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F.2. Création d'arborescences colorées sous l'influence d'additifs et d'impuretés

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Résumé

Pour améliorer la fiabilité d'un câble à tension constante, il est nécessaire de déterminer des facteurs qui nuisent à leurs caractéristiques d'isolement. Le phénomène nommé "arborescences" est reconnu comme l'une des détériorations typiques qui font l'objet de nombreuses études. Les auteurs de ce rapport effectuent des essais avant rupture de câbles en service pendant plusieurs années afin de vérifier l'existence d'arborescences d'eau, à l'origine de l'arbre électrique. Ces essais confirment l'existence d'arborescences d'eau de couleur bleue (arbre bleu). La tension d'apparition est relativement basse par rapport à celle produisant l'arborescence normale. Son développement peut s'expliquer par une détérioration électrochimique. L'arborescence bleue avec des branches étendues se forme au fur et à mesure que cette voie se développe : ce qui cause la réduction de tension de préclaquage du câble.

F.2. Generation of colored trees under the influence of additives and impurities

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Abstract

To improve the reliability of XLPE insurated cables, it is necessary to clarify the factors that cause deterioration of cable insulation. Water tree phenomenon is especially known as one of typical factors and many investigations have been done so far. The authors conducted pre-breakdown tests for cables that had been in service for years to check the water tree existing at the origin of electrical tree. As a result, existence of the water tree with blue color (blue tree) was confirmed. Electrical tree generation voltage of this blue tree was low compared with that of ordinary water tree. The blue tree was developed by electrochemical deterioration and a thick "path" grew. A blue tree with spread branches was formed while this path developed resulting in reduced pre-breakdown voltage.

Introduction

It is considered that a water tree is developed by accelerating the deterioration of polyethylene resulting from Redox reaction. [1]-[3] It is therefore considered that the deterioration of polyethylene changes depending on the electrolyte that penetrates into the insulation and that this results in changes in electrical characteristics of the water tree. On the other hand, a vented tree is known as the water tree that is electrically harmful. Impurities in the semi-conductor material trigger the generation of this vented tree. This indicates that the harmful impurities can be specified with investigation of water tree, when the water tree was detected by pre-breakdown tests of aged cables. It is therefore considered that long term reliability of the cables can be improved significantly by removing impurities that give effects to insulation performances..

Mechanism of electrical tree generation from the water tree may be clarified through detailed investigation of the water tree where an electrical tree is generated. The authors conducted primarily pre-breakdown tests for cables that had been in service for more than 10 years to observe the water tree that was considered to give effects to the electrical performances. Further, harmful water tree was reproduced through sheet experiments to clarify its generation mechanism.

Experimental

Investigation of Cables

Investigations were made on 66 kVCV cables that had been in service for more than 10 years. Composition of cables is shown in Table 1.

Table 1. Composition of Cables

	Material	Thickness
Conductor	Cu	-
Inner Shielding	EVA + Furnace black	1mm
Insulation	XLPE + VS agent	9mm
Outer Shielding	EVA + Acetylene Black	1mm
note	Crosslinking by Steam	-

VS agent : Voltage Stabilizer

Pre-breakdown test were applied to the removed field aged cables.[4] The pre-breakdown voltage of 38 kV was applied for 10 min. Following this, the voltage was increased stepwise at the rate of 10 kV/10 min. until a partial discharge (PD) of 200 pC was detected. At this moment, location of discharge occurrence was confirmed, and cables around that portion were sliced to observe the starting point of electrical tree.