Key properties of next generation XLPE insulation material for HVDC cables

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The installation of HVDC transmission systems has over the last decades grown substantially, especially during the last five years. The driving force for the increased penetration of HVDC links in the network has mainly been governed by the switch to renewable resources, where the generation predominantly is situated far from the use of energy. This growth is projected to continue. In addition, interconnections to strengthen the existing AC grids with bulk transmission of energy over longer distances are needed, which is only achievable with DC. This is to secure the reliability of the network and improve the energy market. Not all these new transmissions lines will be made with cables, however to facilitate shorter lead times for concessions, partly undergrounding with cables is more and more an attractive solution.

For over 15 years it has been possible to use extruded HVDC cables to transmit power over longer distances. The recent development of a new unfilled cross-linkable material has enabled the use of extrudable HVDC cables rated at 525kV.

The new material solution is based on a known technology platform, building on the extensive experience in producing specialized compounds for the highest requirements. However, for the development of insulating materials to be used in cables for HVDC transmission above 320kV, a new way of thinking in terms of contamination was needed - i.e. there was a need for higher chemical cleanliness. Besides the well-known physical cleanliness i.e. minimization of solid particles giving rise to field enhancement, known since decades from the world of AC materials also the chemical cleanliness is of importance. This is characterized by the minimization of species that can contribute negatively on the molecular level to key electrical properties such as DC conductivity.

This paper will present the outcome from the recent development including an in depth analysis of the key material properties such as DC conductivity which are needed to reach HVDC transmission at extra high voltage level. It was found that the improvement of the chemical cleanliness together with optimization of the material composition resulted in a significant reduction of the DC conductivity. This, in turn, has allowed successful type test qualification at 525kV according to Cigre TB 496 recommendation (for voltages up to 500kV). The material shows, furthermore, various interesting processing benefits, compared to a conventional cross-linkable polyethylene.