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15/SCI14/010

CHE 582 – CORROSION ENGINEERING

ASSIGNMENT

1. What is corrosion?
2. With the aid of chemical reactions, briefly describe corrosion mechanisms.
3. Give three (3) catastrophic incidences that had been recorded historically as a result of corrosion failure.

ANSWERS

1. Corrosion is a natural process that converts a refined metal into a more chemically-stable form such as oxide, hydroxide, or sulfide. Corrosion is an all-too-common result of electrochemical reactions between materials and substances in their environment. It is the gradual destruction of materials (usually a metal) by chemical and/or electrochemical reaction with their environment.

Corrosion is also defined as an irreversible interfacial reaction of a material (metal, ceramic, polymer) with its environment which results in consumption of the material or in dissolution into the material of a component of the environment.

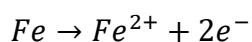
2. There are two mechanisms of corrosion;

- i. Wet corrosion
- ii. Dry corrosion

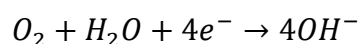
- i. Wet Corrosion: It is also known as electrochemical corrosion. Such type of corrosion is due to the flow of electron from metal surface anodic area towards the cathodic area through a conducting solution. Wet corrosion therefore involves an oxidation reaction at the anode and a reduction reaction at the cathode.

For the wet corrosion of a divalent metal iron (Fe) in an electrolyte containing oxygen:

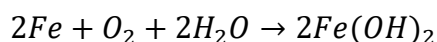
Anodic reaction; iron metal is oxidized to form iron ions;



Cathodic reaction; oxygen in the presence of water is reduced to form hydroxide ions;



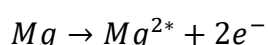
Overall equation for this reaction;



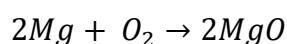
- ii. Dry Corrosion: It is also known as chemical reaction. Such type of corrosion takes place due to direct chemical action of atmospheric gases and anhydrous liquids on the metal surface.

For the dry corrosion of magnesium (Mg):

The basic reaction is;



The overall reaction is;



The metal loses electrons to form an ion and some free electrons. The ionic metal can then react with oxygen to form a metal oxide. In dry corrosion, the oxygen comes from the air, in wet corrosion, the oxygen is supplied by aerated water.

3.

- i. March 4, 1965: The Natchitoches explosion: A 32-inch gas transmission pipeline, north of Natchitoches, Louisiana, belonging to the Tennessee Gas Pipeline exploded and burned from stress corrosion cracking on March 4, killing 17 people. At least 9 others were injured, and 7 homes 450 feet from the rupture were destroyed. The same pipeline also had an explosion on May 9, 1955, just 930 feet (280 m) from the 1965 failure.
- ii. May 5, 1988: Norco, Louisiana, Shell Oil refinery explosion. Hydrocarbon gas escaped from a corroded pipe in a catalytic cracker and was ignited. Louisiana state police evacuated 2,800 residents from nearby neighbourhoods. Seven workers were killed and 42 injured. The total cost arising from the Norco blast is estimated at US\$706 million.
- iii. April 22, 1992: 1992 Guadalajara explosions. A leak of gasoline from a corroded steel pipe, into the sewer system caused 12 explosions in downtown Guadalajara, Mexico between 10:05 and 11:16am, killing 206 – 252 people and injuring 1,800. Eight kilometers of street were destroyed or seriously damaged.