CORROSION OF STAINLESS STEELS

Stainless Steels

Stainless steels are protected against corrosion by a very thin layer of chromiumoxide which is formed on the surface of the metal. This passive layer can be damaged by mechanical or chemical action.

If the protecting layer is destroyed in an aggressive environment the material will corrode.

Different types of corrosion can occur and the choice of stainless steel is based on the requirements from the actual environment.

General Corrosion

General corrosion is a corrosion attack that proceeds at the same velocity over the entire surface. It occurs almost exclusively in acidic or in strongly alkaline solutions.

The resistance against general corrosion is mainly improved by increased content of Cr and Mo in the steel.

Intergranular Corrosion

Intergranular corrosion is a localized attack at and adjacent to the grain boundaries. Some stainless steels can be made sensitive to intergranular corrosion by elevated temperatures (500-900°C) at which carbide precipitation occurs at the grain boundaries resulting in Cr depleted regions. These regions then have a decreased corrosion resistance.

The precipitation of chromiumcarbides can be prevented either by a low C content or by a stabilizing element like Nb or Ti.

Pitting Corrosion

Pitting corrosion is a type of localized attack which is highly destructive, resulting in holes in the metal.

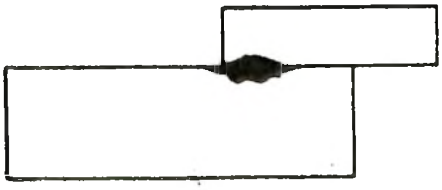
This kind of attack is most commonly found on stainless steels in chloride containing environments.

The resistance against pitting is improved with increased Cr and Mo contents. Also N has a favorable influence.

The Pitting Resistance Equivalent, PRE, is a way of describing the relative influence of the mentioned elements. One way of expressing PRE is: PRE = %Cr + 3.3 %Mo + 16 %N.

The maximum temperature at which a specimen in a special test solution shows no signs of pitting corrosion is called the Critical Pitting Temperature (CPT).

Crevice Corrosion



Crevice corrosion is a kind of corrosion which occurs in narrow crevices filled with a liquid and where the oxygen level is very low, *e.g.*, on gasket surfaces, lap joints and under bolt and rivet heads.

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limit has been exceeded by calculation, using the total fume measurement. Where consumable manufacturers publish or supply data sheets containing typical fume compositions, these can be used to estimate individual element concentrations. Conversely, it is also possible to calculate the maximum allowable fume concentration at which no constituent limit will be exceeded.

Although fume emission may be minimized by selection of an appropriate welding process, the choice is usually restricted by technical and economic factors. It is therefore necessary to control risk by reducing exposure to fume: often this is achieved by general ventilation of the workplace but local ventilation systems that remove fume near its source are more effective and desirable. In this approach, contaminated air is exhausted by fixed or movable extraction units and may be filtered before emission to atmosphere or returned to the workshop. Some metal inert/active gas welding torches are also designed with integral extraction hoses. While personal protective equipment such as an air-fed helmet may also safeguard the wearer, it should only be considered for special situations - welding in a confined space, for example – when alternatives to reducing exposure are not possible or not effective.

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CORROSION OF STAINLESS STEELS

A special form of crevice corrosion is called deposit corrosion. This is when the corrosion is found under non-metallic deposits or coatings on the metal surface.

Steels with good resistance to pitting corrosion have also good resistance to crevice corrosion.

STRESS CORROSION CRACKING (SCC)

Stress corrosion cracking, SCC, is a corrosion attack on a metal subjected to a tensile stress and exposed to a corrosive environment.

During stress corrosion cracking the metal or alloy can remain virtually unattacked on most of its surface, while fine cracks progress through it.

For austenitic stainless steels the risk for SCC is especially, big in solutions containing chlorides or other halogenides. The risk increases with increasing saltconcentration, tensile stress and also increased temperature. SCC is seldom found in solutions with temperatures below 60°C.

The resistance of the austenitic stainless steels is improved by increased Ni content. The ferritic Cr steels totally without Ni are under normal conditions unsensitive for SCC as well as steels which are ferritic-austenitic.

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