JICABLE '99

B4.6

Practical tool for cable ageing monitoring : dynamic mechanical analysis (DMA)

BOUTAUD F., EDF DER, Moret sur Loing, France
CHAILAN J.F., VERNET J.L., Institut des Sciences de l'Ingénieur, Université de Toulon et du Var, France

Résumé

L'étude du comportement à long terme des câbles électriques installés en ambiance nucléaire fait souvent appel aux propriétés mécaniques comme outil de caractérisation et de simulation de la durée de vie (modèle cinétique).
Dans le cas particulier de câble à isolation bicouche, la caractérisation mécanique est appliquée, sans distinction particulière, au 2 matériaux co-extrudés.
Pour accéder à une compréhension plus fine des mécanismes de vieillissement mis en jeu (compléter l'approche "globale"), nous avons eu recours à la technique de DMA. L"objectif est d'évaluer le comportement relatif de chaque matériau au vieillissement (approche " locale "). Les résultats obtenus sur un câble sans halogène K1 à isolation EPDM/EVA sont discutés dans cet article.

Abstract

Mechanical properties are widely used as a sensitive criterion (characterization, lifetime prediction) in order to study long-term behaviour of cables installed in Nuclear Power Plant (NPP).
In the special case of a double-layer insulating cable, mechanical testing is directly applied to the double-layer insulating («global» approach).
In order to identify individually the effects of ageing on each insulating material (« local » investigation), Dynamic Mechanical Analysis (DMA) was investigated.
Experimental results gathered on an EPDM/EVA double-layer insulating of an halogen-free K1 cable are discussed in this paper.

I - Introduction

Instrumentation and Control cables play a key role in Nuclear Power Plant (NPP) operation due to their contribution to the safety of the Unit and their very important number. Moreover, cable polymeric materials are subjected to temperature and radiation (environmental stressors) for duration up to 40 years. Within regard to this fact, the diagnosis of lifetime has a predominant purpose.

The present paper reports results on EPDM/EVA double-layer insulation of an halogen-free safety-related cable. Quantitative analysis of viscoelastic spectra (E', E , tan delta versus temperature) allows to identify individually the effects of ageing on each material.
This approach allows us to define more precisely ageing mechanisms involved on each double-layer insulating material.

II - Experimental

2-1 - Materials

Description of the cable

In order to reduce fire propagation, smoke and corrosive/toxic gas emission during fire, a new generation of cable compounds have been developped by cable manufacturers [1,2]. Materials for insulation and sheathing of cable are based on polyolefins with high concentration of inorganic filler in order to acheive the required degree of fire retardancy.

A low voltage (1 kV) K1 halogen-free cable was studied. A section view of the cable is shown on Figure 1. The cable is made up of four copper cores (conductor size of 1 mm^2) and a metallic braid which are all housed in a external jacket.