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Materials for HVDC extruded cables

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The insulating system properties and performances of accessories are among the important inputs regarding design of HV and EHV cables. Power cables always experience thermal and electrical gradients. On the other hand, under Direct Current (DC) stress the resistivity of the insulating material is more or less temperature and field dependent which leads to space charge accumulation in the insulating layer. Consequences of a such phenomenon is distortion of Laplace field or field enhancement, ageing and even premature failure of the cable.

Development of HVDC extruded cable was performed in two steps:

- (a) a pertinent choice of the insulating system which needs relevant measurement tools to reach key properties that allows to select outstanding insulating materials, then the best insulation/electrode combinations and,
- (b) validation of performances of selected systems on cables through tests recommended by CIGRE and evaluation of space charge features.

Characterisation of several materials candidate for HVDC cable insulation, in terms of field and temperature dependence of the resistivity have already been published. Thus this paper focuses on another key property that deals with space charge features of different insulating materials by means of the Mirror Method (charge trapping and spreading, relaxation of the stored charge) as well as of different insulation/electrode combinations using advanced Thermal Step Method (charge injection into the insulation and contribution to overall charge density). Differences and expected consequences of observed features are discussed. Finally, applicability of each material or combination of materials is examined with respect to the type of cable system aimed for.