Soil Treatments - Earth Enhancing Compounds

Selection and Testing

Earth enhancing compound are conductive compounds to provide low resistance of an earth termination system. These compounds are used to fill the augured hole of a vertical earth electrode or the surroundings of horizontal electrode.

It was a practice in India to apply a combination of salt and charcoal surrounding the earth electrode or to fill the augured hole to achieve low earth resistance value. This method used to provide low resistance earth, but for short time. This salt leach to the surrounding soil and disappear after a rainy season, significantly increasing the resistance value after the rain. Salt is also the reason for corrosion. As a result this combination of salt and charcoal provide only short term results, but brings long term trouble.

Part 7 of IEC 62561 deals with the requirements and tests for earthing enhancing compounds as a part of lightning protection system components (LPSC). The compound need to be used along with the electrode tested according to IEC 62561 part 2

Earthing enhancing compounds shall be so designed and constructed that in normal use, their performance is reliable and without causing hazard to persons and the surrounding. The choice of material depends on its ability to match the particular application requirements. As improper material can create long term problems in soil, it is highly recommended to use tested compounds. To confirm the standard, following tests are recommended

Leaching

The leaching test performed according to the relevant national standard for Fe (iron), Cu (copper), Zn (zinc), Ni (nickel), Cd (cadmium), Co (cobalt) Pb (lead). All these leachable ions shall be with in the limits set by the national regulation.

Sulphur determination

A test for the determination of sulphur shall be performed according to ISO 689-3 or ISO 14869-1 and the adapted analysis instrumentation (ICP-OES, ICP-AES or other ICP Methods). The material is deemed to have passed the test, if all measured values are less than 2 %. The recorded value resulting from this test shall be indicated in the product documentation.

Determination of resistivity

The four–electrode method is used to measure the resistivity of earth enhancing compounds as described in ASTM G57-06.

Three samples of the earth enhancement material shall be tested in a four-electrode soil box. With the four-electrode method, a voltage is impressed on the outer electrodes which causes current to flow. The resulting voltage drop between the inner electrodes is measured using a voltmeter and the resulting resistance is calculated. The resistance of the material can also be measured directly.

The resistance of each earthing enhancing compound sample is converted to resistivity value using the following formula:

$$\rho = \frac{R \times A}{a}$$

where

ρ is the sample resistivity (Ω cm);

R is the resistance (Ω);

A is the cross sectional area of the container perpendicular to the current flow (cm2) ;

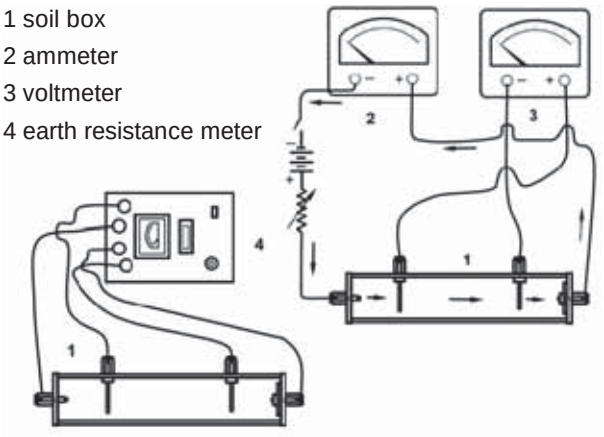
a is the inner electrode spacing, measured from inner edges of electrodes (cm).

1 soil box

2 ammeter

3 voltmeter

4 earth resistance meter



The specimens are deemed to have passed the test if the obtained resistivity value from the three samples are less than or equals to the resistivity value claimed by the manufacturer.

Corrosion tests

This test method covers the procedure for determining the corrosiveness of materials used as earth enhancement compounds. The corrosion rate is determined by using potentio dynamic polarization resistance methods as outlined in ASTM G59-97 and ASTM G102-89. The resulting open circuit potential polarization curves will be used to determine the Tafel curves and polarization resistance. The significance of the test is important because earth enhancement materials have to be physically and chemically inert with the earth electrodes in order to avoid damage to the earthing electrode due to corrosion.

Passing criteria

For copper-plated earth electrodes, the polarization resistance shall be > 4 Ω × m2 for non-aggressive environments and > 8 Ω × m2 for aggressive environments.

For galvanized earth electrodes, the polarization resistance shall be > 3 Ω × m2 for nonaggressive environments and > 7,6 Ω × m2 for aggressive environments.

In addition to the tests prescribed in IEC 62561-7 additional tests such as TCLP can be conducted to ensure that the earth enhancing material do not contain any Toxic materials

Toxicity characteristic leaching procedure (TCLP) is a soil sample extraction method for chemical analysis employed as an analytical method to simulate leaching in soil. The testing methodology is used to determine if a material is characteristically hazardous.

Conclusion

Tested and certified earth enhancement material improves the contact resistance and protect the electrode from corrosion, thereby maintaining a low earth resistance which is constant for a long period.

In recent years, Indian market is crowded with earthing suppliers who claim to offer maintenance free very low earth resistance value irrespective of soil resistivity. The claimed feature being an earth resistance value of about 1 ohm with the help of a magic compound filled inside the augured hole. There is no scientific or practical evidence for this baseless claim. These compounds if not tested and certified as per the standard will soil the surrounding soil as well and are hazardous in nature. ■

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