Corrosion Basics
Understanding the basic principles and causes of corrosion

Corrosion Testing and Monitoring in Manufacturing Plants

Metals and their alloys are used in a multitude of changing conditions, and corrosion failures are not uncommon. The limited predictability of metal performance is the main reason why corrosion tests and corrosion-monitoring programs are so important. Properly conducted, these tests can provide significant savings. In many cases, they are built-in requirements.

Corrosion can lead to failures in plant infrastructure and machines that can be costly in terms of repair, lost or contaminated product, environmental damage, and, ultimately, personnel safety. Decisions regarding the future integrity of a structure or its components depend entirely upon an accurate assessment of the conditions affecting corrosion and the rate of deterioration.

Proper assessment of corrosion risk is the foundation of material selection. This aspect of component design can avoid using materials under unsuitable conditions or using a more expensive material than is required. Accurate evaluation of environments and service conditions, together with corrosion resistance of alloys, may also lead to the development of new materials that perform more economically, efficiently, durably, or safely than commonly used materials. Quality-control corrosion tests are also a means of ensuring that the materials have the capabilities expected of them.

Corrosion-testing programs can be relatively simple, able to be completed in a few minutes or hours; or they can be complex, requiring the combined work of a number of investigators over a period of weeks, months, or years.

Because the process of corrosion is highly time-dependent, the integration of corrosion-monitoring technology in existing systems can also provide early warning of costly corrosion damage and provide information on locations where damage is occurring or possibly could occur.

Corrosion Testing
Corrosion tests are divided into two broad categories: (a) tests made in the laboratory under controlled conditions and (b) tests made in the field under natural or service conditions.

Laboratory Controlled Tests
Tests in the laboratory are made with pure chemicals, or specific combinations of chemicals, under closely controlled conditions. Each test should be reproducible under a fixed set of conditions and durations. An assessment of this reproducibility is especially important when a new test method is used or when a new alloy or fabricated item is evaluated. If reproducible conditions can be achieved, then differences in data truly reflect a difference in the resistance to corrosion of the materials being tested and the investigator knows if an improvement has been made.

Laboratory tests provide indications of what can happen in actual practice; however, the time required for an “indication” depends on the purpose and nature of the tests. Laboratory corrosion tests generally are conducted over a period of time ranging from a few minutes to as long as a year or more. Experimental accelerators, such as increased temperature or higher concentrations of chemicals, must be interpreted with great care because they may change the fundamental corrosion behavior being investigated.

Field Tests
Field tests can be much closer to end use than the usual laboratory tests and normally range in duration from several months to many years. Some tests have been conducted for more than 50 years at well-established outdoor facilities. Field tests may consist of exposure to corrosive conditions in natural environments, particular industrial applications, and particular substances.

Corrosion tests may be further subdivided according to their basic objectives, which in turn depend on the types of environments and test durations that interest an investigator. It is always critical to follow the scientific method, which often requires a large series of tests with a single parameter varied in each one.