

## **DEVELOPMENT OF CLAYS OR MINERALS AS BACKFILL MATERIALS IN LIGHTNING CONDUCTORS**

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Clays are being identified as one of the most appropriate backfill materials with a low resistivity for lightning conductors. This is mainly due to their high water-retaining ability. The resistivity of clays can even be reduced by introducing salts or any other conductivity-enhancing substances. However, selecting such materials has limitations because decrease in resistivity also relates to an increase in corrosion activity of the copper ground rods, which are used as electrodes of the grounding system. The conductivity of clays and minerals may be due to both electrons and ions. When soil minerals are exposed to water, exchangeable ions go into solution, forming an ionic halo around the particles. These ions contribute to the electrical conduction. Locally available clays and some minerals were investigated in this study to use as backfill materials, focusing their resistivity variations with water and salt contents. As the experiments were to be carried out in the laboratory at room temperature the soil box method was used to measure the resistivity of clay/minerals. The resistivity variations of clays/minerals with water content and salt content were measured in order to identify the most conducting clay or the mineral at particular water contents and particular salt contents. Copper sulphate, battery carbon, activated carbon and polyaniline were added to clay/minerals as the conductivity-enhancing materials. Those materials were of interest due to their high conductivity and less corrosive activity with copper ground rods. The water retention ability of clays and minerals were also studied by weighing the mass of clay-water mixture at different time intervals.

X-Ray Diffraction (XRD) patterns were obtained in order to identify the mineral groups present in the clay. Molecular structures and ionic migration of clay groups were also taken into consideration because they have a noticeable influence in water retainability, swelling ability and conductivity of clays.

All the clays and minerals used in this study showed their lowest resistivity at higher water contents (above 40 %) and when they were mixed with polyaniline. Except china clay and Kegalle pottery (red) clay, all the other clays and minerals showed their minimum resistivities below 3  $\Omega$  m. Being an electronically conducting polymer, polyaniline (PANI) contributes to electronic conductivity for the clay-polymer composite materials. It has been observed that the lowest resistivity, comparable with commercially available gemco gel, showed in bentonite clay containing polyaniline. Bentonite clay particles are fine grained and thin layered and also contain easily exchangeable ions. Among the local clays and minerals used in this study, laterite showed lower resistivity at lower water contents (below 30 %), but higher resistivity at higher water contents (above 30 %) than ball clay. The overall results of this study explain that the particle size, water layers, salts present and their ability of exchange in clay and minerals are the predominant factors influencing their conductivity.