

# Corrosion Basics

*Understanding the basic principles and causes of corrosion*

## Special Considerations When Using Inhibitors

### Safety Precautions

**A**n inhibitor is a substance that slows down a chemical reaction (in the present context, a corrosion reaction). Corrosion inhibitors are commonly added in small amounts, either continuously or intermittently, to control serious corrosion in aggressive environments such as acids, cooling waters, and steam. While they can be highly effective, many inhibitors are also toxic, particularly in the concentrations suitable for shipping and storage. It is important to employ precautions to ensure personnel safety, environmental protection, and uninterrupted operation of equipment.

### Handling

Toxic effects of inhibitors must be considered in processes where the compounds may be inhaled or contacted. Extreme care must be taken to avoid the use of toxic compounds in or near equipment that processes food or beverages and in potable water supplies.

When inhibitor solutions are prepared for injection, care should be taken to follow label instructions regarding skin

contact, eye contact, ingestion, and inhalation. All safety information labels should be carefully studied before opening containers of inhibitors. It is essential to confirm the availability of appropriate safety equipment (e.g., for flushing eyes and skin), to establish familiarity with emergency procedures (e.g., whether to induce vomiting in case of ingestion), and to provide contact information for medical and other emergency personnel.

### Disposal

Because a number of inhibitors contain ions and compounds that may be toxic, it is often difficult to dispose of inhibited fluids that are drained, dumped, or leaked from systems. Chromates are a prime example of this problem. In fact, the use of chromate-containing inhibitors has been severely reduced in recent years because of this disposal problem. Disposal must be considered during the inhibitor selection process.

### Foaming

The formation of foam can significantly reduce the efficiency of heat transfer in a fluid system. The most appropriate action to take in avoiding difficulty from foaming is to determine where foam-forming conditions exist in the system. These will consist of places where the inhibitor-containing fluid is agitated with a gas, such as in a gas separator, in a countercurrent stripper, or in an aerator. The next step is to obtain a sample of the fluid and gas from the process, add the inhibitor being considered, adjust the temperature to match the process step, and shake vigorously. If this test produces stable foam, a potential problem exists. There are three alternative remedies:

- An antifoaming agent may be added (this must be tested also).

- Tests can be made to select an inhibitor that does not cause foaming.

- The system can be shut down periodically and treated with a slug of persistent inhibitor.

The last two remedies are the least palatable because a suitable substitute inhibitor may be difficult to identify, and there are few processes that can be shut down with sufficient frequency to maintain effective inhibition by slug treatment.

### Emulsions

Emulsions are similar to foams in that they consist of one phase dispersed in another. Whereas foams are composed of a gas and a liquid phase, emulsions consist of two liquid phases that will not mix. The separation of these liquid phases is sometimes the primary objective of the process, as with crude oil and water. Conditions favorable to emulsion formation are the presence of two liquid phases, agitation, and an emulsion stabilizer. In this case, the corrosion inhibitor may behave as an emulsion stabilizer, so the procedure is to shake the two liquid phases with and without inhibitor and compare the times required for them to separate. If the time required for the separation is longer in the presence of the inhibitor than in its absence, the inhibitor is an emulsion stabilizer. The available remedies are similar to those for foams: add a demulsifier, use another inhibitor that offers superior test results, or inhibit with slugs during shutdown.

**This article is adapted by MP Editorial Advisory Board Member Norm Moriber from *Corrosion Basics—An Introduction, Second Edition*, Pierre R. Roberge, ed. (Houston, TX: NACE International, 2006), pp. 551-553. MP**