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A.9.3. Electroluminescence dans le PR

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Résumé

Le polyéthylène réticulé utilisé pour les câbles haute tension souterrains normalement fonctionne à des températures plus élevées que la température ambiante. Les caractéristiques d'électroluminescence et de la formation d'arborescences électriques dans le XLPE vieillit électriquement à température ambiante et plus élevées sont présentées. On y démontre qu'avant la formation d'arborescences, des régions de dégradation apparaissent dans le polymère mais que le taux de croissance est beaucoup plus rapide à des températures plus élevées qu'à la température ambiante.

A.9.3. Electroluminescence on XLPE

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Abstract

Crosslinked polyethylene used in underground high voltage cables usually operates at temperatures above ambient. The characteristics of electroluminescence and electrical tree inception in XLPE electrically aged at and above ambient temperatures are described in this paper. It is shown that, prior to tree inception, degradation regions appear in the polymer and that their growth rate is much faster at temperatures above ambient.

Introduction

Polymeric insulation such as polyethylene has been used in underground power cables for more than twenty years. Crosslinked polyethylene (XLPE) has been employed in underground transmission and distribution cables because of its excellent properties such as low dielectric constant and dielectric losses, high degree of toughness and flexibility. During the past decade the voltage rating of underground XLPE cables has increased considerably and short lengths of 500 kV cables are currently used in Japan. In the future long lengths of XLPE cables will be employed for underground power transmission at and above 500 kV. However, XLPE is susceptible to degradation due to electrical, mechanical, thermal and other stresses present in the cable. It has been established [1, 2] that prior to electrical tree inception light is emitted at points of electrical stress enhancement in the polymer. This light is not due to partial discharges but due to the phenomenon of electroluminescence (EL) and at ambient temperature the EL inception voltage is the threshold voltage at which the polymer starts to degrade [2].

XLPE used in underground transmission class cables usually operates at temperatures up to 90°C and a thermal gradient exists between the inner and outer layers of the cable insulation. This paper describes the EL and electrical tree inception characteristics of XLPE held at and above ambient temperature. It is shown that degradation regions appear in the polymer prior to tree inception.

Experimental

Cable grade XLPE containing semicon tips ($r \sim 2$ μm) were used in this study. Partially crosslinked, 200 μm thick, semicon ribbons were obliquely cut to produce protrusions having an angle of 30° and then sandwiched between two pre-molded slabs of crosslinkable polyethylene. The samples were crosslinked for 30 min at 170°C and slowly cooled to room temperature. The tip of the semicon was held 9 mm from the bottom surface. The dimensions of a typical sample are shown in Figure 1. To de-