Investigation on Performance Characteristics of Vegetable Oil (SAO) by Usingtio2nanoparticles

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Abstract:
This work shows how the physical ,electrical and thermal properties of vegetable oil(SAO) varies according to the mixture of nanoparticles. Nanoparticles of Tio2 were injected into the vegetable oil (SAO) individually, with particle volume portions ranging from 0.1 percent to 0.4 percent, to create Nanofluids (NFs) that act on the oil's fundamental properties. The qualities like flash point, Breakdown voltage(BDV), firepoint, viscosity were estimated at the room temperature where it is depends upon the standards such as IEC and ASTM standards. When the vegetable oil(SAO) is heated in the presence of nanoparticles,then the break downvoltage will increase. Meanwhile, the flash point and fire point have increased, expanding from 10°C to 15°C, and the viscosity has changed as nanoparticles have grown in size.

Keywords: Vegetable oil(SAO) , Nanoparticles, Nanofluids, blending , tranformers.

I-INTRODUCTION

In the transmission and circulation organization, transformers are the most urgent and significant part. The Protecting oil (Transformer oil) is utilized to give electrical protection to inside components of transformers just as fill in as a hotness trade medium. The transformer's optimal activity is determined by the transformer oil's electrical, physical, and chemical properties[1]. The dielectric protection method is to be faulted for most of transformer disappointments. Nanoparticles, of course, are mixed into transformer oil to work on securing properties[2]. The transformation of magnetite nanoparticles into transformer nanoparticles increases the dielectric strength of the AC and driving circuits. The outer attractive field direction, on the other hand, determines the scattering of magnetite nanoparticles in transformer oil.The magnetite nanoparticles constructed a scaffold across the field hole between the anodes in an attractive field, bringing down the transformer oil's dielectric strength[3]. These liquids ought to have adequate dielectric solidarity to support the possible scope of electrical pressure produced during administration The dielectric strength of halfand half nanofluids was analyzed, and a decrease wasnoted when contrasted with unadulterated oil. The dielectric strength of half and half nanofluids was analyzed, and a decrease was noted when contrasted with unadulterated oil[4-5]. It have explored of lightning motivation breakdown voltage of regular and engineered ester oil based Fe2o3,Al2o3,Sio2 nanofluids[6]. The dielectric consistent increments and the dielectric misfortune steady declines with the consideration of nanoparticles. From the writing study, larger part properties have choosen Tio2,Al2o3,Cuo and Sio2 as nanoparticles. The principle worry of the previously mentioned nanoparticles is that theyhave a lower grating coefficient esteem and are more costly. Most of distributed examination centers around the effectof nanoparticles on the warms and dielectric properties of greasing up oils[7]. The researched of the dielectric and warm properties of Non-Edible cottonseed oil by infusing Tio2 nanoparticles . The nanofluids was used to overcome the confined dielectric and warm properties of cottonseed oil. The dielectric and warm properties were altogether worked on in CSO based nanofluids[8]. The explore the impact of nanoparticles blends on AC breakdown voltage of vegetable oil(SAO).They have seen that the combinations of nanoparticles (Al2O3,SiO2and Fe3O4) is additionally performed utilizing typical and weibull laws[9]. In the existing work, Tio2, Sio2, Al2o3 and Cuo nanoparticles are used, I now use TIO2 nanoparticles, because they have higher dielectric and thermal properties. Vegetable oil(SAO) is a complex compound of hundreds of different chemical compounds, with many molecules comprising carbon and hydrogen. Although vegetable oil(SAO) continues to be a major technological solution compared to the economy, its environmental impact must be considered.

In this study, nanoparticles are introduced to transformer oil to enhance the physical and electrical properties of vegetable oil (SAO), and their qualities are assessed at ambient temperature. The objective of this work is to enhance the representation of the properties of hexagonal boron nitride.In the current work, the breakdown voltage, viscosity, flashpoint, fire point, and execution of the Tio2 nanoparticle orchestrated in vegetable oil (SAO) for various volume centralizations of Tio2 nanofluids were explored.

II Experimental Details

A. Preparation of Nanofluids

In our review ,the Tio2 nanoparticles were included in a vegetable oil(SAO) to create the nanofluids. The Tio2 nanofluids were arranged utilizing underneath referenced cycle with different volume focuses from 0.1to 0.4%.

Figure. 1 magnetic stirrer setup

Using a decorative stirrer, the base oil and Tio2 nanoparticles are mixed. The temperature of each sample was maintained at 40 °C and 1500 rpm for a total of three hours during the dispersion of nanoparticles. The determined amount of Tio2 is then added to the mixture, which is then agitated for a further 30 minutes at the same temperature. After that, an hour of sonication with a test sonicator is performed to get reliable scattering.The Tio2 nanofluid samples areshowninFigure2atvariousvolumeconcentrations.

Figure .2 Preparation of samples

B. Breakdown voltage measurements:

The breakdown voltage of fluid protection is a proportion of the capacity of fluid protection to endure electrical pressure created in working circumstances.

At the room temperature, by using oil test cup the sample's breakdown voltage were measured with specified standard (IEC 60156). Fig3 shows that the oil test cup. The oil testing cup has set up transformer capable of giving upto 60 kv..

For the breakdown voltage measurement of oil,the gap space is set as 2.5mm. First the oil cup is washed with given transformer oil. It is then loaded up with transformer oil, whose dielectric strength is not set in stone. It is permitted to stand adequately and regardless to a stature at least 40mm from the highest point of the cathode. The oil test is giventwo anodes. The oil is filled inside the cup, the bar of the testing pack is inundated in the oil for a profundity of 40mm.The stock is shifted through the variac the breakdown of the optional voltage is noted.

Figure .3 Oil test cup

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 moldy smoke is ready to burn through is known as the fire point.According to ASTM D 93, the flash point and fire points are calculated from the ambient temperature using the Pensky Martin closed cup apparatus. Figure 4 shows the Pensky Martin sealed cup analyzer.A temperature-controlled electric boiler was utilized to increase the temperature while the model was inside of a metal test cup. 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 test of oil

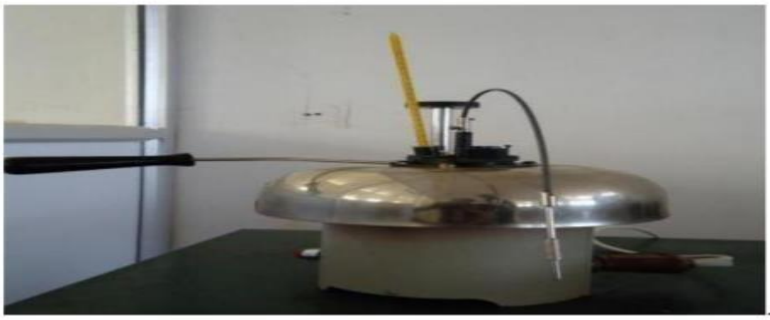

Figure .4 Pensky martin apparatus

D. viscosity measurement :

The transformer oil should have a medium consistency to allow for free oil flow in the transformer tank for cooling reasons. The temperature affects the oil's consistency.
According to ASTM D 445, the redwood viscometer is used to measure the physical property of transformer oil known as viscosity.The redwood viscometer is used in Figure 5.

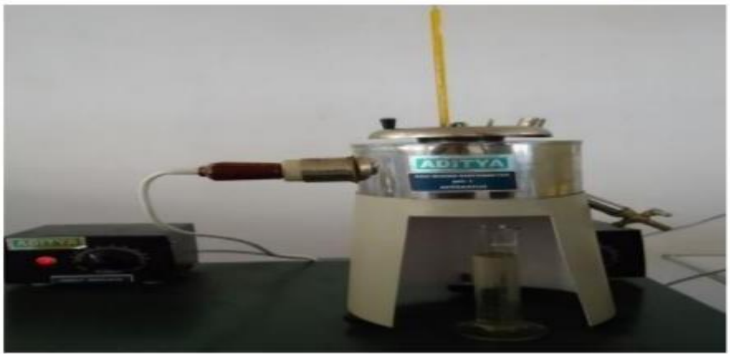

Figure .5 Redwood viscometer

The model was placed within a silver-plated oil cup. You can allow the test to flow through and collect the model in the test reservoir by opening the ball valve (orifice). The time of a social event is determined using 50 mL of test in a recepticle. Viscosity hasn't been steady ever since.

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)	44kv
Flash point	200°C
Fire point	215°C
Viscosity(csk)	60 centistokes

B. Breakdown voltage :

The breakdown voltage of transformer oil-based nanofluids should be addressed in light of the fact that transformer oil is designed to act as an electrical cover in transformer devices that operate in high-voltage environments. If the oil's breakdown voltage can't keep the transformer from reaching the maximum electric field strength, the oil will fizzle.In this vein, a high breakdown voltage is a critical characteristic of high-quality transformer oil. The breakdownvoltage of Tio2-containing transformer oil-based nanofluids was investigated. The after-sample measurements are shown in Table 1. The sample of the nanofluids was prolonged when compared to the basic fluid, as shown in Table 2. Figure 7 shows the breakdown voltage assessment curve of the models before they were warmed up to 100°C. The breakdown voltage was developed in the particle volume section of nanoparticles, according to the breakdown voltage assessment. Before heating the breakdown voltage was minimum range ,because the moisture was presented , after heating the samples the moisture was removedand the breakdown voltage is maximum range.

TABLE 2. NANOFLUIDS MEASUREMENTS OF BREAKDOWN (AFTER SAMPLESPREPARATION)

Tio2 nanoparticles Volume fraction(vol%)	Breakdown voltage (kv)
0.1	25
0.2	27
0.3	29
0.4	31

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

Tio2 nanoparticles volume fractions (vol%)	Breakdown Voltage (kv)
0.1	55
0.2	56
0.3	58
0.4	59

C. Flash point and Fire point :

When air will ignite depends on the thermal properties of transformer oil, also referred to as the flash point and fire point. Table 3 displays, for nanofluids and vegetable oil (SAO) at room temperature, their calculated Fire point and Flash point. When calculating a fluid's flash point, there is no longer a need to start from scratch. Contrast this with the autostart temperature, which doesn't require a start source. The fume may stop consuming if the flash point source of ignition is eliminated. Fluids that are both flammable and combustible are said to as "streak guides." Fire point is used to assess the danger posed by a substance's capacity to support burning.It has been shown that nanoparticles' Fire point and Flash point are constantly changing.

TABLE 4 NANOFLUIDS MEASUREMENTS OF FLASH AND FIRE POINT

Tio2 nanoparticle volume fractions(vol%)	Flashpoint	Firepoint
0.1	200	210
0.2	210	220
0.3	215	225
0.4	220	230

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.

The viscosity upsides of base vegetable oil(SAO) and arranged distinctive volume rates of nanofluids at various temperatures are given in fig 10.The consistency of base and nanofluids are diminishes quickly with expanding temperature Table 4shows that the thickness of nanofluids diminishes in various volume portions. When the temperature used during viscosity analysis for vegetable oil(SAO)s intended for internal use is relatively normal.The viscosity of the vegetable oil(SAO) is more standard value when compared to the vegetable oil. Some approaches for lowering viscosity values have been proposed in the literature. As a result the viscosity increased techniques should be used to operate the research vegetable oil(SAO) as transformers.

TABLE 5 VISCOSITY MEASUREMENTS OF NANOFLUIDS

Tio2 nanoparticle volume fractions(Vol%)	Viscosity(csk)
0.1	60
0.2	62
0.3	63
0.4	65

IV CONCLUSION

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

1. The Tio2 nanoparticles are added into the vegetable oil(SAO) assembles the breakdown voltage, according to the assessment results. The breakdown voltage of nanofluids is increasing as the particle volume part of nanoparticles expands.
2. The flash point of the vegetable oil(SAO) is increased by including nanoparticles. Meanwhile, the temperature of the firesites has increased from 10 to 15 degrees Celsius.
3. When Tio2 nanoparticles gets dissolved in vegetable oil(SAO) which results in increase of viscosity range.
4. According to the findings, adding nanoparticles to vegetable oil(SAO) increases the breakdown voltage and fire point while also increasing the viscosity.

For the future work , replacement of vegetable oil(SAO) by various vegetable oil will be done to determine the performance characteristics.

REFERENCES

1. Senthilkumar, Karthick, Madavan, Arul Marcel Moshi, Sundara Bharathi, S.R.Saroja, Sowmya Dhanalakshmi: Optimization of transformer oil blended with natural ester oils using Taguchi-based grey relational analysis. Fuels, 11, 1813, (2019)
2. V.Salles and S.Bernard Investigated of structural and thermal properties of boron nitride nanoparticles.Vol .168.pp.287-295sep 2011.
3. Subramaniya Siva, Balaji, Akileshwaran, Hemanathan: Experimental Analysis on the Combination of Jatropha Oil and Silk Cotton Oil for Transformer. International Conference on Science Technology Engineering and Mathematics (ICONSTEM), (2019).
4. Rakesh and Joy Thomas: Pongamia Oil, an Eco-friendly Alternative for Mineral Oil used in High Voltage Transformers. IEEE Transactions on Dielectrics and Electrical Insulation, 5, (2018).
5. D.-E.-A. Mansour, A. M. Elsaeed, and M. A. Izzularab, ‘‘The role of interfacial zone in dielectric properties of transformer oil-based nanofluids,’ IEEE Trans. Dielectr. Electr. Insul., vol. 23, no. 6, pp. 3364–3372, Dec. 2016.
6. Diaa –Eldin A. Mansour and Essam M. Shaalan Investigated of Multiple nanoparticles for improvement of thermal and dielectric properties of oil nanofluids.Vol .13,no.7.pp.968-974 ,sep ,2019.
7. Mad mukthar Investigated on synthesis ,characterization , stability, thermo-physical properties and rheological behavior of MCWNTs- kapok seed oil based nanofluid.Vol .277,pp.812-824 ,mar 2019
8. R . Naresh Muthu and S. Rajashabala Investigated of Hydrogen storage performance of lithium borohydride decorated activated hexagonal boron nitride nanocomposite for fuel cell applications.Vol.42 ,no .23. pp. 15586- 15596.Jun2017
9. M. Dong and L.P.Shen Investigated on the electrical conductivity of transformer oil –based AIN nanofluid.Vol.2013 ,Art.no. 842963,Dec2013.
10. S. R. Valantina, K. A. Jayalatha, D. R. P. Angeline, S. Uma, and B. Ashvanth, ‘‘Synthesis and characterisation of electro-rheological property of novel eco-friendly rice bran oil and nanofluid,’’ J. Mol. Liquids, vol. 256, pp. 256–266, Apr. 2018.