

Corrosion: (Corrode = 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. The best-known type of corrosion is commonly known as rust, the oxidation of iron / steel.

This type of damage typically produces oxide(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 their 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% there is almost no corrosion; from 40-60% relative humidity, the risk of corrosion increases proportionately; and above 60% relative humidity, significant corrosion is to be expected.

In contact with air pollution, hygroscopic salts, depending on the object design/structure and the position of the object, whether it is in the countryside or on the coast, the corrosion loads may be considerably increased.

Redox (reduction-oxidation-reaction) is a chemical reaction. This happens when one electron is transferred from one chemical to the other. In this process of electron transfer, electron loss is oxidation and electron absorption is reduction.

In our case, corrosion is formed by the action of oxygen, water, salts, acids, depending on the steel surface, by a chemical reaction. The steel surface is reduced and the surface corrosion increases.

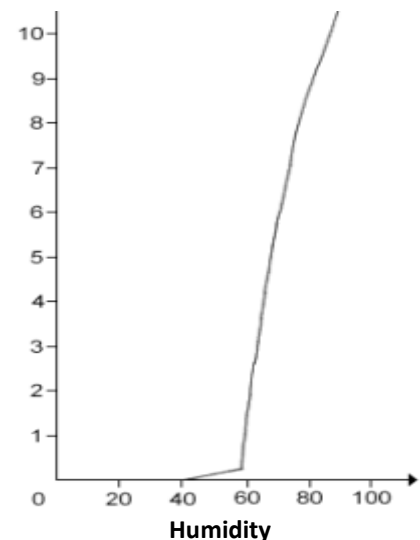
2. Electrochemical corrosion / Contact corrosion

Contact corrosion happens when two metals with different electrode potentials are connected by an electrolyte (water, moist air, salts, etc.). In this case the non-noble metal is the anode and the cathode is the nobler metal, e.g. zinc and copper form a galvanic element (galvanic cell) with an electrolyte. This causes a voltage between the two materials. The negative terminal is non-noble and will erode at the same time as the corrosion of the other, noble, metal will impeded.

Reasons for the creation electrochemical corrosion / contact corrosion

- Different types of metals rubbing together due to the type of 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 by heating (welding) with carbon; the effect is that chrome loses its anticorrosive qualities.
- Different surface tension deformities and stress increase the tendency to corrosion → **Stress corrosion cracking**

Degree of Corrosion



Standard electrode potential of metals

(At 298.15 K / 25°C)

Non-noble				negative (-)				positive (+)				Noble					
2,37 V								Magnesium									
		1,66 V						Aluminum									
				0,76 V						Zinc							
				0,76 V						Chrome							
				0,49 V						Nickel							
				0,41 V						Iron							
				0,40 V						Cadmium							
				0,14 V						Stannic							
				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 shows the **standard electrode potential of metals**. When measuring different metals with an electro voltage device it is found that each type of metal contains different values. The result of each value is in the first column. If aluminum (-) 1,66 V is combined with Iron (-) 0,41 V in a structural object and the object is situated in an area of high humidity, (above 60%), this will result in a buildup of electronic cells and the electrons in the material will move from the noble to the non-noble metal. The contact area will have more negative electrons, and this will increase contact corrosion.

- The composition of the electrolyte**

This type of corrosion depends on the duration of bare metal exposure to moisture. This is accelerated in adverse conditions. When the bare metal has been exposed to moisture, electrolytes with a high conductivity can occur, e.g. in areas with increased levels of industrial pollution, such as salt air, acid rain or where there is contact with sea water or on salted roads.

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

Where metal pieces, e.g. hot-dip galvanized steel (negative charge – 0,76 V) are larger in terms of their contact area with other metal (smaller negative and positive charge), the connection is not usually a problem - quite the contrary. However, if the surface of the hot-dip galvanized steel is smaller than the other connected metal area, there is a need for great caution - e.g., clamps in galvanized steel to copper pipes.

- The oxidation products on the surface of the metals**

If the metal surfaces are heavily oxidized and so influence your voltage potentials, this will have a decisive influence on the extent of corrosion.

Note:

When two metals are connected and one has a greater voltage, it may be necessary to separate the metals by isolation (e.g. screw with plastic disc or rubber mat) to avoid the effect of electrochemical corrosion.

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

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