International standards on corrosion

International Standards on Corrosion

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Corrosion is a very destructive process involving chemical and electrochemical as well as physical and mechanical factors. A survey carried out in a chemical plant in the Fed. Rep. of Germany showed that 40% of corrosion there was due to stress-corrosion cracking, hydrogen embrittlement, and corrosion fatigue – all of which have mechanical as well as chemical aspects.

According to the source quoted above, in 1977 losses due to corrosion in the USA were estimated at USD 15 billion. It is no doubt impossible to estimate the losses due to the corrosion of the world's cultural resources – cathedrals, temples, religious shrines, historical buildings, monuments – as a result of air pollution and acid rain.

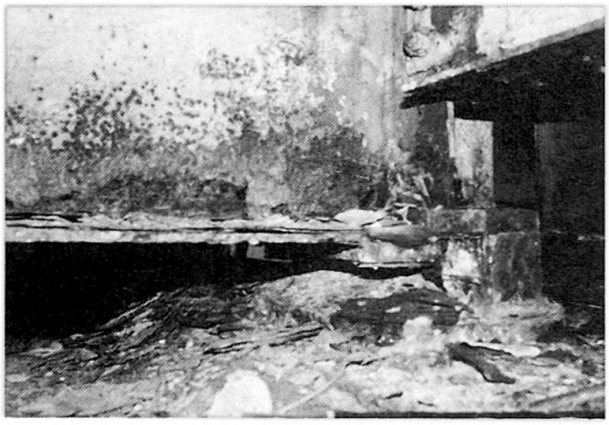
ISO Technical Committee (ISO/TC) 156 *Corrosion of metals and alloys* held its first plenary meeting in 1976 and identified atmospheric corrosion as a priority area for standards development. In 1978, Working Group 4 was given the assignment of developing a classification system for atmospheric corrosion. This system is now contained in four documents currently in the Draft Proposal (DP) stage (DP 9223, 9224, 9225 and 9226). Other standardization work relating to corrosion is underway in Sub-committee 7 *(Corrosion tests)* of Technical Committee (ISO/TC) 107 *Metallic and other irnorganic coatings;* Sub-committee 2 *(Anodized aluminium)* of ISO/TC 79 *Light metals and their alloys;* and in some sub-committees of ISO/TC 35 *Paints and varnishes.*

As part of the ISO standardization process to develop better and more comprehensive values of both long- and short-term corrosion rates, ISO/TC 156 is currently setting up a worldwide programme involving exposure of metals to the environment. The purpose of the programme is to provide more data on the various climates of the world and how atmospheric corrosion can vary from region to region, continent to continent. Four different metals, with 54 specimens of each metal, will be exposed at each site. Both flat panels and wire helixes are being used so that results from the two specimen types can be correlated. Time of wetness data will also be obtained as well as the amount of sulfur dioxide and chloride deposited on the metals. Short- and longterm corrosion rates can thus be studied as a function of atmospheric conditions. The results of this programme are expected to make procedures for estimating atmospheric corrosion rates more reliable.

Defining terms

The scope of ISO Technical Committee (ISO/TC) 156 *Corrosion of metals and alloys* is standardization in the field of corrosion of metals and alloys including corrosion test methods and corrosion prevention methods. International Standard ISO 8044: 1986 *Corrosion of metals and alloys – Terms and definitions* is designed to provide definitions concerning corrosion that can be understood to have the same meanings by all concerned, at international level. «Some corrosion terms in present use have developed through common usage and are not always

Localised corrosion on steel in concrete



An example of corrosion

logical. It has not, therefore, been possible to define certain terms in the form they are used in some countries. Because of the occasional conflicts between tradition and logic some definitions inevitably represent a compromise».

Traditional usage of the term corrosion itself is cited in this International Standard as an example of such a conflict. «Corrosion» has been used to mean the process of corrosion and the products of the process, as well as the damage caused by the process. In Internation Standard ISO 8044, therefore, «corrosion» means the process itself. Any detectable result of corrosion in any part of a corrosion system is termed «corrosion effect». The term «corrosion damage» thus covers any impairment of the funtion of the technical system of which the metal and the environment form a part. Consequently, «corrosion protection» implies that the important thing is to avoid corrosion damage rather than to prevent corrosion, «which in many cases is impossible and sometimes not necessary».

Types of corrosion

Stress-corrosion cracking results in cracks which make structures useless for supporting or containing. Stress corrosion is defined as «a process involving conjoint corrosion and alternating straining of the metal», in International Standard ISO 8044. These types of corrosion are not so directly related to the environment as other forms. Corrosion fatigue results in the formation of cracks affecting such moving parts as gears, propellors, turbines and shafts and their housing and attachments.

Stress corrosion is particularly damaging to high-quality materials: stainless steel, nickel-base alloys, alloy steels, aluminium-base alloys, copper-base alloys and titanium-base alloys. Stress corrosion is the subject of a seven-part International Standard presently being developed, ISO 7539-1 *Corrosion of metals and alloys – Stress corrosion testing.* Part 1: *General guidance on testing procedures* has already been published. The remaining parts of this International Standard are in the final stages or preparation.

Other related standardization work currently underway deals with determination of resistance to exfoliation corrosion of high strength aluminium alloys, determination of resistance to intergranular corrosion of solution heat treatable aluminium alloys, stress corrosion tests on welded specimens, aqueous corrosion testing of zirconium alloys for use in nuclear power reactors, determination of resistance to stress corrosion cracking of aluminium alloys, and determination of dezincification resistance of brass.

Electrochemical corrosion involves at least one electrode reaction and applies to stainless steels and some alloys but has little to do with stress except for «service stress» of the material. Iron, mild steels, alloys steels and stainless steels can also suffer from «hydrogendamage» caused by the entry of hydrogen. In International Standard ISO 8044 this is called «hydrogen embrittlement.

Fretting corrosion occurs between «mated surfaces» which are stressed. In ISO 8044 this is defined as a process involving conjoint corrosion and oscillatory slip between two surfaces in contact. The standard also points out that fretting corrosion may occur at mechanical joints in vibrating structures.

Other types of corrosion include chemical corrosion, gaseous corrosion, atmospheric and microbial corrosion, and pitting corrosion, which is corrosion resulting in pits or cavities extending from the surface into the metal. This type of corrosion is the subject of a future International Standard now in the preliminary stages and entitled Work Item (WI) 6-026 *Corrosion of metals and alloys – Evaluation of pitting corrosion.*

Corrosion testing

A corrosion test is carried out to assess the corrosion behaviour of a metal, the environmetal contamination by corrosion products, the effectiveness of corrosion protection, or the corrosiveness of an environment. A service corrosion test is a test carried out while the equipment or metal is in use («in service»). There are also simulated corrosion tests conducted under simulated service conditions.

Some International Standards in existence or being developed which have to do with corrosion testing have already been mentioned. An International Standard on corrosion fatigue tests is currently in process, as are Standard dealing with corrosion tests in artifical atmospheres at very low concentration of polluting gases, corrosion tests in salt spray atmospheres, and general requirements for field tests for atmospheric corrosion testing, as well as general requirements for corrosion tests in artificial atmospheres.

Much is obviously being done in the area of International Standards concerning corrosion protection, as defined in ISO 8044 *Corrosion of metals and alloys – Terms and definitions.* To conclude by repeating a key passage from this Standard, the important thing is to avoid corrosion damage rather than to prevent corrosion, which in many cases is impossible and sometimes not necessary.

ISO work in corrosion and corrosion testing is part of the on-going international effort to, conserve and protect the environment.

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