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ANALYSIS OF CORONA INCEPTION VOLTAGE OF NANO TRANSFORMER OIL UNDER NON- STANDARD TRANSIENT VOLTAGES

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ABSTRACT

The dielectric property of the wadding will be improved by adding up the projected Nano particles inside the mineral oil .The transformer oil and Nanofluid Particle size analysis were carried out with two hundred impulse breakdowns. The Corona Inception Voltage (CIV) increases by means of an amplify in the wt. % of titania nano particles in the transformer oil, and higher than a certain limit (0.0061 weiht percentage of titania in the transformer oil) of adding together of nanoparticles, an insignificant decrease in CIV was observed, best possible amount of Nano titania discrete transformer oil have elevated CIV and Breakdown strength is also over DC and AC voltages. To improve the CIV by adding together of Surfactant such as CTAB, it increase the uniform dispersion of nano particles in transformer oil and improve the CIV of different voltage profile. The permanence of dispersed nanoparticles in transformer oil is examined through particle size analysis, UV analysis, and fluorescent analysis and by turbidity measurement.

Keywords: *Nano particles, mineral oil, Corona Inception Voltage, Corona Inception Voltage*

INTRODUCTION

The transformers be established from the familiarity of electromagnetic induction laws. Transformers are classified in to step-up and Step-down transformer, if the number of primary turns is less than the number of secondary turns is step-up transformer or Step-down transformer. Insulating oil are classified in two types of, one is Paraffin based and another one is Naphtha based oil. The paraffin oil is minimum of the oxidation rate when related to the Naptha oil, but slush is unsolvable and swift at the underneath of the tank and turn as a barricade to the transformer cooling system. The slush in the naphtha oil is more decipherable than Paraffin oil. Good quality transformer oil act as a liquid padding in an power transformer and dissipate heat from transformer[1].

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The nanofluid is a new-fangled dimensional thermo fluid expression emerges after the pioneering work by Choi et al. (1995). Nanofluids have greater properties like high thermal conductivity, long-term stability, minimal clogging in flow passages, and homogeneity Particle size is the most important physical parameter, since it can be worn to control the nanofluid thermal property as well as the suspension stability of nanoparticles.

The advantages of suspending nanoparticles in base fluids:

- ❖ Increases the surface area as well as the heat capability of the fluid.
- ❖ Enhances the successful thermal conductivity of fluid.
- ❖ Increases the surface of flow passage of base fluids by the collision and interaction among particles.
- ❖ Compared to conventional slurry reduction of particle clogging occurs.

Dielectric Constant

Dielectric constant is a constituent of an electrical insulate material which is the same to the ratio of the capacitance of a capacitor packed with the given material to the capacitance of matching capacitor in a vacuum with no dielectric material. As a result, an interior electric field is bent that reduce the on the whole field inside the dielectric itself. Dielectric strength resolute to take note on sparks between two electrodes immersed in oil and a specific gap between them[10].

CORONA INCEPTION VOLTAGE (CIV)

A corona will take place when the might of gradient of the electric field in the region of a conductor is elevated enough to shape a conductive region, but not towering enough to root electrical breakdown or arcing to close to objects.

The environmental effects produced by corona discharges on conductors play an important role in the design and operation of high-voltage transmission lines. corona can be described as the faint glow on the surface of electrical conductors under high voltages.

- ➢ The objective is to comprehend the quality distinction in breakdown voltage of a transformer oil and nanoparticles using titania dispersed transformer oil under DC, AC and non-standard transient voltages.

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- To understand the CIV and the breakdown voltage is highest for % weight of surfactant detached in transformer oil, under AC, AC and transient voltages.
- To realize that under negative polarity size of particles observed high breakdown and is fewer with nano fluids. It is as well noticed that the turbidity is elevated for nano fluid than transformer oil.

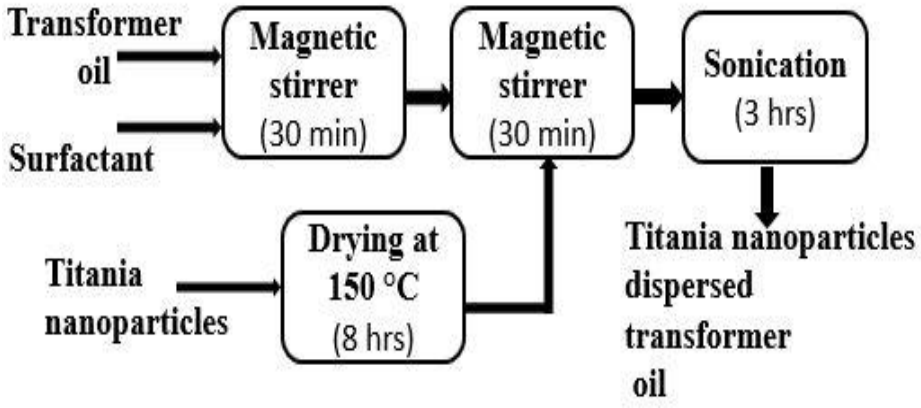

figure1. Schematic diagram for preparation process of Titania nano particle

The normal transformer oil is assorted with a identified volume of titania nanoparticles (less than 15 nm) along with the surfactant Cetyl Trimethyl Ammonium Bromide (CTAB). Titania nanoparticles of necessary volume is placed in hot air oven for eight hours at one hundred and fifty degree celcius to remove moisture. In the primary stage, the surfactant of recognized quantity is added to transformer oil, assorted using magnetic stirrer for thirty minutes. To disband the nano particles, using 500 W, 20 kHz Sonics Vibra-cell sonicator for three hours at about 40°C. On conclusion of the process, titania nanoparticles crammed transformer oil is left for two hours to take away micro bubbles fashioned during the process of ultrasonication as shown in figure1.

ANALYSIS OF CORONA INCEPTION VOLTAGE

The disparity in CIV of transformer oil with different weight percentage of titania nanoparticles, under DC and AC voltages[4]. The CIV is increased with an increase in the weight percentage of titania nanoparticles in transformer oil, a convinced limit in 0.0061 weight percentage of titania in transformer oil, a insignificant reduction in CIV is observed, but not lesser than in transformer oil, under DC and AC voltages.

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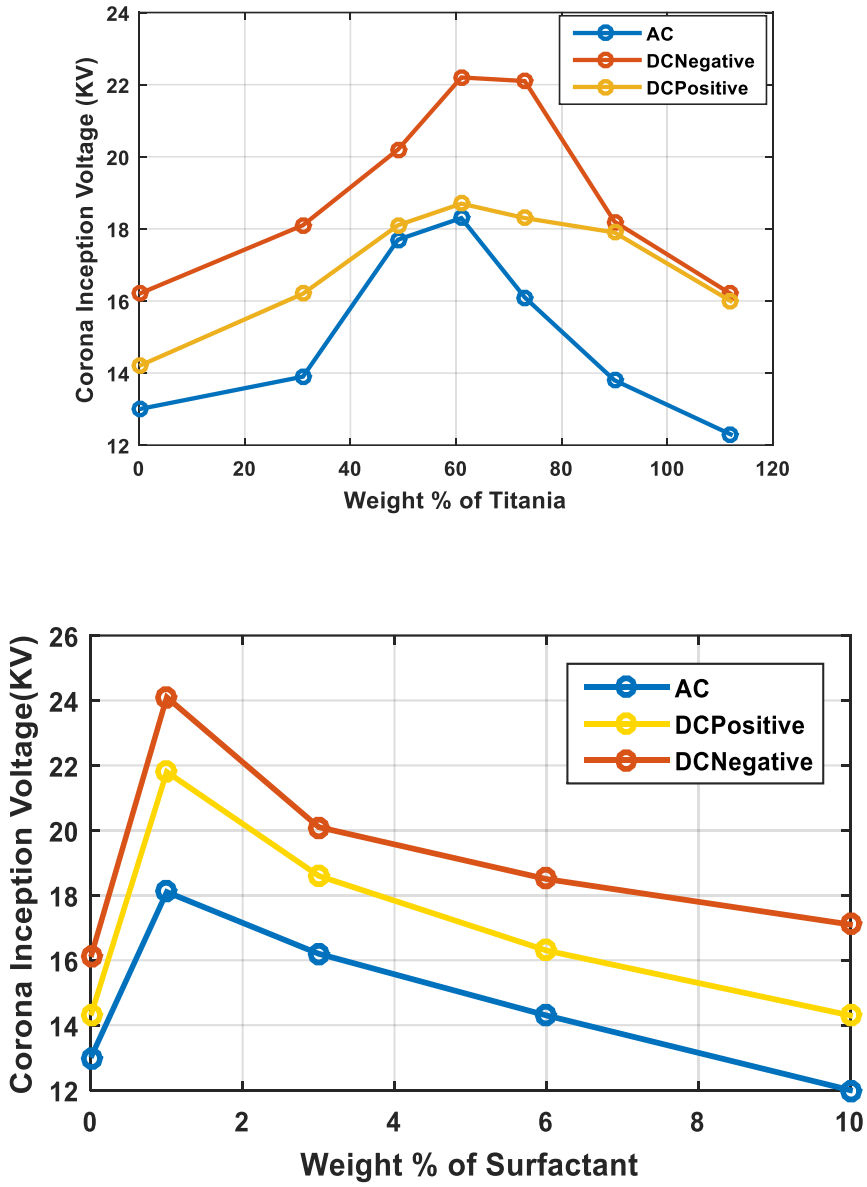

Figure 2: Variation in Corona Inception Voltage with (a) different weight percentage of TiO_2 nanoparticles, (b) different weight percentage of surfactant added to 0.0061 weight percentage titania nanoparticles dispersed in transformer oil under DC and AC voltages.

It is necessary in the direction of optimize the Nano particles added in the normal transformer oil to improve the withstanding capacity of the transformer by applying different voltage profiles. By adding the volume of different Nano particle in the transformer oil and can be optimized by measuring the CIV of positive DC, Negative DC and AC. It is observed

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that0.0061% weight of Titania has high CIV and then it gets decreased by increasing the volume of titania .

Under lightning impulse voltage, the variation in breakdown voltage of nanofluid with different weight percentage of titania in transformer oil, as shown in figure 4.2(a). It is observed that with increase in percentage of nanotitania in transformer oil with increase in breakdown voltage and added enhancement in breakdown voltage is experimental with nanofluid, on adding up of surfactant. In general the breakdown voltage is greatest for 1 weight percentage of surfactant added in 0.0061 weight percentage titania detached transformer oil, under DC, AC and lightning impulse voltages as shown in figure 4.2(b).

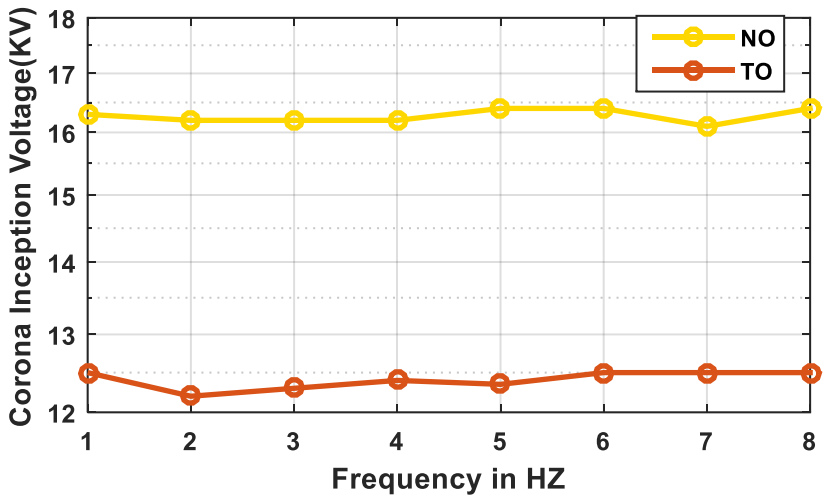

Figure 3: Variation of CIV in transformer oil with TiO_2 under high frequency AC voltages

The figure 3 shows the CIV of transformer oil and 0.0061 weight percentage of titania and 1 weight percentage of surfactant CTAB added nanofluid detached transformer oil with diverse supply frequency. The CIV is calculated using the UHF signal generated by using discharge of electrode gap crammed with nanofluid and transformer oil. The CIV is arrived based on thirty measurements with amplify in frequency of AC voltage. Also, it is observed that the marginal variation by increasing the supply voltage frequency. Figure 4(a and b) shows the variation in CIV of unlike harmonic triplet AC voltage with different THD's of electrode gap filled with nanofluid and transformer oil[10].

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By applying different THD's with varying triplet frequency as the THD's increases the corona inception voltage gets reduces. With increasing THD's as the frequency increases the CIV is maximum for Nanofluid when compared to the transformer oil.

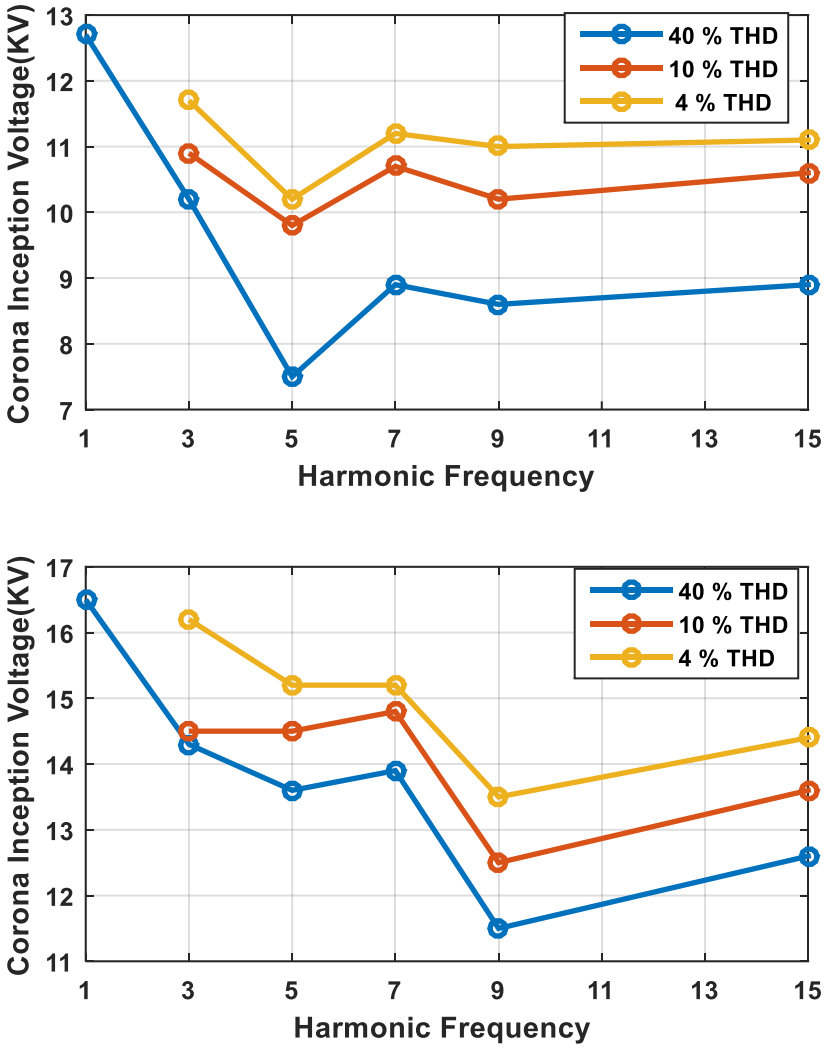

Figure 4: Variation of CIV (a) transformer oil under harmonic AC voltages with different % of THD (b) Nanofluid under harmonic AC voltages with different % of THD

Study of Diagnsotic in Nano Oil

The diagnostic studies conceded out can be sectionalized as Ultra violet analysis, Turbidity and Fluoroscent Analysis.

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a) Ultra violet analysis:

The UV analysis of normal transformer oil and nano oil after two hundred breakdowns as shown in figure 5. There is no characteristic dissimilarity was observed with the virgin transformer oil and nano filled transformer oil.

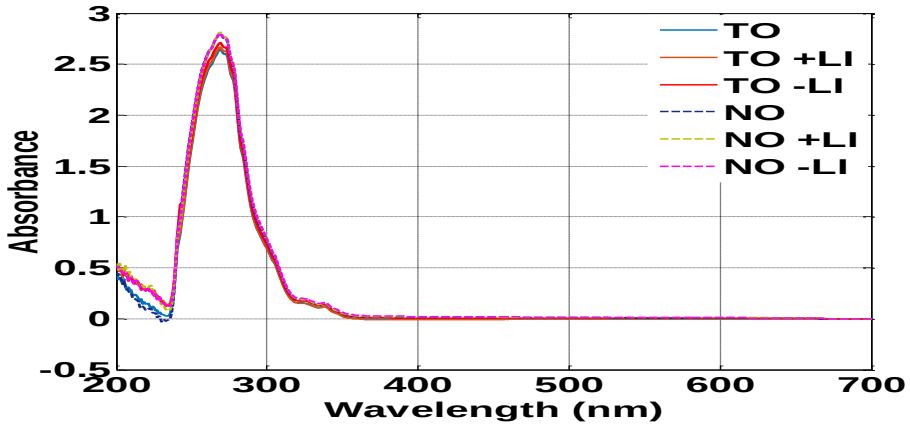

Figure 5: UV measurement of 200 lightning impulse with normal Transformer oil and Titania Nanoparticles with transformer oil

b) Turbidity

This is due to the contamination of the liquid on breakdownand is observed that the turbidity is maximum for negative polarity with 200 lightning impulse for transformer oil is 0.92 and 1.11 for nano fluid as shown in table1

Table 1 Analysis of Turbidity in 200 impulses with normal Transformer oil and Titania Nanoparticles with transformer oil

S.No	Type of Oil		Turbidity(FNU)
1.	Transformer Oil	Virgin	0.63
2.		+200	0.76
3.		-200	0.92
4.	TitaniaNano particles in Transformer oil	Virgin	0.68
5.		+200	0.82
6.		-200	1.11

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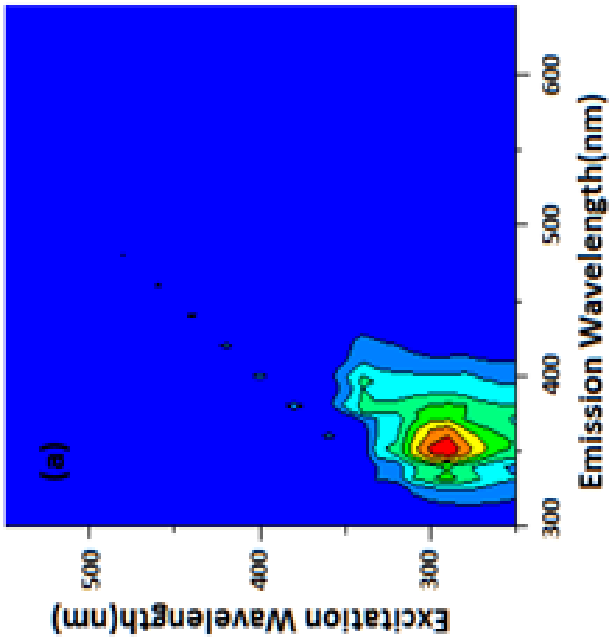
c) Fluoroscent Analysis



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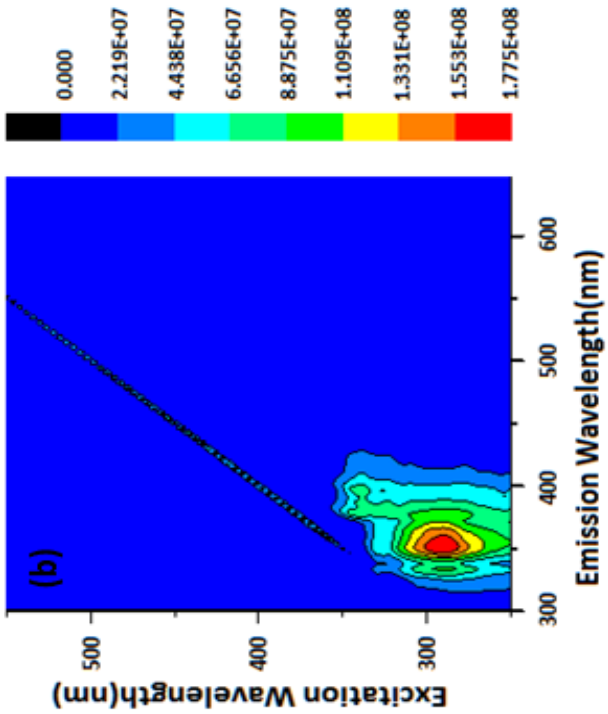

Figure6: Three-dimensional EEM spectra of (a) Normal transformer oil (b) Nano particles with Transformer oil

A three-dimensional EEM spectra of normal transformer oil and nanofluid with transformer oil as shown in figure 6 (a and b) respectively. In EEM fluorescence measurement, normal transformer oil and nano fluid is excited in the range from 250 to 600 nm and emission of fluorescence is recorded in the range from 300 to 800 nm. It is noticed that the oil absorb UV radiation in the range from 250 to 340 nm and emission in the range from 330 to 400 nm due to naphthalene moieties present. The occurrence of nano materials results in minor decrease in intensity of fluorescence due to inner filter effects.

CONCLUSION

The Corona inception Voltage (CIV) and the breakdown voltage (BDV) is maximum for 0.0061percentage weight of TiO_2 with 1 percentage weight of surfactant (CTAB) detached in the transformer oil, under DC, AC and transient voltages. The Particle contamination after Two

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hundred impulse breakdown indicates that size of particles experimental with high breakdown under negative polarity and is fewer with nano fluids but no variations is observed with UV spectra. It is also noticed that the turbidity is high for nano fluid and Fluorescent analysis indicates that marginal reduction in intensity of fluorescence.

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