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New flexible insulation for medium voltage power cables

Laurence H. Gross and P. J. Caronia
The Dow Chemical Co.; 1 Riverview Drive; Somerset NJ 08873

The electrical and physical characteristics of a new, unfilled, flexible medium voltage insulation compound will be presented. This unique material has been shown in laboratory and full scale cable tests to be a significant advancement in these types of materials.

Previous flexible insulation compounds have always been filled materials, specifically EPRs. These EPR compounds have the disadvantage of high density, large dielectric losses (which account for higher operating costs), the presence of lead, slower extrusion line rates than crosslinked polyethylene, and an inability to view the compound in the hot oil test due to the heavy filler loadings. The new material overcomes all of these problems while still offering outstanding electrical and mechanical test results.

The primary objective for the project was to find a new polyethylene which would ensure a highly flexible insulation compound, excellent water tree retardancy to yield long life cables, low losses to ensure low operating expenses, and rheological characteristics to ensure high speed extrusion characteristics. The new product meets all of these objectives. The goals were met through a combination of reactor and catalyst technologies and specific and critical formulation technologies.

The molecular characterization of the base resin will be presented. The molecular weight distribution helped to define the rheological characteristics of the product and ensured high speed extrusion characteristics. The density of the base resin was selected to yield a greatly reduced flexural modulus to give cables with flexural properties equal to or close to most EPRs. In fact over the temperature range of –20°C to 100°C, the flexural modulus for the new insulation compound is very close to the most flexible MV insulation compounds in the market today.

Although the above mentioned physical characteristics of the compound are important, the truly exceptional electrical properties are the most critical features for any new medium voltage insulation. Accelerated water treeing tests as defined in two test protocols typically used in the USA have been employed to test cables made with the new insulation compound. These tests have afforded information which indicates that this new material is greatly improved over other crosslinkable and EPR insulation compounds.

Data will be presented which shows that the ACLT (Accelerated Cable Life Test) using the standard 4xVo and 90°C conductor temperature conditions with a conventional conductor shield gives life performance of the cable which is a significant improvement over all other materials ever tested. In the AWTT type test (Accelerated Water Treeing Test), the new product yields data out to one year which is directly comparable to the other industrial standard tree retardant insulation compound.

For the dielectric losses, the dissipation factor for the new insulation compound is significantly lower over the ambient to 140°C temperature range than those for the other flexible insulations. This ensures that over the operating temperature range of cables, the new insulation will yield significantly lower operating costs for the entire life of the cable.

In summary, a significant new medium voltage compound has been introduced. The electrical and physical characteristics of the new compound indicate that significant advances in the performance have been made with the new material. Long term testing of the product is continuing.