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Effect of ageing on volume resistivity of different kinds of polyethylene cable insulation

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Abstract: Resistivity is one of main parameters characterizing dielectric materials. Measurement of volume resistivity is relatively difficult because of influence of many different factors on its value. Tests of volume resistivity on different new and aged polyethylene samples and medium voltage cable segments were performed. Results show great importance of test procedure on recorded resistivity values.

Keywords: polyethylene insulation, resistivity, test procedure

Résumé: La résistivité est un paramètre principal caractérisant les matériaux diélectriques. La mesure de résistivité est relativement complexe à cause de l'influence de plusieurs facteurs sur sa valeur. Les auteurs ont examiné la résistivité d'échantillons de PE et XLPE à l'état neuf et vieilli et de tronçons de câbles à moyenne tension. Les résultats montrent une grande importance de la procédure de mesure sur la valeur de résistivité.

Mots clés: isolation de polyéthylène, résistivité, procédure de mesure.

1. Introduction

Resistivity of dielectric material is very important electrical parameter, characterising quality of insulation system. For cable insulation the most significant is volume resistivity rather than surface resistivity. This parameter is especially important in HVDC installations due to strict dependence of electric field intensity distribution on properties of dielectric material.

Measurement of resistivity is relatively difficult because of influence of many different factors on its value [1]. Exterior factors are temperature, humidity, surface pollution, time and type of applied voltage; interior are structure, impurities and additives. Measurement of resistivity is performed under DC voltage in most cases. Typical values of measured volume resistivity are 10^{15} - 10^{18} Ω .cm. After voltage is applied polarisation and current flow take place. Macroscopic polarisation influences on a very long time of conduction current stabilization (up to a few hours and longer).

The most important cable type in service is still the paper-insulated cable - amount is twice the amount of medium voltage XLPE AC cables. But today's newly installed cables in voltage range up to 500 kV, have mostly XLPE (crosslinked polyethylene) insulation. Older designs of extruded cables had the PE (thermoplastic polyethylene) insulation. XLPE insulation is applied often in submarine AC cables too. Development of HVDC cables using polymeric insulation is delayed by the problem of space charge formation in a polymer which influences basically on dielectric response in the bulk and the effects at the electrodes.

2. Experiment

Laboratory test were carried out on several kinds of crosslinked polyethylene and thermoplastic polyethylene. Samples and parts of real cables were examined during tests. Influences of temperature, electric field and humidity were also considered, having greatest importance on values of measured volume resistivity. Values recorded for new and aged samples can differ significantly. Measurements on aged polyethylene insulation were performed to