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Application of fifth generation jacketing technology for improved performance

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When designing a cable, careful attention must be paid to the choice of materials, including the outermost layer. The jacket or oversheath insulates the critical components and protects them from degradation by moisture, light and physical damage. The demands on the jacket means that a number of properties are required, such as good processing, abrasion resistance, barrier properties, environmental stress crack resistance (ESCR) and low shrinkage.

Polyethylene resins have, during the last several years, increasingly been used as jacketing material on expense of polyvinyl chloride (PVC). Conventional low density polyethylene, LDPE, produced in high pressure reactors, was the first PE to be used. During recent years there has been a clear trend towards linear materials, produced in low pressure reactors, with LDPE being replaced with linear low density polyethylene (LLDPE). The high temperature requirement in power cables has resulted in high or medium density polyethylene (HDPE or MDPE) being used in both standard black and coloured (often red) versions.

The trend today is clearly towards HDPE as it provides high mechanical strength, good barrier properties and hard surface (Shore D). However, traditional HDPE has necessitated a number of compromises. The ESCR-properties decrease with increased density. In order to match the ESCR-requirements, the melt flow rate has been decreased (i.e. increase of viscosity), which results in increased shrinkage and trading off processing performance, figure 1. The straight line places an upper constraint on the selection of traditional linear PE in order to retain good ESCR-performance. With bimodal PE, the fifth generation of jacketing materials, density and viscosity can be selected independently resulting in a more than threefold improvement in ESCR performance and lower shrinkage.

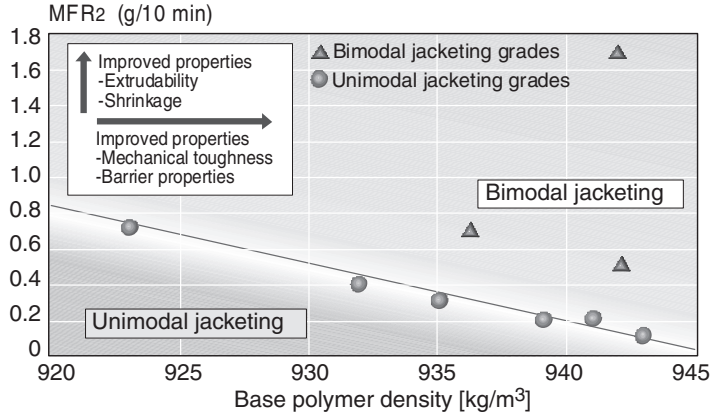

Fig. 1. Viscosity as a function of density for traditional and bimodal PE.

The advantages may be quantified by considering installation in Germany. Up to 90 % of buried cable failures are a result of mechanical damage [1]. The laying costs represent a big portion when installing buried power cables. In certain countries they account for 80 % of the whole project, figure 2 [2]. The laying cost structure can be seen in figure 2. Thus HDPE jackets, with Shore D around 60, which are best able to withstand the rigours of installation, enable a significant reduction in laying costs. Simple modern equipment, like a cable plough, can be used when laying cables.

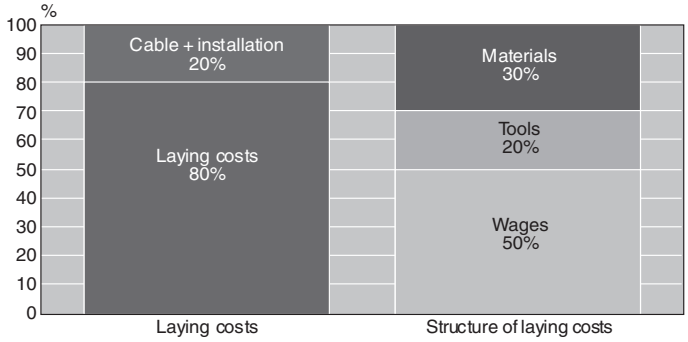

Fig. 2. Laying costs and their structure.

The more robust HDPE jackets mean that it is no longer necessary to lay cables in sand to protect them. Furthermore, the width of the cable trench can be decreased from 80 cm to 35 cm. Overall these result in a significant decrease of cost.

This paper describes the advantages of the fifth generation of jacketing materials using bimodal polyethylene. In particular the experience will be discussed in terms of

- Extrusion processing
- Mechanical protection (hardness, termite resistance)
- Consistently low shrinkage
- Good UV ageing of black and coloured versions
- Improved reliability (installation and service)
- Overall system costs

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