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B.7.2. Techniques de caractérisation des isolations externes synthétiques, application aux extrémités de câbles HT

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B.7.2. Characterisation techniques of non-ceramic outdoor insulation, application to cable terminations

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Abstract

This study presents several diagnostic techniques used for characterising non-ceramic outdoor housing. These materials initially designed for line insulators were aged under voltage application with salt fog, UV light and demineralised water rain according to the IEC 1109 test. Microscopic observations, chemical and physical analysis were performed on EPDM and Silicone rubber materials filled with alumina trihydrate. The results show that some characteristics of the material can change definitively after ageing test. This methodology is convenient to insulating materials for cable terminations housings.

Résumé

Ce travail présente plusieurs techniques de diagnostic utilisées pour la caractérisation des isolants synthétiques pour l'isolation externe. Ces matériaux ont été préalablement vieillis sous tension électrique avec application de brouillard salin, rayonnement ultraviolet et pluie d'eau déminéralisée selon le cycle préconisé dans la norme CEI 1109. Des observations microscopiques et des analyses physico-chimiques ont été réalisées sur des matériaux à base de silicone et d'EPDM chargés avec de l'alumine trihydratée. Les résultats montrent des changements définitifs des matériaux après ces essais de vieillissement. La méthodologie employée est applicable aux matériaux de revêtement des extrémités de câbles synthétiques.

Introduction

Synthetic rubber materials have found a wide range of applications as insulators for outdoor purposes such as line insulators, surge arresters, hollow core and cable terminations. Compounds for high voltage insulators are generally mixtures of rubber, fillers and additives. Polymers are generally either silicone rubber (SR) or EPDM and the fillers are mostly alumina tri-hydrate (ATH) and silica. Unlike the conventional insulators, non-ceramic insulators show changes after several years of exposure to the combined effect of dry band arcing due to pollution, temperature, humidity and UV radiation produced by sunlight. The electrical performance of the insulator is mainly determined by the surface properties of the housings. To this end, ageing tests were carried out on slabs, in order to reproduce, in a daily cycle, most of the stresses which occur in service conditions. On one hand, we focused on permanent changes of the surface after accelerated ageing. On the other hand, we tried to determine the representativity of the accelerated test by comparing natural and accelerated ageing processes. Apart from visual comparison and electrical criteria (such as leakage currents and flashover measurements), changes have been monitored by various techniques such as Scanning Electron Microscopy, surface roughness and hardness, contact angle measurements, Infra-Red spectroscopy and X-Ray Photoelectron spectroscopy. A better knowledge of material degradation modes would help us in explaining ageing phenomena and assessing accelerated tests representativity.

1. Artificial and natural ageing tests

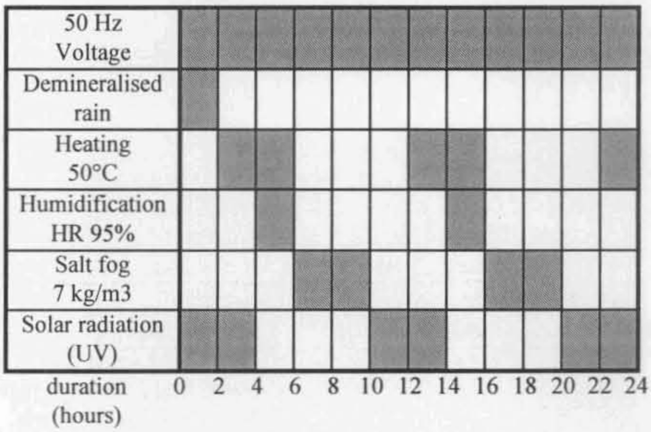

Fig. 1 : Ageing test according IEC 1109.

In order to assess the long-term behaviour of new types of non-ceramic materials, Electricité de France developed in the seventies an artificial ageing test procedure, known as "CIGRE 5000 hours test" and being proposed in the standard IEC 1109. The different steps of this test are given on Fig. 1. In order to compare the effect of such a test with natural ageing, the different materials were exposed at EDF's natural ageing test site located near Martigues. This site is subjected to heavy industrial and coastal pollution (class 3 according to IEC 815) as well as to high sunny levels (Mediterranean coast).