

OVERVIEW

This technical note describes the causes of aluminum discoloration, water staining, and corrosion, and makes recommendations for the methods of handling and storage which will minimize these effects.

BACKGROUND

Aluminum Oxide

Aluminum is one of the most chemically active elements and has a strong affinity for oxygen. However, the presence of oxygen is what makes aluminum so widely used. Unprotected in almost every common environmental situation, a newly produced aluminum surface reacts almost immediately with oxygen, forming a thin oxide layer which effectively protects the pure surface from further oxidation and from the effects of many forms of chemical activity.

The oxide coating tightly adheres to the aluminum in a very thin, transparent coating which is hard and relatively stable. Generally, the oxide is unaffected by chemicals in the range of pH 4.5 to 8.5 but is susceptible to concentrated acids and alkalis.

Discoloration From Oxides

The corrosion of any material can be broadly defined as the destruction or deterioration of a material due to a reaction with its environment. This takes different forms depending on the nature of a material. For aluminum, corrosion generally takes the form of a reaction with the atmosphere and aqueous solutions.

Water is the third most common component of the atmosphere. Water may be in solid form (ice, snow), liquid form (rain) and in the form of humidity (vapor). Aqueous corrosion is an electrochemical relation in which liquid water is the key ingredient of the electrolyte necessary for the corrosion process.

Water dissolves different materials from the gases and solid particulate matter present in the atmosphere. When it falls on a metal surface or condenses on it, that surface becomes coated with what could be a strong electrolyte depending on proximity to coastal areas, industrial processes or a weaker electrolyte if in more rural areas. As an oxidation reaction occurs corrosion progresses and the metal surface is discolored, stained or corroded by the formation of oxides.

COAXIAL CABLE WATER STAINING, DISCOLORATION AND CORROSION

Aerial Cable

Except for areas near the coast or with significant pollutants, bare aluminum coaxial cables have been aerially installed for years with no reported operational problems caused by oxidation or corrosion. Jacketed cables are used in underground applications and where there is close proximity to coastal areas and areas of heavy industrialization. In normal exposed environments the aluminum surface does not experience atmospheric related problems if the surface is naturally washed clean of any potential electrolyte or contaminant. Aluminum's natural resistance to corrosion also offers protection. However, if the aluminum surface is covered and free air movement is restricted, contaminants may accumulate in a concentrated manner and electrolytic corrosion is accelerated.

Sheltered Corrosion

Sheltered corrosion of this type has been observed on coaxial cable which has been stored for a period of time while still tightly enclosed in the shipping wrapper. Although outdoor storage will certainly aggravate the situation, this type of corrosion starts as moisture, condenses on the aluminum surface under the wrapper and is not free to dry out. In the presence of high humidity the surface temperature of wrapped cable can be lower than the dew point temperature. Vapor will begin to condense, leaving the surfaces of the aluminum under the wrapper covered with condensation (aqueous electrolyte).

The resulting electrochemical action on the aluminum takes the form of shallow pits which generally do not degrade mechanical properties. With time, the luster of the aluminum surface will fade as it roughens and is covered with a gray layer of these corrosion products.

PREVENTION

The Aluminum Association, 818 Connecticut Avenue, N.W., Washington, D.C. 20006 has available a publication entitled "Guidelines for Minimizing Water Staining of Aluminum" in which they set forth some guidelines for the handling and storage of aluminum products. These guidelines are applicable for the loading, storage and movement of aluminum materials where particular care and attention can be given to the prevention of condensation by controlling conditions of temperature and humidity.

For the storage of coaxial cable, water and condensation may cause staining, discoloration or corrosion under certain conditions, and it is recommended that cable be stored in a dry location if at all possible. To minimize condensation and staining, discoloration or corrosion, allow air to flow into and through the area under the reel wrapper by removing part of the wrapper such as the test port and allow the cable under the wrapper to come into closer temperature and relative humidity equilibrium with the surrounding air. If using outdoor storage, position the opened portion of the wrapper so that the opening will not collect water.