Classification of Corrosion

Corrosion has been classified in many different ways. Such as :-

1- low- temperature and high – temperature corrosion.
2- direct combination (or oxidation) and electrochemical corrosion.
3- Wet corrosion and Dry Corrosion.
4- Sweet Corrosion and Sour Corrosion

The preferred classification here is:-

(1) Wet corrosion

(2) Dry Corrosion.

(1) Wet corrosion

Occurs when a liquid is present. This usually involves aqueous solutions or electrolytes and accounts for the greatest amount of corrosion by far. A common example is corrosion of steel by water.

(2) Dry Corrosion.

occurs in the absence of a liquid phase or above the dew point of the environment. Vapors and gases are usually the corrodents. Dry corrosion is most often associated with high temperatures. An example is attack on steel by furnace gases.

The presence of even small amounts of moisture could change the corrosion picture completely. For example, dry chlorine is practically non corrosive to ordinary steel, but moist chlorine, or chlorine dissolved in water, is extremely corrosive and attacks of the common metals and alloys.

Sweet Corrosion and Sour Corrosion:-

In the oil and gas industry, Sweet Corrosion and Sour Corrosion are terms used to describe specific types of metal degradation caused by different corrosive agents:

Sweet Corrosion:-

• Cause: Primarily due to the presence of carbon dioxide (CO_2) in the environment. When CO_2 dissolves in water, it forms carbonic acid (H_2CO_3), which can corrode metals like carbon steel.

• Characteristics: Typically results in pitting or material loss where steel is exposed to CO_2 and moisture.

• Prevention: Methods include using corrosion inhibitors, applying protective coatings, and selecting materials resistant to CO_2-induced corrosion.

Sour Corrosion:-

• Cause: Results from exposure to hydrogen sulfide (H_2S). In the presence of moisture, H_2S forms a weak acid that can lead to metal degradation.

• Characteristics: Can cause material failure at stress levels below the metal's normal yield strength.

• Prevention: Involves using materials resistant to H_2S, applying protective coatings, and implementing corrosion inhibitors.

Forms of Corrosion :-

It is convenient to classify corrosion by the forms in which it manifests itself, the basis for classification being the appearance of corroded metal. Each form can be identified by mere visual observation. In most cases the naked eye is sufficient but sometimes magnification is helpful or required. Valuable information for the solution of a corrosion problem can often be obtained through careful observation of the corroded test specimens or failed equipment. Examination before cleaning is particularly desirable.

Some of the eight forms of corrosion are unique, but all of them are more or less interrelated. The eight forms are:

1- Uniform (or General) attack.
2- Galvanic (or Tow- metal) .
3- Crevice corrosion .
4- Pitting.
5- Intergranular corrosion .
6- Erosion corrosion
7- stress corrosion.
8- Corrosion fatigue cracking

1- Uniform (or General) attack.

• Definition : It is the uniform thinning of a metal without any localized attack. Corrosion dose not penetrate very deep inside. The most familiar example is the rusting of steel in air.

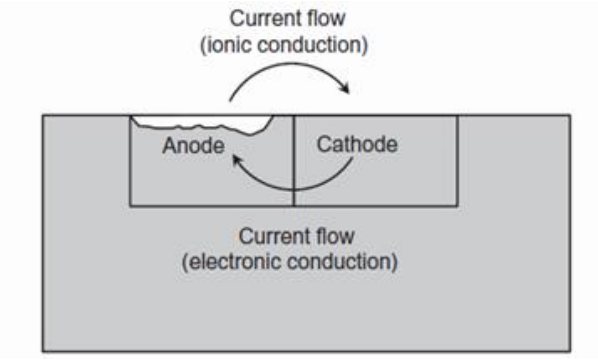
• Environment : the corrosion environment must have the same access to all parts of the metal surface, and the metal itself must be metallurgically and compositionally uniform.

• Characteristics: The other localized forms of corrosion are much less predictable and are to be avoided whenever possible. Thus, uniform corrosion is preferred from a technical view point because it is predictable and thus acceptable for design.

2- Galvanic (or Tow- metal) .

• Definition : Galvanic Corrosion occurs when two dissimilar metals or alloys are coupled in the presence of a corrosive electrolyte one of them is preferentially corroded while the other is protected from corrosion.

• Mechanism : when two metals with different potentials are joined ,such as copper(+0.334 v) and iron (-0.44 v) , a galvanic cell is formed. The driving force for corrosion is a potential different between different materials, the Active side will became the anode and tend to corrode the noble side will became the cathod



Factors affecting galvanic corrosion :-

1- Position of metals in the galvanic series

the further apart the metals are in the galvanic series, the greater is the chance for galvanic corrosion. For a particular environment, the metals selected should be close to each other in the galvanic series to minimize galvanic corrosion.

2- The nature of environment

For instance, water containing copper iron, like seawater, is likely to form galvanic cells on a steel surface of the tank. If the water in contact with steel is either acidic or contains salt, the galvanic reaction is accelerated because of the increased ionization of the electrolyte.

3- Area, Distance and Geometric effects.

The anode to cathode area ratio is extremely important as the magnitude of galvanic corrosion The rate of corrosion increase with the ratio of cathode to anode area.

3- Crevice corrosion .

• Definition : is a type of localized corrosion that can be found within crevices or at shielded surfaces where a stagnant solution is present

• Mechanism : For corrosion to occur, the aggressive solution must permeate the crevice and be sufficiently narrow to keep corrosion products inside the crevice.

Several steps can be taken to prevent and/or control crevice corrosion:

1. Proper design, avoiding crevices
2. Porous gaskets should be avoided.
3. The use of alloys resistant to crevice corrosion

4- Pitting.

• Definition : Pitting represents an extremely localized attack that produces holes in the metal or alloy. It is one of the most destructive, localized forms of corrosion.

• prevent : The severity of pitting corrosion is controlled by environment, chloride concentration, electrolyte acidity, oxidizer concentration, temperature,

5- Intergranular corrosion .

• Definition : is a localized form of corrosion. It is a preferential attack on the grain boundary phases or the zones immediately adjacent to them. Little or no attack is observed on the main body of the grain.

6- Erosion corrosion

• Definition : The term “erosion” applies to deterioration due to mechanical force. Erosion corrosion is usually caused by an aqueous or gaseous corrodent flowing over the metal surface or impinging on it. The acceleration of attack is due to the distribution or removal of the protective surface film by mechanical forces exposing fresh metal surfaces

7- stress corrosion.

• Definition : Stress corrosion cracking (SCC) is defined as crack growth due to simultaneous tensile stress and corrosive environments on active metals or alloys.

7- Corrosion fatigue cracking

• Definition : is mechanical degradation (brittle failure) when exposed to corrosion and cycling loading.