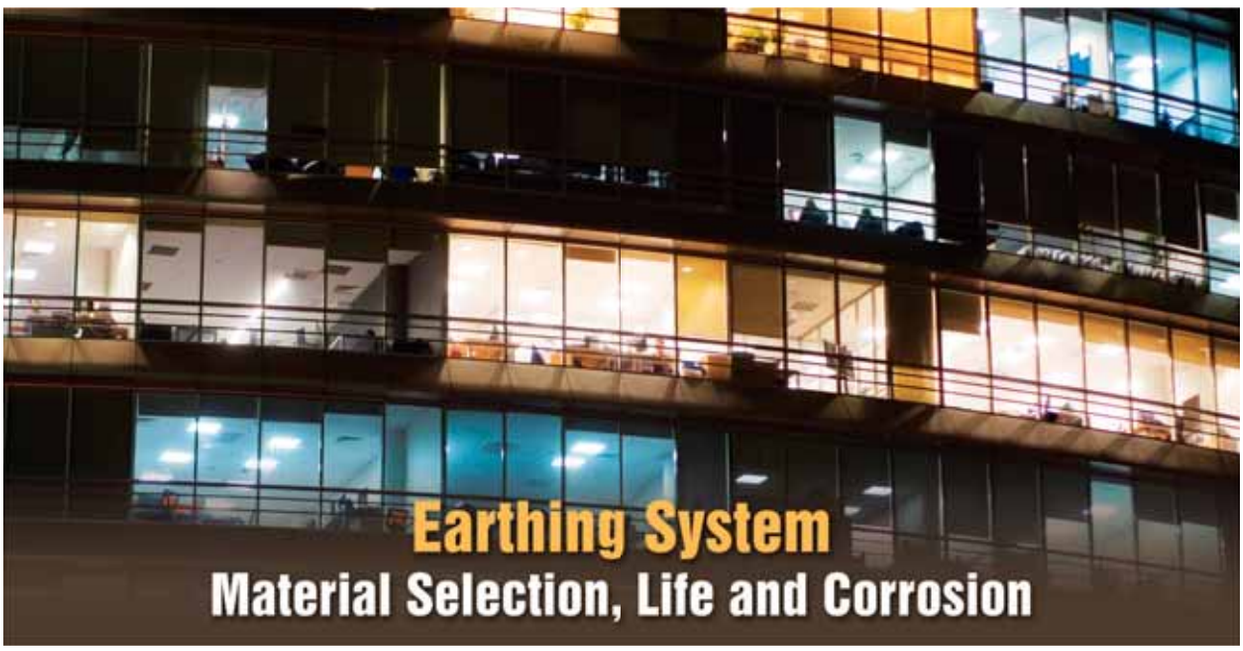

An ideal earthing system especially the earth electrodes shall offer long life almost equal to the life of a building or at least 30 to 40 years. But often the system degrades and need maintenance, replacement or improvement. In general maintenance of earthing is a difficult task for the engineer especially in an industrial and commercial installation. In most of the cases corrosion is the main reason for deterioration of earthing system.

IS 3043-Code practice of earthing explains: The possibility on damage to cables and other underground services and structural metalwork in the vicinity of earth-electrode due to electrolytic action between dissimilar materials should not be overlooked when the material for earth-electrodes is selected. Materials compatible with other metal structures in the vicinity should be selected or other remedial action taken

IS 62305 – 3 elaborates the subject as: It should also be remembered that reinforcing steel rods in concrete generate the same magnitude of galvanic potential as copper conductors in soil. A further problem arises from electrochemical corrosion due to galvanic currents. Therefore, when steel in concrete is connected to steel in soil, a driving galvanic voltage of approximately 1 V causes a corrosion current to flow through the soil and the wet concrete dissolve steel in soil. Earth electrodes in soil should use copper, copper coated steel or stainless steel conductors where these are connected to steel in concrete.

Earth electrodes in a large building consists of vertical and horizontal conductors interconnected, foundation steel, buried pipes etc. It is a common practice in India to use Copper for some application (eg transformer neutral) and GI for other (eg transformer body). Often these electrodes are interconnected. Due to the awareness of bimetallic corrosion the interconnections are made with BI-Metals. But the corrosion due to galvanic effect is never considered or neglected due to un awareness

Corrosion is an electrochemical process in which one metal corrodes preferentially to another when both metals are in electrical contact, in the presence of an electrolyte.

Metals and alloys have different electrode potentials, and when two or more come into contact in an electrolyte, one metal acts as anode and the other as cathode. The electro potential difference between the dissimilar metals is the driving force for an accelerated attack on the anode member of the galvanic couple. The anode metal dissolves into the electrolyte, and deposit collects on the cathodic metal.

Electro Potential of metals (Anodic Index) as per DIN VDE 0151 / 06.86	
Copper, solid or plated	0.0 to - 0.1 V
Steel in concrete	- 0.1 to - 0.4 V
Hot-dip, galvanized steel (GI)	- 0.9 to - 1.1 V

From the chart it is clear that Copper surface is cathodic in nature, where as GI is anodic. GI dissolves (or corrodes and disappear) after some time if it is in contact with copper. Steel inside concrete foundation is also cathodic like copper. Hence corrosion of GI happen due to steel in foundation. Galvanic corrosion is one of the main reason for deterioration of GI earth electrodes reducing the life, which need frequent maintenance or replacement.

The corrosion due to electrolytic action is well know for decades. Often sacrificial anodes are installed to protect buried steel electrodes.

IS/IEC 62305 further explains: The behavior of a galvanized layer on steel in concrete is very complicated, particularly in concrete with chlorides, the zinc will corrode quickly on contact with the reinforcement, and can under certain conditions cause damage to the concrete. Galvanized steel should therefore not be used in coastal areas and where there may be salt in the ground water. As the use of galvanized steel in concrete requires evaluation of many external factors this material should be used only after careful analysis.

New generation International standards recommend to use an isolation device such as a spark gap to connect GI earth electrodes with other metals and foundation to avoid galvanic corrosion. How ever the use of such spark gap devices will isolate the GI electrode and increases the effective Earth resistance.

Further evaluation of the explanations in Indian standards such as IS 3043 as well as IS/IEC 62305 provide the following conclusions

- Use of GI in concrete need careful analysis. Don't use GI in concrete in place where salt water is present in soil. Zinc coating in GI can damage concrete.
- GI in soil will corrode due to steel inside concrete
- GI in soil will corrode if material of copper surface is used together
- Copper, SS or copper coated steel are recommended by IS/IEC 62305 to avoid galvanic corrosion and for long life

Out of these 3 recommended materials, copper is expensive but its strength is less compared to steel, SS is less expensive than copper, but it is very difficult to work due to high tensile strength. Copper coated material is cheaper compared to copper and SS. Copper coated steel is stronger than copper and its corrosion resistance is almost equal to copper. This is the reason copper coated materials are widely accepted now a days in the industry.

Conclusion

GI (Galvanised steel) earth electrode both in soil as well as in concrete corrodes due to galvanic effect, hence the life is limited and it need maintenance.

Copper Coated Steel is used as earth electrode for long life & maintenance free installation ■

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