Date
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CHEMISTRY
Chapter - water Chemistry

Total marks = 100
Internal = 40 — $MST_1 + MST_2$ (each 24), Ass(10M)
External = 60 — 6 Attendance

Absorption and Adsorption
↓ ↓
In the Surface — on the Surface

water
↓ ↓

Soft water
which can produce lather with Soap

Hard water
which cannot produce lather with Soap.

$CO_3^{2-}$ → Carbonate
$HCO_3^-$ → Bicarbonate
$Cl^-$ → Chloride
$SO_4^{2-}$ → Sulphate

Anion → -ve
Cation → +ve

# Hardness → It is a property or Characterisatio of the sample water. It is due to presence of $CO_3^-$, $HCO_3^-$, $SO_4^{2-}$ and $Cl^-$ of $Ca^{2+}/Mg^{2+}$
Hardness unit - mg/l or ppm

Soft water has no impurities.

## Hard water

| Temporary Hardness | Permanent Hardness |
| --- | --- |
| It is due to presence of $CO_3^{2-}$ and $HCO_3^-$ of $Ca^{2+}/Mg^{2+}$. | It is due to presence of $Cl^-$ and $SO_4^{2-}$ of $Ca^{2+}/Mg^{2+}$ |
| Temporary hardness is known as "Carbonate Hardness" | — |
| Easily removed by boiling. | It has a particular method to remove Hardness. |

TEMPORARY

$Ca(HCO_3)_2 \xrightarrow{\Delta} CaCO_3\downarrow + CO_2\uparrow + H_2O$ Soft water.

METHODS TO REMOVE PERMANENT HARDNESS

(i) Lime - Soda Method
(ii) Zeolite
(iii) Ion exchange

unit of hardness = mg/L

= ppm

* $CaCO_3$ as standard due to ppt formed.

## Hardness.

It is property or characterization of water.

Numerical

**Ques** In a water sample having $MgCl_2$ 20mg Hardness in 20 mg/L Calculate the terms of molecular mass

$$\text{Hardness (mg/L) ppm} = \frac{\text{Given Impurity} \times \text{M.M of } CaCO_3 \text{ (standard) (g)}}{\text{Mol. mass of Given Impurity}}$$

$$\Rightarrow \frac{20 \text{ mL/L} \times 100 g}{95 g}$$

$\Rightarrow$

No. of equivalents weight $\Rightarrow \frac{M.M}{n\text{-factor}}$

**Ques** $Ca(HCO_3)_2$ given - 100 mg/L Calculate its Hardness

$40 + 2\times(1+12+48)$    $61$, $122$, $40$, $162$

$$\text{Hardness} = \frac{100}{162} \times 100 \Rightarrow \frac{5000}{81}$$

$$\frac{5 \times 1000}{81} = \frac{10000}{162} \Rightarrow 61.7 \text{ mg/L}$$

Units of Hardness

1. mg/L

2. ppm → $\frac{1 \text{ part of } CaCO_3 \text{ equivalent Hardness}}{10^6 \text{ parts of water}}$

3. °Cl =

$\frac{1 mg \text{ of } CaCO_3 \text{ equ. Hardness}}{1 Lt \text{ of water}}$

1 Lt = 1 Kg = 1000 g = 1000 X 1000 mg

~~1 po~~

3. °Cl = $\frac{1 \text{ part of } CaCO_3 \text{ eq. Hardness}}{70,000 \text{ parts of } H_2O}$

4. °Fr $\frac{1 \text{ part of } CaCO_3 \text{ eq Hardness}}{10^5 \text{ part of } H_2O}$

A Sample of $H_2O$ has Hardness 600 ppm Calculate Hardness in °Fr and °Cl

°Cl = °Clark
°Fr = °French

ppm

1 part of $CaCO_3$ eq Ha
1 part

1 ppm = 1 part of $10^6$ parts of water

1 °Fr 1 part of $10^5$ parts of water

1 °Cl = 1 part of 70,000 parts of water

1 ppm = ~~10^-1~~ $10^{-1}$ °Fr = $7 \times 10^{-2}$ °Cl

600 ppm = 60 °Fr = $600 \times 7 \times 10^{-2}$ °Cl
= 60 °Fr = 42 °Cl

Ques Calculate the temperary & permanent Hardness having a following impurities

I $Mg(HCO_3)_2$ = 7.3 mg/Lt T.H

II $Ca(HCO_3)_2$ = 16.2 mg/Lt T.H

III $MgCl_2$ = 9.5 mg/Lt P.H

IV $CaSO_4$ = 13.6 mg/Lt P.H

T.H = I + II

P.H = III + IV

Calculate hardness
Given : $CaSO_4 = 10ppm$

Calculate $CaCO_3$

$\frac{10\,ppm \times 100}{136}$

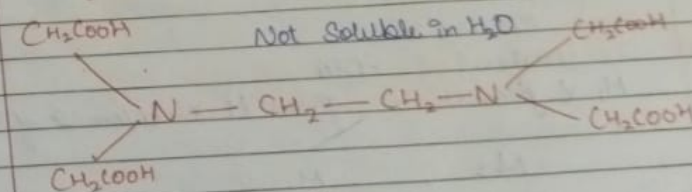
$\frac{1000}{136}$ 7.35

Determination of Hardness of water / EDTA Method / Complexometric Titration.

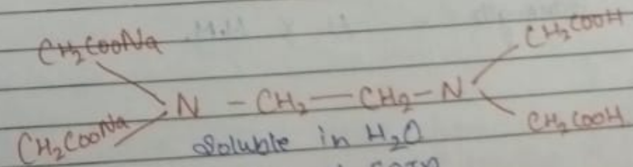
Most of the metal ions react with electron pair donour to form Complex ions. Now the donour species is known as ligand.

EDTA → Ethylene diamine tetra acetate.

Not Soluble in $H_2O$



EDTA



Soluble in $H_2O$

Disodium Salt of EDTA

EDTA is a Hexadentate ligand.

Indicator : EBT (Eriochrome black-T) / (Solochrome black.)
used Indicator

End point → wine Red → Blue

Rxn :→

Ammonia buffer.

$$M^{n+} + EBT \xrightarrow[(pH \sim 11.00)]{NH_3 \text{ buffer}} [M.EBT] \text{ wine Red}$$

$M \to Ca^{2+}/Mg^{2+}$

$\downarrow$ EDTA 0.01 M

$[M.EDTA] + EBT$ Blue

we add $NH_3$ buffer because $rx^n$ become acidic & acidic $s^n$ show nhi kritt is slye

Concordent Reading.

For Calculate Apply Molarity $Eq^n$.

$M_1V_1 = M_2V_2$
water EDTA

$M_1 \times$ given $V_1$ = given M x Given V of EDTA

$M = \_\_\_\_ M$

Strength = M x M.M.

Patent

Disadvantages of Hard water in Domestic and industrial use

Household
- washing
- Cooking.

For Industry.
- Food industry
- Drug

# Boiler Feed $H_2O$

Boiler is a device which is used in various industries to generate steam. water used in boiler for the production of heat, steam is called the Boiler feed water.

Specification for the Boiler Feed water

- It should be free from the Hardness as the har
  If Hard water in Boiler feed $H_2O$ then Problems to be faced.
  There are 4 types of Problems.
  1. Sludge & Scale Problem.
  2. Priming & foaming
  3. Caustic Embrittlement ] * imp
  4. Boiler Corrosion
- It should be free from organic matter eg → oil, grees. to avoid foaming

(iii) Boiler feed $H_2O$ should be free from alkaline impurities.

(iv) It should be free from dissolve gases $CO_2$, $O_2$, $H_2$ etc. other we can face the problem of Boiler Corrosion.

(1.) Problems.

Sludge & Scale → Sludge is
If the precipitates are soft, loose, slimy is Called Sludge.
If the precipitates are hard and Adhering inner walls of Boiler. is Called Scale.

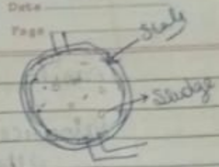
Disadvantages of Sludge.

1.) Low efficiency
2.) Wasting of Fuel.
3.) Explosive due to blockage of & Sludge in pipes by ~~Sludge~~.
4.) wasting of time.

Prevention of Sludge formation.

1.) By using Soft water
2.) By using Blow Down operation. (inlet & outlet of water simply washing.)

Disadvantages of Scale.




1. Low efficiency.
2. wastage of fuel
3. Explode ~~chang~~ chances increases

Prevention of Scale formation.

1.) By using Soft water.
2. By Scratching.

(2.) Priming & Foaming.

when Boiler is producing the steam Rapidly. Some droplets of liq water are ~~called~~ Carried along with steam.

Priming is Caused By:

→ Hard water.
→ Improper ~~Degin~~ designing.
→ No proper washing.

Prevention of Priming.

→ use Soft water
→ & Design properly.
→ By proper washing.

3. Foaming → The formation of foam or bubble at Surface of water in boiler which donot break & dissolve continuing

easily is called foaming

Resource → Soap, oil, greece and alkaline impurity

Prevention

1) By the addition of Coagulant.
of Coagulant
Eg → Sodium Aluminate, Ferrous Sulphate ($FeSO_4$)

2. Foaming can be prevented by antifoaming agent.

Problem.

• Difficulty in level Judge.

OIL — Loss of electron
RIG — Reduction Increase Gain of electron

(4) Boiler Corrosion. (Imp.)

It is decay of Boiler material due to Chemical or Electrochemical reaction with its Environment. Now Corrosion takes place due to the attack of Certain Chemical on boiler Surface. Thereby Rusting the boiler material.

• Boiler Corrosion is due to the following factor.

1) Dissolved $O_2$

water has dissolved $O_2$ which attacks the boiler body as the boiler is made up of iron.

$$4Fe + 2O_2 + 4H_2O \longrightarrow \underset{\text{Ferrous Hydroxide}}{4Fe(OH)_2}$$

$$4Fe(OH)_2 + O_2 \longrightarrow \underset{\text{Rust}}{2[Fe_2O_3 \cdot 2H_2O]}$$

Removal of dissolved oxygen.

• By Mechanical de-aeration (By Creating vaccum)
• By adding Hydrazine ($N_2H_4$), Sodium Sulphite ($Na_2SO_3$), Sodium Sulphide ($Na_2S$).

~~By adding Hydrazine~~

because all these consume oxygen by following reaction :-

$N_2H_4 + O_2 \longrightarrow N_2\uparrow + 2H_2O$

$Na_2SO_3 + \frac{1}{2}O_2 \longrightarrow Na_2SO_4$

~~$Na_2SO$~~

$Na_2S + 2O_2 \longrightarrow Na_2SO_4$

* Dissolved Carbon Dioxide.

Carbon dioxide in water ~~dissolve~~

$CO_2 + H_2O \longrightarrow H_2CO_3$

Removal of $CO_2$.

- Vaccum Create.
- Carbon dioxide in Boiler $H_2O$ form

$CO_2 + H_2O + NH_3 \longrightarrow (NH_4)_2CO_3$
Ammonium Carbonate

-

☆ Mineral acids :-

water has dissolved salt like $MgCl_2$ which on hydrolysis which release

→ Mineral acid

$MgCl_2 + H_2O \longrightarrow Mg(OH)_2 + 2HCl$.

The liberated HCl Reacts with iron walls of Boiler to form Rust

$HCl + Fe \longrightarrow FeCl_2 + H_2\uparrow$

$FeCl_2 + H_2O \longrightarrow Fe(OH)_2$ Ferric.

$Fe(OH)_2 + \cancel{H_2}O_2 \longrightarrow [Fe_2O_3 \cdot 2H_2O]$

- Removal of Acid.

Mineo Mineral acid.

Caustic Embrittlement.

3. Phosphate Conditioning

In high pressure boiler Sodium Phosphate ($Na_3PO_4$) is added to hard water which forms

~~$H_2O$ + $CaCl_2$ ⟶ $Ca(OH)_2$~~

$Na_3PO_4 + CaCl_2 \longrightarrow NaCl +$ Calcium Phosphate ↓

The soft sludge can be removed by blow down operation.

4. Calgon Conditioning

- In this method Calgon (Sodium Hexa-Metaphosphate) [ $Na_2[Na_4(PO_3)_6]$ ] is added to the boiler water. Calgon converts scale forming salt into Soluble Complex.

$Na_4(PO_3)_6] \rightleftharpoons 2Na^+ + [Na_4(PO_3)_6]^{2-}$

$)_6] + CaSO_4 \longrightarrow Na_2SO_4 + [Ca(PO_3)_6]$

Soluble Complex of Calcium

Or

Calgon + $CaSO_4$ ⟶ Soluble Complex of Calcium

Soluble Complex remain in the dissolved form in water without causing any harmful to the boiler.

* Treatment with Sodium Aluminate.

Silica can be removed by coagulant. for eg. Sodium Aluminate, Ferrous Sulphate ($FeSO_4 \cdot 7H_2O$). These release Aluminium Hydroxide ($Al(OH)_3$) and $Fe(OH)_3$ which can trap the silica particle.

Sodium $NaAlO_2 + H_2O \longrightarrow NaOH + Al(OH)_3$

$FeSO_4 + H_2O \longrightarrow Fe(OH)_3$

Sodium Hydroxide form the precipitate of Magnesium Salt.

$MgCl_2 + NaOH \longrightarrow NaCl +$ ~~MgOH~~ $MgOH$.

5. Electrical Conditioning.

6. Radioactive Conditioning

## External Treatment

1. Lime - Soda Method.
( $Ca(OH)_2$ ) + $Na_2CO_3$

(i) Removal of Calcium bicarbonate $Ca(HCO_3)_2$

$Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow 2CaCO_3\downarrow + 2H_2O$

For the removal of 1 mole of Calcium bicarbonate.

1 mole of lime required.

Molecular mass $Ca(OH)_2$ 40 + 32 + 1

$Ca(HCO_3)_2 = 162$.

(ii) Removal of Magnesium bicarbonate

$Mg(HCO_3)_2 + Ca(OH)_2 \longrightarrow Mg(OH)_2\downarrow + Ca(HCO_3)_2$

$Ca(HCO_3)_2 + Ca(OH)_2 \longrightarrow 2CaCO_3\downarrow + 2H_2O$.

Overall $rx^n$

$Mg(HCO_3)_2 + 2Ca(OH)_2 \longrightarrow Mg(OH)_2 + 2CaCO_3\downarrow + H_2O$

1 mole    2 mole of lime

(iii) Removal of Calcium chloride ( $CaCl_2$ )

$CaCl_2 + Ca(OH)_2 \longrightarrow$ X

$CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaCl$.

we use one mole of Soda.

(iv) Removal of Calcium Sulphate.

$CaSO_4 + Na_2CO_3 \longrightarrow CaCO_3\downarrow + Na_2SO_4$

we use one mole of soda.

20 + 32 +

(v) Removal. $MgCl_2$

$MgCl_2 + Ca(OH)_2$

(7.) Removal of Dissolved gasses ($CO_2$ & $H_2S$) Hydrogen Sulphide

$CO_2 + Ca(OH)_2 \longrightarrow CaCO_3 \downarrow + H_2O$

1 mole of lime is required

$H_2S + Ca(OH)_2 \longrightarrow CaS + H_2O$

(8) Removal of Mineral Acid. $H_2SO_4$ / $HCl$.

$2H^+ + Ca(OH)_2 \longrightarrow Ca^{2+} + 2H_2O$

$\cancel{Ca^{2+}} + Na_2CO_3 \rightarrow CaCO_3 \downarrow + 2Na^+$

Overall rxn. $2H^+ + Ca(OH)_2 + Na_2CO_3 \longrightarrow CaCO_3 \downarrow + 2Na^+ + 2H_2O$

1/2 mole of lime + 1/2 mole of Soda is used.

(9.) Removal of Ferrous Sulphate $FeSO_4 \cdot 7H_2O$

$FeSO_4 + Ca(OH)_2 \longrightarrow Fe(OH)_2 + \cancel{CaSO_4}$

$\cancel{CaSO_4} + Na_2CO_3 \longrightarrow CaCO_3 + Na_2SO_4$

Overall Rxn

$FeSO_4 + Ca(OH)_2 + Na_2CO_3 \longrightarrow CaCO_3 + Fe(OH)_2 + Na_2SO_4$

(10) Removal of $Al_2(SO_4)_3$.

$Al_2(SO_4)_3 + 3Ca(OH)_2 \longrightarrow 2Al_2(OH)_3 + \cancel{3CaSO_4}$

$\cancel{3CaSO_4} + 3Na_2CO_3 \longrightarrow 3 \downarrow CaCO_3 + 3Na_2SO_4$

$Al_2(SO_4)_3 + 3Ca(OH)_2 + 3Na_2CO_3 \longrightarrow 2Al_2(OH)_3$

imp * Lime $Ca(OH)_2$ & Soda ($Na_2CO_3$).

$2NaHCO_3 + Ca(OH)_2 \longrightarrow CaCO_3 \downarrow + Na_2CO_3$

1/2 mole of $Ca(OH)_2$ is used. - 1/2 mole of Soda.

(11) Removal of Sodium Aluminate. ($NaAlO_2$)

not React with lime & Soda.

$NaAlO_2 + H_2O \longrightarrow Na(OH) + Al(OH)_3$

one molecule of lime = can release 2 moles of Hydroxide ion $OH^-$

1 molecule of NaOH can release 1 mole of $OH^-$ ion.

$-\frac{1}{2}$ Mole.

Calcium hydroxide.

$Ca(HCO_3)_2$ = 1 mole of lime

$Mg(HCO_3)_2$ = 2 mole of lime

$CaCl_2$ 1 mole of Soda

$CaSO_4$ 1 mole of Soda

$MgCl_2$ 1 mole of lime & Soda.

$MgSO_4$ 1 mole of lime & Soda.

$Ca(OH)_2$

$CaCO_3 = Ca(OH)_2$

M.M = 100 74

74 ml of $Ca(OH)_2$ = 100 ml of $CaCO_3$.

lime req. = $\frac{74}{100}$ = 0.74.

## Lime and Soda

* Lime Requirement $= \frac{74}{100}\left[Ca(HCO_3)_2 + 2Mg(HCO_3)_2 + Mg^{2+} + CO_2/H_2S + \frac{1}{2}H^+ + FeSO_4.7H_2O + 3Al^{3+} + \frac{1}{2}HCO_3^- - \frac{1}{2}\right]$

* Soda Requirement $= \frac{106}{100}\left[CaCl_2/CaSO_4 + Mg^{2+} + \frac{1}{2}H^+ + FeSO_4.7H_2O + 3Al^{3+} - \frac{1}{2}HCO_3^-\right]$

Numerical

(1) Calculate the amount of lime required for the Softening of 5000 L of Hard water containing 72 ppm of $MgSO_4$
mg/lt

Hardness →

$\frac{\cancel{72}^{36}}{\cancel{120}_{\cancel{6}_3}} \times \cancel{100}^{5} = 60$ mg/lt.

lime requirement for the Softening the 5000 lt of water.

[74 - lime M.M, 100 - $CaCO_3$ M.M]

Lime required $= \frac{74}{100} \times 60$ mg/lt $\times 5000$ lt

1 mole × Hardness × given volume

$= \frac{222000}{100}$

Calculate for Soda

$\frac{106}{100} \times 60 \times 5000$ $\quad 106 \times 30 \times 100$

$318 \times 10^3$ mg

$= \frac{318 \times 10^3}{10^6}$ kg

$0.318$ kg.

* $Ca^{2+} = 60$ ppm.
2nd Impurity $Mg^{2+} = 84$
3rd Impurity $HCO_3^- = 140$

$FeSO_4.7H_2O = 80$

Calculate amount of lime required for Softening 12,000 of water.

Soln

| S.No. | Given Impurity ppm/mg/lt | Hardness mg/lt (formula) | Lime requirement | Soda requirement |
|---|---|---|---|---|
| 1 | $Ca^{2+} = 60$ | $\frac{60 \times 100}{40} = 150$ | X | S |
| | | | $L = 350$ | S. |
| 2 | $Mg^{2+} = 84$ | $\frac{84 \times 100}{24} = 350$ | $\frac{229.5}{2} = 114.7$ | |
| 3 | $HCO_3^- = 140$ | $\frac{140 \times 100}{61} = 229.5$ | $\frac{1}{2}$ Lime | $\frac{1}{2}$ S. |
| 4 | $FeSO_4.7H_2O = 80$ | $\frac{80 \times 100}{278} = 28.77$ | L | 1 S. |

34.

Lime required for Softening of 12,000 lt of Water

$$\frac{74}{100}\left[493.5\,mg/lt \times \frac{12000\,lt}{10^6}\right] kg$$

$$= 4.381\ kg$$

Soda Required for Softening of 12,000 lt of $H_2O$

$$\frac{106}{100} \times \frac{414.1}{10^6} \times 12000$$

$$\Rightarrow 5.267\ Kg\ Ans$$

Lime

Purity (90%) (90%)

Ques Calculate the lime and soda for 25,000 lt of $H_2O$. Calc. Impurity

| S.No. | Impurity | Hardness | Lime req. mg/lt | Soda req. |
|---|---|---|---|---|
| 1 | $Ca(HCO_3)_2 = 4.86$ | $\frac{4.8 \times 100}{162} = 3$ | $1 \times 3 = 3$ | X |
| 2 | $Mg(HCO_3)_2 = 7.30$ | $\frac{7.30 \times 100}{146} = 4.93$ | $2 = 9.86$ | X |
| 3 | $CaSO_4 = 6.80$ | $\frac{6.80 \times 100}{136} = 5$ | X | $1 \times 5 = 5$ |
| 4 | $MgCl_2 = 5.70$ | $\frac{5.70 \times 100}{95} = 6$ | $1 \times 6 = 6$ | $1 \times 6 = 6$ |
| 5 | $MgSO_4 = 9$ | $\frac{9 \times 100}{120} = 7.5$ | $1 = 7.5$ | $1 \times 7.5 = 7.5$ |
| | | Total | 26.36 | 18.5 |

40 + 32 + 64
136

$$lime = \frac{74}{100} \times \frac{26.36 \times 25{,}000}{10^6} = 0.49$$

$$Soda = \frac{106}{100} \times 18.5 \times 25{,}000$$

Coagulant

Calculate the amount of lime. 95% purity for the softening 1M lt water and Soda. 85%)

| S.No. | Impurity | ppm ~~Hard~~ | Hardness | L | R |
|---|---|---|---|---|---|
| 1 | $Ca(HCO_3)_2$ | 35 | $\frac{35 \times 100}{162}$ | | |
| 2 | $MgSO_4$ | 20. | $\frac{20 \times 100}{120}$ | | |
| 3 | $CaSO_4$ | 25 | $\frac{25 \times 100}{136}$ | | |
| 4. | $Mg(HCO_3)_2$ | 30. | $\frac{30 \times 100}{146}$ | | |
| 5. | $CaCl_2$ | 27 | $\frac{27 \times 100}{111}$ | | |
| 6 | ~~KCl~~ | 10 | | | |
| 7 | $SiO_2$ | 20 | | | |
| 8. | NaCl | 10 | | | |

$Na_2O \cdot Al_2O_3 \cdot xSiO_2 \cdot yH_2O$

Zeolite method.

Content: Intro, mineral, structure, Explanation, Chem. rxn, Adv. limitation, regeneration

Chemical

$Na_2\boxed{O \cdot Al_2O_3 \cdot xSiO_2 \cdot yH_2O}$ → denoted by Z.

~~Sodium oxide Aluminium~~

Zeolite are the natural occurring hydrated Sodium Aluminium silicate where x lie b/w 2 to 10 and y lie b/w 2 to 6.

→ $Na_2Z$ ] formula of zeolite.

$Ca(HCO_3)_2 + Na_2Z \rightarrow CaZ\downarrow + 2NaHCO_3$.

$Mg(HCO_3)_2 + Na_2Z \rightarrow MgZ\downarrow + 2NaHCO_3$.

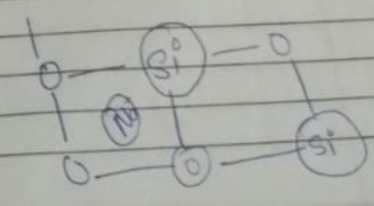
$CaCl_2 + Na_2Z \rightarrow CaZ\downarrow + 2NaCl$.

$MgCl_2 + Na_2Z \rightarrow MgZ + 2NaCl$

$CaSO_4 + Na_2Z \rightarrow CaZ + Na_2SO_4$.

$MgSO_4 + Na_2Z \rightarrow MgZ + Na_2SO_4$.

(Long Ques → Degeneration).



boiler Corrosion
Caustic embrittlement ] 4 Marks.

# Desalination of

It is process of removal of salt from water.

Techniques →

1. Boiling
2. Reverse osmosis.
3. Freezing.
4. Electrodialysis.

anode
LOANC
Left oxidation

OIL RIG
Loss of $e^-$ oxidation
Gain of $e^-$ reduction

1. Reverse Osmosis.

# Water for the Domestic use.

| Impurity | Process |
|---|---|
| Floating matter (leaves, ---) | Screening or filtration |
| Suspended impurity (sand, clay). | ~~Sepd~~ Sedimentation |
| fine Suspenden dord ( | By using Coagulan Sedimentation with Coagulation |
| Microorganism & | |
| Pathogen & | |

Imp Ques 2 Marks
Disinfection of water.
Disinfectant

The Substance or Chem. used for distroying or killing the Pathogen bacteria, micro-organism, etc. from water to make it safe for the use is called the disinfectant and the process is called Disinfection.

Methods for the disinfection of water,

- Boiling
- Chlorination
- By using the Bleaching powder.
- Alum.

- Ozonation
- By using UV rays.
- By using $KMnO_4$.

→ Chlorination

$Cl_2 + H_2O \longrightarrow HCl + HOCl$

$HOCl + \cancel{H_2O} \longrightarrow HCl + [O]$ Nacent oxygen.

$[O]$ + Germs → Killing Action.
Nacent Oxygen.

By Bleaching Powder - $(CaOCl_2)$ Ca-OH

$CaOCl_2 + H_2O \longrightarrow Ca(OH)_2 + Cl_2 + HCl$

the same ↑

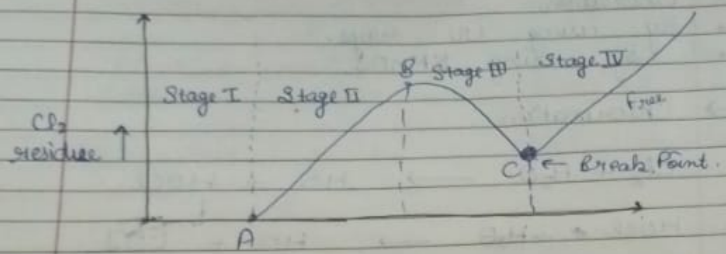
By chloramine tablets: $(ClNH_2)$

$ClNH_2 + H_2O \longrightarrow HOCl + NH_3\uparrow$ (Ammonia)

→ Break point ★

M.A = $\frac{1}{2}$ 1, 1, $\frac{1}{2}$ 3.

Al 31, 35. $HCO_3^-$ → $\frac{1}{2}$ 1, 1, $\frac{1}{2}$




It means the chlorination of water to such an extent and living organism as well as other organic impurities in water.

Stage I [O→A]

Initially less amount of Chlorine → There is no residual. All the added chlorine gets consumed for doing the complete oxidation or Reducing Substances (Fe, Nitrate, etc.)

Stage II [A-B]

As amount of Chlorine addition increase amount of residual is also increase. At this Stage the formation of Chloroorganic Compound without oxidising.

Diffs Soft, Temp, 1
Caustic, Boiler Corrosion, Internal → Comparison, Calgon Condition
Exter → Zeolite, Ion exchange, Lime Soda, Numerical.
→ Electrodyalysis
→ Disinfectant

Stage - III B→C.

At Point B bad smell of chlorine is Started. Higher dose of Chlorine is applied. oxidation of organic Compound and microorganism occur. of the amount of residual chlorine

Point C. Stage IV. after the the point C If we added its chlorine is free residual. (Break Point)