

Dielectric Fitting

Introduction

Corrosion is a maintenance issue that impacts many industries. Metal corrosion can affect a variety of industrial components, including construction materials, various types of industrial equipment, and utility piping. The HVAC and plumbing industries often deal with a specific type of corrosion known as galvanic corrosion, which can damage piping when proper measures aren't taken. However, by utilizing preventative measures like dielectric fittings and diligently employing detection methods, professionals in these industries can significantly reduce the extent and cost of galvanic corrosion.

Basic Corrosion Principles

Metal corrosion is an alteration of a metal by either a conventional chemical attack or by galvanic reaction. Atmospheric corrosion is a common example of a chemical attack: the variety of chemicals in the atmosphere like oxygen, chlorine compounds, carbon dioxide, sulfur, and water vapor corrode metals exposed to them, as seen in Figure 1. Galvanic corrosion, on the other hand, can only occur when a ferrous metal is connected to a non-ferrous metal. Ferrous metals, like black steel, malleable iron, cast iron, stainless steel, and galvanized steel, contain iron. Non-ferrous metals, like copper, brass, aluminum, and bronze, do not. The types of metals involved is not the only criteria for galvanic corrosion, though; all three (3) of the conditions listed below must be present for a reaction to occur:

- Metals with dissimilar electrochemical characteristics.
- Direct electrical contact (actual physical contact) between the metals.
- An electrolyte in contact with the metals.

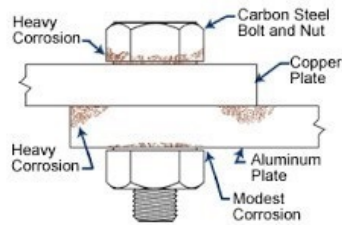


Figure 1 Chemical Attack Corrosion

Figure 2, Anatomy of a Common Dielectric Union, shows a type of fitting used to keep the appropriate conditions for galvanic reaction from arising to prevent corrosion. The intensity and speed of galvanic corrosion can be driven by the following factors:

- Potential difference between materials.
- Cathode efficiency.
- Surface areas of connected materials.
- Electrical resistance of the connection between the materials and of the electrolyte.

As indicated earlier, galvanic corrosion is the result of electrochemical corrosion that occurs when two dissimilar metals come into contact while in the presence of an electrolyte, forming an electrical couple or galvanic couple. The higher the cationic characteristics (the holding capacity for positively-charged elements) of the metal in relation to the other contacting metal, the less likelihood of corrosion there is.

Corrosion Detection

Galvanic corrosion can be detected using galvanic sensors or just plain visual inspection. The galvanic sensor system is normally used for detecting the corrosion damage of steel embedded in concrete structures, as well as for metal used in power lines, conditions that are very difficult to verify with the naked eye. However, if visual inspection can be performed, it is the simplest method for corrosion detection; the corrosion back in Figure 1, for instance, is

easily visually detectable.

Although visual inspections are generally effective, sometimes hidden galvanic corrosion may be taking place. A good example is piping: typical hidden corrosion can be found inside of a pipe that is showing normal

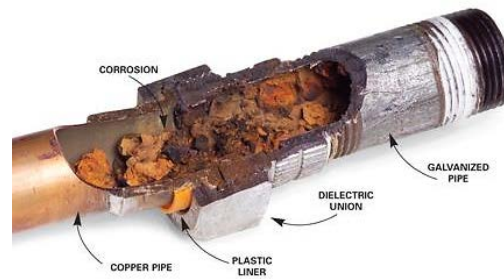


Figure 3 Galvanic Corrosion

physical conditions on the outside. A graphic example of such conditions is shown in Figure 3, where a dielectric union was used. Although dielectric unions are commonly used as a galvanic break, these fittings can leak under certain circumstances, meeting the three (3) conditions described previously that are necessary for galvanic corrosion to occur. Visual inspections can be further impaired when piping insulation is used. When insulation is removed from piping or equipment, moisture may penetrate under the insulation, creating conditions for corrosion to occur; however, because the corrosion is beneath the insulation, it isn't detectable by visual inspection and can be easily missed.

Prevention

It's important to select the most appropriate dielectric fitting based on the ferrous and non-ferrous metals and the electrolyte (fluid) or atmosphere exposure. Piping location, vibration, and movement should also be considered, especially for the installation of dielectric fittings on continuous sections of the piping. Welding of piping should be performed prior to installing dielectric fittings, as heat can damage the isolating component or sleeve of the fitting.



Figure 4 Flange Dielectric Fitting

When using dielectric flanges, like the one in Figure 4, it's important that all components are completely separated with gaskets to avoid any possible contact between dissimilar materials. Such flanges should be fitted with plastic sleeves through the joint bolt holes and bolt gaskets, and considerations should be made when tightening the bolts, as bolts gaskets can shift or split in the process, creating a condition for corrosion. All these factors help to reduce the chance of leakage leading to corrosion.

References for Further Reading

1. <https://pdhonline.com/courses/s118/s118content.pdf>
2. <https://www.corrosionpedia.com/definition/568/galvanic-corrosion>
3. <https://opp.psu.edu/sites/opp/files/3.pdf>