PARTIAL DISCHARGE ANALYSIS OF NANOSTRUCTURED CORN OIL UNDER DC VOLTAGES

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ABSTRACT:

The partial discharge analysis of nanostructure corn oil under dc voltages based nano mineral oil finished by the accumulation of surface modified SiO_2 nano particles with nano structure. The nano fluid of %wt concentration of the mineral lubricant is prearranged in the laboratory. The PD nanostructure was deliberate and measured for partial discharge magnitude, positive dc PD inception voltages, negative dc PD inception voltages, positive &negative dc PD amplitude, and PD signals with increasing voltages. IEC principles are used for testing the experiment. The results of nanostructure corn oil is linked with speculative present mineral lubricant which is used as the primary oil for nano mineral oil and sio_2 nano particles of corn lubricant. The secondary nano structured mineral oil results exposing concentrated PD amplitude, pulse signals with the untreated corn oil and silica added corn oil.

Key words; transformer, partial discharge inception voltage, PD amplitude, pulse signals

1. INTRODUCTION

In arrange to learn the lagging property and Partial discharge performance of new nanostructure. Comparing the results of commercial corn oil and nano structured corn oil which is prepared by a mixture of nano sized silicon di oxide (SiO_2).The nano structured corn oil tested for PD amplitude, PD inception voltage, PD signals with increasing voltages and the determines the peak amplitude and partial discharge magnitude . The results of the nano structured corn oil compared with the primary oil which is untreated silicon mineral lubricant. Some insulating materials such as liquid, solid, gas is used in power system based on the construction requirement of the application. The corn insulated lubricant at rest acts as a chief role for high voltage dc apparatus especially in power transformer and instrument transformer such as PT and CT. In addition of, many test techniques for MO and NMO oil have been verified residentially and proved that its durability is maximum. Partial discharge (PD) testing and analysis acts as a great tool to relieve measurement of insulation state for High voltage DC apparatus. Commonly used SiO_2 Mineral oil otherwise mentioned as transformer lubricant oil acts insulating material due to its elevated dielectric deliberation and thermal property for extended durability.

They are not stable on aspects of green circumstances such as dampness contagions. Owed toward this reason, the researchers have been increasing their work in the field of corn oil to enhance its properties to improve its secureness, consistent and constant operation are in progress for precedent a small number of decades. Partial discharge readings are the progressive insulated ailment observing technique for power transformers. While applying the high voltage direct current of voltage stress, crack be inclined to breakdown, causes liberation in solid which tends to move free electron. Partial discharge inception voltage (PDIV) instead of a key indicator to represent the unity of insulation. The PDIV results used to describe positive and negative characteristics of an insulated nanostructured liquid subjected to high dc electric field stress. IEC standard is available for PDIV measurements of MO and NMO insulations, partial discharge inception voltage capacity for dielectric liquids under DC voltages especially for corn oil. This research is planned to study the PDIV characteristics of nanostructure mineral oil experimented by the needle – plane electrode configuration method. Corn oil and nano structure corn oil with various lubricant conditions be investigated under DC voltage among the special kinds of electrode configuration, PD method is experimented as well as a non-conventional PD reading of both corn oil and nano structured corn oil was performed. The results demonstrate a better understanding of PDIV, PD amplitude and PD signals with the maximum voltage stress in nanostructured corn oil. The analysis of results is done under nanostructured corn oil is compared with the primary lubricant.

2. PROCEDURE FOR PARTIAL DISCHARGE

2.1 Preparation of corn oil:

Corn oil is prepared using the strong oxidizing acid and they are filtered by filler paper (nanofiller) to remove their moisturization. For Further removal of moisturization they are again filter by the filler paper. This filtering process are totally repeated for 2 times. Reduction of their size are obtained by using SiO_2 and are cut into small sheets. This SiO_2 prepared are by the room temperature with the oxygen and activated silicon. To achieve better dispersion, they are heated at the temperature of 60-75 degree Celsius for 45 minutes. The remaining moisture present in the oil are evaporated by this heating technique. After this process, the samples are allowed to obtain its normal temperature without any disturbances. By this time, the nanostructures are settling down in the bottom of the fluid. The lubricate used here are pure mineral oil of Nanostructure Corn oil (SiO_2).

2.2 Partial Discharge test:

In a transformer, PD happens when there is a improvement in electric field with in a limited area of protection. PD recognition is the main symptomatic methods used to analyze survey of transformer high voltage condition. In the transformer, probable kind of PD is corona discharge, which causes the corruption of insulating medium such as oil/corn oil. To create corona discharge PD source in the research laboratory, tests were done utilizing needle-plane electrode arrangement. The arrangement of electrode used to reproduce corona discharge by needle-plane method and lab test cell arrangement used to create corona discharge with needle-plane electrode course of action, the curved range of 1.5μm needle tip is need. A step up transformer with rating of 100kV is used as example which is considered for up to 100 kV. A control board and a 220V DC supply is linked with high voltage transformer in the primary side. The needle electrode, and the plane terminal is firmly earthed in the high voltage side. For the steady partial discharge source in the needle-plane electrode a 3mm is used. Between the needle and ground electrode a 5mm distance is kept.

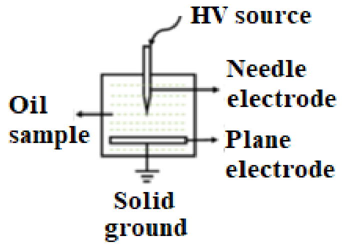

Figure 1:Test setup with needle-plane electrode

2.3 Measurement setup and Detection of PD

PD estimation is done according to IEC Standard test procedures. The experiment is conducted by using step up transformer with voltage rating of 100kV. Current restricting resistor R is utilized for security of the source. Test cell is loaded up with nano structured corn oil arranged at distinctive %wt fixations.

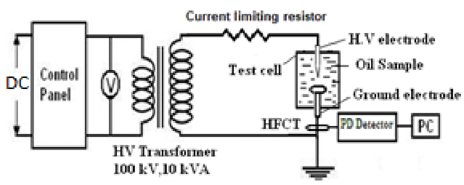

Figure 2:Test setup for partial dscharge study

3. Results and Discussion

A. *Phase Resolved Partial Discharge Analysis*

For test example PD movement is investigated as applied voltage stress. In this test, the needle plane electrode is used as the corona discharge plane and the applied voltage in increased manner and conduction of oil is given as example. The test begins by increasing the voltage step by step until the PD indicator is indicated in the graph and the redundancy of similar applied voltage is acquired in the span of 10 minutes. The first PD pulse which is indicated by the indicator is observed as PDIV. Corn oil and silica is used for partial discharge test. By comparative analysis from the result, while using pure corn oil partial discharge occurs at 13kV and while using the addition of 0.05%wt of SiO2 nano particles the partial discharge occurs at 18kV. This result shows that usage of SiO2 nano particles is 38% greater than the pure corn oil. By the expansion of SiO2 nano particles the PDIV is improved. PDIV improvement by the expansion of SiO2 nano particles was at that point detailed.The PDIV of SiO_2nano liquid is contrasted and virgin corn oil and SiO_2 nano structure corn oil.

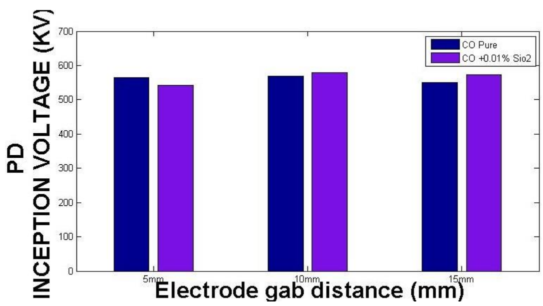

Figure 3: Positive comparison of test nano structured corn oil samplesfor PDIV at different voltage stress

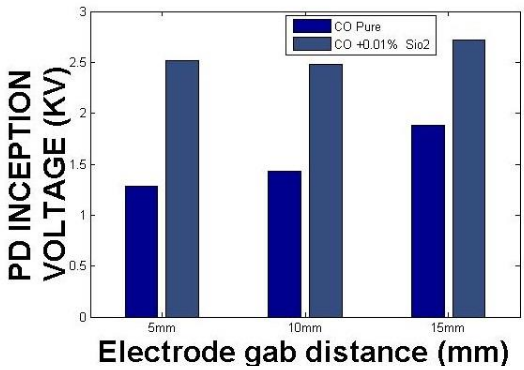

Figure 4: Negative comparison of test nano structured corn oil samplesfor PDIV at different voltage stress

B. *Comparison of Typical PD amplitude at Different DC Voltage stress*

The time-recurrence area examination of PD pulse is dependent on the boundaries, for example, shape of PD signals with increasing voltages. There are variety of input for mineral lubricant which is non contamination, SiO_2 nanostructured corn oil. The PD pulse reaches top in general diminish for nano particles than that of SiO2 nano structure corn oil and virgin corn oil. The recurrence range of unadulterated mineral, SiO_2nano structured corn oil indicates a max at 17, 18 and 20 MHz individually. The pulse span in diminish because of the expansion of SiO_2 nanostructures than for corn oil and SI tests.

The example of pulse scopes are estimated in equal basis for better examination. For a partial discharge signal, the change in the span of partial discharge pulse depends on amount of redundancy rate of the partial discharge succession. Reiteration for lubricant and SiO_2 PD is3.5 and 3.0 at rated 20 kv. Henceforth the expansion of SiO_2nano structured particles to corn oil has diminished the length of PD pulse are grouping up to multiple times than mineral oil and therefore minimum than SiO_2 nano structured corn oil.

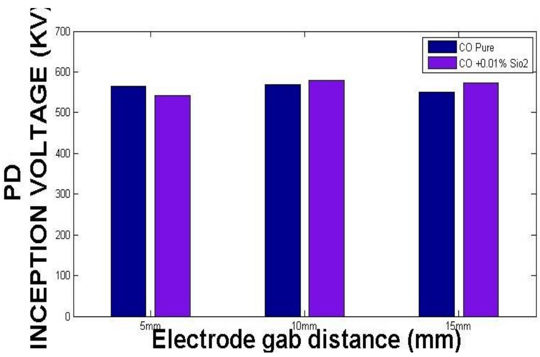

Figure 5: Positive comparison of variation in PD amplitude with respect to different DC voltagestress.

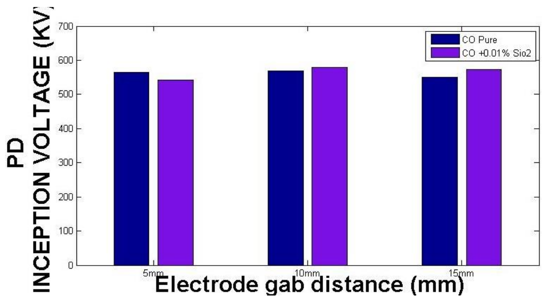

Figure 6: Negative comparison of variation in PD amplitude with respect to differentDC voltagestress.

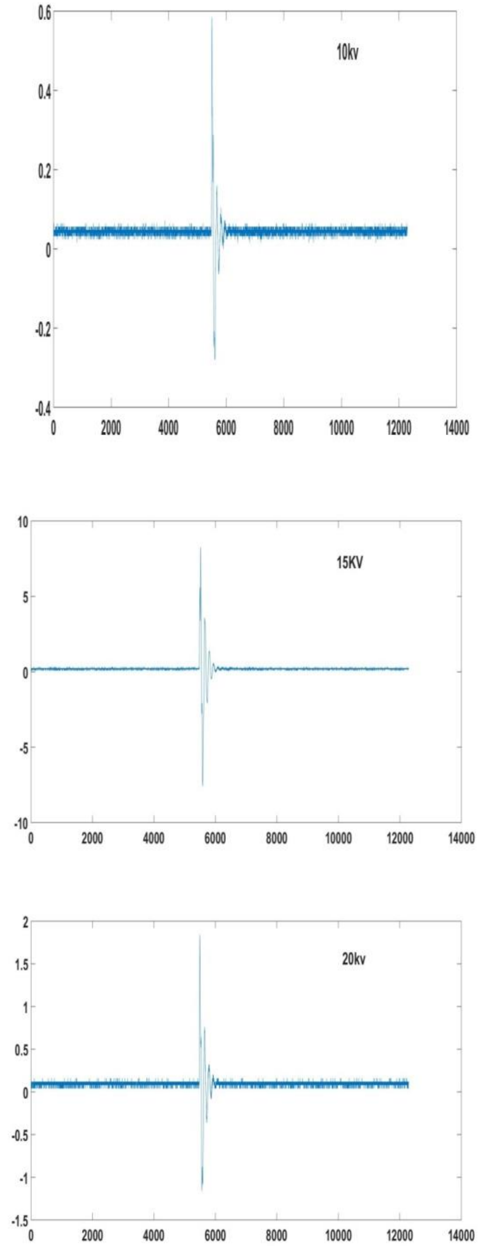

Figure 7: Typical PD signal of 0.01% Wt unprocessed corn oil obtained with needle- plane electrode configuration with increase in applied voltage stress

The redundancy rate of the relative examples of tests regarding increment in the applied voltage. Even in this state of expanding voltage, the SiO2 nano structured corn oil performs better than MO and SI tests.

4. EXAMINATION OFMINERAL OIL BY INCREASING VOLTAGESTRESS

Factual examination of PD parameters utilizing likelihood dissemination methods gives continuous data on the corruption and left over life span of insulating lubricant. It is essential to gather information about factual boundaries of SiO_2 **nano** structured corn oil for better comprehension of the corruption of oil throughout some undefined time frame. Thus the conditional report for positive and negative partial discharge pulse of S_k is done to contemplate. Skewness is consider as the appropriation of information in a predefined reach and it is represented as,

$$(S_k) = \frac{\sum_{i=1}^{N}(x_i-\mu)^3 (f(x_i))}{\sigma^3 \sum_{i=1}^{N} f(x_i)}$$

Where f(x) = Partial discharge amplitude of q,

μ= mean q value,
σ= difference in q.
S_k= skewness

Skewness (S_K)=0, the PRPD design conveyance is symmetric at that point. If SK>0, the PRPD design circulation is uneven at one side, and is irregular towards right at this point. If SK<0. The S_k obtained in this experiment is appeared in Figure.7 kV test voltage is applied in needle electrode. The S_k estimation value in SiO2 nano structured oil oil were discovered to be lower than MO.

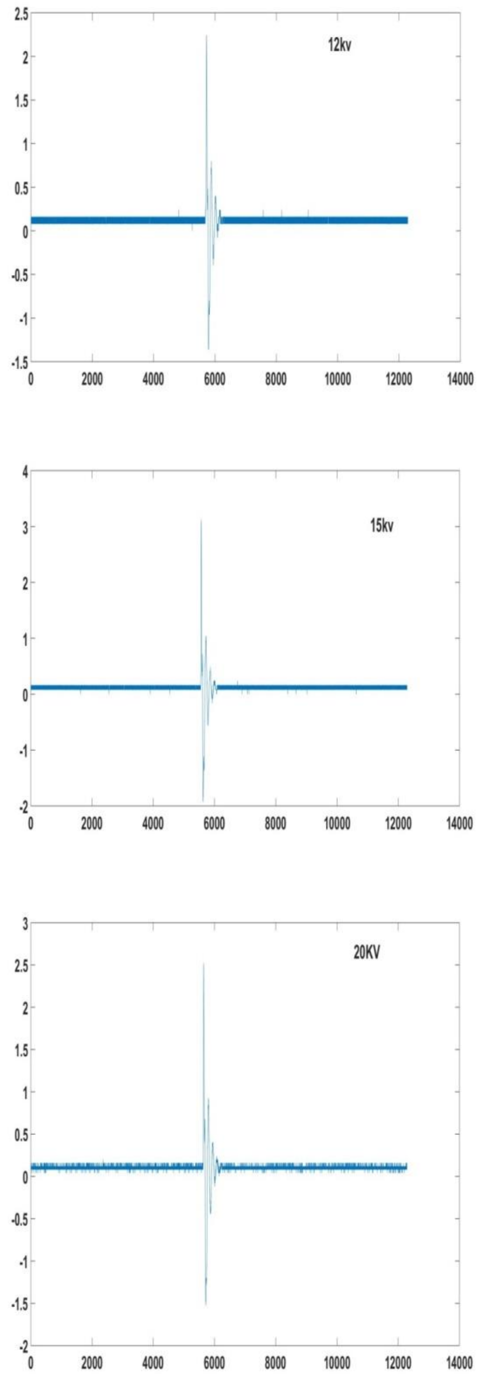

Figure 8: Nano structured corn oil is obtained by using needle- plane electrode configuration by applying various DC voltage stress.

5. CONCLUSION

This experiment proves that the dielectric strength of the nano structure corn oil is far better than the pure corn oil. By applying different voltage stress value to SiO2 nano structure PD signals were measured and the graph is plotted using CRO. And the corona discharge is also generated in laboratory testing using needle plane electrode. By addition of SiO2 nano structure with corn oil results in the increased dielectric strength and the conduction in oil takes longer time. And also PDIV is upto 62% more than available pure lubricant. And PD amplitude is reduced as 0.05V from 0.4V. Hence, this results are experimentally verified in the testing laboratory.

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