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New flexible TR-XLPE insulation for medium voltage power cables

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Abstract: A new medium voltage insulation compound is presented which combines the flexibility of EPRs with the excellent dielectric properties of TR-XLPE. The flexibility of the new, flexible TR-XLPE insulation compound is shown to be greatly improved over the standard TR-XLPE and to approach EPR's flexural properties. The dissipation factor is equivalent to the standard TR-XLPE in the market and far lower than any of the EPRs evaluated. In the accelerated water treeing test, the new flexible insulation has excellent and equivalent performance to the standard TR-XLPE product.

Keywords : power cable, insulation, flexibility

Résumé: Une nouveau compound pour isolation Moyenne Tension est présenté ici. Il combine une fléxibilité équivalente à celle des EPR, avec les excellentes propriétés diélectriques (pertes) des Polyéthylènes réticulés (TR-XLPE). En outre, ce nouveau matériau d'isolation démontre d'excellentes performances lors de tests accélérés de resistance aux arborescence à l'eau, équivalentes à celles des TR-XLPE.

Mots clés : Cable d'énergie, isolation, flexibilité.

1. Introduction

The North American medium voltage utility power cable industry has for many years used two types of insulation products. First, and the predominant volume product, is an unfilled, water tree retardant material (standard TR-XLPE -- Tree-Retardant, crossLinked PolyEtheylene). Second are the EPR based insulation products. Although both types of products have performed well in terms of affording the market with long-life cables, they each bring some specific advantages. In addition to overall excellent dielectric properties, the TR-XLPE cables have very low dielectric losses as compared to EPR based insulations. This ensures lower operating costs for the TR-XLPE as compared to EPR over the entire lifetime of the cable. The high dielectric losses of EPRs are inherent to the product because of the clay filler. On the other hand, filled EPR insulations have better flexibility (handling characteristics) as compared to the standard TR-XLPE.

Flexibility of medium voltage utility cables is an important feature of performance because of the need to maneuver the cables in manholes and ducts. The current TR-XLPE cables, based on high pressure LDPE, are limited in their flexibility because of the degree of crystallinity of the base resin. Flexibility of unfilled, TR-XLPE type insulations has been a goal for the industry for some time. Since the density of the base resin for the TR-XLPE is the controlling parameter for the flexibility, there is an opportunity to utilize a new base resin with lower crystallinity to provide the industry with a more flexible insulation product. This paper describes the features and the performance of this new product.

2. Polyethylene Insulation

Polyethylene has been a well-recognized industry insulation standard since the 1940s when it was first used for insulating radar installations. It has an extremely high dielectric breakdown strength and an excellent low dissipation factor. As the demands of the industry have changed over the years, the need for higher operating temperature products became obvious. This led to the introduction of the currently used crosslinkable products. By crosslinking the molecules, deformation and flow, from the potentially high temperatures of overload or short circuits, can be minimized. In addition, the ability to provide a product that affords resistance to water treeing became a critical feature in the 1970s as the detrimental effects of water became known. This led to the introduction almost 20 years ago of the now-standard TR-XLPE insulation product.

TR-XLPE is the standard in the North American medium voltage power cable utility market and its use world-wide is growing. This is due to its ability to be crosslinked (for high temperature performance) and to its excellent water treeing resistance (as