Remnant static mechanical stresses and water tree ageing of XLPE power cables

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The main purpose of the work presented in this paper was to experimentally examine possible water tree enhancement caused by remnant mechanical stresses, frozen-in during the manufacturing process of extruded XLPE power cables.

The experiments were performed using 3m long samples of 12 kV XLPE cable cores exposed to water and different static tensions during ageing at an effective 50 Hz AC voltage of 14 kV (E_{Max} = 5.2 kV/mm). Received reference cable samples as well as samples with and without remnant stresses were examined at 20, 40 and 60 °C. Upon removal of the cable conductor the insulation was found to longitudinally shrink by about 2 %. Thus at each temperature the following 3 types of samples were examined:

i) Reference cable sample ,with conductor,
ii) non-strained cable sample, without conductor,
iii) mechanically 2 % strained cable sample, without conductor.

The degree of water tree degradation was characterized using optical microscopy investigation of 0.25 mm thick methylene blue stained slices.

Both the density and growth rate of bow-ties and vented water trees were found to increase significantly when applying mechanical tension. Highest number and water trees of longest lengths were found in the reference and the mechanically stresses cable sample. - The results support previous findings and are in good agreement with the mechanical damage theory of water treeing.