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Study the Effect of Iron Particles on Transformer Oil

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Abstract: *Almost all the transformers in power systems contains transformer oil. Transformer oil acts as an insulating oil, also it maintains the power flow and voltage level conversion in the system. Due to ageing, high temperature, oxidation and other contaminants the oil gets degraded over the time. Therefore, for efficient power supply we should deter mine the behaviour of transformer oil under different uncertainties which can happen during the life span of oil. In this paper we have measured breakdown voltages (BDV) at different conditions with the help of BDV kit. During the experiments we found that the aged oil which has undergone routine filtration has significant more dielectric strength than the fresh oil. Also, the metal particles in the oil affects the BDV value drastically.*

Keywords: Transformer, Insulating oil, BDV, Dielectric strength, Contamination.

I. INTRODUCTION

Transformer is one of the most important component of the power system, it needs a special attention so that we get uninterrupted supply of power. Transformers are very costly to replace regularly and must maintained properly to increase its functional life. Under normal conditions the insulating oil keeps on deteriorating due to ageing and several other factors. Since the transformer's life mainly depends on the insulating oil i.e. transformer oil, hence we need to study the factors that can affect the functionality of oil. We will take the dielectric strength of oil as a reference to determine the behaviour of oil under certain condition.

II. DIELECTRIC STRENGTH (BDV)

The dielectric strength of transformer oil is very essential in maintaining reliable operation of transformer. Dielectric strength of oil is determined by the presence of contaminants such as water, acid, and other materials, therefore it is important to keep oil free from such contaminants. The Dielectric strength of oil is extremely sensitive to hydration or introduction of water and moisture, there can be an even more dramatic reduction of dielectric strength when the oil becomes contaminated by other impurities other than water such as acids and particulate matter.

The Dielectric strength is also known as the breakdown voltage of the transformer oil. "Breakdown Voltage" (BDV) is measured by observing the voltage that is required to jump a spark between two electrodes immersed in the oil separated by a specific gap or distance, known as the sparking strength, the higher the voltage required to jump the spark, the higher the BDV will be in the oil. Clean oil with low moisture content giver higher BDV value. Rating of 30kV is the minimum breakdown voltage requires for oil to be used safely in the transformers.

III. EXPERIMENT SETUP

The experiment consists of a fresh oil and an aged oil. Aged oil we took is an oil which has been undergone routine filtration or purification during its usage. The scope of experiment is to observe the effect of ageing and metal particles on breakdown voltage of oil. Here for metal, we have taken iron particles which will mimic the contaminates occur due scaling and deteriorating in the transformers.

We will make two samples of both aged oil and fresh oil. In one of each sample, we will add particles of iron and for the other two we will heat them for 1hour. To test the oil sample, transformer oil sample is poured into a porcelain vessel in which two "disk electrodes," one of 8mm diameter and one of 25mm diameter, are mounted. The distance between the electrodes is set at 2.5 mm. The oil is allowed to settle for 20 minutes to let any air to escape from the test sample. Next, voltage to the electrodes is gradually increased 1 – 2 kV in the second before the onset of breakdown. When testing

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transformer oil, one makes 6 breakdowns at 10-minute intervals. The first testing is considered the trial and its result is ignored. For the value of the breakdown voltage, an average is taken from the five of subsequent breakdowns.

IV. Results and Observations

Table 1: Two Oil Samples Measurement Results

Sample Test No.	Oil after heating 1 hour		Oil with iron particles	
	Fresh oil	Aged oil	Fresh oil	Aged oil
1	36	43	33	35
2	39	45	31	39
3	40	51	28	42
4	38	54	30	38
5	40	52	32	40
6	39	56	29	41

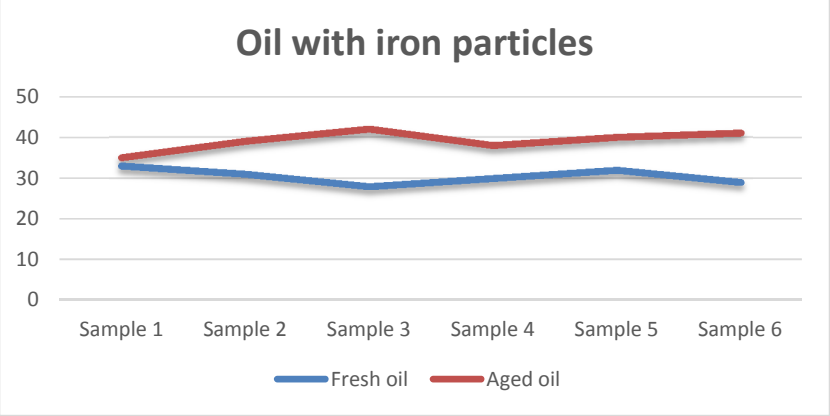

Figure 1: Effect of Iron metal particles on breakdown voltage

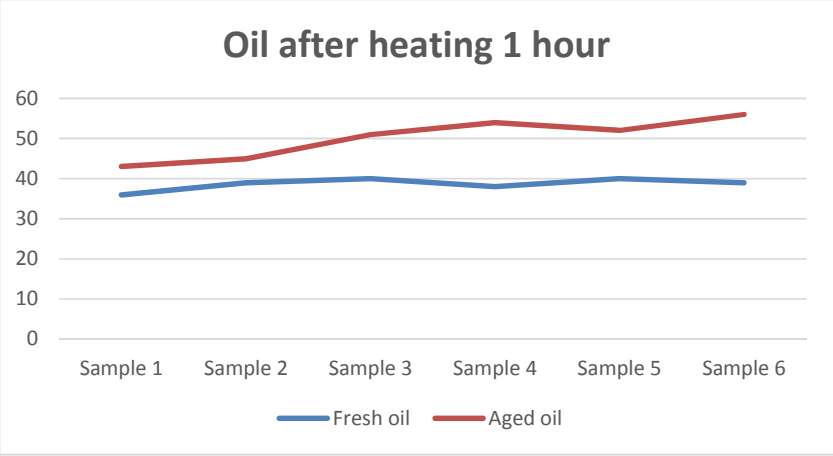

Figure 2: Effect of heat ageing on breakdown voltage

V. Conclusion

Purification the transformer oil should be done periodically so that the transformers can function effectively. It doesn't just help prolong your equipment's life span, but also improve its efficiency. Breakdown voltage test is an important test for the transformer or transformer oil. It helps to detect the problem in transformer oil. By observing the voltage value of transformer oil, we can decide that, is the oil useful for the transformer.

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In this paper, two sample (Fresh and Aged) oil are used to observe the behaviour of transformer oil under heat ageing and the effect of metal particles on breakdown voltage of oil. We found that:

1. Any metal particles contamination like iron can cause serious damage to the dielectric strength of oil and may also lead to failure of transformers.
2. The dielectric strength of aged oil is greater than that of fresh oil as it has undergone heat ageing which cause reduction in moisture contain and humidity over time. Also, this aged oil has gone through periodic filtration and purification which has boost its performance and heat retaining strength.

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