DISTRIBUTION OF PEROXIDE BY-PRODUCTS ALONG DEGASSED XLPE HV CABLES

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ABSTRACT

For both technical as well as safety reasons the cores of crosslinked (XLPE) High Voltage cables have to be subjected to a degassing process to reduce the concentration of by-products formed during the manufacturing process.

Analysis of the concentration of by-products is typically determined on samples taken from the end of the cable laid up on a reel. Little has however been published about the distribution of these by-products along the lengths of a cable core after degassing.

This study has shown that there is a higher concentration of methane in the inner layers of the reel and that the polar by-products follow the same pattern.

KEYWORDS

Crosslinked (XLPE) High Voltage cable, degassing, by-products, methane, acetophenone, cumyl alcohol

INTRODUCTION

Cable manufacturers have to degas crosslinked (XLPE) High Voltage (HV) cables. This is critically important in order to eliminate the risk for fires or explosion during handling and installation of cables due to a too high content of methane. Methane comes off as one decomposition product during peroxide crosslinking of polyethylene but is removed from the cable core in a degassing process. Polar by-products, primarily acetophenone and cumyl alcohol, are also formed during the crosslinking step. These by-products influence electrical properties such as dissipation factor and space charge accumulation [1].

Several publications have discussed the importance of degassing of HV cables as well as different test methods for the analysis of the by-products in samples taken from cables [2], [3], and [4].

Samples from HV cables are for practical reasons typically taken from the end of a cable reel during and after the degassing process for analysis of the by-product content. However little is published about the distribution of the by-products along the cables on a reel. Difference in temperature and air circulation around a cable on a cable reel might influence the distribution. For future cable applications and cable designs it is important to fully understand the by-product distribution in the HV XLPE cables. To address this issue a study has been made where samples from a degassed cable have been taken to represent different positions along the cable on a cable reel (outer, middle and inner) for determination of by-product content.

This paper reports the content of methane, acetophenone and cumyl alcohol in both longitude and radial direction along a HV XLPE cable after degassing.

CABLE DESIGN AND MATERIALS

The chosen cable studied had a 1200mm^2 stranded aluminium conductor with thickness of conductor shield 0.6mm, insulation 14.1mm and insulation shield 0.6mm.

A commonly used commercial acrylate polymer based conductive compound was used as both conductor and insulation shield. For insulation, a compound developed for lower degassing burden was selected.

The cable was extruded and crosslinked on a modern CCV line.

In total 520m of this HV cable was manufactured. This length generated five layers on a M30 reel (outer diameter 3m, inner diameter 1.5m and width 1.5m) without venting holes (see figure 1).

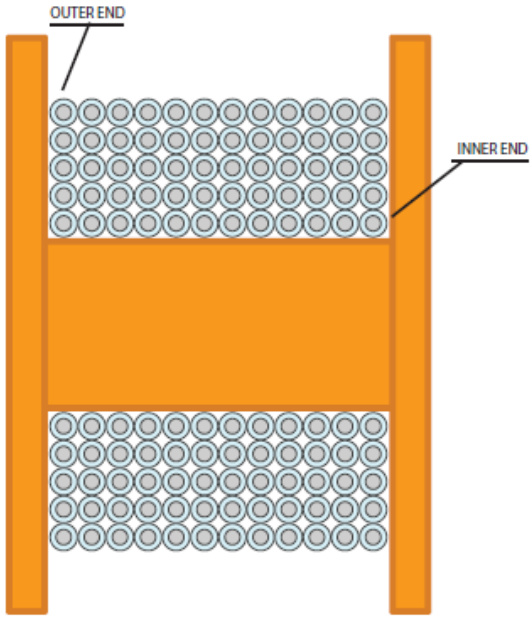

Figure 1: Schematic description of HV cable on a M30 drum.