'95 Jicable

A.9.5. Qualification et détermination de la durée de vie de matériaux isolants sous forme de films minces, sous champ électrique intense

FOULON-BELKACEMI N., GOLDMAN M., GOLDMAN A., CNRS/SUPELEC, Gif/Yvette, France
GATELLET J., Merlin Gerin, Grenoble, France

Résumé:

Les densités de charges déposées sur un polymère par les "streamers" filamentaires d'une décharge couronne sous tension alternative étant de loin prédominantes par rapport à celles qui sont apportées par les composantes diffuses de la décharge, il en va de même des champs induits dans le matériau par ces différents apports de charges. D'où l'idée d'utiliser les "streamers" d'une telle décharge comme moyen de qualification et de diagnostic de santé de matériaux isolants, tout au moins sous forme de films minces dans l'état actuel des connaissances.

La méthode a été testée sur du polypropylène et du polyéthylène téréphtalate en feuilles et, à cet effet, il a été développé un filtre électrique original qui permet de suivre l'évolution du courant induit dans le matériau par l'impact localisé d'une série de "streamers" successifs. Les résultats montrent que l'intensité de ce courant et son évolution sont effectivement représentatives de l'état et de la durée de vie du matériau. Notamment, après une certaine période, ce courant atteint une valeur de stabilisation qui, indépendamment de l'épaisseur du matériau dans la gamme d'épaisseurs analysées (5 à 50 µm), semble être caractéristique de sa nature.

A.9.5. Qualification and life duration determination of thin sheeted extruded material under high electrical field

FOULON-BELKACEMI N., GOLDMAN M., GOLDMAN A., CNRS/SUPELEC, Gif/Yvette, France
GATELLET J., Merlin Gerin, Grenoble, France

Abstract:

The densities of the charges deposited on a polymer by the filamentary streamers of a corona discharge under alternating voltage being far more predominant with respect to the ones which are provided by the diffuse components of the discharge, it is the same for the fields induced in the material by these different charge supplies. This brought to the idea of using streamers as a tool to qualify insulating materials, at least in the form of thin films in the present state of knowledge.

The method was tested on polypropylene and polyethylene terephtalate films and, for this purpose, it has been developed an electrical filter which allows to follow the evolution of the current induced in the material by the local impact of a serie of successive "streamers". The results show that the intensity of this current and that its evolution are effectively representative of the state and lifetime of the material. In particular, after a given period, this current reaches a stabilization value which, independently of the thickness of the polymer film in the range of thickness analysed (5 to 50 µm), seems to be characteristic of its nature.

Introduction:

The problems which are raised by the ageing of insulating materials under electrical stress and severe environmental conditions have led the researchers to a variety of studies on the evolution of their degradation. But this type of studies implies to select a parameter well representative of the degradation phenomena which could be defined by the changes being substained by one or more of overall or of particular properties varying with the physical, chemical and structural modifications of the materials.

Our study concerns the development of a method using filamentary corona discharges in atmospheric air to determine the lifetime and the degradation state of a polymer, at least if it is in the form of a thin film. This kind of discharge, called streamer discharges, is monitored by gas phenomena which can have severe effects, both on the surface and on the bulk of the materials on which they are impinging. Propagating high electric fields across the gaseous gap, the streamers ensure the transport of high current densities (2000 to 3000 A/cm^2) [1] and provide to the surfaces reached by them highly reactive species among which ions with a kinetic energy which can reach up to one hundred electron-volts.

The most common use of corona discharges on insulating materials is for surface treatments and the knowledge on bulk effects of gas discharges originates more often from studies performed on partial discharges which occur in microvoids inside the bulk. However, many similarities in the processes into play and in the effects in both cases can be found [2]. For instance, if we refer to the effects on the electrical properties and behaviour of the materials affected by one or the other of the two discharge modes, one can make a clear relation between the changes produced in the dielectric losses by partial discharges [3] on the one hand and by the impact of corona streamers [4] on the other hand.