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Development of factory-expanded cold-shrinkable joint for EHV XLPE cables

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We have been pursuing the ideal application of one-piece premolded joints to EHV XLPE cables. We studied the quality function deployment of EHV XLPE cable joints and found that factory-expanded cold-shrinkable technology provides an ideal solution for such a joint.

We studied the installation process, interfacial property, insulating property, elastic property, and thermal behavior of the joint, and succeeded in applying cold-shrinkable technology to premolded joints using silicone rubber, which has superior elasticity and good insulating properties. With cold-shrinkable technology, a premolded rubber unit can be shipped expanded onto the carrier pipe. The carrier pipe is made of a plastic string and can be removed easily by hand. The user therefore requires no tools for assembly at the jointing site and simply has to pull out the carrier pipes. The required insulating properties of the rubber unit can be tested in the factory, and the expansion process of rubber unit is carried out in the clean, controlled conditions of the factory. The installation process can thus maintain the high reliability of the insulating properties of the joint.

In a one-piece premolded joint, the interfacial property is important as a guarantee of quality because the insulating property inside the rubber unit can be tested in the factory. Interfacial pressure is an important parameter of the interfacial insulating property. The interfacial pressure between a one-piece premolded joint and the cable insulation is caused by the expansion of the rubber. We therefore studied the interfacial insulating property and elastic property of the rubber and found that silicone rubber gives excellent results in terms of both properties, enabling the rubber unit to be expanded up to 300% and to maintain the expanded state for over one year. Because the rubber unit can be expanded up to 300%, the inside diameter of the carrier pipe can be larger than the cable jacket. The overall size of the joint including a protection box can be minimized, because additional removal of the cable jacket can be avoided. One rubber unit is also applicable to various cable sizes, allowing it to be used to joint cables of different sizes (e.g., 1800 mm^2 – 800 mm^2).

We also studied the insulating properties of the rubber. We carried out AC voltage tests, impulse voltage tests, and long-term tests, and found that the silicone rubber that we had selected possesses excellent electrical properties for cable accessories. The electrical stress of the rubber unit has been optimized by field analysis with respect to deformation of the unit.

We have already completed IEC PQ & type tests up to the 230 kV class without encountering any problems.