ENGINEERING

Checking Metal Corrosion

➤ THE POOLING of knowledge on metal corrosion and its prevention, gained from scientific research by many men in various parts of the world, is responsible for modern methods now widely applied to give metals in use longer life, the UNSCCUR will be told at its Lake Success meeting this summer by F. L. LaQue of the International Nickel Company, New York. This is the international United Nations Scientific Conference on the Conservation and Utilization of Resources.

The most effective means of preventing corrosion, not including the use of protective coatings such as grease, paint and zinc, will be reviewed by him. They include humidity control, de-aeration, the use of inhibitors, cathodic protection, design and the use of alloying materials.

Since practically all common corrosion processes require the presence of water, or water vapor, it is possible to prevent corrosion by eliminating water, he will say. It has been established that when the relative humidity is kept below 30% corrosion will be negligible. The control of humidity in large spaces can be accomplished by the use of air-conditioning equipment. With packaged apparatus, the air within can be kept dry with the use of a suitable moisture-absorbing substance such as silica gel. When the package is a metal container, the inside air can be replaced with an inert gas such as nitrogen.

De-aeration, or deaeration, includes the removal of atmospheric or other oxygen from the environment. Oxygen plays a part in much corrosion. An example of the application of this process is in the use of a deaerator in the treatment of boiler feed water. It is possible to reduce the oxygen content of water below 0.01 part per million, he will state. Deaeration has also been applied successfully to the prevention of corrosion of steel pipe lines used to carry otherwise corrosive water for long distances.

Inhibitors are defined by him as compounds that stifle either the anodic or cathodic portions of the normal corrosion reaction, or both. Most inhibitors function as chemically or physically absorbed films which either alter the electrochemical characteristics of the metal, or serve as mechanical barriers to the normal corrosion processes. The reaction of various chemical inhibitors will be described by Mr. LaQue.

Cathodic protection, first used in 1824 by Sir Humphrey Davy, is one of the most effective means of preventing or arresting corrosion. It is based on the principle that most corrosion of practical importance is electrochemical in nature and results from the flow of current through an electrolyte between areas of different potential which may exist on the surface of a single metal or between two or more different metals. The solution is to bring all surfaces to the same potential.

This can be accomplished in most cases by introducing a current to offset the one produced by the difference in potential. In Mr. LaQue's language, "by discharging current on the more noble (cathodic) surfaces so as to achieve their cathodic polarization to the potential of the adjacent anodes." By far the most important application of cathodic protection has been in connection with the thousands of miles of underground oil, gas and water pipe lines, and power and communication cables.

Good design for metal structures avoids crevices favorable to corrosive action, or to galvanic action that could cause corrosion. It is bad practice, according to Mr. LaQue, to use threaded connections between dissimilar metals; brazed or welded points are much better.

One of the most effective means of increasing the durability of the elemental metals is to combine them in alloys or to control their minor constituents so as to achieve the corrosion-resisting properties desired. Stainless steel is the most spectacular example. Iron alloyed with chromium and nickel, sometimes supplemented with molybdenum, columbium, titanium, silicon, copper or tungsten added for specific purposes, may have its ability to resist corrosion increased 100,000 times that of ordinary iron.

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