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E.4. Influence du recuit sur le comportement électrique du polyéthylène basse densité

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Résumé

Dans les câbles à isolation synthétique, l'élévation de température qui résulte de l'échauffement de l'âme centrale, en service, peut être une cause d'évolution des matériaux au cours du temps. Afin de mieux comprendre les conséquences de ces variations de température sur les propriétés électriques des matériaux, nous avons étudié la façon dont se forme une charge d'espace, sous tension continue, dans des échantillons soumis à des traitements thermiques. Dans ce but, la méthode de l'onde de pression est appliquée à l'étude de l'évolution des charges d'espace dans des plaques de polyéthylène basse densité soumises à des phases successives de recuit à 70°C et de polarisation. Une attention particulière est portée aux effets d'interface qui peuvent être liés au mode de fabrication des plaques. Une amélioration des propriété électriques à la suite de recuits successifs est observée.

E.4. Influence of annealing on the electric behaviour of low density polyethylene

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Abstract

In synthetic extruded high voltage cables, a modification of the properties of the materials can be attributed to the increase of temperature which results from Joule heating in the inner conductor. The consequences of these variations of temperature on the electrical properties of the materials can be approached by studying the build up of a space charge, under dc voltage, in samples submitted to thermal treatments. In this paper, the PWP method is used to study the evolution of space charge in plaques of low density polyethylene submitted to successive annealings at 70°C and polarization under dc voltage. A particular attention is given to the interfacial effects which depend on the manufacturing process of the plaques. The most important result is that annealings improve the electrical behavior of the materials, by reducing the amount of space charge which develop under dc voltage.

I - Introduction

Many studies are being made in order to improve the performances of polyethylene based high voltage (HV) cables. Cross linked polyethylene (XLPE) and low density polyethylene (LDPE) are now extensively used for the transport of energy at high alternative voltages (ac) in synthetic extruded cables, and attempts are also made to use the same technology for direct current (dc) energy transport cables.

In both cases, ac or dc, studying the evolution of space charges under dc voltage application can bring some information on the electric behavior of the cable, and on the aging of its constituents [1]. This was made possible in the last few years by the development of non destructive techniques, which allow for such measurements. They use either the diffusion of heat in the sample [2], or the propagation of a pressure wave. In this later case, two approaches can be followed, leading either to the pressure wave propagation (PWP) method [3-5] or to the pulsed electro-acoustic (PEA) method [6]. Although these methods can be applied directly to cables [7], it is often more convenient to perform preliminary studies on plaques made of the same materials as the cables. Generally such samples are obtained by hot pressing semiconducting electrodes on extruded disks of the insulating resin. The measurement of the development of space charges in plaques submitted to an electric stress brings some information on the electric behavior of the structure and, by extrapolation, on the cable made of the same materials.

It is well known that during exploitation, the energy loss due to Joule heating creates a gradient of temperature in the cable, and that the resulting cyclic variations of temperature are a factor of aging of the materials. In this paper, an approach to get a better understanding of these phenomena is made by submitting LDPE plaques to successive polarization and annealing cycles and studying the influence of