

A Brief History of EPR Dielectric

Ethylene-propylene rubber was the result of the catalyst development work by Karl Ziegler and Giulio Natta in the 1950's. These types of catalyst allowed the efficient conversion of various olefins to high polymers, chief among them being the co-polymerization of ethylene with propylene. This offered the potential for a true elastomer with far superior chemical and heat stability than had been available previously. A number of polymer manufacturers began development work in this area and by 1962 had commercial offerings. A number of wire and cable companies also recognized the potential advantages that an olefinic elastomer would provide to primary electrical insulation systems and quickly began development work. Commercial EPR insulation compounds were available from a number of wire and cable manufacturers by 1963.

Other advances in material science such as cross-linking via peroxides and surface treated calcined Kaolin combined to deliver rubbery materials that were highly resistant to moisture, stable at high temperatures, and highly resistant to oxidative attack via ozone, O₂ or corona. These potential advantages were quickly realized, and since 1963, EPR has been providing highly reliable medium and low voltage cable insulations for industrial and utility installations. Cables made in the early 1960s continue to operate today with no common failure mechanism in evidence. This 40+ years of service is due to the unique molecular architecture and composite structure of EPR compounds.

On the molecular level, an EPR is a high molecular weight polymer with random coil conformations. The random coil conformation accounts for the rubber like properties, which imparts a high viscosity to the polymers rendering them very resistant to flow at high temperatures. After cross-linking, EPR develops an unmatched thermal stability where field cables have withstood temperatures of 160°C or higher and suffered no ill effects.

EPR insulations are more than co- and ter- EP polymers. They are engineered composites of the polymer and primarily a highly refined Kaolin. Kaolin, a clay mineral, is refined via a multi-step process of washing, chemical modification, classification and various extractions to produce a highly inert and purified particulate mineral in a narrow range of particle sizes. Further processing at high temperatures permanently alters the crystal structure and removes bound hydroxyls and adsorbed water. The particles are then chemically treated to produce a highly hydrophobic surface and provide a mechanism for interaction with the EP polymer. When combined and properly dispersed in the EP polymer, the result is a composite with increased temperature stability, high dielectric strength, resistance to water migration, treeing, corona cutting, ozone attack and degradation by other oxidative mechanisms.