Experimental investigation of surface streamers in SF6 - N2 mixtures

O12

Experimental Investigation of Surface Streamers in SF_6 - N_2 Mixtures

A. Chvyreva[1], A.J.M. Pemen[1]
[1] *Departement of Electrical Engineering, Eindhoven University of Technology, 5612AZ, The Netherlands*

Sulfur hexafluoride (SF_6) is commonly used as a gaseous dielectric in high-voltage equipment due to its excellent insulating properties and chemical stability. However it significantly contributes to the greenhouse effect, and can under certain circumstances (after a discharge event) be poisonous for persons. Therefore, SF_6-nitrogen mixtures are taken into consideration, in order to decrease the negative effects, while still keeping the required dielectric properties.
This work presents experiments on streamer discharges in mixtures of SF_6 with nitrogen under different experimental conditions. All experiments were performed in a specially designed vessel that allowed setting up and maintaining the parameters of gaseous environment. Discharges under investigation were streamers, propagating along the surface of an epoxy-resin dielectric. They originate on the gas-insulator interface without any contact with electrodes, and are nowadays the major cause of failure of various high voltage technologies. In the present work the voltage of discharge inception was determined for different amounts of SF_6. It was shown, that the inception voltage increases rapidly starting at very small admixtures of SF_6 (5%), and continues to increase at a lower rate with the further increase of SF_6 percentage. The voltage of streamer inception also increases with the increase of gas pressure (in these experiments the concentration of SF_6 was kept constant). The velocity of discharge propagation was estimated from the analysis of time-resolved discharge current measurements. The rise-time of the current increased significantly with the addition of SF_6, moreover, for high concentrations of the above the majority of the discharges were originating as leaders, skipping the streamer phase. The fall time of the current behaves in a similar way, thus the total duration of the discharge decreases almost by a factor of 10 (from tens to several nanoseconds for pure nitrogen and 5%

SF_6 admixture respectively).
The main conclusion of the present study is that discharge behavior changes significantly already with a small admixture of SF_6 to nitrogen, which gives the possibilities for organizing gas mixtures possessing the positive features of highly electronegative gases, while at the same time significantly decreasing the dangerous influence on the atmosphere.