

EFFECT OF QUALITY OF OIL TRANSFORMER ON THE BREAKDOWN VOLTAGE OF SOLID DIELECTRIC IMMERSSED IN OIL TRANSFORMER

S.A.HASSAN and L.A.ELZEFTAWY

*Electrical Eng. Dept. of
Menoufia University,
Menoufia, Egypt.*

Y.A.ABED and T.D.EISH

*Electrical Eng. Dept. of
Mansoura University,
Mansoura, Egypt.*

ABSTRACT

In this paper the effect of emulsion water impurities and fibrous impurities-such as fibres of paper and cotton fabric on the quality of oil transformer have been studied carefully. It has been found that the above mentioned impurities reduce the quality of oil transformer considerably. This paper presents an experimental investigation to study the effect of quality of oil transformer on the breakdown voltage of perspex, teflon and bakalite as synthetic insulating materials. The specimens of the materials and electrodes were immersed in a pirex vessel containing oil transformer. These samples of insulations were subjected to A.C. and D.C. voltages increased gradually to that limit at which breakdown takes place. It has been demonstrated that the breakdown voltage of the mentioned materials decreases with the decreasing of quality of oil transformer.

INTRODUCTION

Transformer oil has been found to be a good insulating medium and is used widely in a many high voltage and extra high voltage equipments such as high voltage cables, transformers, circuit breaker, ect....

The most important factor affecting the electric strength of electrical insulating oil transformer

purified only to a degree suitable for industrial use is the presence of contaminants in the oil, primarily of water in a state of emulsion, i.e in the form of finest droplets suspended in the oil.

On the other hand the purchaser may require that no major changes in crude oil type or refining process may be made without the purchaser being informed. Because of the above mentioned requirements of the purchasers concerning the insulating oil quality, as well as the needs of producers, appropriate rapid and reliable analytical instrumental methods for characterization and source recognition of insulating oils became a necessity.

In this paper the authors report the results of their investigations of the breakdown phenomenon in solid dielectric immersed in oil transformer under influence of quality of oil transformer.

EXPERIMENTAL SET-UP PROCEDURE

For studying the effect of emulsion water impurities with fibrous impurities on the electric strength of oil a standard cell with the electrodes was used Fig. (1.a), where the electrodes are brass disks 25 mm in diameter, the radius of curvature at the edges of the electrodes is 2.5 mm and the distance between the electrodes is 2.5 mm.

For studying the effect of quality of oil transformer on the breakdown of solid dielectrics, A rod plate electrode system mounted inside a perspex tube has been used for investigations Fig. (1.b). The electric breakdown of the synthetic materials is investigated under A.C.high voltage obtained from high voltage generating circuit. The voltage is increased at a constant rate of 1 KV/Sec during all experiments

reported here until the breakdown of the specimen under test takes place. Ten specimens are used for each reading of the breakdown voltage. Thus, any value of the breakdown voltage given or mentioned here represents the mean value of the ten reading. Breakdowns are conducted under non uniform field by using rod plate electrode system. The rod of 3 mm diameter and with a tip of 20 μ m is inserted only a few micrometers into the specimen. The plate is a disc of 12 mm diameter and thickness in close contact with the other face of the specimen. The spacing between the two electrodes can be smoothly controlled to hold the samples under test. The specimens are squares of 5 cm sides cut from perspex, teflon and bakalite sheets of 0.4 cm thickness.

RESULTS AND DISCUSSIONS

The effect of emulsion water impurities and fibrous impurities (paper and cotton) on the breakdown voltage of oil is illustrated in Fig. (2), where the content of water in oil (in per cent by mass) is plotted on X axis and the breakdown voltage in kilovolts on Y axis for oil in a standard cell with the electrodes shown in Fig. (1.a). As can be seen in Fig. (2), an admixture of even 0.015 per cent of water appreciably reduces the breakdown voltage of oil. Oil with this content of water is no longer suitable to fill high voltage power transformers. This clearly pronounced dependence of the electric breakdown of oil on the content of very small quantities of water and fibrous impurities (1,2).

Figures (3 and 4) illustrates, the breakdown voltages of the mentioned solid dielectrics as a function of quality of transformer oil for A.C. and D.C. voltages respectively. As seen from these figures, the quality

of transformer oil has a noticeable effect on the breakdown voltage of synthetic insulating materials. As the quality of oil increases the breakdown voltages of solid dielectric increases. It is clearly seen that the specimens of perspex given the highest values of breakdown voltage, while the lowest values of breakdown voltage of the three materials under test were obtained with bakelite specimens. Figure (4) indicate that the breakdown voltage for negative polarity are always greater than those for positive polarity (3,4)

CONCLUSIONS

The following conclusions can be drawn from the investigations reported in this paper :

- 1] The breakdown voltage of transformer oil decreases by increasing water and fibrous impurities.
- 2] The breakdown voltage of solid insulating materials increase as the quality of transformer oil increase.
- 3] The breakdown voltage of solid insulating materials is lower for positive D.C voltages than for negative D.C voltages.

REFERENCES

- 1] M.E.Zein El Dine, H. Tropper "The electric strength of transformer oil" Proc. IEE, London June 1965, pp 35-45.
- 2] E.Takahashi, T. Tsutsumi, K. Okuyama "Paratial discharge characteristics of oil immersed insulation systems under D.C. combined A.C-D.C and D.C revensed polarily voltage" IEEE PAS-95, No.1, pp. 411-414, 1976.
- 3] F.A.M. Rizk, C. Vincent "Testing for low Breakdown Probability with special reference to liquied insulation", IEEE Trans. Insul. Vol PAS-96, No.6, Nov. 1977.
- 4] K. Petrovic and D.Vitorovic "Examination of insulating oils for transformers by instrumental methods" IEEE Trqns. Insul. Vol. E.I. - 18 No. 6, December 1983.

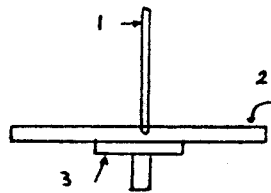


Fig (1-b) A rod-plate electrode system

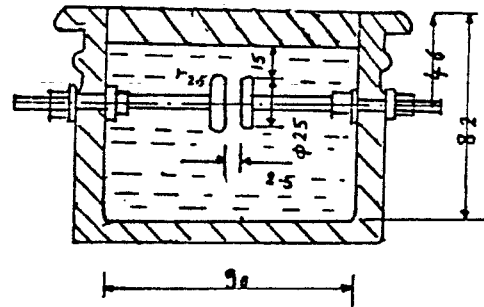


Fig (1-a): Cell for testing oil for breakdown

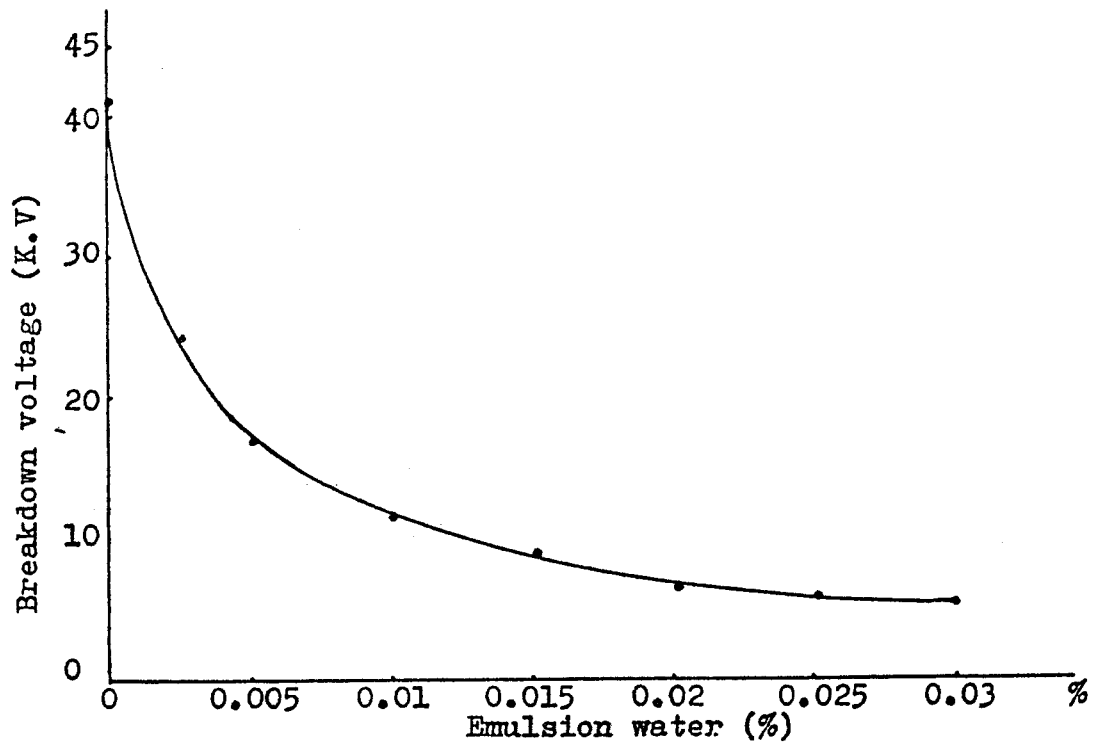


Fig (2): Effect of emulsion water with fibrous impurities (in %) on breakdown voltage of a layer of oil 2.5 mm thick.

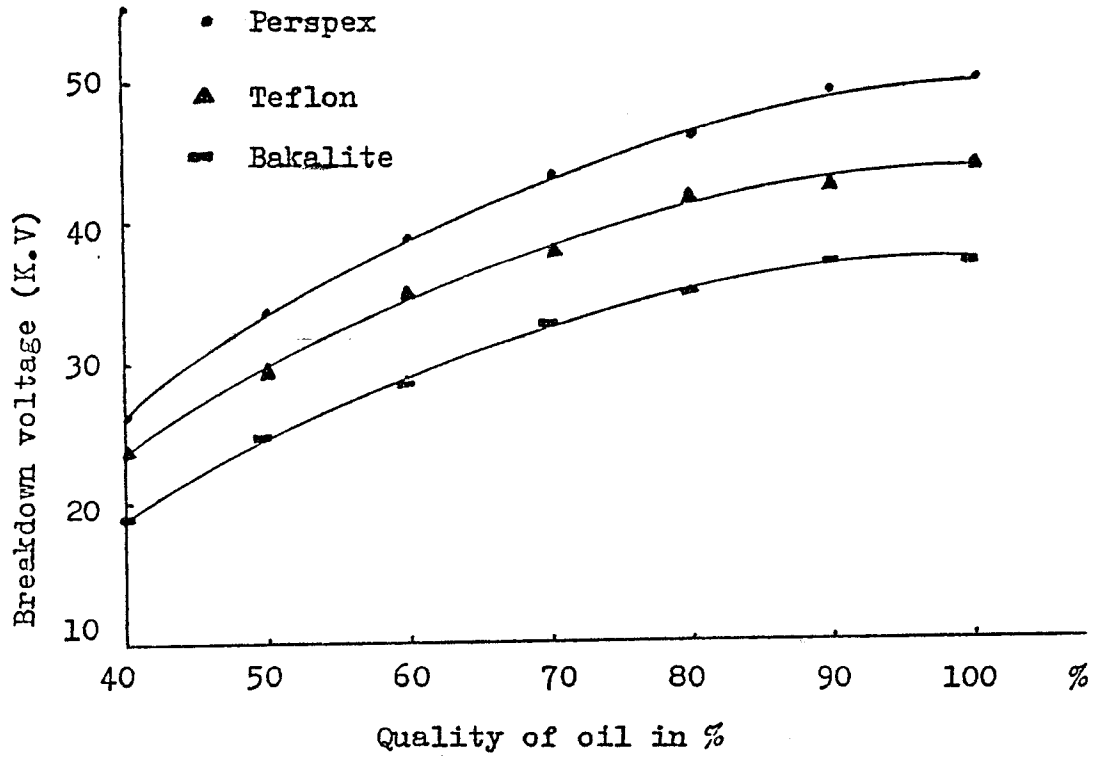


Fig (3): Effect of quality of oil on breakdown voltage of synthetic insulating materials under A.C voltage.

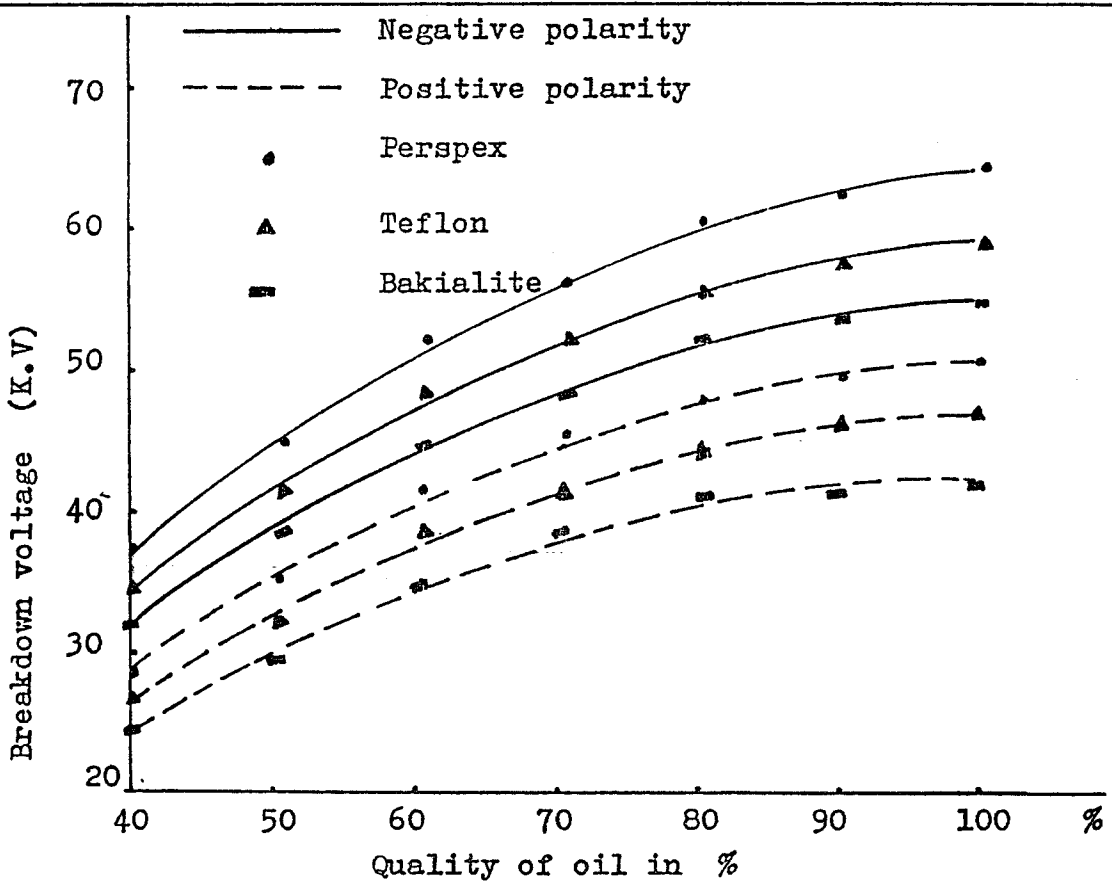


Fig (4): Effect of quality of oil on breakdown voltage of synthetic insulating materials under D.C voltage.