B.5.1.

New stabilizer concepts for polyethylene used in power cable applications

STRICKER F., KOLB M., Ciba Specialty Chemicals, Switzerland

Abstract: Peroxide crosslinked polyethylene is commonly used for insulation of medium and high voltage power cables. Major challenge for stabilizers and antioxidants, respectively, is to provide long service life-time by effectively protecting the polymer from degradation and consequently maintain physical and electrical properties after processing and ageing. The final cable performance is also dependent on the purity of the polymer and the antioxidant as well as on their compatibility. Beside this highest demands exist on processability in terms of scorch resistance, the limiting factor for productivity and downsizing. Currently established solid stabilizers and a new liquid stabilizer have been compared according to these parameters.
Halogen-free flame retardant (HFFR) compounds for cable jacketing and insulation are constantly penetrating the market, so far predominantly in jacketing applications. High filler loadings and more stringent specifications require proper stabilization in order to provide excellent long-term stability as well as improved processability. The efficiency of various antioxidants on the performance of HFFR compounds has been determined.

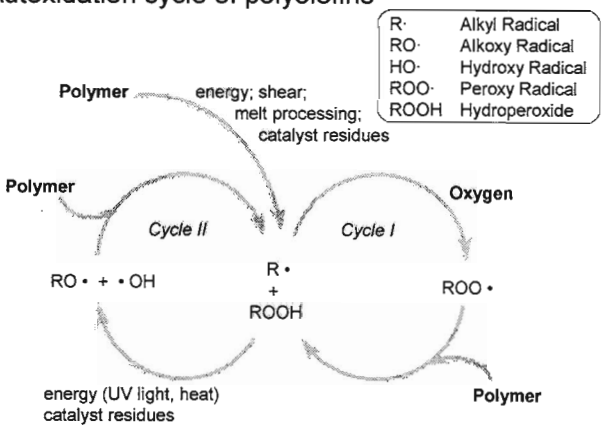
Résumé: Les PE réticulés avec du peroxide sont généralement utilisés pour l'isolation des câbles Haute et Moyenne Tension. Le principal défit des stabilisants et antioxidants est, respectivement de garantir une longue durée d'utilisation en protégeant efficacement le polymère de la dégradation, ce qui permet ainsi de maintenir les propriétés physiques et électriques après transformation et vieillissement. La performance du câble final dépend également de la pureté des composants et de leur compatibilité. De même, des contraintes existent lors de la transformation du polymère, notamment en termes de 'scorch résistance', facteur limitant la productivité. Des stabilisants solides usuels, ainsi qu'un nouveau stabilisant liquide ont été comparés, en tenant compte de ces paramètres ;
Les matériaux ignifuges, sans Halogène, utilisés pour le gainage et l'isolation des câbles pénètrent de plus en plus le marché, notamment dans le gainage. Les taux élevés de charges et les spécifications rigoureuses exigent une stabilisation appropriée afin de fournir une excellente stabilité à long terme ainsi qu'une bonne transformation. Ainsi le rôle de différents anti-oxydants sur la performance de composants chargés en HFFR a été déterminé.

Keywords: Stabilization, peroxide XLPE, HFFR

1. Introduction

On their way from the reactor to the final article polymers undergo multiple thermal and mechanical stresses. The combination of heat, shear stress and the presence of oxygen cause radical chain mechanisms resulting in degradation by chain scission or uncontrolled crosslinking. Appropriate stabilizers can efficiently retain the initial properties of the polymer by different mechanisms [1/2].

Autoxidation cycle of polyolefins



Phenols are able to donate a hydrogen radical and by this to neutralize and scavenge alkoxy and peroxy radicals being previously formed through severe processing conditions in presence of oxygen or by cleavage of hydroperoxides. Phenolic antioxidants protect polymers during processing as well as in the end application as long-term thermal stabilizers [3/4]. Organosulphur compounds such as sulphides, dialkyl-dithiocarbamates or thiodipropionates are well known hydroperoxide decomposers.