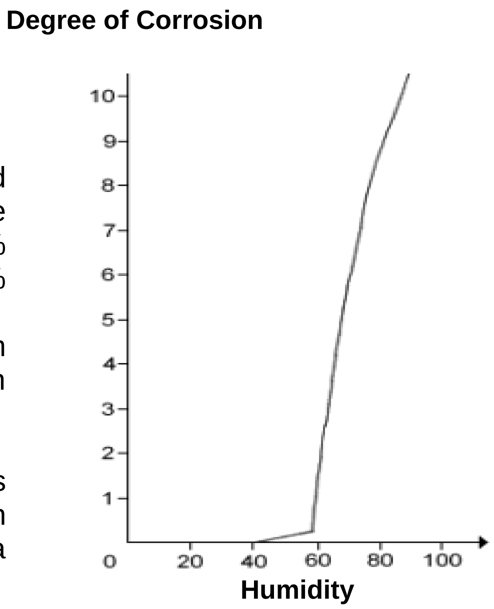
Corrosion (from Latin ‘corrodere’ = to rot away)

Corrosion is the gradual destruction of material, usually metals, by chemical reaction with its environment. In the most common use of the word, this means electrochemical oxidization of metals in reaction with an oxidant such as oxygen. Rusting, the formation of iron oxides, is a well-known example of electrochemical corrosion. This type of damage typically produces oxide(s) or salt(s) of the original metal. Corrosion can also occur in materials other than metals, such as ceramics or polymers, although in this context, the term degradation is more common. Corrosion degrades the useful properties of materials and structures including strength, appearance and permeability to liquids and gases

Fixed scale of corrosion in:

- **Chemical corrosion**
- **Electrochemical corrosion**



1. Chemical corrosion

Corrosion is a process that occurs when oxygen, water, acids and salts mix together. The temperature must be above 0°C. When the relative humidity is below 40% almost no corrosion, from 40-60% increases the risk of corrosion proportionately and above 60% (relative humidity) significant corrosion is to be expected.
In connecting with air pollution, hygroscopic salts, depending on the construction and the position of the component, the corrosion stress loads are considerably increased.

Redox (reduction-oxidation-reaction) is a chemical reaction. This happens when one electron is transferred to the other. In such an electron transfer reaction the electron cuts (oxidation) through a material on an electron uptake (reduction).

In our case: By the action of oxygen, water, salts, acids, it depends on the steel surface for a chemical reaction – corrosion takes space. The steel surface is reduced and the surface corrosion increases.

2. Electrochemical corrosion / Contact corrosion

Contact corrosion arises when two metals with different solution potential are connected through an electrolyte (water, moist air, salts…). The non-noble material (to be sacrificed) becomes the anode and the nobler material acts as the cathode, e.g. Zinc and Copper form with an electrolyte, a galvanic element (galvanic cell). This creates a voltage between the two materials. The negative terminal is non-noble and will corrode, and at the same time, corrosion of the other noble metal will be prevented.

General Information: Corrosion TI – G 1 / USA

Reasons for the development of electrochemical corrosion / contact corrosion

- Different types of metals rubbing together due to (false) construction results in what is called electrolysis → **Corrosion**
- Different structural components from the manufacturing process in alloys form a galvanic cell → Intergranular corrosion, e.g. Chrome in steel alloys combines on heating (welding) with the carbon, effect is - chrome loose the anticorrosive properties.

- Different surface tension through deformities and stress increase the corrosion-tendency → **Stress corrosion cracking**

Standard electrode potential of metals

(At 298.15 K / 25°C)

Non-noble **negative (-)**	**positive (+)** **Noble**
2,37 V	Magnesium
1.66 V	Aluminium
0.76 V	Zinc
0.76 V	Chrome
0.49 V	Nickel
0.41 V	Iron
0.40 V	Cadmium
0.14 V	Tin
0.13 V	Lead
0 V	Hydrogen
Copper	+0.52 V
Silver	+0.8 V
Platinum	+1.2 V
Gold	+1.4 V
-2.5 -2.0 -1.5 -1.0 -0.5	**0** +0.5 +1.0 +1.5

This chart above show the **Standard electrode potential of metals.** If you measure the metals with an electro voltage device the result is the value in the column. If you join Aluminium (-) 1,66 V with Iron (-) 0,41 V in a construction, and the local environment has more than 60% of humidity or if it is raining, an electronic cell will be created, and the electrons are moving from the noble to the non noble metal. More negative electrons will gather on the contact area, and the metal will corroded more – contact corrosion will develop.

- **The composition of the electrolyte**

  Outdoor in connection with weathering (rain, fog), this type of corrosion depends on the duration of exposure to moisture. Very adverse conditions prevail when the metal has been left out in the moisture and electrolytes occur with a high conductivity e.g. in areas with high levels of industrial pollution, salt air, in contact with sea water or on salted roads.

- **The size of the contact surfaces and the surfaces of the components (surface area ratio)**

  If metal pieces e.g. hot-dip galvanized steel (- charge) are greater in terms of surface area, the pairing with other materials is (-/+ charge) usually is a minor a problem. If the surface of the hot-dip galvanized steel is smaller than the other pairing area then take precautions, e.g., clamps in galvanized steel to copper pipes.

- **Oxidation products on the surface of the metals**

  When metal surfaces are heavily oxidised, the voltage potential will chance, which in turn will have a considerable effect on the extent of the.

If metals which are widely spaced in the voltage spread of the chemical elements must be paired, the metals should be separated by insulation media (e.g. plastic disc or rubber mat).

Note:
Zinc, negative charge (-) can be corroded by noble metals, positive charge (+).
Small galvanized parts in contact with larger metal areas are more vulnerable.

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