Evaluation of degradation of PVC by dielectric spectroscopy, and SEM and FTIR analyzes

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Polyvinyl chloride is one of the most polymers used in electrical cable insulation. It has a greater resistance to abrasion and an excellent resistance to high temperature and good electrical and chemical properties.

Under the action of electric field, the surface of the polymer is degraded. This degradation caused by irreversible changes in the material can rapidly shorten lifetime. The chemical reactions occurring in the process are: cross-linking reactions between the chains, oxidation, hydrolyze.... The kinetics of degradation depends on the concentration of the different constituents of the polymer. Several modifications of polymer structures have been observed: change in color, reduction in volume, brittleness.

This paper presents an experimental study the effect of electrical aging on surface degradation of the polyvinyl chloride. In this study we have subjected the PVC samples to AC voltage. For each applied voltage, we have studied the variations of the dielectric loss factor, the relative permittivity and the volume resistivity as a function of aging time and frequency (1-10 kHz). The morphology of the samples was studied by electron microscopy (SEM), and the Fourier transform infrared (FTIR) is used to determine the chemical changes to the surface of PVC. Based on the results, we conclude that the electrical aging influences slightly the dielectric constant. However, we observed a significant degradation of the used material (PVC) under the aging conditions abovementioned. This degradation is characterized by the dissipation factor increase and the decrease of volume resistivity.