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Study of AC charging ability of XLPE insulating for power cable

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Résumé :

Cette étude porte sur le polyéthylène, qui est le matériau le plus utilisé pour l'isolation des câbles d'énergie. En Belgique, deux compositions chimiques différentes ont été utilisées pour les câbles HT souterrains :

- le polyéthylène réticulé chimiquement PRC
- le polyéthylène co-polymérisé avec acrylate d'éthyle PRC-AE.

Une étude a été entreprise dans le but notamment de mieux connaître leur faculté à accumuler des charges d'espace.

Après application d'une tension Alternative ou Continue, les propriétés de charge de ces deux matériaux ont été étudiées. Les résultats importants obtenus par la Méthode de l'Onde Thermique sur des échantillons type plaques ou directement sur des tronçons de câble montrent la présence, l'accumulation et l'évolution des charges d'espace après mise sous tension alternative. Une comparaison des facultés de charge de ces deux différents polyéthylènes est présentée.

Abstract :

This study is focused on polyethylene (XLPE), which is widely used for power cable insulation. In Belgium, two different chemical composition of HV cables have been underground installed :

- chemically cross-linked polyethylene XLPE
- polyethylene co-polymerized with ethyl acrylat (XLPE-EA).

This study was partly devoted to obtaining a better understanding of their capacity to store space charges.

After applying alternative (AC) or direct (DC) voltage, the space charge storage properties of these two polymer materials were studied. The results obtained by the Thermal Step Method on flat samples or on cable section show the presence, the accumulation and the temporal evolution of space charge even after applying alternative voltage. A comparison of the charging abilities of these two different polyethylene has been carried out.

1. INTRODUCTION

During the past few years, many studies have been carried out on charging ability of polyethylene subjected to high DC electrical stresses, but few studies have been concerned with AC voltage. The Laboratoire d'Electrotechnique de Montpellier (L.E.M.) and LABORELEC, concerned about the study of the aging of power cable insulation, have carried out these works comparing charging ability of chemically cross-linked polyethylene XLPE, under AC or DC conditioning.

Space charge is probably one of the causes for aging of power cables insulation. A good understanding of phenomena leading to space charge accumulation (injection, ionic migration, polarization...), as well as determining the origin of traps, are necessary to improve the reliability and lifetime of cable insulation. The Thermal Step Method (TSM) set up at L.E.M. allows to measure space charge density and remanent electric field both in plaque type samples or directly in cables.

In Belgium two different chemical composition for the insulation of underground cables have been installed, namely chemically cross-linked polyethylene XLPE and XLPE co-polymerized with ethyl acrylat (XLPE-EA).

This study is carried out first on flat 1 mm thick XLPE samples and afterwards directly on 15kV pieces of cables (5 mm thick of insulation).

After AC or DC voltage applying, the space charge storage properties of these two polymers