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Research Article

Empirical Study on the Main Physical Items of Nano Oil in an Isolated Vertical Pipe

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Abstract: Finding the properties of crude oil after addition of nano particle is considered in this work. Results are shown in Figures indicate on the positive effect of nano particles in the oil sweetening processes. The amount of H_2S removal increases about 0.19 and 0.11 for both oil types of heavy and light, respectively. Temperature varies in range of 80 C to 120 C and pressure is adjusted between 50 atm to 250 atm. Addition of nano particle shows the decrease in the amount of viscosity about 70% and 50% for light and heavy oil, respectively. However, nano particle in oil doesn't improve the recovery percentage and also asphalting precipitation. Due to the results, the optimums of properties can be evaluated. Ultimately, the experimental results show the effect of addition of nano particle in the percentage of oil recovery versus the input energy for sample A and sample B, respectively.
Keywords: Nano; Petroleum; Hydrogen sulfide; Light; Heavy; Properties.

INTRODUCTION

Crude oil, liquid petroleum that is found accumulated in various porous rock formations in Earth’s crust and is extracted for burning as fuel or for processing into chemical products. Although it is often called "black gold," crude oil has ranging viscosity and can vary in color to various shades of black and yellow depending on its hydrocarbon composition.

In 1847, the process to distill kerosene from crude oil was invented by James Young [1]. He noticed a natural petroleum seepage in the Riddings colliery at Alfreton, Derbyshire from which he distilled a light thin oil suitable for use as lamp oil, at the same time obtaining a thicker oil suitable for lubricating machinery. In 1848 Young set up a small business refining the crude oil [2]. Young eventually succeeded, by distilling cannel coal at a low heat, in creating fluid resembling petroleum, which when treated in the same way as the seep oil gave similar products. Young found that by slow distillation he could obtain a number of useful liquids from it, one of which he named "paraffine oil" because at low temperatures it congealed into a substance resembling paraffin wax.

Another early refinery was built by Ignacy Łukasiewicz, providing a cheaper alternative to whale oil. The demand for petroleum as a fuel for lighting in North America and around the world quickly grew [3].

Desulfurization of crude oil is an important process used in a 16 petroleum refinery to reduce the sulfur concentration and produc- 17 tion of fuel products such as gasoline, jet fuel, kerosene, diesel, 18 and heating oil [1]. So, the resulting fuels meet environmental 19 protection standards [2]. Sulfur and its derivatives existed in 20 extracted petroleum are released in air during burning and heating 21 process and disturb the laborer’s health [3]. The challenge of 22 fulfilling the world’s growing transportation energy needs is no 23 longer a simple issue of producing enough liquid hydrocarbon 24 fuels [4]. This challenge is instead accentuated by a complex 25 interplay of environmental and operational issues. Severe changes 26 in the climate, which lead to disasters, are caused by the pollutants 27 from fuel burning [5]. Environmental issues include societal 28 demands that liquid hydrocarbon fuels are clean and less polluting 29 [6,7]. The emergence of new refining processes and the increasing 30 use of new forms of energy production, e.g., fuel cells, exemplify 31 operational issues [7,8]. Although studies on new forms of renew- 32 able energies have been investigated recently [7,8], fossil fuels are 33 the major source of energy yet. Together, these trends are driving 34 the need for deep desulfurization of diesel and jet fuels. 35 1.1 Desulfurization Processes. In the past two decades, 36 petroleum refining has changed extensively and the fortunes of 37 hydro treating, in particular, have witnessed a sea change [8,9]. 38 Hydro-treaters now occupy a central role in modern refineries and 39 more than 50% of all refinery streams now pass through hydro- 40 treaters for conversion, finishing, and pretreatment purposes 41 [10,11]. Hydro-desulfurization is the largest application of cata- 42 lytic technology in terms of the volume of material processed. On 43 the basis of usage volume, Hydrodesulfurization catalysts are 44 ranked third behind catalysts used for automobile emission control 45 and fluid catalytic cracking. Commercial hydro-treating catalysts 46 are, typically, Zn, Co, or Mo. For example, Mo, known for its high hydrogenation activities, is preferred as a promoter when 47 feed stocks containing high amounts of nitrogen and aromatics 48 need to be processed. Catalyst based on Cr (III) shows high selec- 49 tivity for sulfur removal in gasoline treatment [12]. It seems nano- 50 particles such as metal oxides can promote the heating and 51 cooling process [12–14]. Nano metal oxide application in heating 52 and cooling is extended in various fields related to the exploring, 53 storage, refining, and recovery of oil [15]. For example, the nano 54 substances like metal oxides can enhance the thermal stability of 55 some of the materials [16]. Today, about 90% of vehicular fuel 56 needs are met by oil. Petroleum also makes up 40% of total 57 energy consumption in the U.S., but is responsible for only 1% of 58 electricity generation. Petroleum's worth as a portable, dense 59 energy source powering the vast majority of vehicles and as the 60 base of many industrial chemicals makes it one of the world's 61 most important commodities. The viability of the oil commodity 62 is controlled by several key parameters, number of vehicles in the 63 world competing for fuel, the quantity of oil exported to the world 64 market (export land model), Net Energy Gain (economically use- 65 ful energy provided minus energy consumed), political stability of 66 oil exporting nations, and ability to defend oil supply lines. The 67 top three oil-producing countries are Russia, Saudi Arabia, and 68 the U.S. About 80% of the world's readily accessible reserves are 69 located in the Middle East, with 62.5% coming from the Arab 5: 70 Saudi Arabia, UAE, Iraq, Qatar and Kuwait. A large portion of 71 the world's total oil exists as unconventional sources, such as bitu- 72 men in Canada and extra heavy oil in Venezuela. While signifi- 73 cant volumes of oil are extracted from oil sands, particularly in 74 Canada, logistical and technical hurdles remain, as oil extraction 75 requires large amounts of heat and water, making its net energy 76 content quite low relative to conventional crude oil. Thus, Cana- 77 da's oil sands are not expected to provide more than a few million 78 barrels per day in the foreseeable future. In its strictest sense, 79 petroleum includes only crude oil, but in common usage it 80 includes all liquid, gaseous, and solid hydrocarbons. An oil well 81 produces predominantly crude oil, with some natural gas dis- 82 solved in it. Because the pressure is lower at the surface than 83 underground, some of the gas will come out of solution and be 84 recovered (or burned) as associated gas or solution gas. At surface conditions, 90 these will condense out of the gas to form natural gas condensate, 91 often shortened to condensate. Condensate resembles petrol in 92 appearance and is similar in composition to some volatile light 93 crude oils. The proportion of light hydrocarbons in the petroleum 94 mixture varies greatly among different oil fields, ranging from as 95 much as 97% by weight in the lighter oils to as little as 50% in the 96 heavier oils and bitumens. The exact molecular composition 97 varies widely from formation to formation but the proportion of 98 chemical elements varies over fairly narrow limits as follows. Dis- 99 tillation, the process by which oil is heated and separated into dif- 100 ferent components, is the first stage in refining. Crude oil is any 101 naturally occurring flammable mixture of hydrocarbons found in 102 geologic formations, such as rock strata. Most petroleum is a fos- 103 sil fuel, formed from the action of intense pressure and heat on 104 buried dead zooplankton and algae. Technically, the term petro- 105 leum only refers to crude oil, but sometimes it is applied to 106 describe any solid, liquid, or gaseous hydrocarbons. Petroleum 107 consists primarily of paraffins and naphthenes, with a smaller 108 amount of aromatics and asphaltenes. The exact chemical compo- 109 sition is a sort of fingerprint for the source of the petroleum 110 [17, 18]. Petroleum assay need to be focused in selection of the 111 treatment process and sulfur removal from the extracted oil 112 [17, 18].

Access to oil was and still is a major factor in several military conflicts of the twentieth century, including World War II, during which oil facilities were a major strategic asset and were extensively bombed [19].

The recovery percentage of nano crude oil and also, the recovery percentage of simple crude oil are investigated in this paper. The recovery percentage of nano and simple crude oil in different amounts of heat values are measured in this paper.

MATERIALS AND METHODS

Two samples of crude oil are used in this experimental work. 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 and heavy oil with and without nano particles, separately. Sand bed is weighted before experiment. Oil stream passed through the bed at the same conditions. Sand bed is weighted after passing the oil. The vessel, is heated till the amounts of oil recovery are leveled out at different temperatures.

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 nano aluminum particles in two kinds of medium and light oil samples is investigated and viscosity and recovery% of oils are surveyed. Also, H2S removal and asphaltene precipitation in different temperatures and pressures are investigated, experimentally.

The Figures 1 and 2 show the effect of addition of nano particle in the percentage of oil recovery versus the input energy for sample A and sample B, respectively.

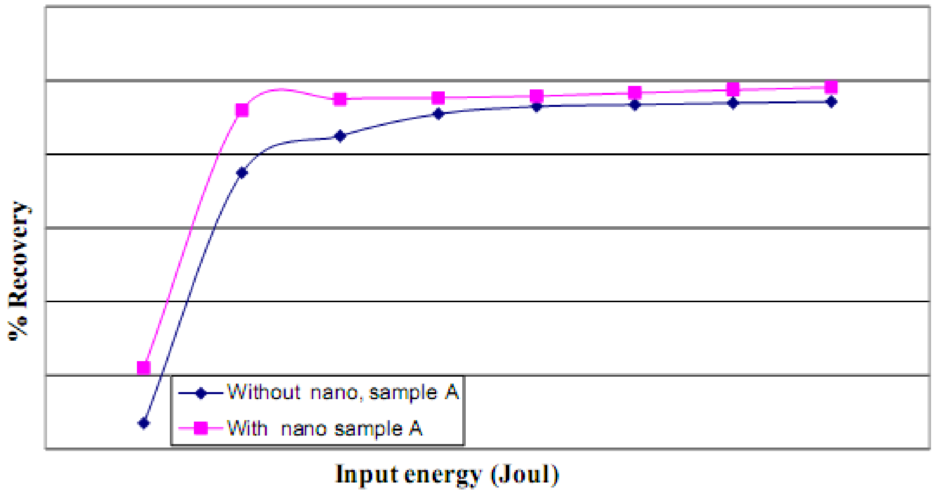

Fig-1: Recovery percentage of sample A versus input energy

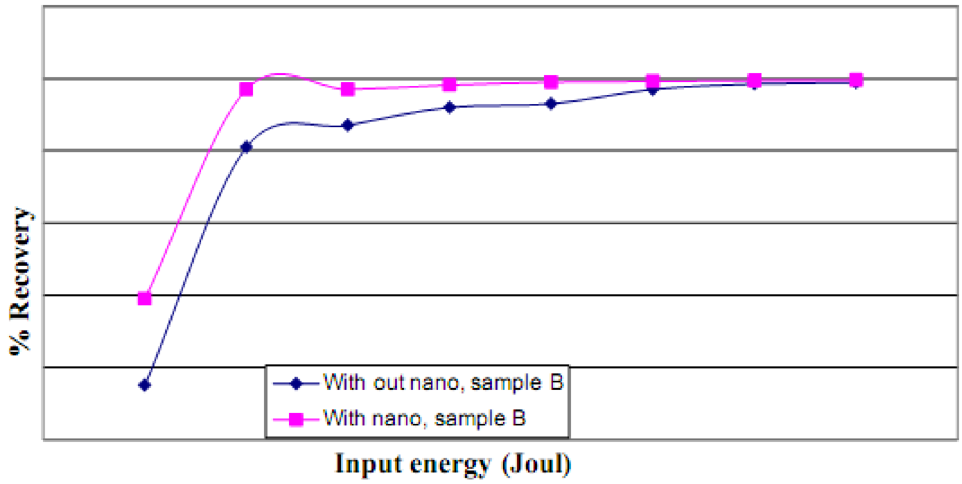

Fig-2: Recovery percentage of sample B versus input energy

Operating conditions such as temperature and pressure are effective on the percentage of asphaltene precipitation.

Figure 3 shows the effect of nanoparticles in variations of oil viscosity for sample A, with various temperatures. Results show the increase in temperature from 80 C to 120 C decreases the amount of viscosity. Nano particle decreases the viscosity about 50%, averagely.

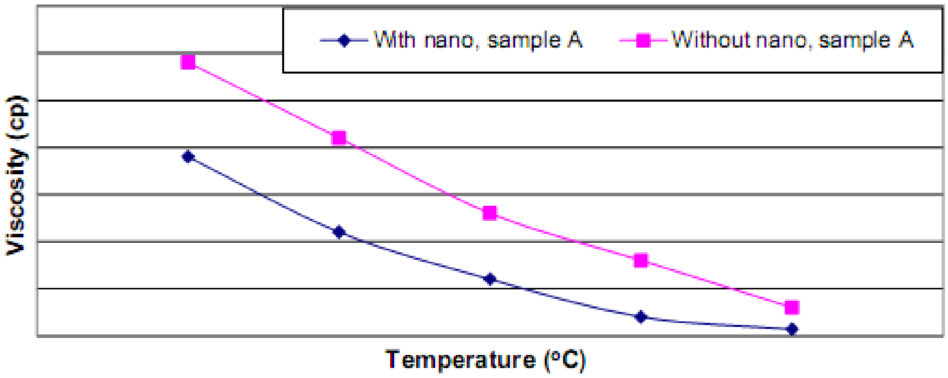

Fig-3: Viscosity versus temperature of sample A with and without nano particle

Figure 4 shows the variations in viscosity of oil type B with temperature with and without nano particles. Increasing temperature from 80 C to 120 C decreases the viscosity from 22 cp to 1.3 cp and 12 cp to 0.13 cp for sample B without nano and with nano, respectively. Nano particle decreases the viscosity of oil sample B about 70%, averagely comparing with the viscosity of oil sample B without nano.

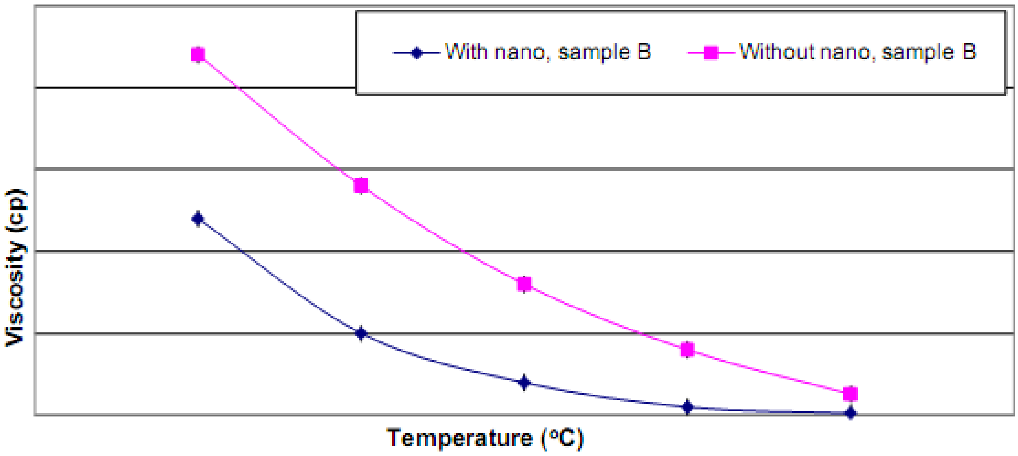

Fig- 4: Viscosity versus temperature of sample B with and without nano particle

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 Figures 3 and 4.

CONCLUSIONS

Application of nano particles to introduce the novel oil refinement techniques is studied, in this work. The effect of nano aluminum oxide particle on the important factors in oil refinery process for light oil (API= 32.95) and heavy oil (API =21.45) is considered. Experiments are held to investigate the viscosity, the amount of asphltene precipitation, oil recovery from the sand bed and H2S removal percentage for oil samples containing nano particles. Also, the values of properties are obtained at different temperatures and pressures. Results show increasing temperature from 80 C to 120 C decreases the viscosity from 22 cp to 1.3 cp and 12 cp to 0.13 cp for light crude oil without nano and with nano, respectively. Nano particle decreases the viscosity of light crude oil about 70%, averagely comparing with the viscosity of light crude oil without nano.

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