C.8.3.9.

An analysis of the water treeing resistance of polymer compounds for cable insulation using the two needles method

Teissèdre G., LEMD, CNRS / UJF, Grenoble, France
Nylander P., Borealis AB, Stenungsund, Sweden
Campus A., Borealis polymers NV, Belgium
Filippini J.C., LEMD, CNRS / UJF, Grenoble, France

During the last years significant progress has been made in the understanding of the causes of insulation breakdown induced by the presence of water trees: defects – e.g. small conducting particles – become dangerous initiation points for breakdown if water trees appear in their vicinity due to the phenomenon of water tree-induced electric field enhancement. A new laboratory method based on this remark was recently proposed to compare the water treeing resistance of materials for cable insulation [1]. The method uses specimens with two facing needles: one of them is a water needle at the tip of which an individual water tree has been grown in accelerating conditions, the second is a metal needle simulating the residual defect. In a first step of the test a number of identical specimens for each tested material are put under voltage in identical ageing conditions to grow the water trees. Then, each specimen is submitted to a breakdown resistance test where a 50 Hz voltage of linearly increasing amplitude is applied between the two needles. Partial discharges, followed by electrical tree propagation and insulation breakdown, eventually appear at the metal needle tip. According to the nature of the water trees – size, length,,water content, etc…- and, consequently, to the nature of the insulating compound, this field value is reached for different values of the voltage, thus allowing us to characterize the different compounds by partial discharge inception voltage (PDIV) values and by breakdown voltage (BV) values.

In this communication we present the results of a study on two groups of compounds for cable insulation. The compounds of the first group are crosslinkable materials (XLPE, XLPE-A, XLTR- 1, XLTR- 2) whereas those of the second group are intermediate products without crosslinking agent (PE-A, TR-2). The interest of the thermoplastic form of the materials of the second group was to simplify the specimen moulding procedure without modifying the intrinsic water tree resistance of the material as can be expected from [2].

Notable differences were observed between the materials of the first group: XLPE presented a broad BV distribution whereas the BV distributions of XLPE-A and XLTR-2 were particularly narrow. On the other hand, the average BV values of XLPE-A and XLTR-2 were practically identical. That of XLTR-1 was the highest but with a less narrow distribution. In the second group it was noticed that the average PDIV value was the same for PE-A and TR-2 whereas the average BV value was higher for TR-2 than for PE-A. These results will be discussed in the paper, in particular in terms of expected cable performance.

As a conclusion we can say that the two needles method gives us a new way to characterize the insulating materials as regards water treeing rather based on the concept of materials resistant to water trees than on that of water tree retardant materials.

REFERENCES

[1] J.C.Filippini, I. Radu, P. Notingher, A. Campus, " A new test method to evaluate the water treeing resistance of polymers for cable insulation", this conference.

[2] F. Ciuprina, G.Teissèdre, J.C. Filippini, "Polyethylene crosslinking and water treeing", Polymer, vol. 42, pp 7841-7846, 2001.