Investigation on Critical Characteristics of Edible Vegetable Oil by using Cuo Nanoparticles

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Abstract
This work demonstrates how the composition of the nanoparticles affects the thermal, electrical, and physical characteristics of vegetable oil (RBO). Cuo nanoparticles with particle volume fractions varying from 0.1 percent to 0.4 percent were injected one at a time into vegetable oil (RBO) to produce nanofluids (NFs) that affect the basic characteristics of the oil. It was able to evaluate characteristics including room temperature viscosity, firepoint, breakdown voltage (BDV), and flash point using IEC and ASTM standards. The breakdown voltage rises when the vegetable oil (RBO) oil is heated in the presence of nanoparticles. The size of the nanoparticles has changed the viscosity, and the flash and fire points have gone from 10°C to 15°C..

Keywords: Vegetable Oil (RBO), Nanoparticles, Nanofluids, Blending, Transformers.

I. INTRODUCTION

Transformers are the most important and crucial component of the transmission and circulation system. Transformer oil, often known as protective oil, serves as both a fill-in and a hotness trading medium for internal components of transformers. The electrical, physical, and chemical qualities of the transformer oil dictate the transformer's ideal activity[1]. The majority of transformer failures can be attributed to the dielectric protection mechanism. Naturally, transformer oil is blended with nanoparticles to help with securing properties[2]. The AC and driving circuits' dielectric strength is increased when magnetite nanoparticles are converted into transformer nanoparticles. On the other hand, the magnetite nanoparticle scattering in transformer oil is determined by the direction of the outer attractive field.A scaffold was built by the magnetite nanoparticles spanning the field hole[3]. These liquids should be sufficiently dielectrically solid to withstand the potential range of electrical pressure generated during delivery. When half-and-half nanofluids were compared to pure oil, the dielectric strength of the former was found to be lower. When half and half nanofluids were compared to pure oil, the dielectric strength of the former was found to be lower[4-5]. Fe2o3,Al2o3, and SiO2 nanofluids based on ordinary and modified ester oil have had their lightning motivation breakdown voltage investigated[6]. When nanoparticles are taken into account, the dielectric constant rises and the dielectric unfortunate steadily falls. The majority of properties in the writing study selected TiO2, Al2O3, CuO, and SiO2 as nanoparticles. The main concern with the aforementioned nanoparticles is their higher cost and lower grating coefficient of esteem[7]. Cuo nanoparticles were infused into non-edible cottonseed oil to study its dielectric and warming characteristics. The heated and constrained dielectric characteristics of cottonseed oil were overcome by the use of nanofluids. RBO-based nanofluids' dielectric and warm

qualities were all addressed[8]. Investigate how mixtures of nanoparticles affect vegetable oil's AC breakdown voltage (RBO).They have observed that typical and Weibull laws are also used in the combinations of nanoparticles (Al_2O_3, SiO_2, and Fe_3O_4)[9]. While TiO_2, SiO_2, Al_2O_3, and CuO nanoparticles are employed in the current work, I now use CUO nanoparticles due to their superior thermal and dielectric characteristics. RBO, or vegetable oil, is a complex mixture of hundreds of different chemical components, many of which are hydrogen and carbon atoms.
In order to improve the physical and electrical properties of vegetable oil (RBO), nanoparticles are added to transformer oil and their qualities are examined at room temperature. This work aims to improve the way that hexagonal boron nitride is presented in terms of its actual properties.The viscosity, flashpoint, fire point, breakdown voltage, and execution of the Cuo nanoparticle coordinated in vegetable oil (RBO) for the current study were investigated for various volume centralizations of Cuo nanofluids.

II. Experimental Details

A. Preparation of Nanofluids

In our review ,the Cuo nanoparticles were included in a vegetable oil(RBO) to create the nanofluids. The Cuo nanofluids were arranged utilizing underneath referenced cycle with different volume focuses from 0.1to 0.4%.

Figure. 1 magnetic stirrer setup

Cuo nanoparticles and base oil are combined using an eye-catching stirrer. The magnetic stirrer's speed and each sample's temperature were held at 1500 rpm and 40°C for a total of three hours during the scattering of nanoparticles. The arrangement is then supplemented with the calculated amount of Cuo and stirred for an additional 30 minutes at the same temperature. After that, a test sonicator is used to sonicate for an hour in order to obtain consistent scattering. Figure 2 displays the Cuo nanofluid samples at various volume concentrations.

Figure .2 Preparation of samples

B. Breakdown voltage measurements:

The fluid protection's breakdown voltage is a measure of its ability to withstand the electrical pressure generated under operating conditions. The sample's breakdown voltage was determined at room temperature using an oil test cup and a defined standard (IEC 60156). Figure 3 depicts the oil test cup. The oil testing cup is equipped with a transformer that can provide up to 60 kV.

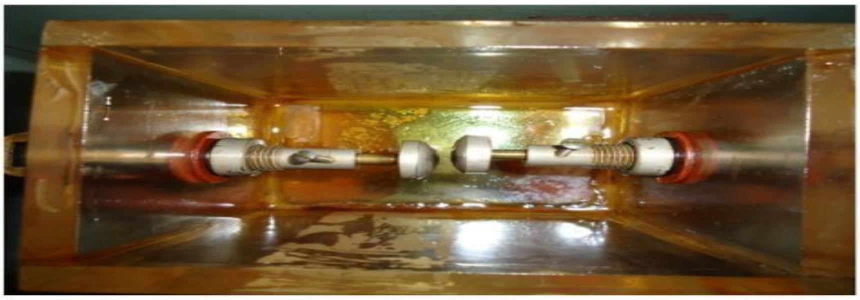

Figure .3 Oil test cup

For measuring oil breakdown voltage, the gap distance is set to 2.5 mm. First, use the transformer oil that is given to clean the oil cup. Subsequently, it is filled with transformer oil, whose dielectric strength is variable. Standing suitably and at least 40mm away from the highest point of the cathode is acceptable, regardless of stature. In the oil test, two anodes are utilized. Oil is poured into the cup, and the testing pack's bar is submerged in it to a depth of 40 mm.As the stock passes through the variac, the optional voltage breakdown is observed.

C. Flash point and Fire point measurements:

Low combustibility is one of the primary concepts being researched for improved fluid protection.The temperature at which the moulded smoke is ready to burn through is referred to as the fire point.In line with ASTM D 93, the flash and fire points are calculated from the ambient temperature using the Pensky Martin closed cup apparatus. Figure 4 depicts the Pensky Martin sealed cup analyzer.The model was placed in a metal test cup, and the temperature was raised using a temperature-controlled electric boiler. The temperature corresponding to the flash point was found in the model using a small test fire and ephemeral flames on the oil surface. heating a 50 ml oil test

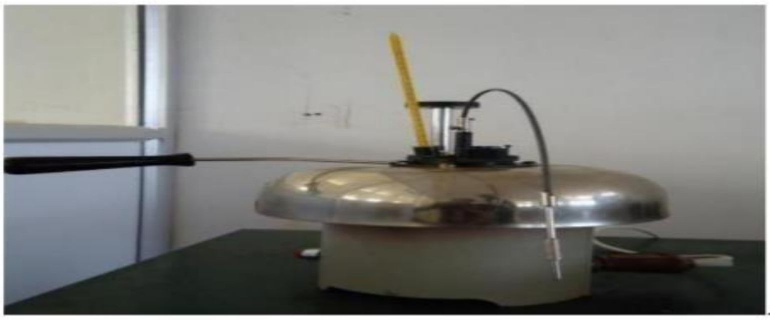

Figure .4 Pensky martin apparatus

D.viscosity measurement:

The transformer oil should have a medium consistency, with the idea that oil will flow freely in the transformer tank for cooling purposes. The temperature affects the oil's consistency. The viscosity is the physical property of vegetable oil which is measured by the apparatus called redwood viscometer by the standard ASTM D 445.The redwood viscometer is displayed in Figure 5. The model was filled in an oil cup with a silver plating. By opening the ball valve, you can let the test to move through the orifice and gather the model inside the test recepticle. Using 50 mL of test in a recepticle, calculate how long a social event will take. Viscosity hasn't been set in stone since then.Underneath the falling head, there is a little, regular-sized opening..

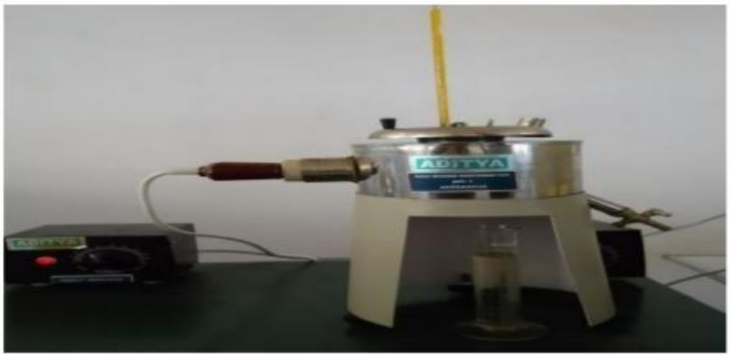

Figure .5 Redwood viscometer

III. Results and Discussions

A. Properties of Base oil

The properties of base oil (Transformer oil) were measured at room temperature according to as per the standardsASTM and IEC . The properties are shown in Table 1.

Table 1 : PROPERTIES OF BASE FLUIDS

Properties	Values
Breakdown Voltage (kv)	37kv
Flash point	195°C
Fire point	205°C
Viscosity(csk)	65 centistokes

B. Breakdown voltage :

The breakdown voltage of transformer oil-based nanofluids needs to be taken into account, since transformer oil is intended to be employed as an electrical cover in high-voltage transformer devices. The oil will burn if the breakdown voltage of the oil is not high enough to stop the transformer from producing its strongest electric field.Premium transformer oil consequently needs to have a high breakdown voltage. Investigations were conducted on the breakdown voltage of vegetable oil-based nanofluids containing Cuo. Table 2 displays the measurements taken following the sampling.

TABLE 2. NANOFLUIDS MEASUREMENTS OF BREAKDOWN (AFTER SAMPLES PREPARATION)

Cuo nanoparticles Volume fraction(vol%)	Breakdown voltage (kv)
0.1	20
0.2	22
0.3	24

0.4	26

TABLE 3 .NANOFLUIDS MEASUREMENTS OF BREAKDOWN VOLTAGE (AFTER HEATING OF SAMPLES UPTO 100◦C)

Cuo nanoparticles volume fractions (vol%)	Breakdown Voltage (kv)
0.1	35
0.2	40
0.3	42
0.4	45

C. Flash point and Fire point :

When air ignites is determined by the thermal properties of transformer oil, which are referred to as the fire point and flash point. The intentional fire and flash points of vegetable oil (RBO) and nanofluids at room temperature are displayed in Table 3. It is no longer required to begin when determining the flash point of a fluid. Contrary to this, the autostart temperature does not require a start source. The fume may cease to be consumed at the flash point if the source of the start is eliminated. Both flammable and combustible fluids are included in the definition of "streak guide". Fire point is used to calculate the danger related to a material's capacity for burning.

It has been shown that when the volume fraction of the nanoparticles increases, the Fire point and Flash point of the nanoparticles also continuously increase. According to Table 3, nanofluids have a fire point that is 10 to 15 degrees Celsius higher than base liquids, but their flash point is comparable to that of base liquids.At the fire location, the example will keep the ignition on for five seconds.A visual illustrating the examination of Fire point and Flash point may be seen in Figures 8 and 9. As the liquid temperature rises, there is a recurrence of ignition, which raises the flash and fire points.

TABLE 4 NANOFLUIDS MEASUREMENTS OF FLASH AND FIRE POINT

Cuo nanoparticle volume fractions(vol%)	Flashpoint	Firepoint
0.1	195	205
0.2	205	215
0.3	215	225
0.4	225	235

D. Viscosity:

A high viscosity indicates good stream protection, whereas a low consistency indicates poor stream protection.viscosity changes were directly proportional to temperature. viscosity is likewise impacted by pressure, high tension makes the consistency increment and hence the heap conveying limit of the oil additionally increments.

As temperatures rise, the consistency of the base and nanofluids drastically deteriorates. Table 4 illustrates how the thickness of nanofluids reduces as the volume fraction rises. when the temperature that's used to measure the internal viscosity of vegetable oil (RBO) is normal.When compared to other oils, vegetable oil (RBO) has a more typical viscosity. Several approaches to reduce viscosity have been put forth in the literature. Therefore, by increasing the viscosity, the research vegetable oil (RBO) should be employed as transformers.

TABLE 5 VISCOSITY MEASUREMENTS OF NANOFLUIDS

Cuo nanoparticle volume fractions(Vol%)	Viscosity(csk)
0.1	63
0.2	65
0.3	67
0.4	69

IV.CONCLUSION

Nanofluids were created in this study by dispersing nanoparticles in vegetable oil(RBO). At normal temperature, the essential features of nanofluids were examined.

1. Cuo nanoparticles are added to vegetable oil (RBO) in accordance with the assessment's findings, and this assembles the breakdown voltage. As the particle volume fraction of nanoparticles grows, so does the breakdown voltage of nanofluids.
2. The use of nanoparticles raises vegetable oil's flash point (RBO). The temperature at the fire spots has increased from 10 to 15 degrees Celsius in the interim.
3. The range of viscosity is expanded when Cuo nanoparticles dissolve in vegetable oil (RBO)...
4. The results show that the breakdown voltage, fire point, and viscosity of vegetable oil (RBO) are enhanced by the addition of nanoparticles.

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