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IMPROVING THE PERFORMANCE OF ELECTRICAL SYSTEM WITH DIELECTRIC STRENGTH REDUCTION METHODS

P. Upendra Kumar, Assistant Professor**, Lakshmana Rao Kalabarige,** Associate Professor**,**
Department of Electrical and Electronics Engineering, GMRIT, Rajam, Andhra Pradesh, India, 532127.

Abstract
Dielectric strength holds a crucial significance in the functioning of numerous electrical engineering applications. This paper, therefore, offers an extensive experimental examination of the dielectric strength of ascoril oil. The evaluation of the oil's dielectric strength is conducted using a precise measurement system, free from impurities. Additionally, the oil is subjected to doping with varying concentrations, and the dielectric properties are also assessed using the same measurement system. The experimental analysis reveals noteworthy variations in the dielectric properties of the oil. These findings have the potential to assist in mitigating losses across a range of electrical engineering applications.
Keywords: Dielectric strength, Oil, Losses.

Introduction

Transformers play a pivotal role in the power distribution system, and their reliable and efficient performance is of utmost importance in maintaining a stable power supply [1]. Transformer insulation is specifically engineered to endure electrical stress and avert breakdowns, which can lead to expensive disruptions and potential safety risks. Nevertheless, recent studies have indicated that incorporating specific doping materials into transformer oil may decrease the dielectric strength of the insulation system.

This study explores the impact of introducing doping material into transformer oil on the dielectric strength of the insulation system [2]. Due to its notable attributes such as high thermal stability, electrical conductivity, and minimal toxicity, this material has emerged as a promising choice for doping. Nonetheless, the exact mechanisms responsible for the reduction in dielectric strength resulting from the inclusion of doping material in transformer oil remain unclear [3].

The objective of this research paper is to pinpoint the ideal concentration of doping material for incorporation into transformer oil and to scrutinize the factors responsible for the decline in dielectric strength through experimental investigations and subsequent data analysis. Additionally, this research aims to yield insights that can be utilized to enhance the durability and effectiveness of transformer insulation systems, ultimately elevating the reliability and safety of power distribution systems [4].

Significance of Dielectric Strength

Dielectric strength denotes the capacity of an insulating substance to endure electrical stress without undergoing breakdown and transforming into a conductor. This attribute holds significant importance when it comes to insulating materials employed in electrical apparatus and systems. Certain situations or instances may arise where deliberately diminishing dielectric strength becomes a requisite or offers benefits. A low dielectric strength indicates that a material can endure lower electric field strengths before reaching the point of electrical breakdown, at which it starts to conduct electricity [5]. Materials characterized by low dielectric strength are typically unsuitable for electrical insulation purposes in environments with high voltages because they are prone to current leakage and electrical breakdown.

Results

The various test samples are taken into consideration after performing the dielectric strength on transformer oil without and with the addition of the doping material as mentioned earlier. The dielectric strength results are follows as shown in the table 3.1 and 3.2. At 5mm gap the average dielectric strength of material is around 21.16 KV. The same oil with doping the dielectric strength is around 16.16 KV. It shows that the dielectric strength is reduced.

Table 3.1 Results without Addition of Doping Material

	5mm	6mm	8mm	10mm
Voltage (KV)	22	20	30	31
	22	22	28	29
	20	24	32	34
	20	20	28	40
	21	20	29	36
	22	22	30	32
Average(KV)	**21.16**	**21.33**	**29.5**	**35.33**

Table 3.2 Results with Addition of Doping Material

	3mm	5mm
Voltage (KV)	10	20
	10	17
	10	14
	10	13
	10	16
	10	17
Average (KV)	**10**	**16.16**

Conclusion

The dielectric strength test showed that introducing doping agents into transformer oil resulted in a reduction in the fluid's dielectric strength. This decline in dielectric strength can be attributed to the presence of doping particles, which disrupt the uniformity of the oil and create localized areas of heightened electrical stress. In summary, this process offers valuable insights into how doping materials affect the electrical insulation properties of transformer oil. These findings can be employed to fine-tune the optimal concentration of doping material to be incorporated into transformer oil. Such knowledge can play a pivotal role in enhancing the reliability and safety of power distribution systems, ensuring that transformer insulation systems can withstand electrical stress and prevent breakdowns.

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