TECHNICAL BULLETIN CGL-01

The MITIGATOR™ vs. Bare Copper Cable

The MATCOR MITIGATOR™ represents the first engineered packaged copper grounding system designed for use in AC Mitigation applications. In this technical bulletin we discuss the advantages of the MITIGATOR™ as opposed to bare copper cable.

ENHANCED GROUND RESISTANCE/CONTACT

Bare AWG 2/0 cable has a nominal diameter of 0.365 inches while the MATCOR MITIGATOR™ has a nominal diameter of 1.5 inches. This represents an increased surface area in excess of 400% using the MITIGATOR™. For typical AC Mitigation applications, the gradient control wire (the technical term for a long grounding line parallel to the pipeline) length is typically quite long and as such the wire resistance to ground is quite low. There are a variety of modeling techniques that can be applied to estimate the resistance to ground; however, in all cases the length is a significant factor with the wire radius being less of a significant factor.

Using Dwight's equation, as an example, the difference in resistance from a 1.5" diameter MITIGATOR™ to a bare 2/0 cable results in a difference of approximately 18%. Of course all of these models are based on good intimate contact between the soil and the conductor. This is where the enhanced surface area provides an additional benefit over bare copper – the large surface area helps to ensure a more thorough contact – particularly in higher resistivity soils that might have issues with soil shrinkage, extreme drying and cracking, etc… But it is probably safe to say that for AC Mitigation applications, the improvement in resistance is on the order of 15-20%

COPPER CORROSION INHIBITOR

More importantly, the use of the enhanced grounding backfill provides a highly conductive, corrosion inhibited material encapsulated around the copper cable to protect it from soil environments that might be corrosive. Bare copper in many soils is relatively inert due to the formation of a passive copper oxide (Cu_2O.) Unfortunately, for many AC mitigation applications, the areas most at risk are also the areas that might be susceptible to copper corrosion including low soil resistivity environments, long cross country pipelines in agricultural areas where ammonia based fertilizers are prevalent, marshy/wet areas with considerable water and chlorides, etc…

Published studies clearly establish that the underground corrosion of copper is unusually complicated. In general, corrosion cannot be directly related to any one or even several factors, as many interrelated soil conditions are involved. The published data presented in various studies and permit some tentative conclusions regarding the corrosion of copper in underground environments. These include:

- Corrosion is often associated with a combination of elevated sulfate or chloride content in the soil in conjunction with poor drainage, a soil having considerable capacity to hold moisture, and a moderate to heavy annual rainfall.
- Elevated concentrations of sulfate or chloride or both in the soil are probably the primary factor in the underground corrosion process, but considerable moisture is required to support the

electrochemical action. The sulfates and chlorides may not adversely affect the copper if the rainfall is slight and drainage is adequate.

- Very low soil resistivity (i.e., less than 100-500 ohm-cm) generally indicates a soil that could be aggressive.
- Soils containing large quantities of organic matter (particularly soils containing organic acids) can be corrosive
- Soils such as clay, sand, gravel, loam, and chalk seldom possess the combination of properties that are associated with corrosion
- Organic soils supporting active anaerobic bacteria (i.e., sulfate-reducing species) can produce sulfides, which are aggressive to copper
- Soils containing inorganic acids can be unusually aggressive to copper
- Soils containing appreciable amounts of ammonia compounds, common in most fertilizers, are usually corrosive to copper

EASE OF INSTALLATION

Many operating companies have used an enhanced grounding backfill around bare copper cable for their AC Mitigation installations. The MITIGATOR™ provides all off the benefits that are derived from the use of the enhanced backfill, while eliminating the time consuming installation task of pouring a layer of backfill, installing the bare copper, and then pouring additional backfill. The MITIGATOR™ can be installed in a conventional trench; cable plowed or pulled through a directional bore.