Effect of humidity on Partial Discharge Inception Voltage

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The aim of this paper was to investigate the impact of humidity on the Partial Discharge Inception Voltage (PDIV). The effect of humidity was quantified by measuring the PDIV for metallic parallel electrodes under DC voltage and atmospheric pressure. The study was made in absolute humidity in the range [2-80g/m^3], for two temperatures T=25°C and T=50°C. To control environmental conditions a climatic chamber allowing Pressure, Temperature and humidity (P, T, H) variations is used. Considering that the humidity is slightly depending on temperature, the main result of this study shows different PDIV behaviours as a function of humidity for the two considered temperatures.

1. Introduction

The work presented in here is part of a larger study concerning the analysis of breakdown voltage under aeronautical environmental conditions. Many works were interested by the influence of the humidity on PDIV values on enamelled wires [1], [2]. Here we propose to investigate the case of non-insulated electrodes.

1. Experimental set-up

Figure 1 shows the experimental set-up used to perform PDIV measurements. The studied device was two metallic spherical electrodes without any solid insulation. The environmental parameters were controlled using a climatic chamber.

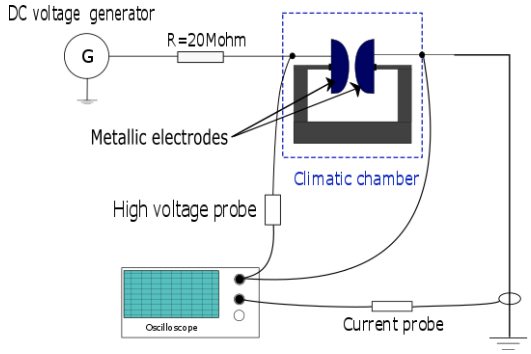

Figure 1: experimental set-up

3. Results and discussion

Figure 2 shows that at T=25°C, the PDIV decreases as the absolute humidity increase until HA=10g/m3, and slightly increases above HA=10g/m3. At higher temperature T=50°C, the behaviour is slightly different: first, PDIV increases with humidity before slightly decreasing above HA=45g/m^3.

In the interval [10g/m^3 - 45g/m^3] the PDIV increases because of water evaporation acting like an electro-negative gas, attaching the electrons responsible of discharges so increasing PDIV. Above this range, the electric field is enhanced locally around water particles created by condensation, so decreasing the PDIV. These observations are in accordance with [1], [2]. These results highlight the importance of correlation between temperature and humidity.

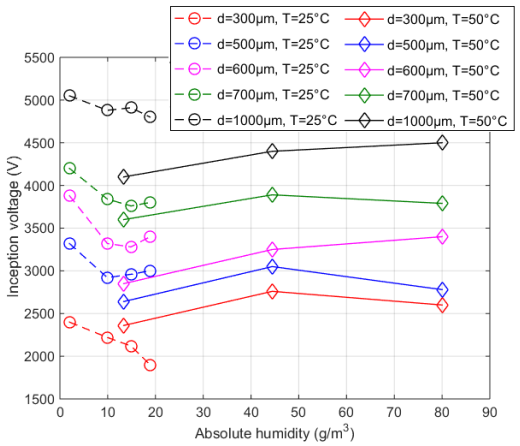

Figure 2: PDIV as a function of absolute humidity for different distances at T=25°C and T=50°C

References

[1] Y. Kikuchi, T. Murata, Y. Uozumi, N. Fukumoto, M. Nagata, Y. Wakimoto, and T. Yoshimitsu, "Effects of ambient humidity and temperature on partial discharge characteristics of conventional and nanocomposite enameled magnet wires," *IEEE Trans. Dielectr. Electr. Insul.*, vol. 15, no. 6, pp. 1617–1625, 2008.

[2] M. Fenger and +G. C. Stone, "Investigations into the Effect of Humiditv on Stator Winding Partial Discharges," vol. 12, no. April, pp. 341–346, 2005.