

BREAKDOWN IN COMPOSITE DIELECTRICS

A vacuum system is one in which the pressure maintained is at a value below the atmospheric pressure and is measured in terms of mm of mercury. One standard atmospheric pressure at 0°C is equal to 760 mm of mercury. One mm of Hg pressure is also known as one torr after the name of Torricelli who was the first to obtain pressures below atmosphere.

In a Townsend type of discharge, in a gas, the mean free path of the particles is small and electrons get multiplied due to various ionization processes and an electron avalanche is formed. In a vacuum of the order of 10^{-5} torr, the mean free path is of the order of few meters and thus when the electrodes are separated by a few mm an electron crosses the gap without any collision. Therefore, in a vacuum, the current growth prior to breakdown cannot take place due to formation of electron avalanches.

However, if it could be possible to liberate gas in the vacuum by some means, the discharge could take place according to Townsend process. Thus, a vacuum arc is different from the general class of low and high pressure arcs. In the vacuum arc, the neutral atoms, ions and electrons do not come from the medium in which the arc is drawn but they are obtained from the electrodes themselves by evaporating its surface material. Because of the large mean free path for the electrons, the dielectric strength of the vacuum is a thousand times more than when the gas is used as the interrupting medium.

In this range of vacuum, the breakdown strength is independent of the gas density and depends only on the gap length and upon the condition of electrode surface. Highly polished and thoroughly degassed electrodes show higher breakdown strength. Electrodes get roughened after use and thus the dielectric strength or breakdown strength decreases which can be improved by applying successive high voltage impulses which of course does not change the roughened surface but removes the loosely adhering metal particles from the electrodes which were deposited during arcing.

It has been observed that for a vacuum of 10^{-6} torr, some of the metals like silver,

bismuth-copper etc. attain their maximum breakdown strength when the gap is slightly less than 3 mm. This property of vacuum switches permits the use of short gaps for fast operation.

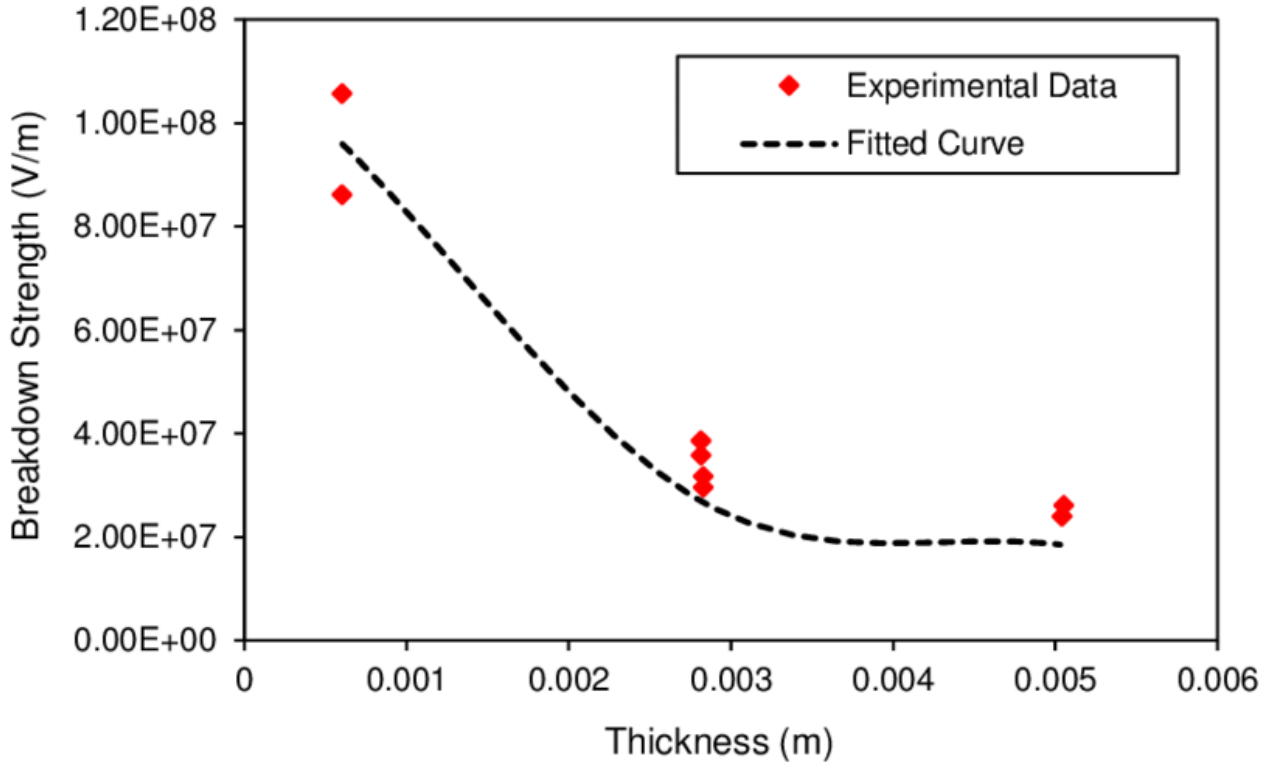


Figure 1.2.1 Glass Fiber Composite

[Source: "High Voltage Engineering" by C.L. Wadhwa, Page – 185]

