BATU-EXAM

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MET BKC IOT

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Water Treatment

Q1 MULTIPLE CHOICE QUESTIONS

a] In Zeolite process, the exchange of cation takes place

i] Anion
ii] Cation
iii] Both Anion and Cation
iv] No ion exchange

b] Which of following ions is released from cation exchange resin ?

i] Ca^{2+}
ii] K^{+}
iii] Na^{+}
iv] H^{+}

c] The exhausted cation exchange column is regenerated by passing a solution of

i] Dil. NaCl
ii] Conc. NaCl
iii] Conc. HCl
iv] Dil. HCl.

d] The exhausted anion exchange column is

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regenerated by passing solution of

i) Dil. KOH
ii) Conc. NaOH
iii) Conc. KOH
iv) Dil. NaOH

e] Which is molecular formula for lime ?

i) $CaCO_3$
ii) $Al(OH)_3$
iii) $Ca(OH)_2$
iv) $Mg(OH)_2$

Q2 Explain in Detail the zeolite process with its advantages and disadvantages.

Ans. This is the process used for removing both temporary and permanent hardness. Zeolite is complex silicates of metallic and non metallic oxides. They have approximate chemical formula.

$Na_2Al_2Si_2O_8 \cdot H_2O$

These silicates hold sodium ions loosely. Hence, these are called sodium Zeolites (Na_2Z).

PRINCIPALE : XNa_2Z when comes in contact with hard water with Na^+ ions, Ca and Mg and for insoluble CaZ and MgZ.

PROCEDURE : Na_2Z is placed in suitable container and hard water is allowed to passed through it. The Ca and salts are retained in filter bed and water free from those salts left behind.

$Ca(HCO_3)_2 + Na_2Z \longrightarrow CaZ + 2NaHCO_3$

$Mg(HCO_3)_2 + Na_2Z \longrightarrow MgZ + 2NaHCO_3$

For permanent hardness,

$CaCl_2 + Na_2Z \longrightarrow CaZ + 2NaCl$

$MgCl_2 + Na_2Z \longrightarrow MgZ + 2NaCl$

$CaSO_4 + Na_2Z \longrightarrow CaZ + Na_2SO_4$

$MgSO_4 + Na_2Z \longrightarrow MgZ + Na_2SO_4$

When process is continued for some hards all Na^+ ions from and zeolite stop working get exhausted. Therefore, it is nessesary to regenerate it. It is regenerated by treating 10% brine solution (NaCl solution) for few minutes Na_2Z is formed and again be used for hard water.

$CaZ + 2NaCl \longrightarrow CaCl_2 + Na_2Z$

$MgZ + 2NaCl \longrightarrow MgCl_2 + Na_2Z$

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DISADVANTAGES :—

1. The water softened by zeolite method cannot be used in chemical, pharmaceutical and polymer industry because it contains eq amount of Na ions.
2. If hard water is turbid it may blocked the pores of zeolite and it restrict flow of water.
3. The hard water contains coloured ions then zeolite cannot be regenerated easily.
4. Supply of hot water should be avoided because zeolite dissolved in it.

ADVANTAGES :—

1. It has hardness 0-10 ppm only.
2. The filteration assembly is contactless space. Installation and operational cost is low.
3. It doesnot required highly skilled manpower. The process is clean and require less time.

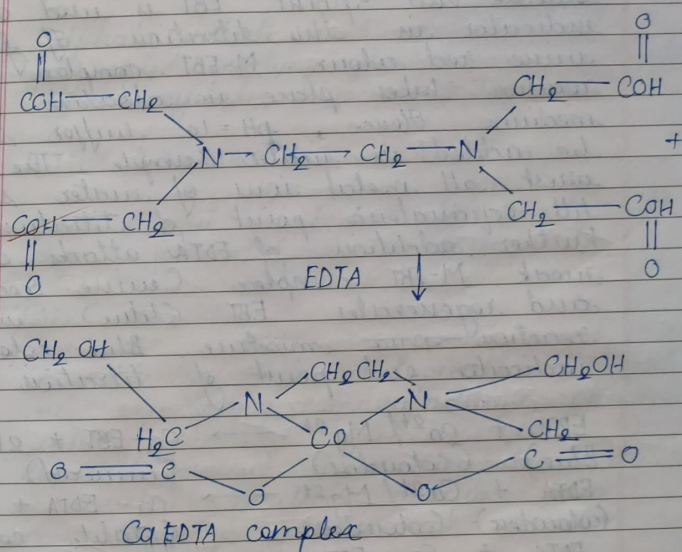
Q3 How does hardness of water determined by EDTA complexometric method.

Ans. The hardness of water can be estimated quantitatively by titration of hardwater against standard EDTA solution.

EDTA is weak acid and can ~~hoole~~ $4H^+$ ions on complete ionization.

$NaOH + HCl \longrightarrow NaCl + H_2O$

INDICATOR : Phenopthelene.



Ca EDTA complex

EDTA is sparingly soluable in water and it is hexadented ligand. It form stable complex with heavy metal ion during titration with hardwater. Thus, titration is known

as complexometric titration. In this experiment, standard EDTA solution is used to determine hardness of unknown water sample. EDTA and metal ions both are colourless. Therefore, titration proceeds with application of colour indicator to observe end point. EBT is used as indicator in this titration. It forms wine red colour. M-EBT complex reaction takes place in alkaline medium. Hence, pH = 10 buffer should be added in water sample. The EDTA arrest all metal ions of water sample till equivalence point of titration. Further addition of EDTA attacks on weak M-EBT complex (wine red) and regenerates EBT (blue) in reaction mixture. Blue colour indicator end point of titration.

EBT + Ca^{2+} / Mg^{2+} → Ca-EBT + $2H^+$
(Blue) (colourless) (winered)
EDTA + Ca^{2+} / Mg^{2+} → Ca-EDTA + $2H^+$
(colourless) (colourless) (Stable complex)
EDTA + Ca-EBT → Ca-EDTA + EBT
(colourless) (winered) (Regenerate blue)

Q4 What are effects of hardwater on textile industry, pharmaceutical industry, dying industry, paper industry,

Ans. TEXTILE INDUSTRY

Ca and Mg precipitates of soap stick to fabrics and interfere of colouring and doesnot give good washing resu

SUGAR INDUSTRY

Sulphate nitrate and carbonate of polyvated carbon present in hardwater affect crystalization of sugar.

DYING INDUSTRY

Salt present in hardwater react with dye unwanted colour precipitate.

PAPER INDUSTRY

Ca and Mg salts react with chemical use in paper manufacturing pharma-utical industry.
The salt present in water leads to unwanted reactions during drug manufacturing process.

Q5 Write short note on COD.

Ans The amount of oxygen required by organic matter present in water for its complet decompotition by oxidising agent is known as COD.

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Tutorial No. 2

MULTIPLE CHOICE QUESTIONS

Q1 Water obtained from ion exchange method is known as

a] coagulated water b] disinfected water
c] Potable water d] Demineralised water

2 The residual hardness of water obtained from ion exchange process :-

a] 0-2 ppm b] 5-10 ppm
c] 10-15 ppm d] 20-30 ppm

3 Ion exchange resin is

a] soluble b] linear
c] low molecular weight d] semipermiable organic p

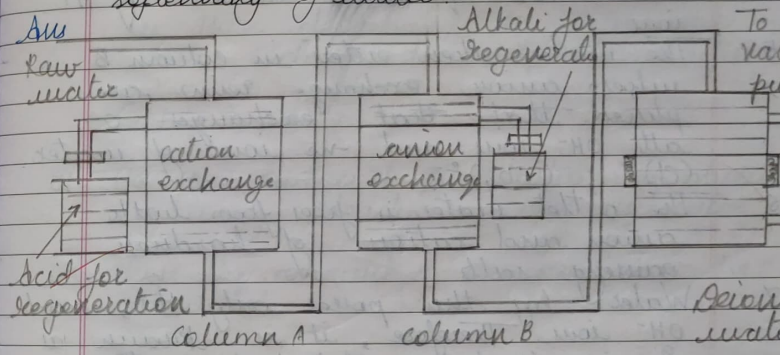
4 For the determination of COD is used as an indicator

a] starch b] Ferroin
c] EBT d] $K_2Cr_2O_7$.

5 Which of the following is known not used as coagulant process ?

a] Alum b] $Ca(HCO_3)_2$
c] $Al_2(SO_4)_3$ d] $NaAlO_2$

6 Explain the ion exchange method for softening of water.



The process of exchanging cation and anion of hardness causing metal salt with H^+ and OH^- ion ~~at~~ is called an ion exchange process. Ion exchange replaces undesirable ions of hard water with H^+ and OH^- ions.

PROCESS

1 An ion exchange ~~process~~ unit consist of 2 specially designed columns

2 The cation exchange resin and anion

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exchange resin are placed in column A and base in column B.

3 The hardwater enters in column A and passes through cation exchange resin.

4 The cation exchange resin captures all metal ions (Ca^{2+}, Mg^{2+}) and releases an equivalent amount of H^+ ions.

5 The water then enters in column B where anion exchange resin are placed that exchanges all OH^- ions and -ve ions of water $(Cl)^-$, $(SO_4)^{2-}$.

6 The outlet water is free from both anion and cation of hardness causing salts.

7 Water by this posses only H^+, and OH^- ions. Therefore, it is known as demineralised or deionised water.

REGENERATION OF EXHAUSTED RESINS

1 Cation exchange resin

$R'Ca + 2HCl \longrightarrow R'H_2 + CaCl_2$

$R'Mg + 2HCl \longrightarrow R'H_2 + MgCl_2$

2 Anion exchange resin

$R'Cl_2 + 2NaOH \longrightarrow R'(OH)_2 + 2NaCl$

$R(HCO_3)_2 + 2NaOH \longrightarrow R'(OH)_2 + 2NaHCO_3$

7 Explain determination of DO by Winckler's method.

Ans [i] O_2 present in water sample oxidises iodied ion to iodine quantitatively.

[ii] The amount of iodine titrated is then determined by titration with sodium thiosulphate solution $(Na_2S_2O_3)^{-2}$

[iii] The endpoint of titration is observed by using starch as an indicator.

[iv] Then the amount of oxygen can be calculated.

$I_2 + I \longrightarrow I_3$

$I_3 + 2S_2O_3 \longrightarrow 3I^- + S_4O_6^{2-}$

8 Write note on BOD.

Ans BOD is amount of dissolved oxygen required for biochemical decomposition of organic matter under aerobic condition at 20°C and for a period of 5 days. The unit of BOD is mg per litre or ppm.

organic waste + DO $\xrightarrow{\text{aerobic bacteria}}$ $CO_2 + H_2O$

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Q What are the factors dissolved oxygen (DO) level in water

Ans 1 Temperature :- Water cannot hold much of dissolved oxygen at higher temperature Therefore, the natural ability of water to hold dissolved oxygen decreases in summer

2 Flow :- Dry season affects the flow of water to hold dissolved oxygen decreases in summer. seriously and increases water temperatures. This results in reduced dissolved oxygen levels. Precipitation (rainfall) increases the flow thereby by mixing of atmospheric oxygen into water also increases.

3 Salinity of Water :- The solubility of gases in water usually decreases by addition of salts Therefore, the dissolved oxygen concentration is found to be low in saline water

4 Water Turbulance :- Turbulance or agitation causes aeration of water which increases the DO level in water

5 Aquatic plants :- They consume CO_2 and water to form sugar and oxygen (photosynthesis) Oxygen realeses in respiration process directly into water which results in increased DO level of water.

6 Marine Animals :- Aquatic animals organisms consumes dissolved oxygen in respiration process in respiration in respiration process which reduces the DO level in water

7 Organic Matter :- Dissolved oxygen decr largely by decomp of organic waste. Organic waste comes into water due to many reasons, such as dead aquatic plant, dead animals sewage discharge etc. Aerobic bacteria consu oxygen during decompositions of orgnic matter, as decompos is called aerobic decomposition.

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Tutorial 3

Q1 Multiple choice questions

1 The mathematical form of phase rule is

a) $F = C - P + 2$ b) $F = C + P + 2$
c) $F = C - P + 2$ d) $F = C + P + 2$

2 What is degree of freedom when 2 phases of single component exist in equation

a) 2 b) 3
c) 0 d) 1

3 Identify the degree of freedom in following equilibrium system.

Ice $\rightleftharpoons$ Water $\rightleftharpoons$ Vapour

a) 1 b) 2 c) 3 d) 0.

4 Emmision of oil and water is

a) Single phase b) 2 phase
c) 3 phase d) none of these

5 A system with more than 1 phase is known as

a) Homogeneous system b) Isolated system.

c) Open system d) Heterogeneous system.

Q2 What is phase rule ? Explain the term phase, component, degree of freedom.

Ans PHASE RULE

Phase rule can be stated as when an equilibrium between phases of heterogeneous system is influenced by temperature, pressure, and concentration only and it is independent of gravity, electrical field, magnetic forces and surface tensions. Then no of degree of freedom of system is related to no. of component (C) and no. of phase by phase rule equations.

$F = C - P + 2$

1 PHASE

It is homogeneous physically distinct and mechanically seperable portion of system which is seperated from other. Such part of system by definite boundry surfaces.

For example :-

$CHCl_3$ → chloroform

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2 COMPONENT

The component can be defined as minimum no of independent variable chemical constituent participating in equilibrium by means of which the composition of every phase can be expressed directly all in form of chemical equations.

3 DEGREE OF FREEDOM

It can be defined as no. of intensive variable that may change indepently without disturbing no. of phases in equilibrium.
On the basis of degree of freedom the equilibrium system can be divided a

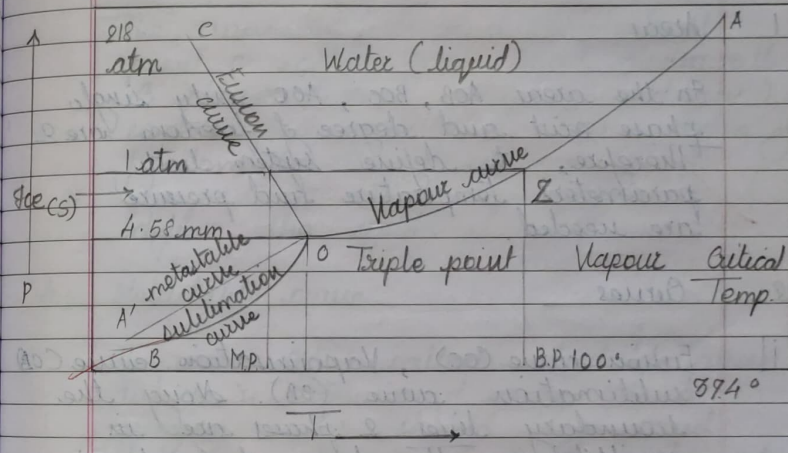
a] Monovarient system (F=1)
b] Bivarient system (F=2).
c] Non varient system (F=3).

Q3 Explain 1 component water system with phase diagram.

Ans When composition of all phases of all system are expressed by chemical constituent, the system is known as 1 components system.
One component system will exhibit maximum 2° of freedom

If C=1, P=1

F = C - P + 2
F = 1 - 1 + 2
F = 2



Therefore, 1 component system requires minimum 2 variables.

2 phases in equilibrium :-

a] Sublimation of Ice :-

$Ice_{(s)} \rightleftharpoons Vapour_{(g)}$

b] Vapour of water :-

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Water (l) ⟷ Vapour (g)

c] Fusion of Ice

Ice (s) ⟷ Water (l).

1 Areas

In the areas AOB, BOC, AOC only single phase exist and degree of freedom are 2. Therefore, to define system both parameters temperature and pressure are needed.

2 Curves

i] Fusion curve (OC), Vapourisation curve (OA) sublimation curve (OB). Along the boundary lines 2 phases are in equilibrium. The degree of freedom is 1 i.e temperature or pressure is needed to define a system. The curve OC shows that melting point of ice decreased with increase in pressure. The curve o terminate at point A for critical point corresponds to 218 atm 374°. Above this phase liquid phase merge into other. A point on curve OA corresponds to 1 atm pressure at 100°C temperature is boiling point of water. The curve OB terminates at point B corresponds to 0.0098° below which solid and vapour phase merge into each other.

3 The triple point

The curve OC, OA and OB meet at point O called triple point means all 3 phases (solid, liquid and gas) coexist in equilibrium. Here, degree of freedom is 0. Therefore, neither temperature nor pressure needed to define the system.

4 Metastable curve

The curve OA' is called metastable curve which is extension of curve OA. At freezing water should freeze and form ice. But removal of solid particle water may be cooled below its freezing point without forming ice. It is possible to extend vapour curve even below normal freezing point.

Q4 What is meant by eutatic point & explain silver lead alloy system with phase diagram.

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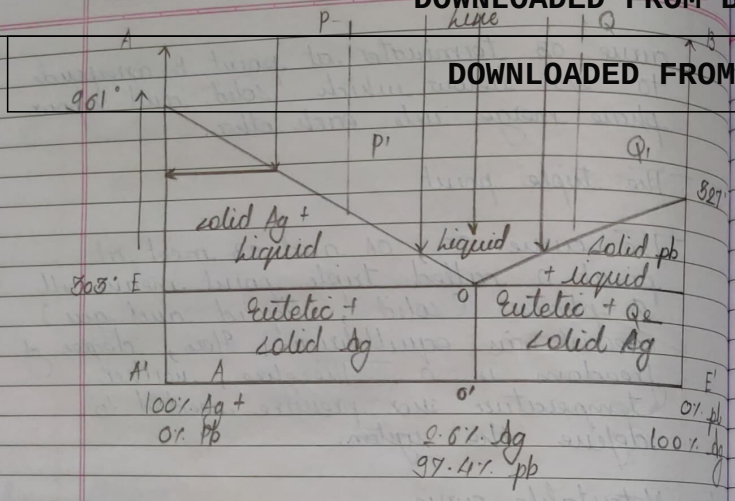

SILVER LEAD ALLOY SYSTEM

1. CURVES :-

1. Curves AO :-

It is freezing point curve of silver. It starts from point A at 961°C ie M.P. of Ag. It indicates that addition of lead to silver the M.P. of Ag decreases gradually along AO till point O is reached. At point O no more lead go to into solution if added. it seperates as solid lead.

2. Curves BO :-

It is the freezing point curve of lead. It starts from point B at 327°C ie MP of Pb. It indicates that on addition of silver to lead the MP of pb decreases gradually along BO till point O is reached. At point O no more silver go into solution if added it seperates as solid silver. Along curve AO solid Ag and liquid are in equation. Thus, Along the curve, 2 phases are in equation and degree of freedom is 1 either temperature or concentration needs to define system.

3. Eutetic point :-

The curve AO and BO meet at point O called Eutetic point.
At point O all 3 phases are in equilibrium

At Eutetic point,

$P = 3$ and $C = 2$

$F = C - P + 2$
$= 2 - 3 + 2$
$= 1$

The system is non varient at eutetic point
At eutetic point the composition is ~~2.6%~~ 2.6%.

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Ag and 97.4% pb called Eutectic and temperature is 303°C called Eutectic Temperature.

Eutectic temperature is lowest temperature at which a liquid phase can exist in system.

4 Area AOB :-

Consider a sample of liquid melt of Ag and pb corresponds to Q, having composition less than 2.6% Ag is taken as cooling melts temperature gradually decreased without any competition till on curve BC. Further cooling allows composition to vary along Q, O and lead start separating similarly if composition having more that 2.6% silver is taken and cooled, till Ag get separated it till eutating point of composition is attained.

Tutorial 4

Q1 MULTIPLE CHOICE QUESTIONS

1 Which type of chemical reaction is observed at cathod in electrochemical corossion?

a] Oxidation reaction b] Redox reaction
✓b] Reduction reaction d] None of these.

2 The mechanism of wet corossion depends on _____ of conducting liquid.

✓a] pH b] reactivity
c] Ionisation d] All of these.

3 If corossive medium is _____ then corossion occurs with evolution of hydrogen gas at cathod.

a] Basic b] Neutral
✓c] Sadic d] Non conducting

4 The direct chemical attack of metal by atmospheric gases _____

d] Dry corossion b] Chemical corossion
✓c] Both a and b d] None of these.

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5 Thermodynamically corrosion process of extraction of metals from their ores

a] Further b] Next
c] Reverse d] None of these.

Q2 What is oxidation corrosion? Explain different types of oxide film.

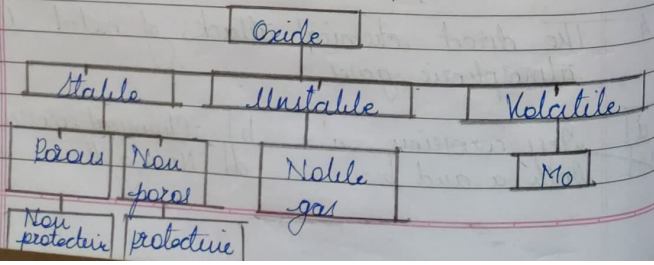
Ans. Corrosion due to oxygen oxidation or oxidation corrosion. This type of corrosion affect all types of metal except noble metals.

$2M \longrightarrow 2M^{n+} + 2ne^- \longrightarrow$ oxidation

$nO_2 + 2ne^- \longrightarrow 2nO^{2-} \longrightarrow$ Reduction

$2M + nO_2 \longrightarrow 2M^{n+} + 2nO^{2-} \longrightarrow 2MO$

Nature of metal oxide film cat can be understood by pelling Bedworth rule. These rule state that if volume of product of corrosion is greater than volume of corroded metal then metal oxide layer will be non porous and in such case metal get protected.



Nature of oxide film formed on surface of metal plays an important ~~rol~~ part in oxidation corrosion process. The film can be classified in 3 categories:

1] Stable film
2] Unstable film
3] Volatile film.

STABLE FILM

Stable film can be classified into 2 types:

a] Porous film (Non protective)
b] Non porous film (protective).

a] Porous film (Non protective)

This type of film is observed on alkali and alkaline earth metals. In this cases volume of oxide film formed insufficient to cover completely the larger surface area of metal. Therefore if faces, stress and strain which develops cracks in structure through which corrosion continues.

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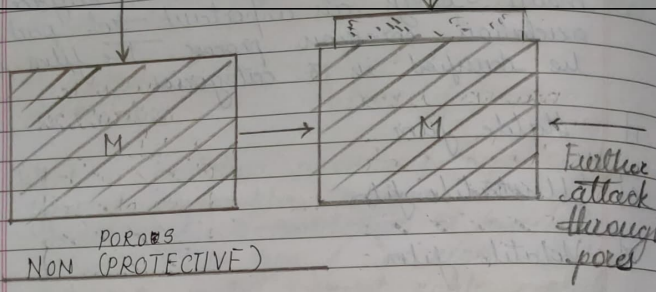
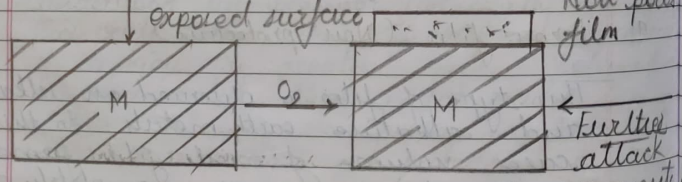
exposed structure porous oxide film



b] NON (PROTECTIVE) POROUS

In this case oxide film form is greater than volume of metal and film is non porous. Due to absence of cracks, the rate of oxidation of metal decreases and metal get protected.

For example : Al, Pb, Cu, Ni - (Tin)

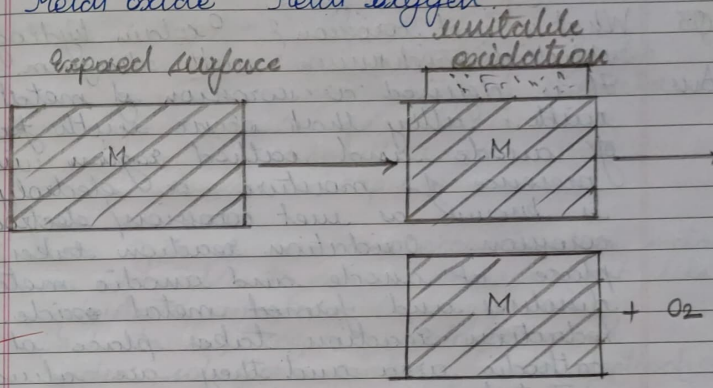


When oxide is unstable and decomposes back into metal and O_2 soon as it is formed.

ii] UNSTABLE FILM

$2M_2O_3 \rightarrow 4M + 3O_2 \uparrow$

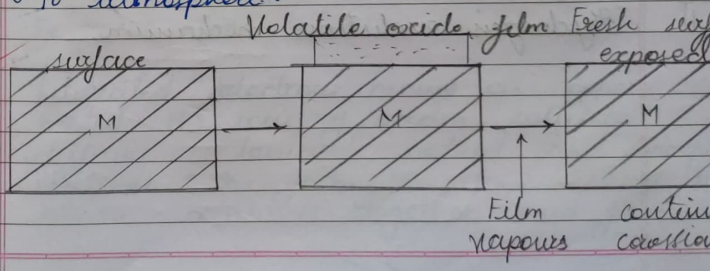
Metal oxide Metal oxygen



Example eg : Alkali Metals, Au, Ag.

iii] VOLATILE FILM

When oxide film is volatile it vapourise as soon as it formed, therefore fresh metal surface is exposed continu to atmosphere.



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Eg: MoO_3 and $SnCl_2$ explain by dry chlorine.

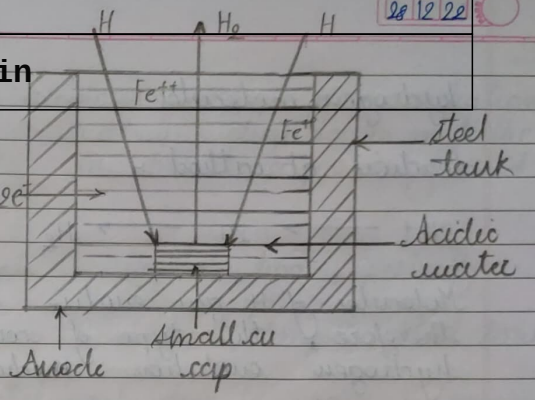
Q8 What is wet corrosion? Explain hydrogen evolution mechanism with diagram.

Ans. It is defined as corrosion of metal with alloy that occur with formation of anode and cathod region in presence of moisture or electrolyte is known as wet corrosion/ electrochemical corrosion. Oxidation reaction takes place at anode and anodic metal dissolves and formed metal oxide. Reduction reaction takes place at cathodic area and they are always protected from corrosion.

- The mechanism of wet corrosion depend on pH of conducting medium.
- The wet corrosion proceed via 2 mechanism

1. Hydrogen evolution mechanism.
2. Oxygen absorption mechanism.

1. Hydrogen evolution mechanism.



$Fe \longrightarrow Fe^{++} + 2e^-$

These type of corrosion occurs when meta are exposed to acidic environment like industrial waste (HCl).
Steel tank, copper plumbing and acidic solution makes an electroche cell. Oxidation potential of steel (iron) is higher than copper. Thus, steel tank behaves as anode while copper behaves as cathod. corosion takes places area (steel tank). The tank liberates electrons and form metal ion

Reaction at anode :-

$Fe \longrightarrow Fe^{++} + 2e^-$

liberated electrons moves on copper metal H^+ ions of acidic solutions diffuses towards cathod and accept electrons to form H atom. Theses H atoms combines together and form

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Hydrogen molecules

Reaction at cathod :-

$2H^+ \longrightarrow 2H \longrightarrow H_2$

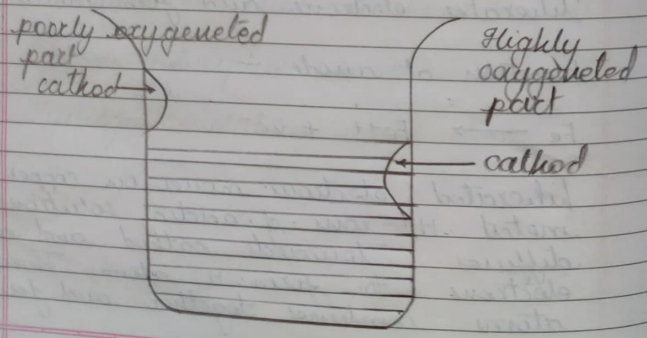
Molecules of H gas evolve over cathod therefore, this type of corrosion called hydrogen evolution mechanism.

Features of Hydrogen evolution mechanism

1. Anodic area is large and cathodic area small.
2. This type of mechanism is possible when metal undergoes acidic corrosive medium.
3. The rate of corrosion is slower than oxygen gas absorption mechanism.

Q4 Explain waterline corrosion.

Ans.



Waterline corrosion is a type of concentration cell. It is mainly observed in metallic installation in which a portion of metal underwater.

For example : ships or boat, partially deeped pipes, pipes, water storage, steel tank

The metal part deep in water is exposed only to dissolved oxygen while part of metal above waterline is exposed to atmosphere oxygen. Due to this it the part of metal under water act as anode and part above water is free from corrosion.

Anode reaction

$Fe \longrightarrow Fe^{2+} + 2e^-$

At cathod

$1/2\ O_2 + H_2O + 2e^- \longrightarrow 2OH^-$

Overall reaction

$Fe^{2+} + 2OH^- \longrightarrow Fe(OH)_2$

Waterline corrosion can be prevented by

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1 It can be avoided by applying the powder coating on metal placed in water. The portion

2 Use alternative materials that are not undergoes oxidation as steel.

3 Steel stainless steel and alluminium metals are better alternatives to minimise corrosion

Q5 Explain Microbial corrosion

Ans In this type of corrosion metal is affected by certain types of microorganism. There are some bacteria that cause microbial corrosion carbon steel, stainless steel, some alluminium alloy, copper alloy in aquous medium. These bacteria are classified into 2 categories

1 Aerobic bacteria

2 Anaerobic bacteria

1 Aerobic bacteria

These bacteria use molecular oxygen & electron acceptor transport process

Example: Sulphate reducing bacteria

accelerate corrosion damage to ships and steel structure.

2 Anaerobic bacteria

These bacteria use molecules or compound other than oxygen as electron acceptor in corrosion process.

Example: Iron and Mn oxidising bacteria are frequently associated with accelarated pitting on stainless steel at welds.

Mechanism

It is caused by specific class of bacteria which develops on nutrients of water and soil. Sea water is main source of SRB. The biological activities changes the nature of surrounding of metal

For example: Iron oxidising bacteria can penetrate 5mm thick stainless steel tank in just over a month.

Prevention

1 Regular mechanical cleaning.

2 Chemical treatment with biocide &

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control growth of bacteria

8 Dry storage.

Tutorial 5

1 Chemical action during corrosion converts metal into metallic components :-

i) Hydroxide ii) Sulphate.
iii) oxide iv) Any of the above.

2 When metal is exposed to slightly alkaline or neutral electrolyte solution. Then corrosion occurs with _____

a) Absorbtion and O_2 b) Evolution of O_2
c) Absorbtion and H_2 d) Evolution of H_2

3 Which of the following is not correct ?

a) Metal which has lower oxidation tendancy behaves as cathod
b) Metal with higher oxidation tendancy behaves as anode.
c) Differentiate in oxidation potential of 2 electrically connected metals is driving force for corrosion.
d) Metal which act as cathod undergoes corrosion anodic metals remains unaffected

4 Which of the following reaction of metal occur in acidic medium ?

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a] $O_2 + 2H_2O \longrightarrow 4OH^-$

b] $2H^+ + O^- \longrightarrow H_2O$

c] $2H^+ + 2e^- \longrightarrow H_2O$

d] $O_2 + 2H_2 \longrightarrow 2H_2O$

5 _____ is technique which reduces corrosion of a metal by taking it as an anode just an inert cathod in the cell.

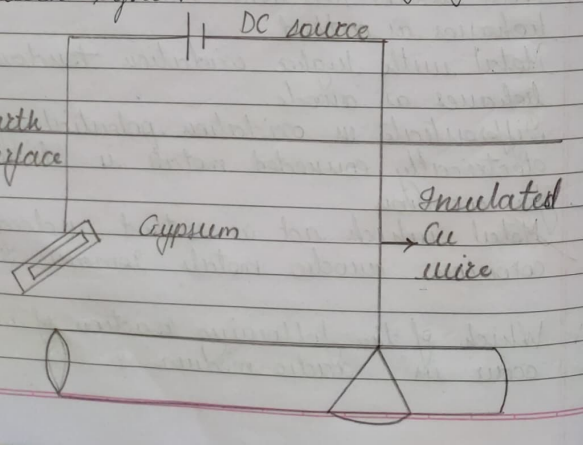
a] Cathodic protection b] Anodic protection

c] Sacrificial anode protection.

d] Impress current protection

Q2 Give construction and working of impress current system

Ans.



In this process a battery or a rectifier DC supply is used as power sour An insoluble electrode (anode) such as graphite block, platinum metal, steel, high silica iron, etc is place in blackfilm. The blackfilm is compo of gypsum.

Metallic structure is connected to -ve terminal of power supply and insoluble anode is connected to +ve terminal. When power supply switched on metallic structure become cathodic and doesn undergoes corrosion.

Application

1 This method is useful when metal is present in highly corosive soil or water and current requirments are high.

2. This method is switched in protection on large metallic structures and long term application.

3 It is applicable in case of open wate box coolers, water tanks, buried pipelines, marine pipelines, etc.

Q3 Explain anodic protection method.

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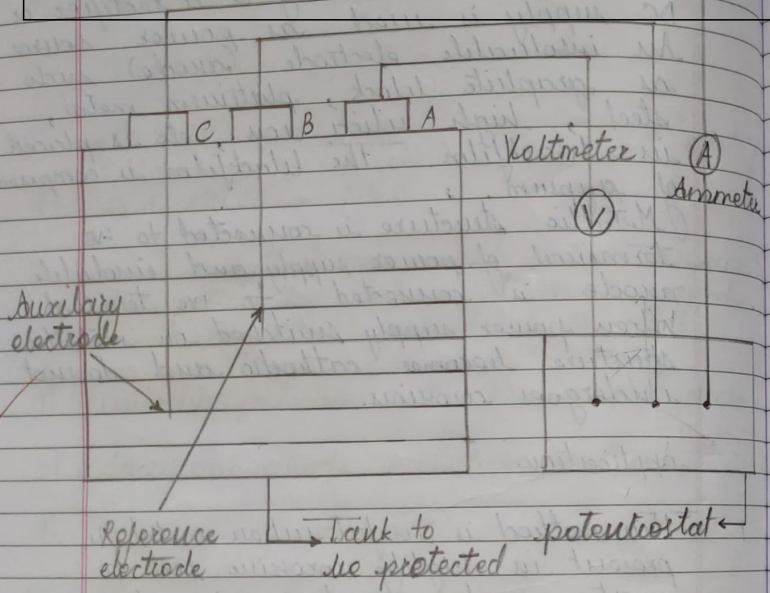

It is a technique in which corrosion of metal reduces by taking it as an anode and an inert cathod in cell. An external anodic current which is of passive range is also applied between anode and cathod to minimize.

Process

This method is suitable for those metals which have active passive behaviour under influence of applied voltage. This process is mostly used case of steel, stainless steel, alluminium. These metals becomes passive and do not react. If an external current (anodic) is applied in careful and controlled manner. The device which is used in this method is called potentiostat. Steel tank is made anodic by connecting it with an inert cathod. A current by potential is applied by potentiostat to minimize corrosion current.

Advantage

1. Operating cost is low
2. Can be applied in highly corrosive environment.
3. Ability to protect large and complex metallic structures.

Limitations

1. This method is applied to metals which shows active passive behaviour.
2. Continuous monitoring is required.
3. High starting current required.

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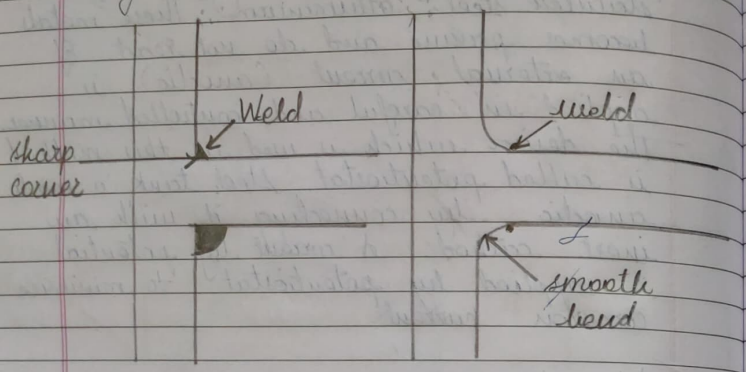
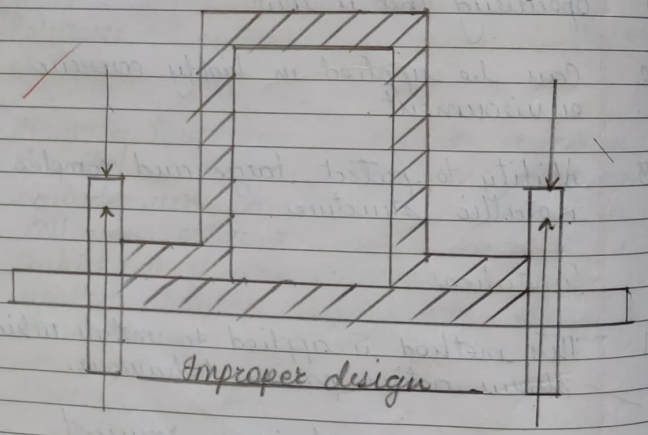
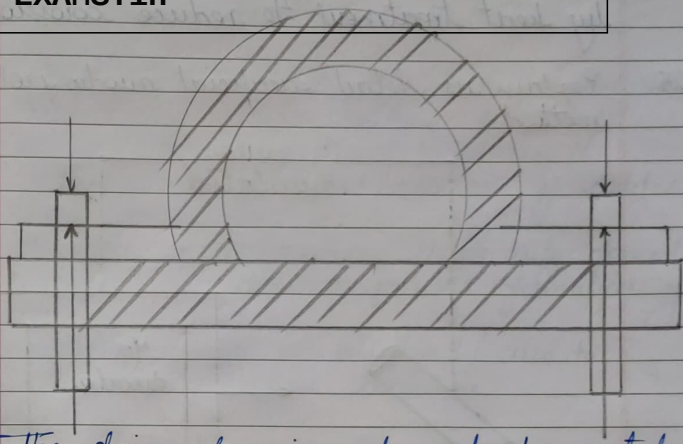
Q4 Explain corrosion control ~~methods~~ by proper design method.



Improper design — Proper design





The design of equipment made by metals plays an important role in corrosion control. Following are possibilities to minimise corrosion.

1. The metallic structure should be proper design in order to minimise rate of corrosion.
2. The structure which doesnot have localised area doesnot undergoes intens corrosion.
3. Equipment should have sharp bends, laps, to joint, to joints, to avoid formation of concentration cell.
4. Tanks and pipelines shouldnot have crevices to avoid differential aeration corrosion.
5. Internal stress of metal can be reduced

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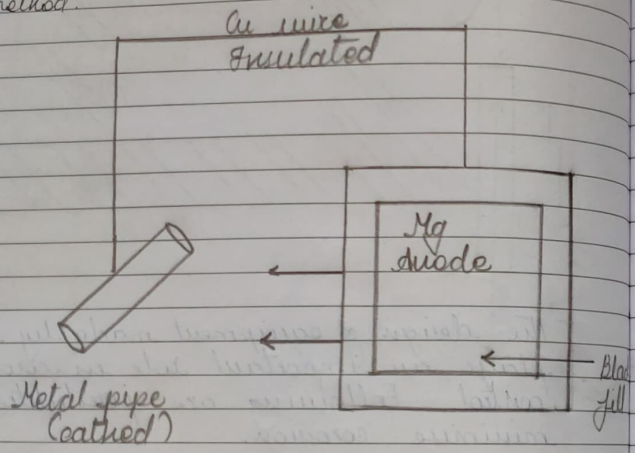
by heat treatment to reduce corrosion.

Q5 Explain in detail sacrificial anodic protection method.



In metallic structure to be protected from corrossion is connected to anodic metal (active) by an insulating wire. The more active metals like Zn, Al, Mg act as anode and gets corroded. Hence, it is known as sacrificial anode. For the purpose of increasing electrical contact, the active metal is placed in backfill (Coal + Nacl). When the sacrificial consumed completely it is replaced by fresh pipe.

Application

1. Protection of buried pipe line, underground cables, storage tanks, base of towers, etc. from soil corrossion.
2. Protection of marine corrossion of cables ship hull, etc.
3. Insertion of magnesium sheets into domestic water boilers to prevent formation of scale.
4. Calcium metal is employed / use to minimise engine corrossion.

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