EFFET OF CROSS-LINKING AND ANTIOXIDANT ON THE CONDUCTIVITY OF THE POLYETHYLENE

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ABSTRACTS

The studied material is a polyethylene (PE) intended for the insulation of the cables of energy transport of which reliability in time is wished. The samples are obtained by hot pressing of PE granulate placed between two kapton sheets and carried to 140°C under a weight of 10 kg during 10 min. The thickness of the samples obtained varies between 90 and 110 µm. For a better homogeneity of the structure, the samples are then subjected to a thermal cycle. To be able to carry out the electric characterization, the samples are metallized on the two faces. The samples are then preserved from the air and moisture.

In a first part the physicochemical and electric study of a low density polyethylene (LDPE) virgin of additives was undertaken. Measurements of Differential Scanning Calorimetric (DSC), of Fourier Transform Infrared spectroscopy (FTIR) and measurements of conduction current highlighted a change of material morphology for temperatures higher than 45°C, as well as a change of electric behaviour for the same temperature threshold. The probable mechanism, being able to explain the electric behaviour of the LDPE under a thermal stress, called upon a diffusion of the crystal defects toward the amorphous interface crystal, thus involving a density of deep traps being able to take part in conduction.

In a second part, the material chemically cross-linked by addition of peroxide dicumyl, then the influence of the antioxidant addition to this same basic resin was studied. The antioxidant used is of Santonox type. It is added to the basic resin in a proportion of 0.2% in mass. It has be shown on the one hand that the residual products of the cross-linking involved a reduction in the bulk conductivity, whose origin is allotted to an increase in the density of deep traps, on the other hand that the action of the antioxidant additive relates at the same time on morphology and the electric behaviour. An increase in conductivity in the area of the high fields (>10 kV/mm) is interpreted by an increase in the distance between traps due to the reduction in the microstructure sizes.

The characterization of material cross-linked and with an antioxidant added, allowed the study of the cumulated effect of the major increase in traps and the reduction in the microstructure sizes. It is showed that the cross-linking effect is dominating on the antioxidant effect in the direction where the conductivity of PR with antioxidant remains lower than that of the basic resin in all the range of fields studied. The increase in conductivity in the area of the high fields due to the presence of antioxidant is visible when current-voltage characteristics of PR and the PR provided with the additive are compared. These results compared the dominating role of the deep traps to the increase in mobility of the carriers in the range of fields studied.