PENFLEX

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Environmental Corrosion of Stainless Steel

Environmental corrosion is a naturally occurring chemical deterioration of a material due to reaction with environment and especially with oxygen. The extent of deterioration of a metal depends on the chemical nature of the material.

For example, when iron is exposed to an industrial atmosphere for a period of time, iron oxide or rust forms on the surface. The rust is very porous to oxygen and water in the atmosphere and consequently the corrosion process continues until the metal is entirely consumed.

It is generally assumed that stainless steel has a very good resistance to atmospheric corrosion and yet when analyzing the effect of general corrosion on steel, attention has to be given to corrosivity of atmospheres. Depending on the location—rural, industrial, marine or their combination—corrosiveness of atmospheres can be significant.

Atmospheric corrosion is an electrochemical process with the electrolyte being a thin layer of moisture on the metal surface. Some locations with heavy industrial pollution in the atmosphere may have significant presence of sulfur oxides (SOx), nitrogen oxides (NOx), hydrogen sulfide, ammonia, carbonyl sulfide (COS) and other pollutants which amplify the “acidity” of rainfalls and, as a result, the deposition of those pollutants on the metal surface (or in other words in electrolyte).

With the “help” of some environmental factors like high humidity, high temperature—either ambient or due to solar radiation, frequent rainfalls and such—the corrosion penetration rates can lead to loss in the metal thickness. Environmental factors can cause the median thickness loss to vary by as much as 50% or more in a few extreme cases!

As we are often reminded by some of the “old hands” that it is called “stainless” not “stain-free” and therefore attention should always be given to proper care in handling and storage of stainless steel assemblies and their components.

To better see how environment can influence corrosion rates of the steel, please refer to the table below.

TYPICAL CORROSION RATES FOR CARBON STEEL IN DIFFERENT TYPES OF ATMOSPHERES

Type of atmosphere	Corrosion rates (mpy)	Comments
Rural	0.20 – 0.39	Measured at various places in Eastern Europe and Western Europe
Urban	0.39 – 1.18	
Industrial	1.18– 2.36	
Marine	0.39 – 1.57	Measured after 4 years of exposure at various places in Scandinavia
Arctic	0.16	Measured after 4 years of exposure in northern Sweden

Note: Corrosion rates at higher humidity and temperature, like in some places in the US, as well as in conditions with “combined atmospheres,” may be several times higher.

If you have any questions or comments, please contact us.

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