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ENRICHMENT OF NANO MODIFIED INSULATING MINERAL OIL

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ABSTRACT

Now-a-days the world preserving incessant power supply is the major crucial problem for electrical engineers in the power system. In that, Transformer plays a major role in the network of power system. The transformer inner-core is insulated and cooled by using transformer oil (liquid paraffin). In that transformer oil performances as an insulating medium. Solid and liquid dielectrics[1, 2] offer insulation for transformer to protect the life time. In this paper, our core target is to increase the transformer life time even more by adding nano powder in the transformer oil. As transformer oil deteriorates through aging and moisture ingress. Transformer duty, economics are the major factors which depending on the transformer oil and the other factors should be tested regularly. Transformer oil testing sequences and procedures are defined by various international standards. In this work, the process taken to enrich on nano-modified insulating mineral oil. By stirring of nano iota the nano-fluids were prepared. So, the following mixtures are undergone to ultrasound agitation process. Viscosity, breakdown voltage (BDV), flash point, fire point and pour point are various critical parameters measured by using IEC and ASTM standards.

INTRODUCTION:

Transformer oil is an actual significant portion of the transformer protection/insulation system and has the essential function of performing as an electrical insulation as well as coolant to dissipate heat losses. The nano powder is added to the transformer oil to improve the life time of transformer for long period.

SYNTHESIS OF NANO-POWDER:

Sol gel process[3] (bottom-up method) is used for the preparation of nano powder. This process is done by using magnetic stirrer, filter paper and ultrasonic homogenizer. Magnetic stirrer is used to stirring the sol solution. Stirred solution is placed in filter paper and kept in sunlight for one day. After that the solution is sedimented in the paper.[4] The sedimented part is taken from that and using ultrasonic homogenizer[8] the sedimented part is converted into nanoparticles.

NANO-FLUIDS:

By stirring up the nanoparticles with transformer oil, nanofluids are prepared by ultrasonic agitation process. SEM[10] and EDS[10] images are used to find out size of nanoparticles. Fresh transformer oil and aged transformer oil are taken for mixing up them with nanoparticles to know the concentration of both nanofluids.

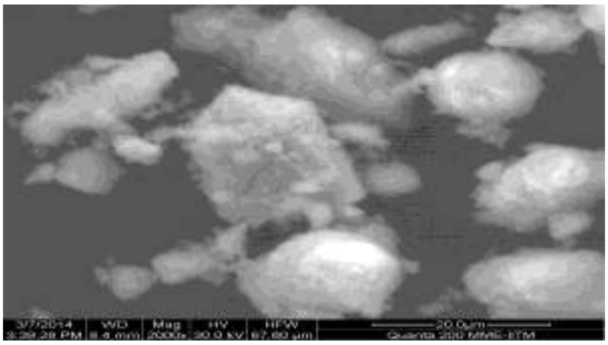
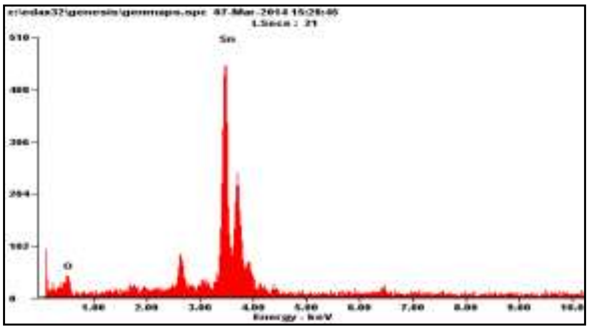
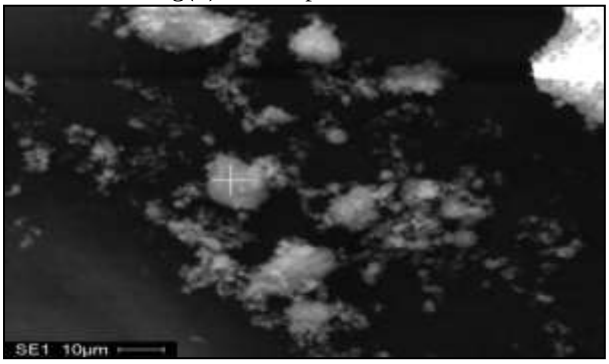


Fig (i).SEM image for SnO



Fig(ii).Size of particle for SnO



Fig(iii).SEM image for Al_2O_3

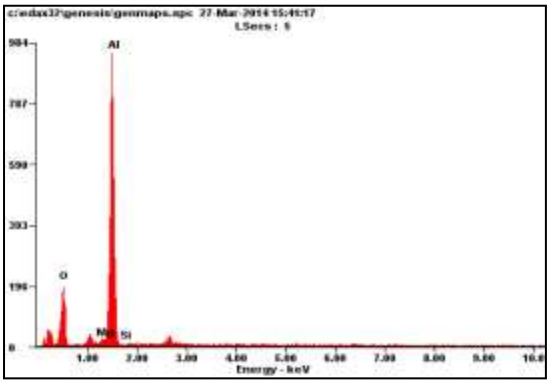


Fig (iv).Size of particle for Al_2O_3

Size of nanoparticles for SnO is displayed in Fig (i).

The Fig (ii) represents the SEM image size of Tin varies from 1m to 100nm.

Size of nanoparticles for Al_2O_3 is displayed in Fig (iii).

The Fig (iv) represents the SEM image size of Al_2O_3 varies from 1m to 100nm.

EXPERIMENTAL SETUP AND RESULTS:

The measure of oil resistance to shear is the viscosity. The resistance to flow is known as viscosity. The series of fluid super-imposed on each other is considered as lubricating oil. The measure of resistance to flow between the individual layers is known as viscosity of oil. High viscosity induces high resistances to flow; low viscosity induces low resistances to flow. Viscosity is inversely proportional to the temperature. The uses of the red wood viscometer are to measure the nanofluids viscosity [9]. The most critical thermal property of TQL is nothing but flash and fire point. Martin pensky open cup apparatus is used for measuring nanofluids thermal property [12]. Transformer oil BDV is finding out by BDV testing kit range of up to 80kV. The sphere-sphere type of electrodes is used during the measurement of BDV to obtain uniform file distribution. Absorbance and transmittance are the two factors of UV spectral response. This process is mainly used for the confirmation of proper mixing of the nanoparticles with TQL. The absorbance peak will be reduces and there will be no transmission only for the nanoparticles which are not mixed properly. Low absorbance and high transmittance are the features of the pure transformer oil. For the determination of the absorption capacity of the nanofluids UV spectrophotometer[5] is used. UV visible test is not a mandatory test according to the American Society for Testing and Materials (ASTM), International Electro technical Commission (IEC) and IS standards. UV[11] light sources is developed from the initiative nanofluids, also spectral response characteristics[8] is studied, that creates some technique on quantity of particles mixed with TQL. The measure of the base or the acid level is mainly based on the pH[6] value of the nano fluids. The digital pH meter[7] is used to analyse the level of pH value. Volume of fractions 0.1, 1 and 2% of used oil, SnO, fresh oil, and aluminium oxide (Al_2O_3) are measured for various particles in critical parameters of TQL. Following results for pure transformer oil and TQL based nanofluids is tabulated.

BREAKDOWN VOLTAGE (SnO):

Sl no.	Breakdown voltage for used transformer oil + SnO_2 kV	Breakdown voltage for fresh transformer oil + SnO_2 kV
1.	40	50
2.	38	48
3.	36	46
4.	38	48
5.	38	45
Average	38.4	47.5

Table 1. Expose the BDV for SnO to know its breakdown strength in both Used transformer oil and Fresh transformer oil..

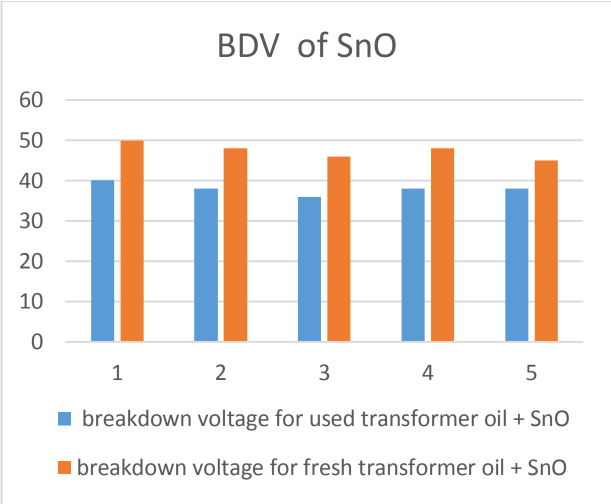


Fig (v) shows the BDV rating (kV) for
1. Used transformer oil + SnO
2. Fresh transformer oil + SnO

BREAKDOWN VOLTAGE (Al_2O_3):

Sl no.	Temperature °c	Time taken for 50 ml seconds	Kinematic viscosity m²/s	Density Kg/m³	Absolute viscosity Ns/m²
1.	35	51	9.887	0.846	8.374
2.	40	50	9.560	0.843	8.064
3.	45	48	8.897	0.840	7.496
4.	55	43	7.180	0.837	6.010
5.	60	39	5.729	0.833	4.773
6.	65	38	5.3536	0.830	4.443
Average				0.840	7.110

Table 2. Describes the BDV for Al_2O_3 in both Used transformer oil and Fresh transformer oil.

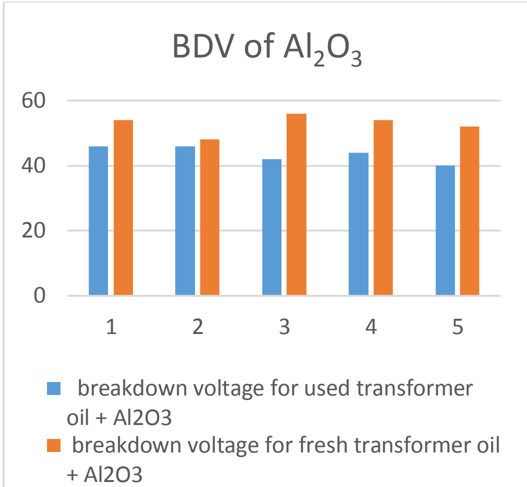


Fig (vi) Shows the BDV rating (kV) for both
1. Used transformer oil +Al_2O_3
2. Fresh transformer oil + Al_2O_3

BDV means Break-Down Voltage which helps to determine the breakdown strength of transformer oil using Transformer oil tester. The oil testing kit has step up transformer capable of giving up to 80kV. The set is complete with standard oil test cup transformer cover which is electrically interlocked to prevent accidental touch to live ports. First test oil cup is rinsed with given transformer oil. It is then filled with transformer oil, whose dielectric strength is to be determined. It is allowed to stand sufficiently and in any case to a height not less than 40mm from the top of electrode. The oil test provide with two electrodes. The gap between the electrodes can be adjusted by using standard rods of size 2mm. Two limits switches are provided for the precaution of the operator and provided atControl knob of transformer and Transparent cover. The gap between the electrode by the rod provided with punch mark for GO. The oil is filled within the cup; the rod of the testing kit is immersed in the oil for a depth of 40mm. The supply is varied by means of variac the breakdown of the secondary voltage is noted.

VISCOSITY:

FRESH TRANSFORMER OIL+Al_2O_3:

Table 3: illustrates the viscosity readings for Fresh transformer oil + Al_2O_3

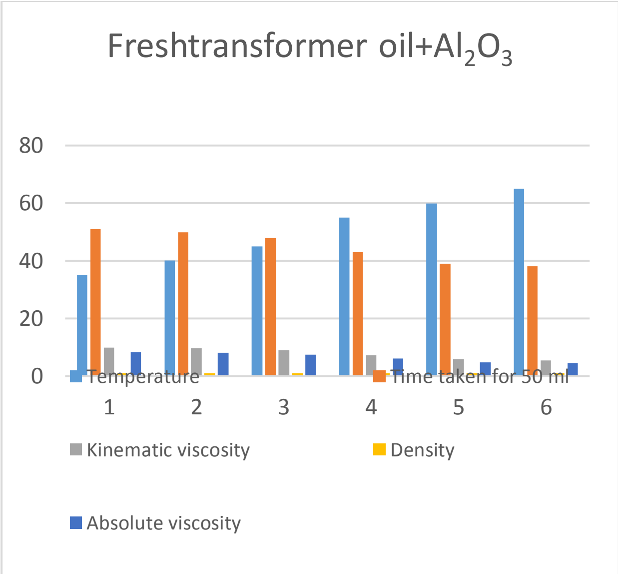


Fig (vii) illustrates the viscosity of Fresh transformer oil + Al_2O_3

VISCOSITY:

FRESH TRANSFORMER OIL+SnO:

	Breakdown voltage for used transformer oil + Al_2O_3 kV	Breakdown voltage for fresh transformer oil + Al_2O_3 kV
1.	46	54
2.	46	48
3.	42	56
4.	44	54
5.	40	52
Average	46.8	52.8

Sl no.	Temperature °c	Time taken for 50 ml seconds	Kinematic viscosity m^2/s	Density Kg/m^3	Absolute viscosity Ns/m^2
1.	35	80	18.65	0.848	15.828
2.	40	60	12.74	0.845	10.770
3.	45	52	10.22	0.842	8.607
4.	50	50	9.56	0.838	8.019
5.	55	48	8.89	0.835	7.434
6.	65	46	8.22	0.832	6.843
Average				0.840	9.583

Table 4&5 illustrates the reading of fresh transformer oil +Sno

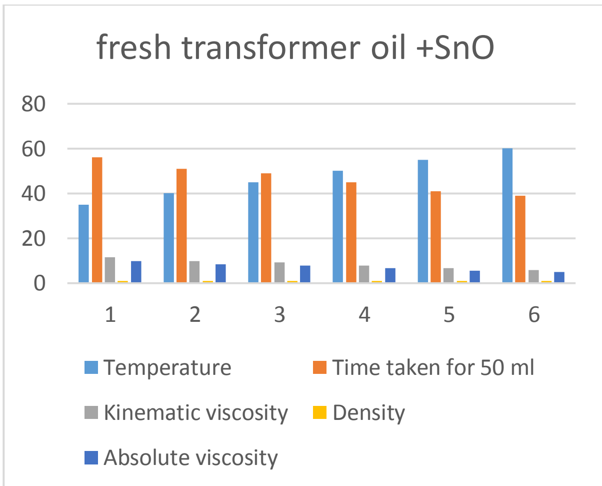


Fig (viii)shows the viscosity of fresh transformer oil+SnO

VISCOSITY:

Sl no.	Temperature °c	Time taken for 50 ml seconds	Kinematic viscosity m²/s	Density Kg/m³	Absolute viscosity Ns/m²
1.	35	56	11.489	0.848	9.750
2.	40	51	9.887	0.845	8.358
3.	45	49	9.229	0.842	7.772
4.	50	45	7.877	0.838	6.608
5.	55	41	6.465	0.835	5.402
6.	60	39	5.729	0.832	4.768
Average				0.840	7.110

USED TRANSFORMER OIL+ $Al_2 O_3$:

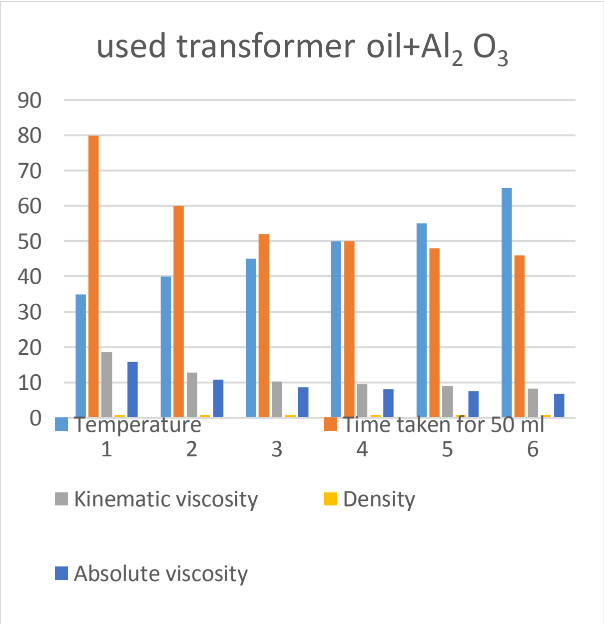


Fig (ix)shows viscosity of used transformer oil+Al_2O_3

VISCOSITY:

USED TRANSFORMER OIL+SnO:

Sl no.	Temperature °c	Time taken for 50 ml seconds	Kinematic viscosity m²/s	Density Kg/m³	Absolute viscosity Ns/m²
1.	40	90	21.489	0.846	18.186
2.	45	81	18.936	0.843	15.972
3.	50	65	14.253	0.840	11.976
4.	55	52	10.212	0.837	8.547
5.	60	44	7.530	0.833	6.307
6.	65	39	5.729	0.830	4.758
Average				0.839	10.957

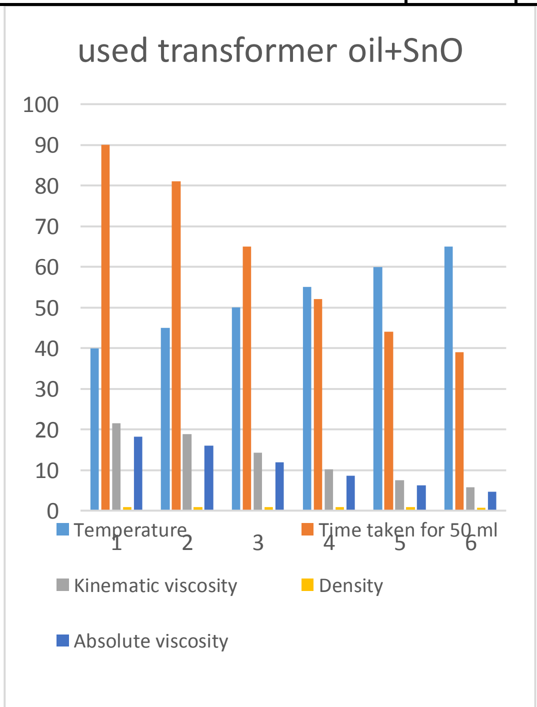


Fig (x) shows the viscosity of used transformer oil + SnO

COMPARISON WITHOUT AND WITH NANOPARTICLES:

Parameters	Fresh Mineral oil	Used minera l oil	AlO 2 + Fres h oil	AlO 2 + Used oil	SnO 2 + Fres h oil	SnO2 + Used oil
Breakdown voltage kV	47.166	37	52.8	46.8	47.5	38.4
Flash point Temperatur e ˚C	150	140	155	148	160	150
Fire point Temperatur e ˚C	160	150	165	158	170	160
Viscosity Ns/m2	5.112	8.109	6.52 6	9.58 3	7.11 0	10.95 7
Density Kg/m3	0.838	0.837	0.83 8	0.84 0	0.84 0	0.839

Table. Finally shows the thermal properties and dielectric properties of Al_2O_3 and SnO
With the help of transformer oil.

COMPARISON WITHOUT AND WITH NANOPARTICLES:

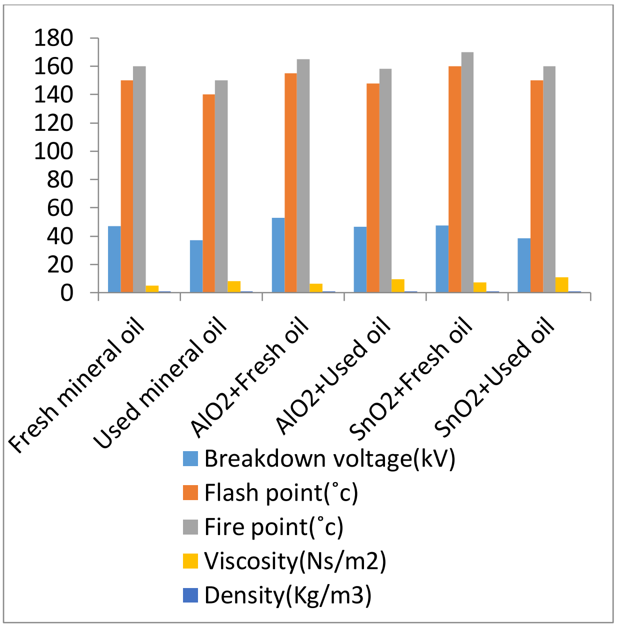


Fig (xi) finally shows the improvement in the thermal properties and dielectric properties of both additives.

CONCLUSION:

By using metal oxide nano-powder, there identified the thermal and dielectric properties of mineral oil using Al_2O_3 and Sno. Also their properties was measured and analysed. The viscosity, density, flashpoint, fire point and BDV are the parameters were measured. Through the result we determine that Al_2O_3 nano powder is good insulating media in the mineral oil. In addition with tin oxide nano powder the BDV is not modified but the thermal properties is highly revises. The parameters like flash point and fire point of the thermal properties improves 10% of the normal mineral oil value. By using Al_2O_3 nano powder mineral oil thermal properties improves a lot. By the mixture of Al_2O_3 and SnO nano powder are marginally increase the viscosity and density because of the size and mass of metal oxide nano powder.

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