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Investigation of electrochemical degradation in service-aged, cable-cure-restorated PE-insulated M.V. cables

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It has occasionally been observed that stress induced electrochemical degradation (SIED) in the inner semicon layer of extruded-insulated cables can initiate vented trees [1], though it is still not clear, to what extend this effect is of practical relevance for cables under normal operating conditions.

However, under certain circumstances e.g. when cables are wet aged under accelerating conditions or when water tree-aged cables have been treated with the cable-cure method, it cannot be excluded that this effect could play a role and influence the electrical behaviour, respectively.

The paper reports about electrochemical degradation effects in the latter case. The investigations were made because of failures in service-aged 10 and 20 kV PE-insulated cables manufactured in the 70's which were treated by the cable-cure method about two years ago.

The cables show areas of cable-thickening obviously caused by a strong direct chemical reaction of the aluminium conductor with methanol from the crosslinking process of the phyenylmethyldimethyloxysilane with water. The force of the existing galvanic cell leads to a degradation of the semicon, to cracks (SIED-structures) and the initiation of vented trees. In the failure areas aluminium-oxide particles and pieces of the disrupted semicon can be observed in the insulation.

The reasons for the electrical failures and the ageing mechanisms as well as possible causes for better field experiences with cable-cure restorated cables in the US are discussed.

Reference

[1] Steinfeld, K., Kalkner, W., IEEE Transactions on Dielectrics and Electrical Insulation, Vol. 5, 1998, p. 774-778