Technical Bulletin – Bentonite

1) Overview

Bentonite is a moisture retaining clay consisting largely of sodium montmorillonite, which when mixed with water swells to many times its dry volume. Its main advantage as far as earthing is concerned, is that it has the ability to hold its moisture content for a considerable period of time and to absorb moisture from the surrounding soil.

2) Application

Bentonite moisture retaining clay may be used to reduce the contact resistance and increase the effective size of earth electrodes. e.g. as a backfill for earth rods installed in drilled holes or as a layer encapsulating horizontal earth conductors buried in a trench.

It has been used for many years as an earth electrode backfill to help reduce an earth electrodes’ resistance to earth by retaining moisture in the immediate vicinity of the earth rod. It also has the added advantage of making intimate contact with the electrode and the surrounding soil, thus helping to protect the electrode from corrosion.

Bentonite will absorb up to five times its weight in water and swell to thirteen times its dry volume. At six times its dry volume it is a very dense, pasty clay that can hold its own shape and will adhere to any surface it touches. These two characteristics solve the compaction and soil to rod contact problems.

Bentonite hydrates chemically, holding water in its structure. The material is a natural clay formed years ago by volcanic action. It is non-corrosive, stable and will not change characteristics as time elapses.

The resistivity of Bentonite varies from about 3ρm upwards depending on its moisture content (BS7430 clause 8.5)

3) Mixing Procedure

The expansion of Bentonite depends very much on how much water it is mixed with. As a rule of thumb, we assume an expansion ratio of 2:1.

1 x 25kg bag = 1cu ft or 0.0283m³ (dry)

= 2cu ft or 0.0566m³ (wet)

Example:

To backfill 10 no. Earth rods in 3.6m deep, 0.1m diameter boreholes will require the following quantity of Bentonite:

Volume of boreholes = 10 x π r² x h

= 10 x π x 0.05² x 3.6

= 0.28m³

Number of Bags = 0.28 / 0.0566

= 5 bags
4) Installation Procedure - Borehole

For the installation of a rod in a borehole the following procedure is recommended. See **figure 1**.

1. Bore / auger a hole at the desired rod location of 75 - 100mm (3 - 4 inches) diameter. The depth of the borehole should be determined by the designer of the earthing system.

2. Insert the earth rod into the borehole. Ensure that the top of the earth rod is at the correct level for it connection.

3. Backfill the borehole with a Bentonite slurry. Regular agitation of the earth rod should ensure that no voids are formed within the backfill.

4. Remove any standing water from the top of the borehole

5. Make final inspection to the earth rod and make good i.e. Fit an inspection chamber.

5) Installation Procedure - Trench

For the installation of a rod in a trench the following procedure is recommended. See **figure 2**.

1. Dig a trench at the desired strip electrode location of 200 - 300mm (8 -12 inches) wide. The depth of the trench (typically 600mm) should be determined by the designer of the earthing system.

2. Cover the bottom of the trench with a stiff mix of Bentonite 25 - 50mm (1 - 2 inches) thick. Lay the earth strip into the trench. Ensure that the strip electrode is not depressed too far into the Bentonite.

3. Apply another layer of Bentonite 25 - 50mm (1 - 2 inches) thick. Ensure that the strip electrode is fully covered.

4. Carefully backfill and compact the remainder of the trench