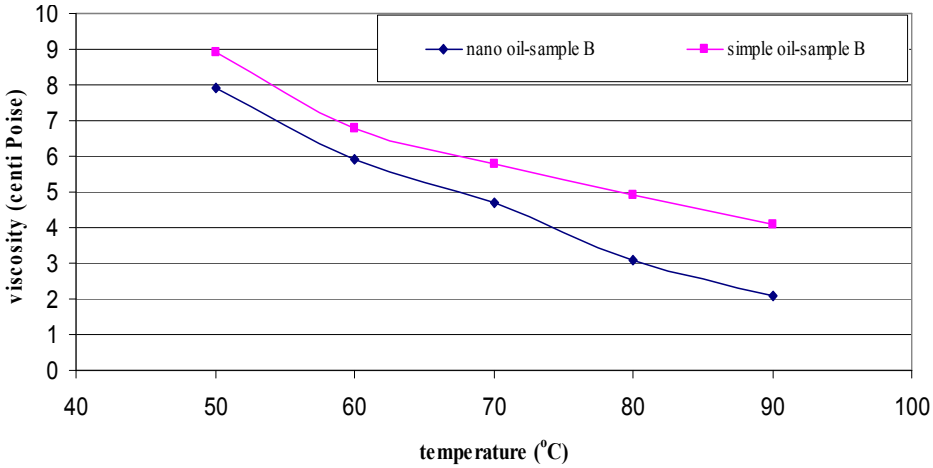

Figure 3. Viscosity versus temperature of sample B with and without nano particle.

The Figure 3 shows the variations in viscosity of oil type B with temperature with and without nano particles. Increasing temperature from 50°C to 90°C decreases the viscosity from 9 cP to 4 cP and 8 cP to 2.1 cP for sample B without nano and with nano, respectively. The ferric oxide nano particle decreases the viscosity of oil sample B about 11.4%, averagely comparing with the viscosity of oil sample B without the nano. Viscosity is a basic parameter in the determination of rheological property of fluid. The figure 3 shows the interaction between the molecules increases with increasing of operating temperature. In other words, the distance between molecules increases in high temperature values.

The constant temperature for oil means the constant kinetic energy for one type of oil with and without nano particle. So, nano particle seems to affect the cohesion and adhesion forces in oil contains nano particle to change the viscosity, according to the obtained results. All of the obtained results show the nano particles can improve the heat transfer rate in the text of crude oil. So, the trends of all of the experimental graphs are decreasing. Totally, extracted results for light, medium and heavy oil prove the decreasing in the viscosity value with increasing of temperature. Decreasing of viscosity is occurred in high operating temperature and so fluidity of oil will increase severely. This subject is so important in enhanced oil recovery problems.

4. Conclusions

Application of nano particles to introduce the novel oil refinement techniques is studied, in this work. The effect of nano ferric oxide particle on the important factors in oil refinery process for light oil (API= 32.95), medium crude oil (API=27.9) and heavy oil (API =21.45) is considered. The experiments are held to investigate the viscosity values. The experimental results show, the effect of nanoparticles in variations of oil viscosity for sample A, with various temperatures. In other words, results show the increase in temperature from 50°C to 90°C decreases the amount of viscosity. Nano particle decreases 13.9% the viscosity of nano oil relative to viscosity of simple oil, averagely. In addition, obtained results show the variations in viscosity of oil type B with temperature with and without nano particles. Increasing temperature from 50°C to 90°C decreases the viscosity from 9 cP to 4 cP and 8 cP to 2.1 cP for sample B without nano and with nano, respectively. The ferric oxide nano particle decreases the viscosity of oil sample B about 11.4%, averagely comparing with the viscosity of oil sample B without the nano. Also, the empirical results illustrate the variation of temperature from 50°C to 90°C for medium crude oil (Sample C). The experimental results show, the decreasing in viscosity values for nano and simple medium oil. The obtained results show the trend of viscosity for nano oil is severely than simple oil. The average decreasing in the viscosity values are measured as 12.9% comparing with the viscosity of simple oil.

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