SOLUTION SET

INTERNAL ASSESMENT TEST I

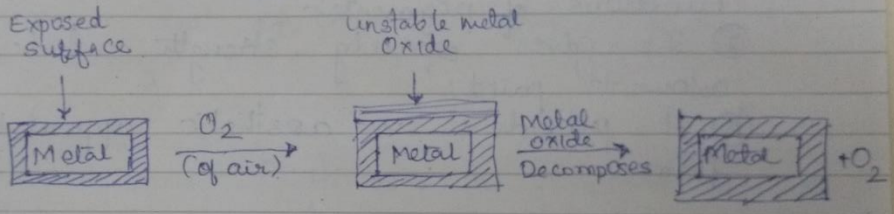
APPLIED CHEMISTRY II

Solution Set IAT I - AC-II

Q.1

(a) Platinum jewelry does not get corroded due to oxidation because (a) the oxidation product product formed is unstable.
(b) It decomposes on the metal surfaces forming back the metal and oxygen.

Metal + Oxygen ⟶ Metal oxide ⟶ Metal + oxygen



(b) We cannot store food in galvanized containers because
(a) Galvanizing is coating of zinc on iron
(b) If acidic food is stored in galvanized containers zinc dissolves in dilute acids to form highly toxic and even poisonous compounds.

(d) ~~Ans~~ (a) when cathode and anode are equal, cathodic and anodic current densities are equal. Corrosion phenomenon will not get accelerated.
(b) If cathode area is much larger than anode area, anodic current density will be greater, as

a result corrosion of anode ~~of~~ metal will be more

Rate of corrosion $\propto \frac{\text{Cathodic area}}{\text{Anodic area}}$.

(c) Constituents of paint

(i) Pigment : Principal constituent of paint and provides colour to the paint.

Functions of pigments:-
(a) It gives opacity, strength and desired colour to paint
(b) It provides an aesthetic appeal to the film.

(ii) Drying oil (Vehicle) :- It is the film forming constituent of paints.

Functions :-
(a) Holds the pigments on metal surfaces.
(b) It forms protective film by evaporation or by oxidation & polymerization of the unsaturated constituents of drying oil.

(iii) Thinners :- Volatile substance which evaporates easily after application of paints.
They are added to reduce the viscosity.

Function :-
(a) Reduces the viscosity of paint to ~~resistance~~ render

(2)

it easy to handle and apply to the metal surface.

(b) They evaporate easily and help the drying of the film.

(iv) Fillers or extenders:- They are inert, low refractive indices materials generally of white colour.

Functions:-

(a) Serves to fill voids in film.

(b) Reduce cost of paint without reducing the efficiency.

(v) Plasticizers:- Plasticizers in common use are Triphenyl phosphate, Tributyl phthalate.

Functions:-

(a) To provide elasticity.

(b) To prevent cracking of the film.

e) "Al clad" sheeting, in which a plate of duralumin is ~~sandwhich~~ sandwiched between two layers of 99.5% pure aluminium. It is used in aircraft industries.

(f) A good design of metallic structure should not possess bolts and nuts made from different metals because this will give rise to corrosion or formation of a galvanic cell which inturn will lead corrosion.
The metal which is placed higher up in galvanic series will undergo corrosion.

(g) Corrosion inhibitors will dissolve in the medium to form certain products which deposit on anode or cathode and thus slow down the anodic or cathodic reaction.

Q2

(a) Factors affecting rate of corrosion:

(a) Position of metal in galvanic series
The extent of corrosion depends upon the position of the metal in the galvanic and electrochemical series.
(1) More the negative value of standard electrode potential, more the metal corrodes.
(2) The greater the difference in the position of metal in the galvanic series, the faster will be the corrosion of the anodic metal.

(H)

This develops

Temperature :- As the temperature increases the rate of chemical reaction, diffusion rate also increases.
It increase the ionization and mobility of all reacting ions and thus increasing the corrosion.

Humidity :- This is most important factor because that gases and vapours present in the atmosphere furnish water to the electrolyte essential for setting up an electrochemical corrosion cell.

b) Season cracking :- It is due to the high residual stresses left in the brass. It is a combined effect of static tensile stresses and the corrosive environment on a metal.
stresses can make the alphabrass more susceptible to intergranular corrosion in presence of ammonia. Thus leading to the formation of fissure and tetraamine Copper and tetraamine zinc.

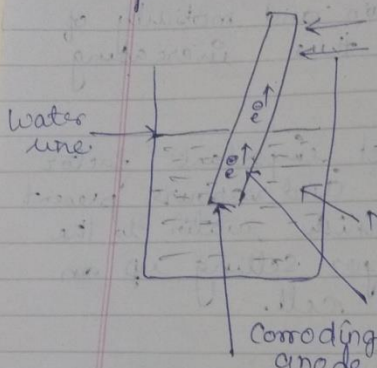
CO2

(c.) Differential areation Corrosion :- this is the important and common type of Corrosion. This type of corrosion occur when one part of the metal is exposed to a different air concentration from the other part of the metal.
This develops a difference in potential between differently aerated areas.

(5)

Exposed

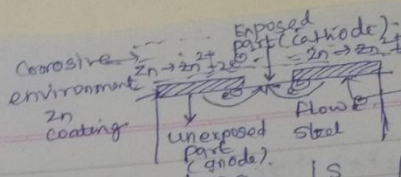
It has been found the poor oxygenated part act as anode and highly oxygenated part act as cathode.



Differential aeration corrosion occurs when metals are partially immersed in a solution just below the waterline. A metal (zinc) immersed in dil soln of neutral salt (NaCl) and is not agitated properly.

Part of metal above water line cathode
Reduction Rxn
$\frac{1}{2}O_2 + H_2O + 2e^{\ominus} \rightarrow 2OH^{\ominus}$ (absorption of O_2)

Part of metal below water line anode
Oxidation Rxn
$Zn \rightarrow Zn^{2+} + 2e^{\ominus}$



(d) (1) Anodic coating is preferred over Cathodic coating because, coating of zinc, aluminium and cadmium on steel are anodic coating, since these are more active metal.

(2) If the coating metal is attacked, leaving the underlying Cathodic metal unattacked.

(3) Thus no attack on the base metal occurs, until practically all the coating has first corroded in the viscinity of the exposed based betal.

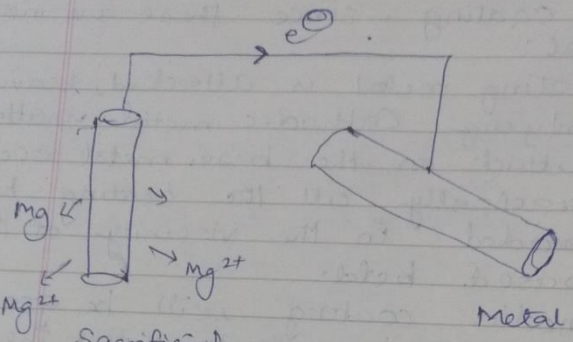
(4) Thus anodic coating will be good under all conditions and protect the base metal from corrosion irrespective of whether the coating is non-porous or porous and continuous or discontinuous.

Q3 (a) Cathodic protection:- It is to force the metal to behave like a cathode and since there will not be any anodic area on the base metal, corrosion does not occur.

The methode used for protecting undergro-und pipelines using Mg block is sacrificial anode method. In this method Mg which is a more active metal is connected to the underground pipe line so that all the corrosion is concentrated at the more active metal and thus saving the underground pipeline.

(7)

The Mg metal itself undergo corrosion slowly. while the pipeline is protected Thus, sacrificial Anode"



Rxn at anode → $Mg \rightarrow Mg^{2+} + 2e^{\ominus}$.

(b) Given :-

C = 72% H = 8% O = 12% N = 3.5%

Ash = 4.5% , S = 0%

Find =

H.C.V = ?

N.C.V ?

Formula :-

$$HCV = \frac{1}{100}\left[8080\,C + 34500\left(H - \frac{O}{8}\right) + 2240\,S\right] \text{ kcal/kg}$$

$$= \frac{1}{100}\left[8080(72) + 34500\left(8 - \frac{12}{8}\right) + 2240(0)\right]$$

$$= \frac{1}{100}\left(581,760 + 276000 - 51,750 + 0\right)$$

$$HCV = \frac{1}{100}\left(806,010\right) = 8,060.1 \text{ kcal/kg}.$$

(8)

$$LCV = [HCV - (0.09 \times H \times 587)]$$
$$= [8060.1 - (0.09 \times 8 \times 587)]$$
$$= 7637.46 \text{ Kcal/kg}$$

Q8. Mechanism of electrochemical corrosion of iron kept in acidic environment will be evolution of H_2.
Considering the case of iron metal the anodic reaction involves dissolution of iron as Fe^{2+} ion with the liberation of electrons.

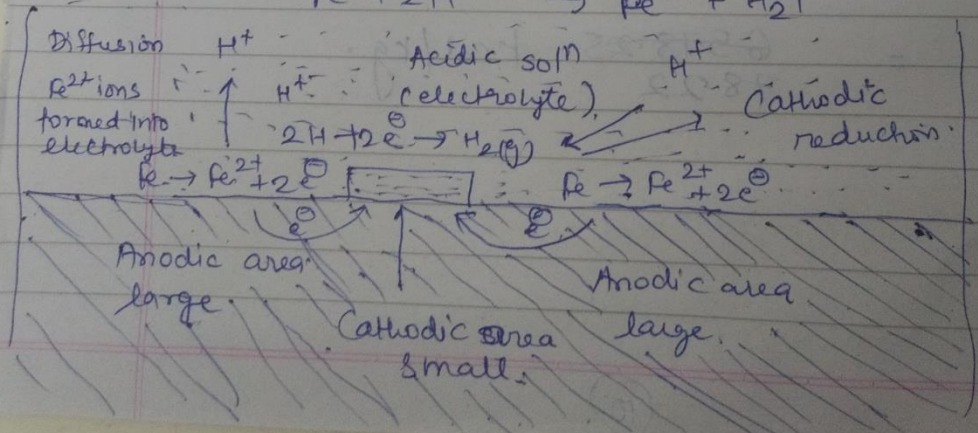
$$Fe \longrightarrow Fe^{2+} + 2e^{\ominus} \quad \text{(oxidation, at anode)}$$

These electrons flow from anode to cathode through the metal and H^+ ions from acidic solution accepts them and get reduced to hydrogen gas at cathode.

$$2H^+ + 2e^{\ominus} \longrightarrow H_2\uparrow(g) \quad \text{(reduction, at cathode)}$$

Thus, over all reaction

$$Fe + 2H^+ \rightarrow Fe^{2+} + H_2\uparrow$$



(d) Given:-
C = 83% H = 5% O = 8% N = 2% ash = 2%
S = 0%

Find GCV = ? NCV = ?

Formula

$$GCV = \frac{1}{100}\left[8080\,C + 3400\left(H - \frac{O}{8}\right) + 2240\,S\right] \text{ kcal/kg.}$$

$$= \frac{1}{100}\left[8080\,(83) + 3400\left(5 - \frac{8}{8}\right) + 2240\,(0)\right]$$

$$= \frac{1}{100}\left[670.640 + 13,600 - 3400\right]$$

$$= \frac{684,240}{100}$$

$$= 6842.4 \text{ kcal/kg.}$$

8086.40

$$NCV = HCV - (0.09 \times H \times 587).$$

8086.40

$$= 6842.4 - (0.09 \times 5 \times 587)$$

$$= 6578.25 \text{ kcal/kg.}$$

7822

(10)