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#### **Novel polymeric insulating compounds for HVDC applications**

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Over the last few years, there has been a high level of interest in polymeric insulations for high voltage dc applications. The advantages and concerns of HVDC extruded polymeric cable are discussed. The main technical challenges for a polymeric high voltage dc cable are to prevent early insulation failure due to a local field enhancement caused by stress inversion and space charge build-up, or a significant reduction in dc breakdown strength caused by service aging. Localized space charge build-up during polarity reversal under surge or lightning impulse can significantly enhance the local field to exceed the breakdown strength of the insulating materials. Typical XLPE insulation materials used for high voltage ac cables suffer from these shortcomings.

Space charge can be trapped by physical traps formed between crystalline and amorphous phase boundaries or chemical traps due to the chemical structure of ingredients used in the formulation. Many patents have disclosed how to modify polyethylene compositions to be useful for dc applications. Our approach is to use ethylene-alpha olefin copolymers with very low crystallinity to reduce physical space charge trapping sites, and special additives or modifiers to leak space charge quickly when local stress is enhanced, stabilize or neutralize the space charge, and minimize internal charge generation from degradation during aging.

The effects of the new polymers combined with the special additives have been investigated using a PEA (pulsed electro acoustic) method after 24 hours with either positive or negative 20 kV/mm applied. Our novel HVDC polymeric compound showed low and flat space charge distribution with time and had space charge density no more than 2 coulombs per cubic millimeter (C/mm<sup>3</sup>) at either positive or negative stress level of 20 kV/mm. This paper shows that excellent space charge performance has been achieved when compared with standard XLPE for HVDC applications.