

Performance of a strippable thermoplastic medium voltage cable

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ABSTRACT

In recent years there have been a lot of publications about the development of a thermoplastic insulation. It makes sense to look into different ways of how to isolate cables still having the advantages of an extruded insulation but avoiding the cross-linking process. Therefore one of the polymers that has been looked at is polypropylene. This polymer has good heat resistance and acceptable costs avoiding the process of cross-linking. There have been a lot of publications describing different insulation properties but less attention in the literature has been given to the semi-conductive screens, the conductor and the insulation screen. In most of the countries this screen is the same material, however, in some countries the insulation screen needs to be strippable. This paper will address the challenges of having a strippable screen for medium voltage that will give a good performance on the cable at – 20 °C and at + 105 °C including the short circuit behaviour at 250 °C.

Thermal conductivity of the insulation and the semi-conductive compounds is compared to XLPE and unmodified polypropylene.

KEYWORDS

Thermoplastic insulation, power cable, ampacity, polypropylene, strippable

SUMMARY

A recyclable medium voltage cable based on a polypropylene compound has been developed. It showed no difference to commercial available medium voltage cables. Two different suppliers of polypropylene were evaluated and also alternative suppliers for the antioxidants.

All three layers are based on polypropylene:

- Conductor screen
- Insulation
- Insulation screen, strippable

The cable has been type tested and has fulfilled all the requirements including all the special requirements that were thought being useful.

Furthermore, the cable is suitable for a conductor temperature of 105 °C and it can be installed, if needed at –20 °C.

Currently the cable is in an application test at one major utility in China in a live network.

INTRODUCTION

The customer wanted to produce an environmentally friendly cable that was completely recyclable and could be used between – 20 °C outside temperature and + 105 °C conductor temperature. Additionally the cable should have

a strippable outer screen that should ensure easy installation according to the local recommendations. Further, the cable should be based on locally sourced raw materials.

Two different suppliers of polypropylene were evaluated; one was an international active supplier and the second one was a local supplier from China.

DEVELOPMENT

Table 1: Mechanical and electrical properties of the insulation material

Property	Unit	PPC 1	PPC 2
Tensile Strength	MPa	32	33
Elongation at break	%	550	700
Mechanical properties after ageing at 135 °C, 10 days			
Tensile Strength	MPa	27	26
Elongation at break	%	500	550
Flexural Modulus	MPa	400	400
Dissipation factor	10 ⁻⁴	0.2	0.2

First of all, we started with the insulation compound. As base material we used a random polypropylene copolymer with a suitable melt index for medium voltage application. The melt index was chosen as a compromise between processing and melt stability avoiding a 'pear-drop' effect. The stabilisation was chosen according to the requirements as outlined for example in NEN HD 620 S1. This requirement was also taken for the semi-conductive compounds. Furthermore an alternative polymer source was found locally and was evaluated as alternative. An additional polymer was added to improve the flexibility and the performance at cold temperature. This polymer should be at least electrically neutral.