FLASHOVER STUDIES ON A SOLID DIELECTRIC SURFACE

H. N. SURESH^{*} , M. C. SIDDAGANGAPPA,
Department of High voltage Engineering,
Indian Institute of Science,
Bangalore-560012,INDIA.

***Department of Electrical Engineering,**
Malnad College of Engineering,
Hassan-573201,INDIA.

INTRODUCTION

Solid-gas interface in a high voltage insulating system is often subjected to highly localised critical electrical stresses leading to microdischarges and subsequent surface flashover. Such a failure at the interface is of serious concern in a high voltage system. This paper presents results of the power frequency and impulse flashover studies carried out in air on a solid dielectric surface in a non uniform field with air as the surrounding media. The influence of humidity on the power frequency flashover voltages on a solid dielectric surface is also discussed.

EXPERIMENT

Surface flashover studies were carried out on a frosted glass plate (600mm x 450mm). Glass plate was chosen because of its non hygroscopic nature and flashover experiments could be repeated on the same solid dielectric specimen with no change in surface conditions. An aluminium circular ground electrode (120 mm ϕ) with smoothly finished edge was fixed to one

of 5 mm ϕ tapered to approximately 0.5 mm. One end was used as the high voltage electrode.

A single phase, 50 Hz, 2 KVA, 230 V / 2 transformer was used as high voltage source. The experiments relating to humidity effect on surface flashover studies were conducted in a humidity and temperature controlled (900mm x 600mm x 600mm). Impulse voltage (1.4/70 μ s wave) was obtained from a generator.

The electrode gap system shown in figure 1 is similar to the one described by Seiji Hasegawa and Hideo Akagami [2]. The glass plate was placed horizontally on an insulator. The gap length 'G' is the shortest distance between the tip of the point electrode and the circular plate electrode. Height 'H' is the vertical air gap maintained by the tip of the point electrode above the glass plate. The angle ' θ ' is a measure of the inclination of the point electrode with the glass plane, maintained at 60° throughout the study.

RESULTS

Power frequency flashover voltage experimentally obtained with and without dielectric surface in the composite gap and H are plotted against 'G' in figure 2. It has been observed that even in non uniform electric field, presence of solid dielectric surface reduces the power frequency flashover voltage across the composite gap. Similar trend

Figure 3 shows the observed variations of power frequency flashover voltage at different gap lengths 'G' and a constant vertical height $H=0$ for relative humidities of 60, 80 and 90 per cent respectively. The flashover voltage in the composite gap decreases with increase in humidity.

Experiments were also conducted at a relative humidity of 90 per cent for different 'G' and 'H' values. Figure 4 shows the flashover data corresponding to $H = 0, 0.4$ cm and 0.8 cm over a range of horizontal gap lengths 'G' varying from 0.5 cm to 4 cm in steps of 0.5 cm.

Positive impulse data of 50% flashover voltages for different 'H' values are plotted against horizontal gap lengths in figure 5. Increase in air gap distance 'H' between point electrode and the surface of the solid dielectric resulted in increased flashover voltages for a particular gap length (G).

DISCUSSION

It is well known that breakdown strength of any gaseous gap is controlled by effective ionisation coefficient ($\alpha-n$), properties of the electrode, and non uniformity of the applied field. Apart from these conditions, inclusion of solid dielectric surface even in a non uniform field gap brings down the breakdown strength of the gap. Further, reduction in flashover voltage occurred due to fall in leakage resistance of the solid dielectric at high humidities.

With the increase in vertical air gap 'H'. at

longer gap lengths 'G' flash characteristics of composite gap approach path length characteristic (flashover voltage versus 'G' characteristic for constant vertical height $H = 0$). G to H ratio at which the phenomenon occurs can be defined as "Critical G/H ratio". Referring to figure 4, the critical G/H ratio is 2.5 in both the cases of present study. However, critical G/H ratios were 1.2 with the similar experiments conducted by Seiichi Hasegawa and Hideo Akagami [2] relative humidity of 90 per cent maintained at 25°C. But, the present study though done at relative humidity of 90 per cent, temperature was maintained at 36°C. This suggests that critical G/H ratios seem dependent on the ambient temperature and relative humidity.

REFERENCES

- [1] Craig Miller.H., "Surface flashover of insulators", IEEE Transactions on Electrical Insulation, vol.24, No.5, 786,1989.
- [2] Seiichi Hasegawa and Hideo Akagami, "Discharge characteristics of a needle-rod electrode gap with dielectric surface under high humidity", Japanese Journal of Applied Physics 27, No.10, pp1942-1946, Oct.1988.
- [3] Cooke.C.M., "Surface flashover of solid interfaces", Proceedings of the international symposium on Gaseous Discharge Phenomena, 1988.

FIG.1 SCHEMATIC ARRANGEMENT OF ELECTRODES

Fig.2 Power frequency flashover characteristics under ambient conditions.

Fig. 4 Power frequency flashover characteristics with solid dielectric under conditions.