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Impact Ofantioxidant And Degasification Ona New Liquid Dielectric Suitable For Transformer Applications

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Abstract:
The transformer oil which is petroleum based has been used for the transformer as the dielectric media. It acts as a coolant in transformer. Soil will be contaminated when a mineral oil spill takes place. In future there will be scarcity of mineral oil as it is extracted from petroleum products. Now a day's Synthetic oil and natural esters are the alternativesfor transformer oil because of they are biodegradable. Oxidation stability of ester oil must be improved as they are very poor in oxidation stability.In this paper, Investigation is carried out to study the performance of Indigenous oil. The different properties wereInvestigated i.e. Viscosity, breakdown voltage, Flash point. The comparison of properties has been made among mineral oil, Indigenous oil and vegetable oil without additives and degassing and BDV of Indigenous oil is investigated by adding additive like DBPC and by degassing. The Indigenous oil is code named as DM and Indigenous oil with DBPC is codenamed as DM1. The result shows that Indigenous oil is better compared to mineral oil and BDV values are improved by adding antioxidant and also by degasification.

Keywords: Transformer oil, Indigenous oil, Palm oil, breakdown voltage, Viscosity, flash point.

1. INTRODUCTION

Insulating oil is commonly called as mineral oil in transformers [1]. Crude petroleum oil is distilled and treated to obtain mineral oil. This oil behaves like a cooling agent and dissipates heat. It is highly difficult know the properties of oil in operating condition [2, 3]. Transformer oil is highly harmful to the environment, both soil and water in case of explosion [4]. Hence, liquid dielectric should have nontoxicity, easily disposable, non-hazardous and thermally stable [7]. Oxidation stability is important to measure quality and life time of liquid dielectrics [9]. This will be improved by adding antioxidants and also by degasification. Thus several researches have been carried to find the alternate dielectric material for transformer oil.

2. Liquid Dielectrics

A liquid dielectric material is a "highly compressed gas" and the molecules present in the liquids are arranged very close to each other. Because of their inherent properties, Liquid dielectrics would be better insulating materials than solid and gaseous dielectric. Liquid dielectric is a mixture of hydrocarbons. The electrical breakdown occurs when there is a steep increment in voltage.

3. Breakdown in Liquid Dielectrics

Liquids get contaminated easily, which contain solids, liquid and dissolved gasses. In continuous energized equipment, liquids are not used above 100KV/cm because liquids are contaminated easily [5, 6]. Due to continuous supply of voltage, solid impurities will be at the right angles to equipotential [8]. At low voltage, breakdown occurs due to distortion of field.

4. Viscosity in Liquid

Viscosity is a resistance initiated by the liquid internally when it flows from one layer to the other layer. This is because of interrelation between the fluid molecules. Viscosity of liquid varies due to temperature and pressure.Dynamic viscosity:Dynamic viscosity is the opposition offered to the movement of fluid.Kinematic viscosity:The fluid internal resistance which is flow under gravitational force is measured with a help of kinematic viscosity. This is determined by considering the time in sec and fixed volume of fluid travel through capillary tube with in a calibrated viscometer at controlled temperature.

5. Experimental Procedure

1. Indigenous oil, Vegetable oil (Palm oil) and mineral oil in its pure forms are considered for investigation for investigation ofViscosity, breakdown voltage and Flash point.
2. For 1108 ml of Indigenous oil, 9 gms of DBPC is added and it is magnetically stirred to ensure complete dissolution.

Further Indigenous oil with DBPC is put under degasification with nitrogen gas to remove oxygen present in the Indigenous oil.

6. Breakdown Voltage Test

BDV test is conducted as per IEC 60156 standards. Two electrodes which are of sphere in shape, fixed at a gap of 2.5mm and specimen is poured in the test cup. Six breakdowns were considered for analysis. High voltage ac supply is slowly varied at a rate of 2kV/sec till the flash over occurs.

7. Kinematic Viscosity

Cannon-Fensken viscometer (fig.2.) is used for the viscosity test. The specimen is filled in the tube. For about 20-30 minutes. The tube is heated up to temperature 400 C and maintained constant. The flow of oil from top to bottom mark in the bulb is observed and the time is recorded using stop watch. By considering calibration constant, Viscosity is calculated.

8. Flash Point

The fire in the form of a flash occurs under specified conditions at lowest temperature is the flash point of a specimen.Fill and heat the oil in the flash point apparatus.. Introduce external fire at regular interval till the flash takes place. Record the temperature at which flash occurs.
Flash point=Recorded temperature at which flash occurs.

9. Results and Discussion

BDV for different oils are illustrated as shown in Fig 5. The kinematic viscosity for various oils is shown in Fig 7. The Flash point in degree Celsius for various oils is shown in Fig8.

10. Breakdown Strength

From fig.5, the highest value of breakdown strength is obtained for Indigenous oil from this experiment. Breakdown strength value of indigenous oil is12.26kv.Lower breakdown strength is obtained for palm oil. The value of lower breakdown strength is 10.46kv.In this experiment, mineral oil breakdown strength is 11.46kv From figure.6.the BDV of indigenous oil is high with respect to palm and mineral oil. Mineral oil breaks down between the range17kv-36kv, the palm oil lies between the range 22kv-38kv and the break down voltage of indigenous oil lies between the ranges of 26kv-58kv.

11. Kinematic Viscosity

From fig.7.indigenous oil has low viscosity as compare to mineral oil and palm oil. The value of kinematic viscosity forindigenousoilis3.6cSt.Inthisexperiment,highest value of kinematic viscosity is obtained for palm oil i.e.36.26cSt.For mineral oil the value of kinematic viscosity is 14.88 cSt. Lesser the value of viscosity in oil more the electrical insulation properties. Thus from this work, indigenous oil has high electrical insulation property and palm oil has low electrical insulating property.

12. Flash Point

From fig 8, flash point of indigenous oil with respect to mineral oil is high. Palm oil is at 314°C whereasindigenousoilisat256°C.Mineraloilhaslowerflashpoint of 215°C.Therefore, indigenous oil can be used as a insulation material as compare to mineral oil.

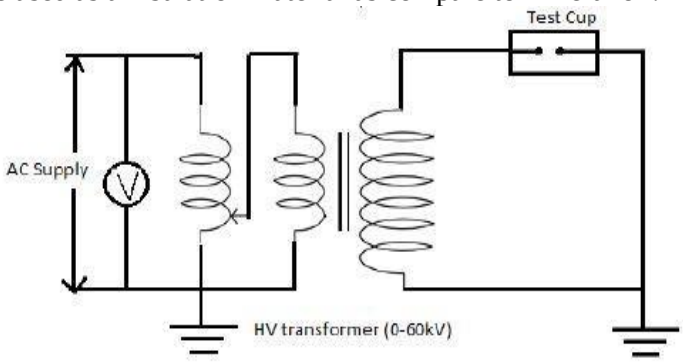


Figure 1. BDV measurement

Figure.1.1 BDV measuring apparatus

Figure2. Cannon –Fensken viscometer

Figure3. Viscometer tube

Figure4. Pensky martens

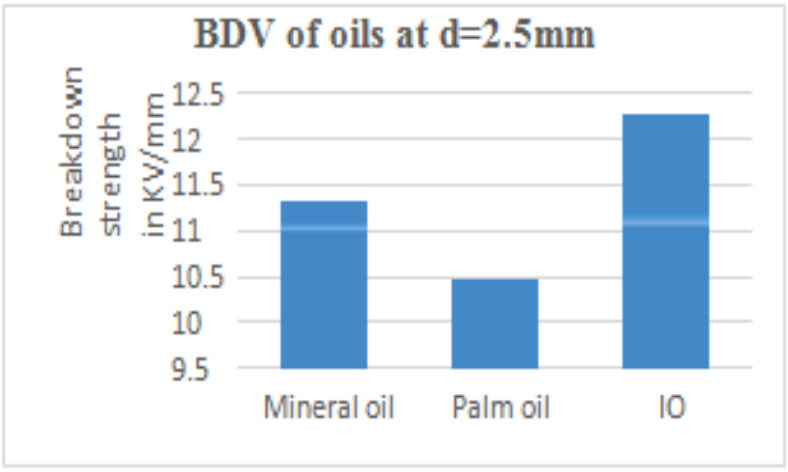


Figure5. breakdown voltages for different oils

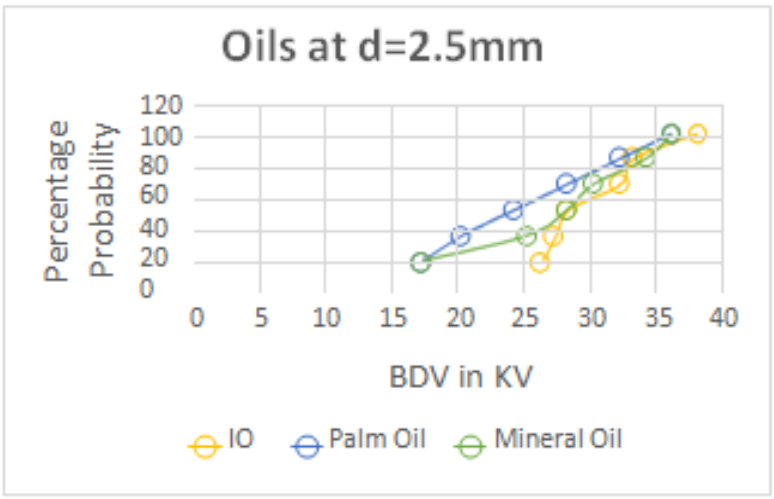


Figure.6. Comparison of BDV of all Oils

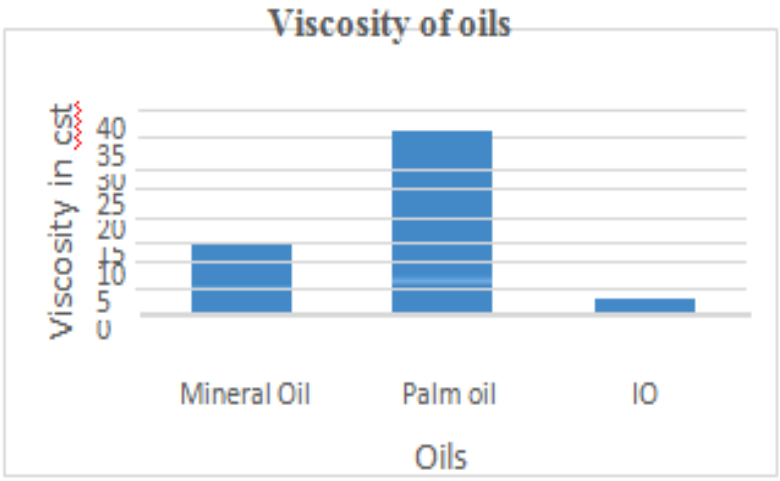


Figure7. kinematic viscosity for different oils

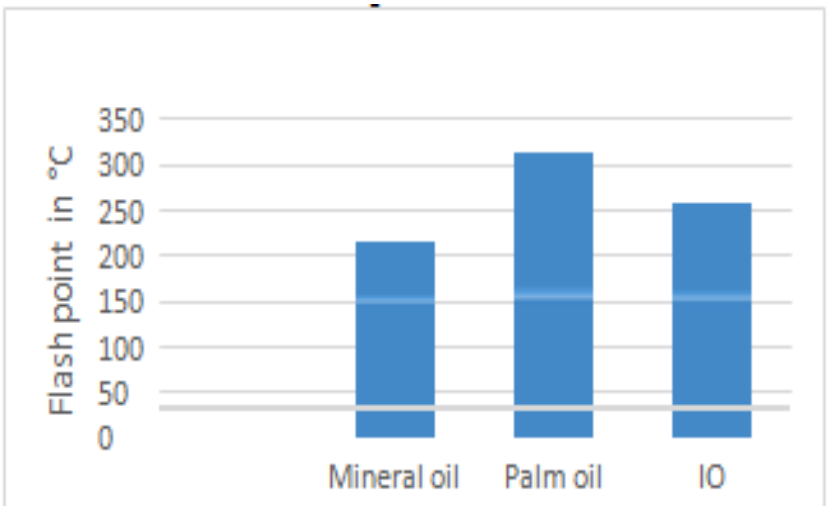


Figure8. Flash point in degree Celsius for different oils

XIII. Improvement in BDV Values:

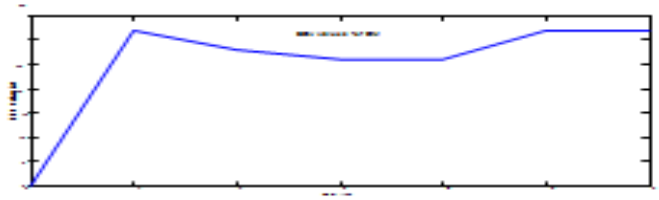


Figure.9. BDV values of Indigenous oil

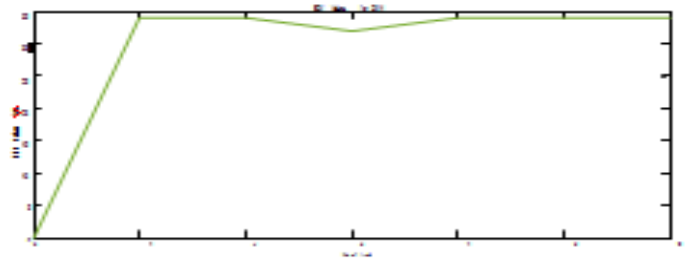


Figure.10. BDV values of Indigenous oil with DBPC

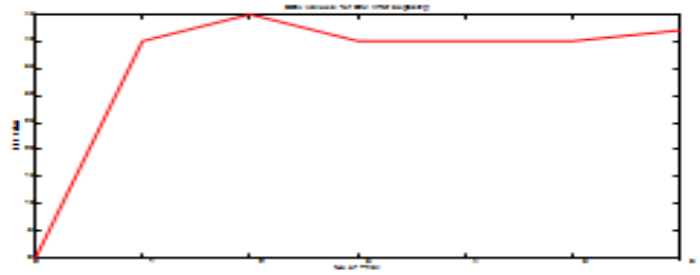
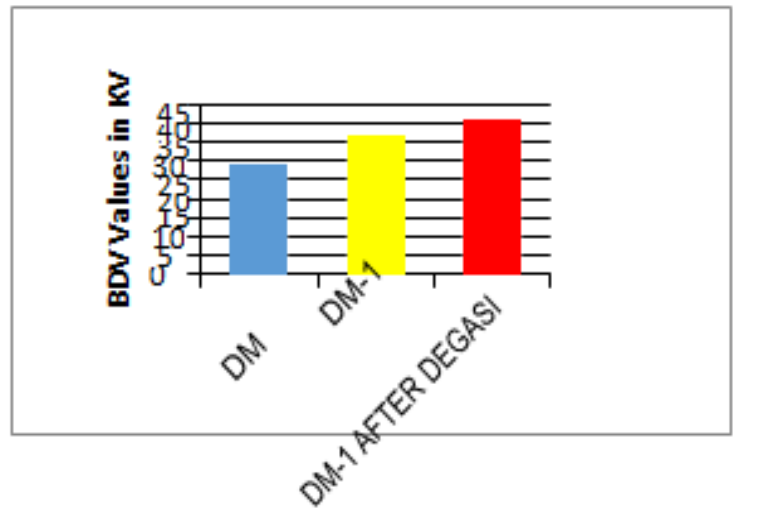


Figure.11. BDV values of Indigenous oil with DBPC after Degassing



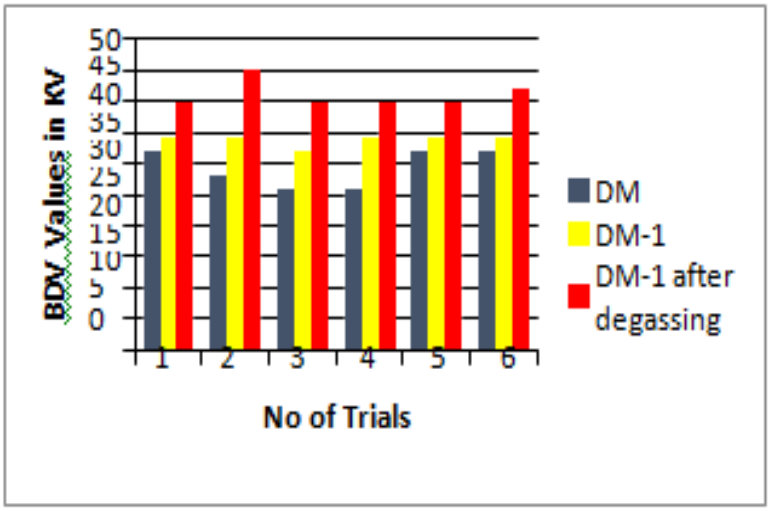


Figure.12. Comparison of BDV values for all oil

14. CONCLUSION

Insulation is the most sensitive part in high voltage apparatus. In this work, Indigenous oil (3.6cSt) is better dielectric than mineral oil (14.88cSt) in terms of viscosity. The flash point of Indigenous oil (256°C) is higher than mineral oil (215°C). Breakdown strength of indigenous oil (12.26kv/mm) is marginally good compared to mineral oil (11.33kv/mm).

Further BDV values of Indigenous oil can be improved by adding suitable antioxidants and degassing. Hence the indigenous oil can be treated as alternate oil for transformer applications in power system. The values of various oil properties can be enhanced by reducing the moisture content by adding different antioxidants.

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