THE ELECTROCHEMICAL STUDY OF THE FACTORS AFFECTING UNDERGROUND CORROSION.

Daniel Isaiah Nthurima

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SUMMARY

An electrochemical study of some of the factors affecting the corrosion of steel in soils has been carried out. The factors studied were oxygen diffusion rates, soil moisture content, soil resistivity, salt concentrations, pH and bacteria activity. The soils studied ranged from pure sand, clayeous sand, clay and peat, obtained from different places in Trondheim. The corrosion rates of steel were determined by means of polarization and weight loss measurements.

The presence and rate of transport of oxygen in a soil appears to be the most important factor. The corrosion rate of steel in soils studied, like in many neutral electrolytes is determined by the dissolved oxygen content available at the surface of the metal, and any factor affecting diffusion of oxygen has been found to have a marked effect on the corrosion rate. Unequal distribution of oxygen occurred in dry or porous soils where a nonuniform condition of the soil aggregate existed and in soils of varying moisture and salt contents. Such conditions have been found to give rise to local galvanic action on buried steel specimens.

In most soils, the maximum rate of corrosion has been found to occur when the soil was moist rather than wet or saturated and when the salt concentration was low rather than high. The cathodic oxygen reduction has been found to be highest when soils (ranging from pure sand to clay) contained between 15 and 30% moisture. This coincided with the point of maximum corrosion rate, implying that the oxygen reduction was the corrosion rate determining reaction.

In peat soil, the maximum cathodic activity occurred when there was 80% moisture. The rate of corrosion of steel decreased in saturated or "salty" soils because of the limited supply of oxygen.

The increase in salt content results in a decrease in electrical resistivity and the oxygen diffusion rates. It has been found that in increasing the salt content of the soil, the corrosion rate increased up to a point, after which it dropped, probably due to reducing of the oxygen availability. The study reveals that it is not possible to categorize soils into aggressive and non aggressive based on analysis of the individual properties.

The long term laboratory measurements reveal high increase in corrosion rate with time in soils where one has bacterial activity. This takes place when all the oxygen previously present in soils has been used up.

Direct observations of probes placed in soils in the field have shown that the highest corrosion was concentrated on the upper part of the specimen. This can be attributed to differential aeration. Bacteria corrosion was observed to have taken place in the part which was deepest in the soil. Even in peat soils with a pH of 4.6, the rate of corrosion did not depend on the acidity of the soil but was wholly determined by the rate of oxygen penetration.