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Influence of gamma radiation and temperature on the ageing of EVA cable insulation studied by DSC

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Highlights

- The effect of combined ageing on the residual stability of EVA was quantified.
- Residual stabilities decrease exponentially with increasing radiation dose.
- Thermal ageing at 90 °C reduces stability less than the radiation ageing.

Abstract

Effect of gamma radiation and temperature on the stability of ethylene vinyl-acetate copolymer (EVA) cable insulation was studied by non-isothermal DSC measurements. From the dependences of oxidation onset temperatures on heating rates, the kinetic parameters describing the temperature dependence of induction period have been obtained. The kinetic parameters enabled to calculate the length of induction period for a chosen temperature and to evaluate the residual stability of EVA cable insulation after an artificial ageing stress. It has been shown that the extinction of residual stability with radiation dose obeys a first-order kinetics for all studied temperatures and the extinction constants of residual stabilities have been calculated. Their values indicate, that the radiation ageing has a more significant effect on the residual stability of EVA cable insulation than the temperature ageing at 90 °C.

Keywords: gamma radiation; induction period; thermooxidation; residual stability; EVA; accelerated ageing

Introduction

Ageing of polymeric materials leads to deterioration of their physico-mechanical and chemical properties and therefore represents a serious problem, especially in the case of cable insulations in nuclear power plants. The most common degrading factors affecting the stability of cable insulations in nuclear power plants are the presence of oxygen, elevated temperature and gamma radiation [1]. Therefore, it is necessary to predict the stability of cable insulations in such conditions. Accelerated aging tests are frequently used to estimate the extent of