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# The Empirical Investigation of Major and Important Parameters of Nano Oil; Introduction of a Novel Aspect

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## Abstract

The environmental problems damage the ecosystem, severely. The hydrocarbons in crude oil are mostly alkanes, cycloalkanes and various aromatic hydrocarbons while the other organic compounds contain nitrogen, oxygen and sulfur, and trace amounts of metals such as iron, nickel, copper and vanadium. In this paper, the tests are designed for investigation of the effects of the ferric oxide nano particle prepared by ultrasonic on the crude oil flowing properties. Rheological and thermal properties of crude oil with nano particle are surveyed, experimentally. Results show, the increase in temperature from 30°C to 90°C increases the values of conductive heat transfer coefficient 1.13 times and 1.1 times for nano oil (1wt%) and simple oil, respectively.

## Keywords

Rheology, Environmental Problems, Crude Oil, Heat Properties, Ultra-sonic, Nano Particles

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## 1. Introduction

The way in which we use available natural resources has effects on our health and the environment and is to a large part heavily influenced by cultural aspects and personal choices. Natural resources are an important factor in the economy and an important element of our welfare [1]. Technological innovations, including those resulting from nano sciences and nanotechnologies, can play a key role in the more efficient use of our resources. Before the development or use of any application from nanotechnologies, the question of social utility should be asked [2]. To answer that question the potential contribution of specific applications from nanotechnologies to solve a specific socially relevant problem such as climate change, water shortages and starvation should be known [3]. Health and environmental risks and possible side effects on society and economy should be taken into account as well as existing alternative solutions. The result of such an evaluation will always be a local decision (country, region) [4]. For the majority of developing countries, commodity production is the backbone of the economy. Historically, advances in science and technology have also had profound impacts on commodity production and trade. There are concerns that nanotechnology will change the commodity markets, disrupt trade and eliminate jobs [5]. Worker-displacement brought on by commodity obsolescence will hurt the poorest and most vulnerable, particularly those workers in the developing world who don't have the economic flexibility to respond to sudden demands for new skills or different raw materials. Currently, nanotech innovations and intellectual property are being driven mainly from developed countries [6]. The world's largest transnational companies, leading academic laboratories nanotech start-ups are seeking intellectual

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property on novel materials, devices and manufacturing processes. Commodity dependent developing countries must gain a fuller understanding of the direction and impacts of nanotechnology-induced technological transformations, and participate in determining how emerging technologies could affect their futures [7]. There are concerns as well that developed countries will benefit more from nanotechnology and that developing countries will suffer more from potential risks (e.g occupational health and safety standards may be lower, waste management and waste disposal infrastructure may not be adequate for nanomaterials and nano-enabeled products) [8]. Materials are used at nm scale for their new properties. One can expect effects of the same level on health and environment [9]. Various studies have shown that, because of their small size, unbound nanoparticles can be inhaled and enter the bloodstream via the lungs, disperse throughout the body and penetrate other organs, however it should be noted that many of these studies use instillation rather than inhalation as a way to administer nanoparticles, and generally in a greater quantity dose than reflects actual practical circumstances [10]. It has also been shown that, depending on their properties, some manufactured nanoparticles can be damaging to cells. Little data is available on the toxicology, release, environmental behavior and safety of nanomaterials. Although a few studies have been carried out, not all of their results are meaningful, since many of these investigations were carried out using very high concentrations of particles, and with samples or reference materials that had not been accurately characterized (see Annex 8.2, 8.3, 8.4) [11]. Several countries have launched research programs to reinforce independent risk research (see point 7). Greater coordination of these programs could facilitate more efficient use of time and resources [12]. In the literature it is often stressed that results for one nanoparticle cannot be generalized to other nanomaterials [13]. This is mainly because the characteristics that influence toxicity have not yet been defined. Standardized test protocols and standardized reference compounds would enable comparisons to be made between the different materials and studies [14]. International organizations such as OECD and ISO and national agencies have established programs to fill this gap. Based on the scientific and methodological principles currently available, no conclusive requirements for the safety of manufactures nanomaterials can yet be formulated. Nevertheless, safety precautions must be taken based on a precautionary estimation of hazard and exposure risk, as with hazardous materials [15]. As soon as the conditions for evidence-based risk assessments of manufactured nanomaterials are present, existing statutory frameworks need to be assessed, and, where necessary amended, to provide conditions for the safe handling of such materials and of nano-enabled products throughout their life cycle [16]. As more knowledge becomes available, safe handling guidelines can be iteratively formulated and revised. Broad information on opportunities and risks of nanotechnology and nanomaterials is important for public opinion making. Communication is a key prerequisite for the public engagement with new technologies [17]. This opinion-forming process may leave its mark on the development of technologies and their application. Communication should therefore extend further than the field of manufactured nanomaterials to encompass all of nanotechnologies [18]. It should reflect the current state of social, scientific and political knowledge and of public engagement. Account should be taken of both the promise of nanotechnologies and the public fear or rejection it may create. The involvement of industry, authorities and the public in the debate on opportunities and risks must be an integral part of technological development [19]. For an integrated approach, this debate should be as broad as possible and not restricted to individual levels or topics (e.g. scientific, psychological, and sociological) [20]. A challenge is to communicate information on risks and benefits to enable a public dialogue and informed decisions; the challenge will be even more difficult in developing countries [21]. Dissemination of awareness of possible risks of nanotechnology to the public of developed and developing countries should be coupled with positive aspects of nanotechnology, particularly in development of monitoring tools [22]. It should be noted that nanoparticles are released in large quantities in industrial processes as unintended by-product of combustion, welding, explosions, etc., but their detection is currently very limited, mostly due to the lack of established detection mechanisms and because of lack of awareness of the need for monitoring [23 and 24]. Many different ways of detection of nanoparticles of different kind can be foreseen [25 and 26].

Basic tests are designed for investigation of the effects of the ferric oxide nano particle prepared by ultrasonic on the crude oil flowing properties, in this paper. Therefore, the rheological and thermal properties of crude oil with nano particle are surveyed, experimentally.

## 2. Materials and Methods

The API of crude oil is classified according to the Table 1. The API degree of crude oil which is used in this research is 32.

**Table 1.** Composition of crude oil.

| Component | API |
|---|---|
| Crude oil | 32 |

The pictures of synthesized nano particles are stated in different scales. It seems that the morphology of synthesized nano particles is spherical. The physical property of synthesized ferric oxide nano particles is mentioned in the Table 2.

**Table 2.** Physical properties of ferric nano particles.

| Ferric oxide nano properties | |
|---|---|
| ferric | 71.79% |
| oxygen | 28.21% |
| Resistivity | $0.92\times10^{6}\Omega$.cm at 20°C |
| Average size | 60 - 90nm (approximately) |

The experimental set up includes mixing tank, adiabatic tube test section and electrical heater is used to survey the behavior of nano crude oil.

# 3. Results and Discussions

Experiments are held to investigate the properties and behavior of nano oil comparing with simple oil. Thermo-physical properties like density, viscosity, thermal conductivity, thermal diffusivity with changes in temperature and amount of nano particle are surveyed. Some of important dimensionless numbers such as Reynolds, Prandtle, Peclet and Stanton numbers are also presented. Results are evaluated as follow.

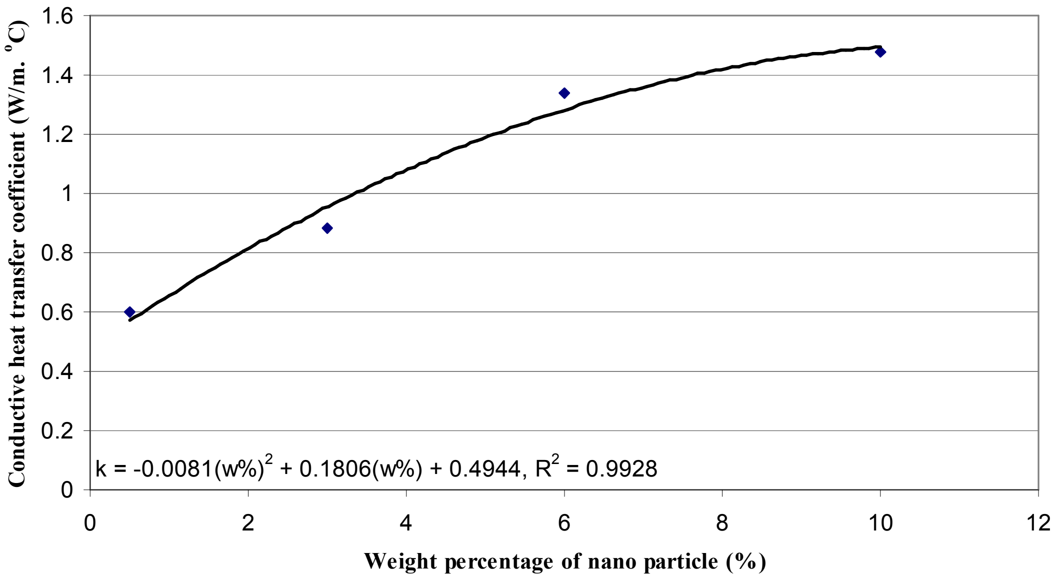


**Figure 1.** Conductive coefficient factor versus amount of nano particle.

The effect of amounts of nano particle in weight percent on the amounts of conductive coefficient is shown in the Figure 1. The increase in the amounts of nano particle in weight percent from 0.5% to 10% increases the values of conductive coefficient factor from 0.6 (W/m.K) to 1.48 (W/m.K). However the rate of increase in the amounts of conductive coefficient decreases when the weight percent of nano particle increases from 7% to 11%.

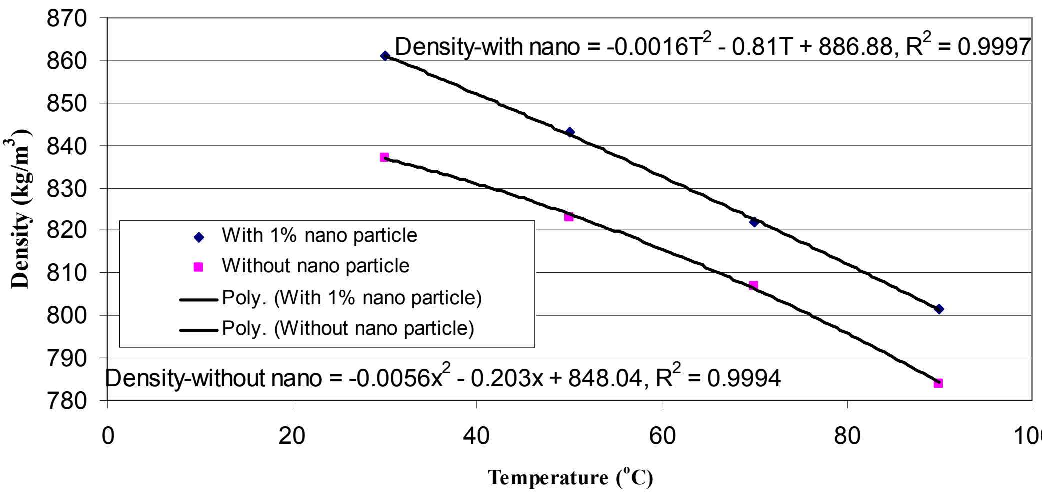


**Figure 2.** Density versus temperature.

The Figure 2 shows the decrease trend of density of both simple and nano oil (1 wt%) with temperature enhancement. The temperature changes in range of (30, 50, 70 and 90°C) changes values of density for simple oil from 841 kg/m$^3$ to

781 kg/m$^3$ and for nano oil from 858 kg/m$^3$ to 798 kg/m$^3$. Higher values of density are obtained for nano oil than simple oil at the same temperature. This is obviously relates to the higher value of nano oil mass than simple oil mass at per unit volume of each oil. The decrease trend of density with temperature is also described by the increase in the amount of kinetic energy, the increase in volume of both simple and nano oil which decreases the value of density for two types of oil. Fluid flow specifications are so important to predict the behavior of fluid in the transferring line. Fluid velocity is representative of behavior of fluid.

# 4. Conclusions

Application of nano ferric oxide in oil is studied in this manuscript. The effect of addition of different weight percentage of nano particle into the oil which flows vertically under different temperatures (ranges from 30-70°C, 25-85°C, 30-90°C) in a tube section is investigated, experimentally. Test tube with 0.025 m in diameter and 0.3 m in length is used in the study. Some important thermo-physical properties are measured. Besides, some applicable dimensionless groups in hydrodynamic calculations and heat transfer are presented. Results show, the increase in temperature from 30°C to 90°C increases the values of conductive heat transfer coefficient 1.13 times and 1.1 times for nano oil (1 wt%) and simple oil, respectively. This range of temperature decreases the density value for nano oil (1 wt%) and simple oil to 0.93 and 0.929 of the initial value, respectively. The experimental results show, values changing of density in simple oil is from 841 kg/m$^3$ to 781 kg/m$^3$. This physical property for nano oil is between 858 kg/m$^3$ and 798 kg/m$^3$.

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