A.2.3. Expérience de relaxation en ligne de câbles haute tension à isolation polyéthylène réticulé

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Resumé

Une méthode de relaxation directe a été développé pour reduire des charges mécaniques dans l'isolant PR et pour diminuer le retrait axial. La méthode est basée sur une zone de chauffage supplémentaire au milieu du section de refroidissement dans la chaîne de vulcanisation en continu. La surface d'isolation est chauffée et refroidie encore une fois. Ce traitement diminue d'une manière significative les charges mécaniques intérieurs. La friction entre la couche semi-conductive et le conducteur augmente aussi.

La méthode de relaxation directe a été essaiée dans la nouvelle ligne verticale CDCC haute-tension. Plusieurs câbles ont été analysés en essai standard et quelques essais ad hoc ont été développé specialement pour déterminer les charges intérieurs de l'isolation au polyéthylène réticulé. Ces essais montrent clairement que le retrait axial et les charges mécaniques intérieurs peuvent être réduits d'une manière significative.

A.2.3. Experience in on-line relaxation of XLPE insulated high voltage cables

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Abstract

An on-line relaxation method has been developed to minimize mechanical stresses in the XLPE insulation and to decrease axial shrinkback. The method is based on an additional heating zone in the middle of the cooling section of the Continuous Vulcanizing (CV) line. Insulation surface is heated up and cooled down again. This treatment reduces internal mechanical stresses significantly. Friction between the conductor and the conductor screen is also increased.

The on-line relaxation method has been examined in a new vertical high-voltage Completely Dry Curing and Cooling (CDCC) line. Several cables have been tested using standard tests as well as some ad hoc tests developed specially for determining internal stresses in XLPE insulation. These tests show clearly that both shrinkback and internal mechanical stresses can be significantly reduced.

Introduction

The specific volume of XLPE insulation increases with increasing temperature [1]. The specific volume of XLPE as a function of temperature is shown in Figure 1. During insulating of high voltage cables the temperature dependence results in uneven mechanical stresses in the XLPE insulation. Shrinkback caused by mechanical stresses may cause problems in cable terminations and joints.

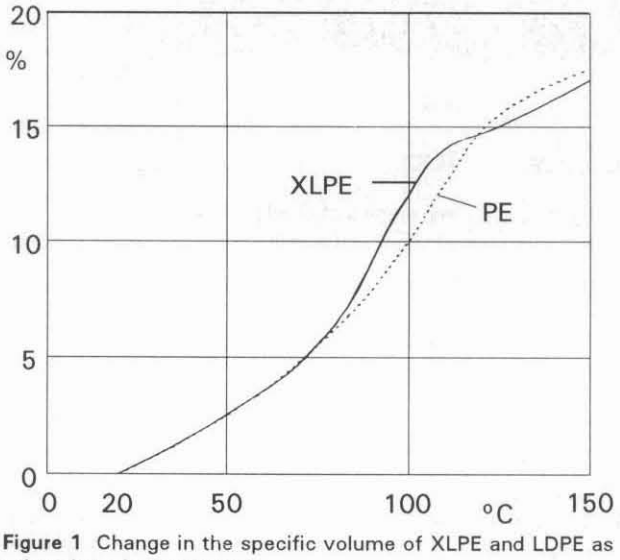

Figure 1 Change in the specific volume of XLPE and LDPE as a function of temperature

This paper discusses:

- Mechanical stresses of XLPE insulation
- The on-line relaxation method invented to reduce mechanical stresses and shrinkback of the XLPE insulation in high voltage cables
- Comparison between non-relaxed and relaxed high voltage cables. Visual inspection, inspection of mechanical forces, shrinkback and electrical tests have been carried out.

Mechanical Stresses of XLPE

Temperature dependence of XLPE results in uneven mechanical stresses inside the cable insulation. This phenomenon can be explained as follows.

In the Continuous Vulcanizing (CV) process, the conductor is first covered with extruded XLPE. Then it is heated up in a pressurised atmosphere to activate cross-linking of XLPE insulation material. The specific volume of the XLPE insulation is now much higher than at a room temperature.

Finally, XLPE insulation is cooled down from the outside before leaving the CV tube. In the beginning of cooling the insulation surface cools, crystallizes and becomes hard first, while the outer diameter of the insulation is still much larger than at a room temperature. The interior is still hot, soft and expanded. Then the interior cools down, crystallizes and tries to shrink. However, large diameter of the hard insulation surface tries to prevent this shrinkage (Figure 2). As a result, radial strain appears in the cable insulation.