MV ENHANCED THERMOPLASTIC POLYPROPYLENE BASED CABLES TO UPGRADE POWER DISTRIBUTION AND TRANSMISSION NETWORKS.

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ABSTRACT

Polypropylene based thermoplastic power cables are the latest frontier in the field of energy transport and distribution, as they bring superior electrical properties, higher operating and emergency temperature to support the expansion of networks with larger capacities and a higher level of robustness and safety margin in the networks. Additionally, they contribute to circular economy with complete material recyclability and they help improving manufacturing cycles as no degassing is needed.
This paper presents an independent development of materials, extrusion process and subsequent testing programs assessing the expected cable properties.
Moreover, the paper focuses on full size cable production, testing and qualification process.
PP insulated cables have been submitted to thermal cycle tests for operating temperature up to 110°C such as emergency temperature up to 130°C and water ageing test according to Cenelec procedure.
Above all, PP insulated cable was successfully submitted to qualification as per Italian standard CEI 20-86, so opening the way to commercial applications.

KEYWORDS

Polypropylene, power cables, medium voltage, recyclable.

INTRODUCTION

Current XLPE technology benefits of long history records in terms of performances and reliability and offers solutions for specific applications such as MV WTR, HVAC and HVDC markets.

However, despite well-established market acceptance, some technical limits and drawbacks are present and well known.

From a general standpoint, XLPE cable manufacturing is for example affected by degassing need, requiring long lasting thermal treatments in particular for HV applications. As a consequence, manufacturing of XLPE cables definitely requires two step process, comprising cable extrusion and degassing. Moreover, the risk of scorch phenomena, even though well mastered, represents an intrinsic technical limit and reduces manufacturing campaign duration.

In addition, from a MV market point of view, the evolution of distribution network with the addition of renewable energy sources can fit the performances of new cable generation, able to absorb power peaks with higher operating temperature.

Actually, a peculiarity of wind and solar farms is the temporary generation of power peaks which correspond to higher currents for limited time periods.

Therefore, cables of new generation are expected to offer larger flexibility, as far as nominal current and operating/emergency temperature are concerned.

Eco-friendly aspects and recyclability are nowadays gaining increasing importance and they become a new general trend of any industrial manufacturing activities.

Despite expected long product life, even the recyclability of MV power cables is being considered more and more seriously.

Lower energy consumption of PP insulated cable technology represents an advantage as well.

Even though some works to recycle XLPE have been done, this material remains quite far from ideal recyclability needs and expectations.

Fig. 1 12/20 kV PP insulated cable

Thermoplastic power cables offered solutions during cable history to the above mentioned needs and drawbacks, however their practical applications were also negatively affected by limits in terms of thermo-mechanical properties, such as in the case of LDPE and HDPE insulated cables.

PP insulated cables, based on selected formulations, benefit of excellent electrical properties together with outstanding thermo-mechanical behavior as well as good recyclability.

In fact, PP insulated cables offer the practical opportunity, without the need of separating semiconductive layer from the insulation, to provide a recyclable PP based compound that can be easily transformed into a material with practical commercial applications.

The present paper describes the successful conception of PP insulation, based on independent insulating compound