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Application of new ethylene elastomers in wire and cable

HEMPHILL J., Dupont Dow Elastomers, Freeport, USA

Résumé

Les progrès constants de la technologie de synthèse des polymères ont permis d'offrir aux câbliers de nouveaux produits pour améliorer les performances de leurs fabrications. En particulier, les élastomères d'éthylène, produits selon la technologie métallocène, sont utilisés dans de nombreuses applications de l'industrie des câbles. Cette présentation souligne les caractéristiques de ces nouveaux polymères et décrit plusieurs exemples d'applications comme des isolations basse et moyenne tension, des écrans semi-conducteurs et des constructions sans halogène.

Abstract

Continuing advances in polymer technologies are enabling creation of new products which allow producers to match or improve cable performance. In particular, ethylene elastomers can be produced via metallocene technologies which are useful in a number of wire and cable applications. This paper will outline the characteristics of these emerging polymers and highlight several application examples including low and medium voltage insulations, semi-conductive shields, and halogen-free constructions.

Introduction

Rapid advancements in polymer technologies are providing new capabilities and products that are beginning to make an impact in the transmission and distribution industry. The recent advances in metallocene catalyst technologies,[1] often referred to as a single site or constrained geometry catalyst (CGC) are now enabling manufacturers to refine the polymer design and optimize compound processing and end-use performance.

Previous technical papers have outlined some of the changes in polymers and processes employed in the production of utility cables.[2, 3] These changes have included progression from natural rubber and sulfur curing at the turn of the 20th century to the predominant use of peroxide curing of ethylene propylene (EPR) and polyethylene (XLPE) polymers as we enter the 21st century. The recent metallocene polymerization advances are enhancing the polymers that can go into these cable constructions.

This paper will describe what differentiates metallocene technology resins from traditional polymers, the new polymers that can be designed and created, benefits that these products offer, and application data to support their adoption.

Evolution to New Polymers

The design, manufacture, and use of ethylene-based polymers for utility wire and cable use has evolved over the years. Previous technical papers have discussed the specific chemistry and morphology of polyethylene homo- and copolymers made by various catalytic processes, as well as similar discussions of ethylene/propylene co- and terpolymers (EPM and EPDM) prepared by Ziegler-Natta (Z-N) catalysis.[4, 5] While these ethylene-based resins have been successfully used, further advances in product design have been constrained by the variability in the structure and behavior of the polymerization catalysts. The advent of metallocene catalyst technology has provided a major point of differentiation by minimizing the variability of the traditional catalysts and providing the means to design and produce a more ideal polymer.

Variability of polymer architecture is a direct result of the traditional catalyst being used. For instance, low-density polyethylene, which uses peroxide decomposition as its "catalyst", produces a product with significant numbers of short and long chain branches as shown in Fig. 1. Another example of this variability is a polymer produced with Z-N catalysis - these catalysts consist of multiple catalytically active sites, all chemically related, but each having its own