

COMPARISON OF DIFFERENT METHODOLOGIES TO ASSESS THE LIFETIME OF CABLE

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ABSTRACT

In the context of sustainable development, some customers require to provide the service lifetime of cables. The lifetime models specified in cable standards are very often based on an Arrhenius's diagram with failure criteria (elongation at break). Due to the extrapolation process in this method, the risk is in the error propagation which can lead to significant change in the final result. This article presents other kinetic models based on mechanical and chemical failure properties and show the influence of the sample shape on the prediction of the lifetime of a Low Smoke Zero Halogen sheath..

KEYWORDS

Ageing, Kinetic model, cable LSZH, lifetime

INTRODUCTION

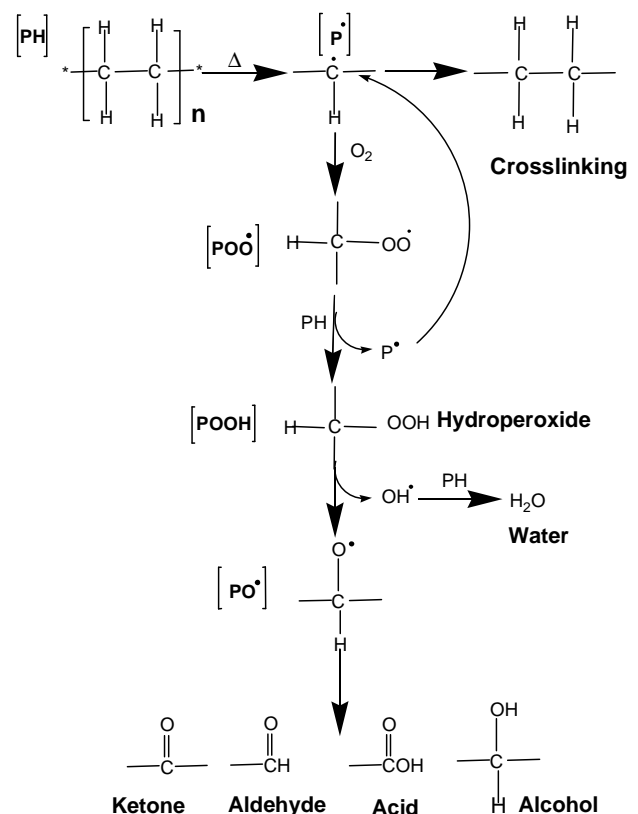
Sustainable development becomes a major issue for the cable manufacturer. In this framework, several customers such as railway rolling stock, nuclear or photovoltaic power plants require to provide the service life of cables.

The durability of polymeric materials is an important target for R&D teams who have to predict the lifetime of their products. The assessment of long-term behaviour is possible only from artificial accelerated ageing. The tests shall be representative of service life behaviour: chemical and mechanical evolutions must be of the same nature as those observed in reality.

MATERIAL AGEING

Degradation mechanisms that govern ageing of materials are well known [1-3] (Scheme 1)

The first stage of degradation of polyolefin (PH) is the formation of a macroradical (P[•]). The reaction with oxygen produces peroxy radical (POO[•]). This oxygen radical is transformed into hydroperoxide by abstraction of a hydrogen atom from the polymer. Hydroperoxides are very unstable and decompose to yield highly reactive free radical species (PO[•]) and (OH[•]). Further reactions lead by combination of two radicals (PO[•]) to peroxides (POOP), and by breaking chain to oxidized function such as ketone, aldehyde, acid, alcohol...:



The hydroxyl functions (water, alcohol, hydroperoxide ...) are observed by infrared spectroscopy around 3400 cm⁻¹ while the carbonyl function appear around 1700 cm⁻¹. During these various stages of degradation, the radical (P[•]) dimerises to form a macro polymer (crosslinking) and decomposes by intra and intermolecular reactions to generate Terminal Vinyl bonds ($\nu = 908 \text{ cm}^{-1}$) and Trans Vinyl bonds ($\nu = 964 \text{ cm}^{-1}$) [4-5] (scheme 2).