



TRINITY
Institute of Technology & Research

ENGINEERING CHEMISTRY (BT101)

TOPIC : POLYEMER

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Polymers-

Q. Write the preparation, properties & use of the following:-

- 1). Polythene
- 2). Teflon
- 3). PVC
- 4). PMMA
- 5). Nylon
- 6). Bakelite

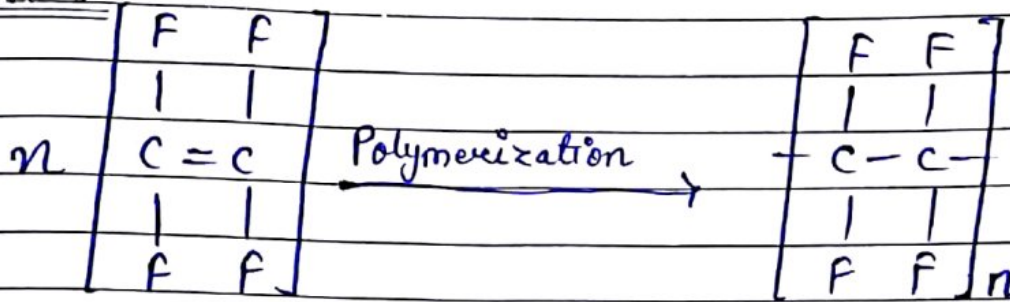
1) Polythene:- Polythene is manufactured by ethylene.

Manufacture:-

In High pressure -

In higher pressure processing oxygen or peroxides are used as catalyst. In first step methane is removed from ethylene. After removing methane free radical yielding catalyst like peroxide is added to the ethylene. Now it is compressed to the operating pressure (1000 to 5000 atm) and fed to the tubular reactor which is maintained at a temperature of 190°C . The effluent from the reactor is passed to a high pressure separator where unconverted ethylene is removed and recycled.

Teflon is~



Tetrafluoroethylene

Polytetrafluoroethylene (Teflon)

Polytetrafluoroethylene is prepared by polymerization of water emulsion of tetrafluoroethylene, under pressure in presence of benzoyl peroxide as catalyst. It is also called FLOON.

Properties is~

Due to the presence of highly electronegative fluorine atoms, there are very strong attractive forces between different chains. These strong attractive forces are responsible for its excellent toughness, high density, excellent electronic electrical insulation properties & very low coefficient of friction.

Uses is~

- 1) PTFE or teflon is used as insulating material.
- 2) It is used for making gaskets, packings pump parts, tank linings.
- 3) It is used for coating of frying pans.
- 4) It is used for non-lubricating bearings.

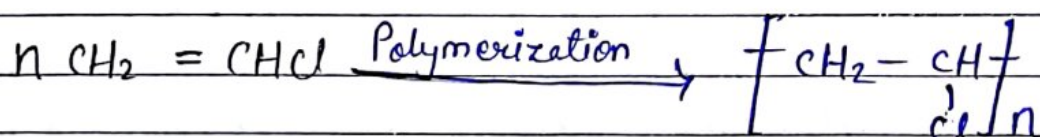
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PVC

Preparation :-

It is obtained by heating a water emulsion of vinyl chloride in the presence of small amount of hydrogen peroxide or benzoyl peroxide in an autoclave.



& Vinyl chloride

is polyvinyl chloride.

properties :-

- i) The C-Cl dipole makes PVC a polymeric polar molecule, but because of the immobility of the dipole at room temperature, power factor of PVC is comparatively low.
- ii) PVC is colourless, odourless, non-inflammable & chemically inert powder.
- iii) It has excellent oil resistance.

Uses :-

- i) Rigid PVC have superior chemical resistance & high rigidity but is brittle.
- ii) It is used for tank linings, linings, light fitting safety helmets, tyres.
- iii) It has excellent resistance.

PMMA:-

PMMA is obtained by polymerization of methyl methacrylate. It is an acrylic polymer.



Properties:-

PMMA is hard, fairly rigid material with a high softening point at about 130-140°C but it become rubber like at a temperature above 65°C. It has optical transparency, high resistance to sunlight & ability of transmitting light completely.

Uses:-

for making lenses, aircraft light fixtures, bomber noses, gun turrets, cockpit canopies, emulsion, paints

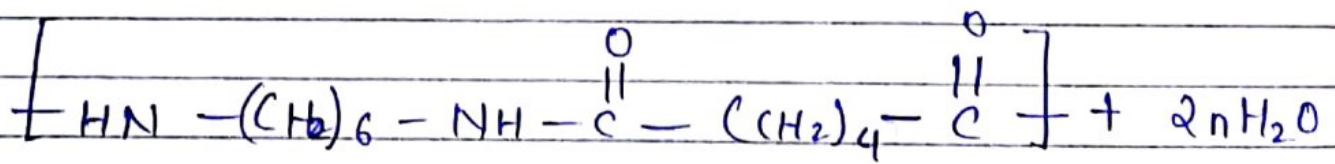
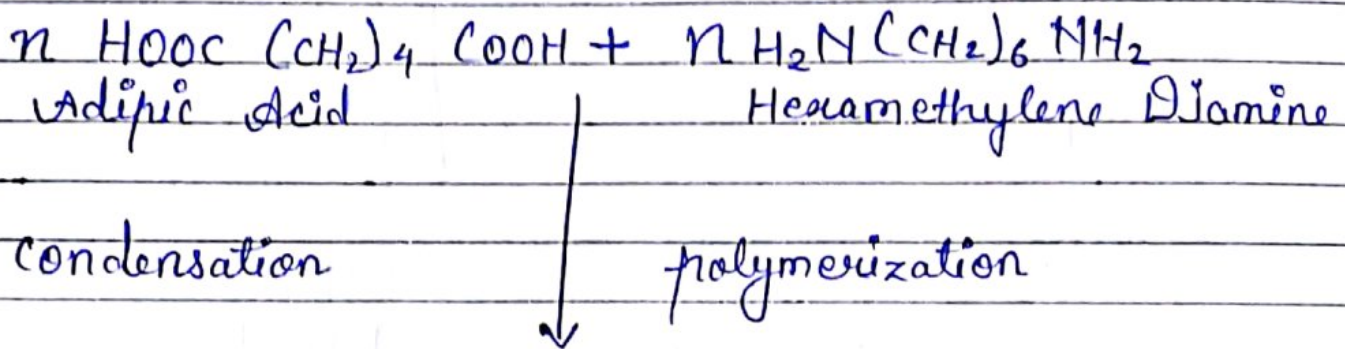
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Nylon 6:6 -

Preparation:

It is prepared by the condensation polymerization of adipic acid & hexamethylene diamine in 1:1 ratio.



Nylon 6:6

Properties:

They are translucent, horny, high melting polymers. They possess high temperature stability and good abrasion resistance. They are insoluble in organic solvents.

Uses:

Nylon 6:6 is primarily used for fibers, which find uses in making socks, dresses, carpets etc. Nylon 6:6 are mainly used for moulding purpose for gears, bearings etc.

Bakelite is

Preparation -

phenol formaldehyde resin is commercially known as bakelite. It is prepared by condensation of phenol with formaldehyde in presence of acidic or alkaline catalyst. The initial reaction results in the formation of O- & P hydroxy methyl phenol which react to form linear polymer.

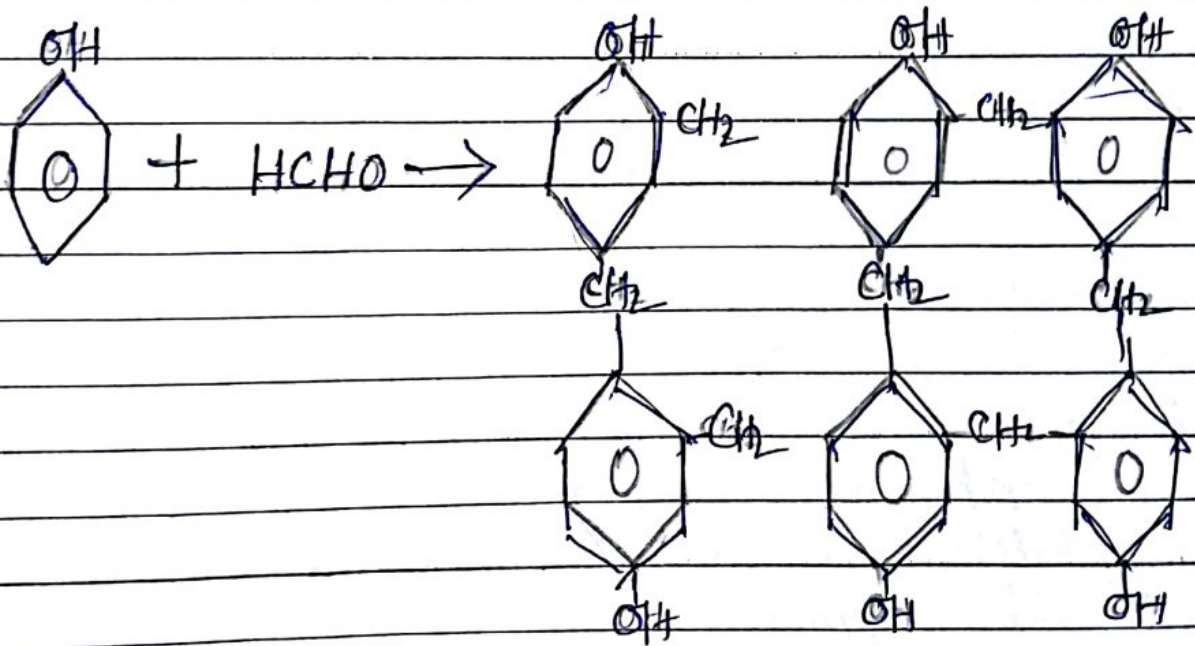
Properties is

Bakelite set to rigid, hard, scratch-resistant, infusible, water resistance resistant insoluble solids which are resistant to non-oxidizing acids, salts & many organic solvents, They possess excellent electrical insulating character.

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Uses :-

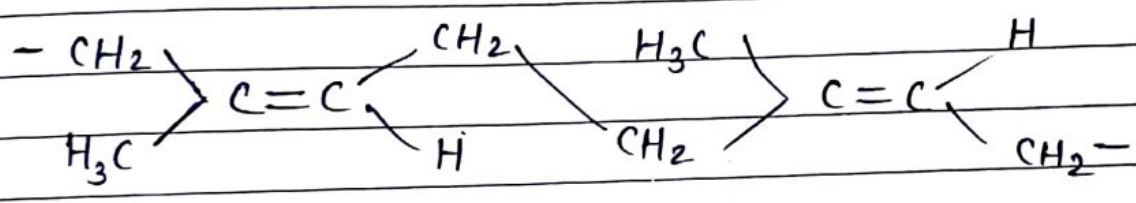
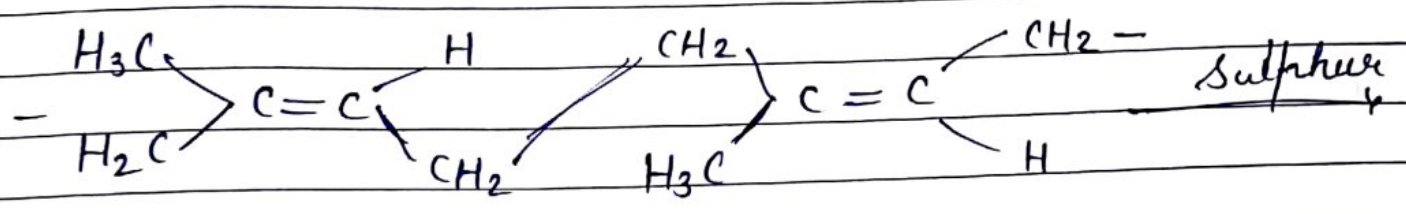
- 1) It is used as an adhesive for grinding wheels.
- 2) It is used for making bearings, used in propeller shafts for paper industry.
- 3) It is used in paints & varnishes.
- 4) It is used for impregnating fabrics.



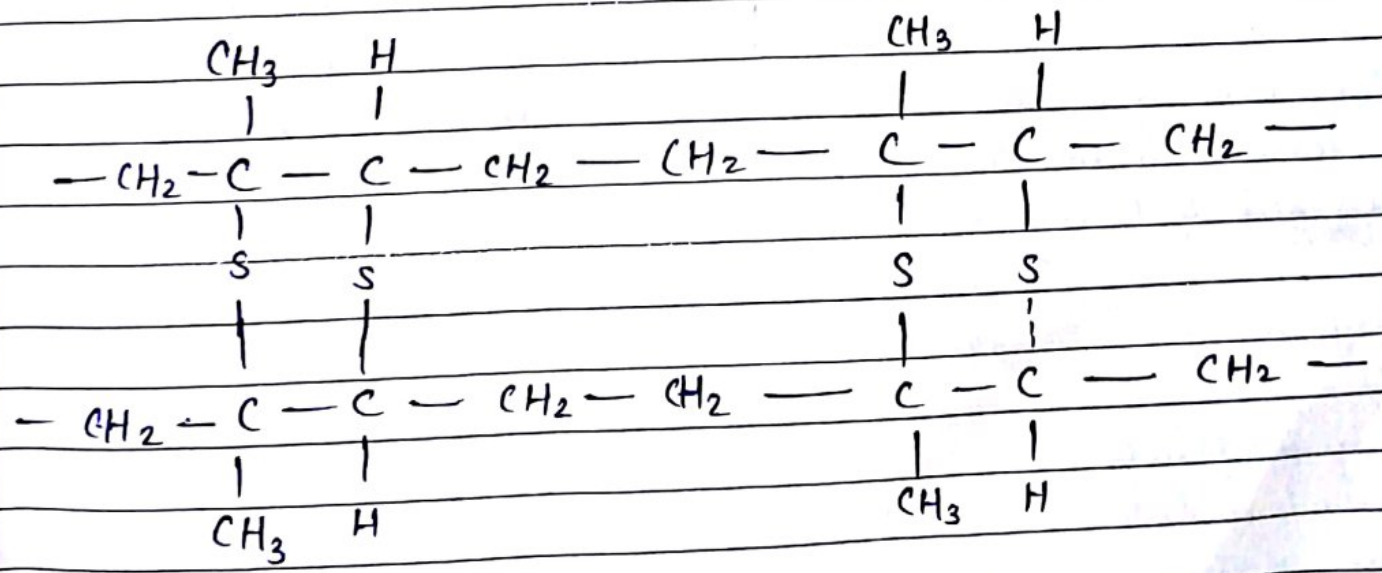
(Bakelite)

Vulcanization of rubber

The process in which heating raw rubber in presence of sulphur or dipping it in a solution of S_2Cl_2 in CS_2 is called vulcanization



Unvulcanized rubber springs



Vulcanized Rubber.

All the drawbacks are removed by vulcanization of Rubber. Vulcanized-Rubber, has more elasticity, less plasticity.

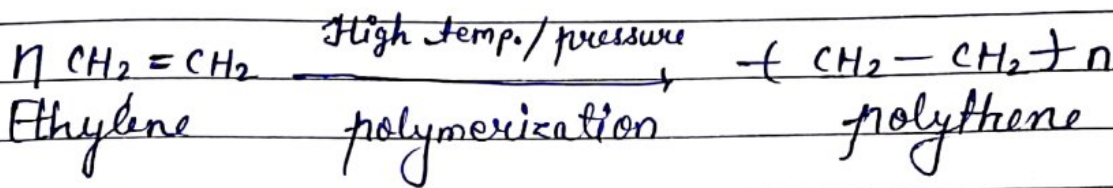
Applications :-

- 1) It is used in manufacture of tyres used in bicycle, automobiles & aeroplanes, v-belts
- 2) Rubber gaskets are used for sealing many types of equipments such as cookers, oven doors,
- 3) It is also used in making toys, sports.

Thermoplastic polymers	Thermosetting polymers
1. They have low molecular weight.	High molecular weight
2. These are usually soluble in some organic solvents.	These are insoluble in almost all organic solvents due to strong bonds & consist in their shape & structure.
3. By heating to a temp. they can be softened & reshaped & thus reused	They retain their shape & structure even on heating.
4. Nylon, PVC, polythene.	
5. They consist of long chain linear polymers with negligible cross crosslinks.	Bakelite, Teflon, PMMA They have three-dimensional network structure.

Q What do you mean by polymerization?

Ans- The chemical reaction in which two or more simple and small molecules combined in a regular manner & form a giant molecule is called polymerization reaction.



In polymerization reaction, giant molecule formed is called polymer & small molecules which are participating in polymerization is called monomer.

Q Explain Condensation & addition polymerization?

Addition Polymerization -

The polymerization reaction in which the polymer formed by the direct addition of repeated monomer units is called addition polymerization & the polymer formed is called addition polymer.

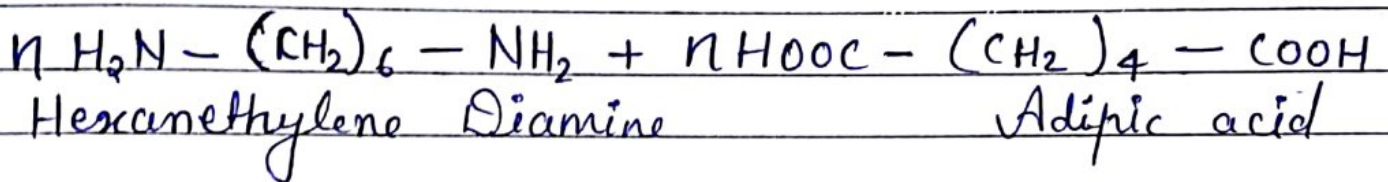


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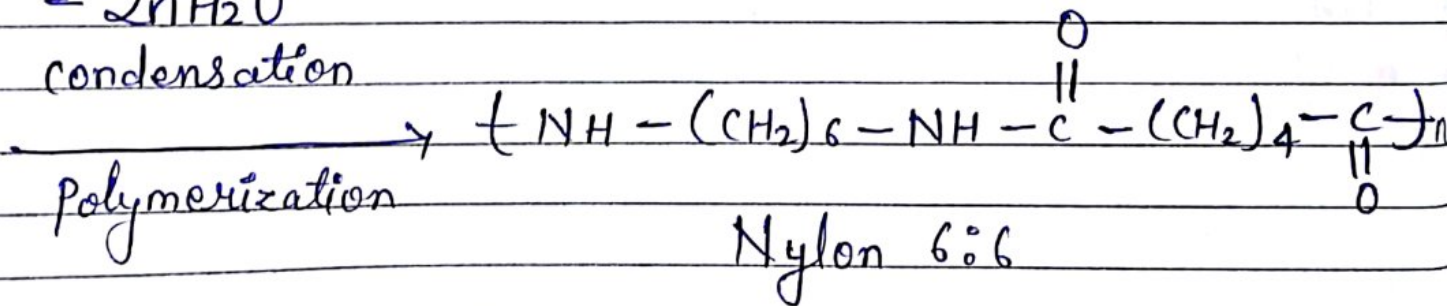
Condensation Polymerization -

The polymerization reaction in which the polymer is formed by the condensation of two or more monomers is called condensation polymerization & the polymer formed is called condensation polymer.



- 2nH₂O

condensation



UNIT - I

Water - Analysis, Treatments & Industrial Applications.

Q. - Write short note on sludge.

Ans - Sludge is a loose and slimy ppt which adheres in the inner wall of the boiler, it can be removed by wire brush. It is the bad conductor of heat. It is caused by the use of hard water in boiler.

Scale →

Scale is a hard crust layer formed in the inner wall of boiler. It is caused by the use of ~~hard~~ hard water in the boiler. It is the bad conductor of heat.

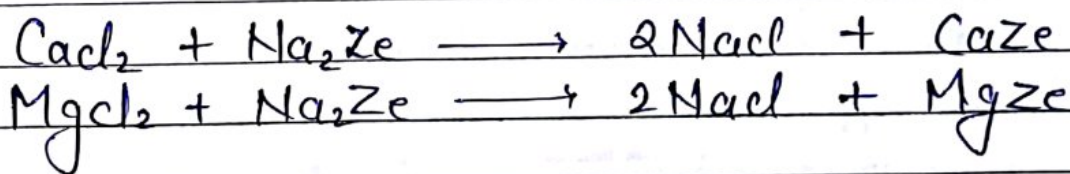
Foaming :-

It is phenomenon which is caused due to the presence of oil in the boiler feed water. It decreases the efficiency of boiler.

- percolate : feed water drop wise
- $\text{CaCl}_2 + 2\text{Na}_2\text{Ze} \longrightarrow 4\text{NaCl} + \text{Mgze} + \text{CaZe}$
 hard water brine solution

- Brine solution ; ~ 100% of NaCl solution
 It is used to re-generate Na zeolite because after some time Na-zeolite is exhausted.

In these method the hard water is percolated from the top of the instrument, when hard water reaches on the Na_2Ze bed, the following reaction takes place.

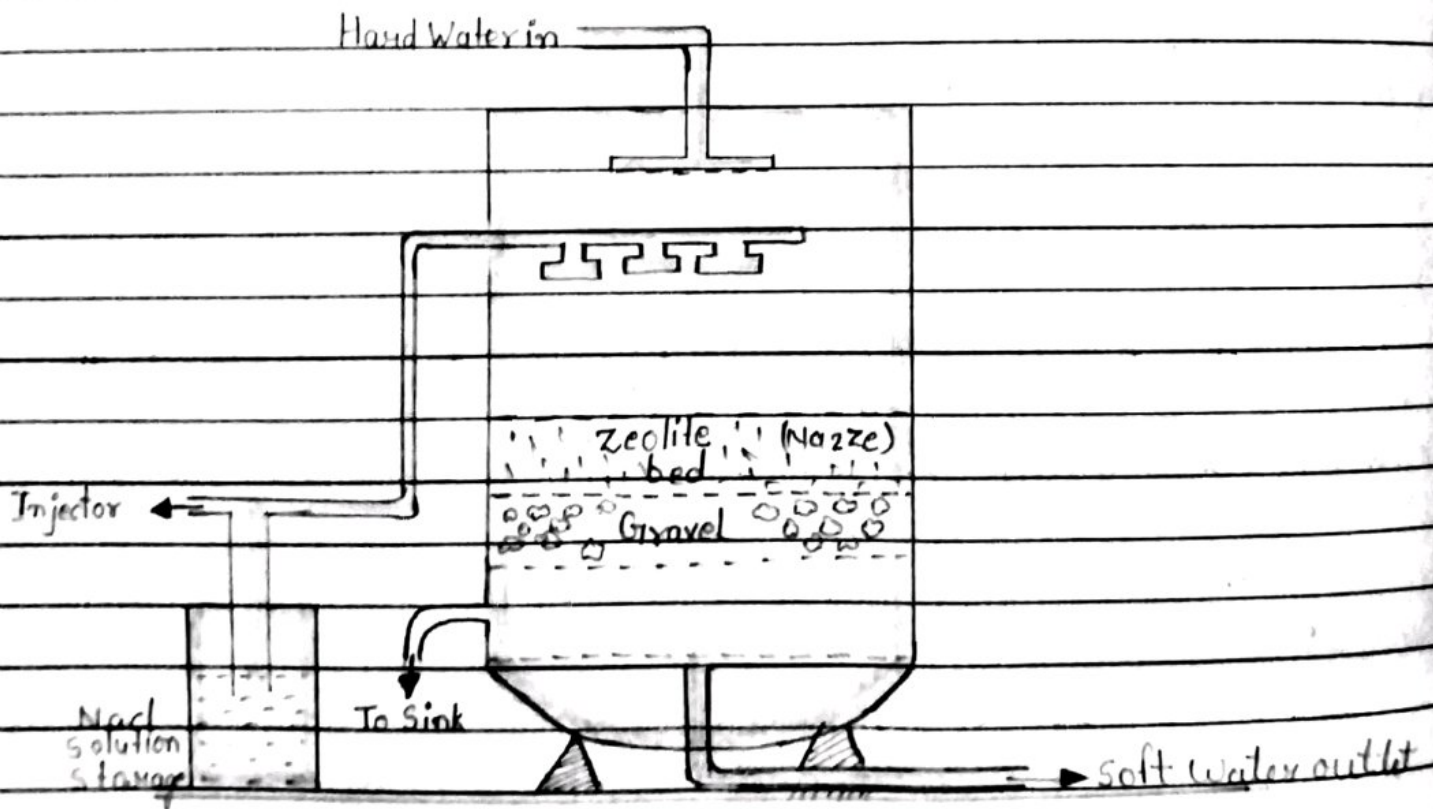


In this above reaction NaCl is formed. However, this NaCl does not produce any type of hardness. This NaCl is passed through small gravels & finally they absorbed & we get soft water. After some time all the Na_2Ze exhausted into CaZe , Mgze . Now softening process stop, so in order to regenerate the Na_2Ze again. We use 100% NaCl solution which is called Brine solution.

Priming :- Priming is a process in which liquid droplets are formed during the formation of steam. It decreases the efficiency of boiler. It is caused by the presence of very small solid particles in boiler feed water.

Softening Methods :-

* 1 Zeolite Method (Permutit process) :-

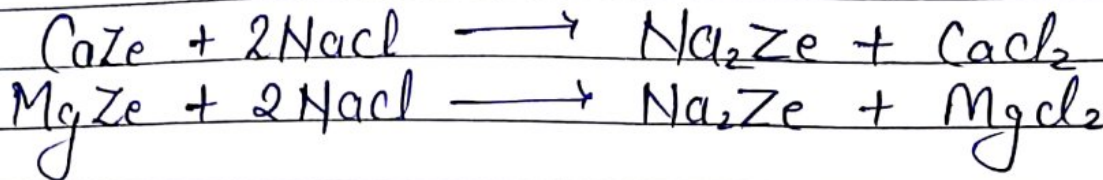


Zeolite Softener

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The following reaction takes place.

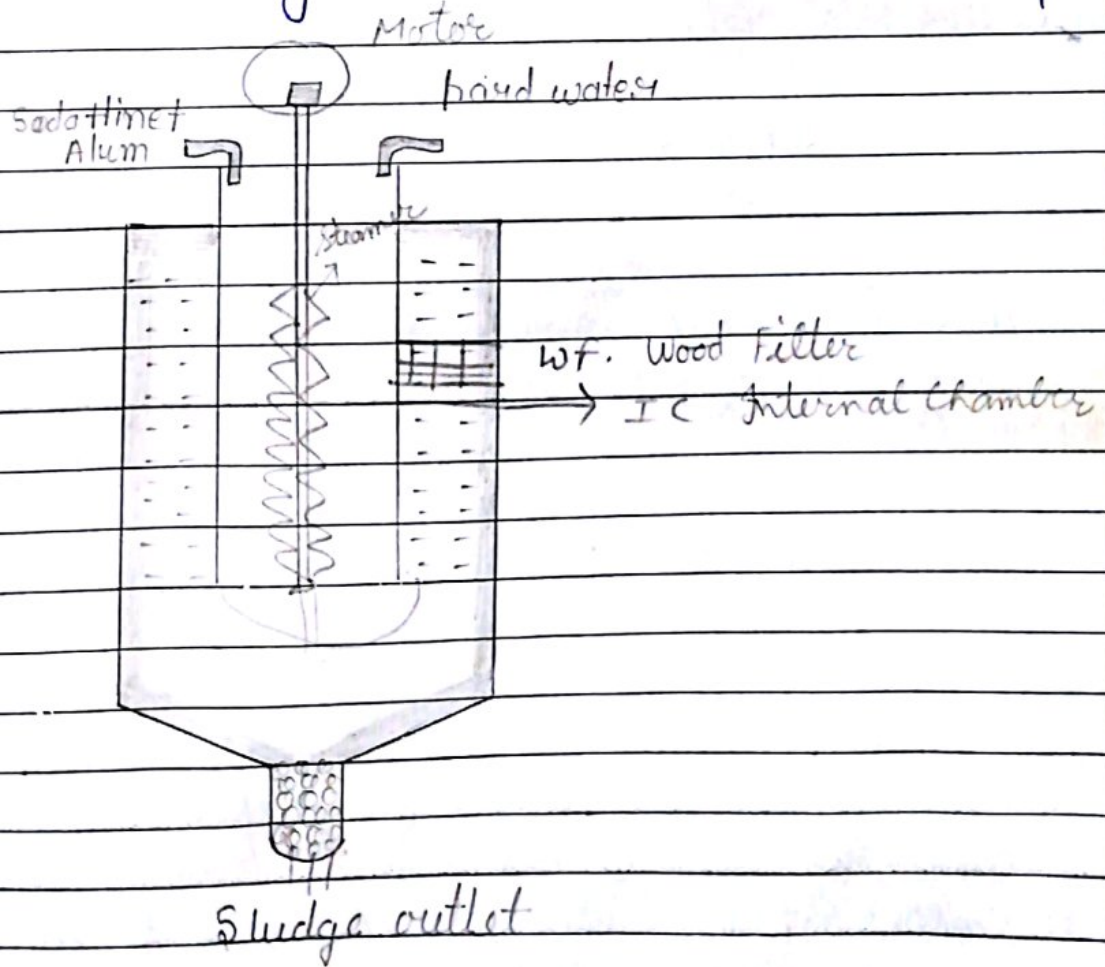


Limitations :-

1. If the supply of water is turbid, the suspended matter must be removed, otherwise the turbidity will clog the pores of zeolite bed.
2. Mineral acids must be neutralised with soda, if present in water, destroy the zeolite bed.

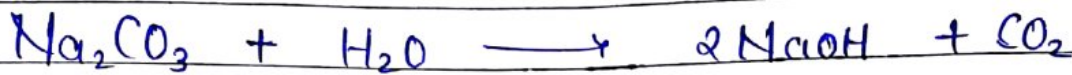
2. Lime - Soda process :-

This process is used for removal of hardness. In this method lime, soda, Alum is used and is carried out at room temperature. In this method lime & soda are added from the top of the instrument & hard water is also fed from the top of the instrument into the internal chamber. There is stirrer fitted in internal chamber. Vigorous stirring ensures continuous mixing & thus as the raw water & chemicals flow down, softening of water takes place. The softened water is allowed to come into chamber. The sludge settles down & filtered water comes out through water outlet at the top.

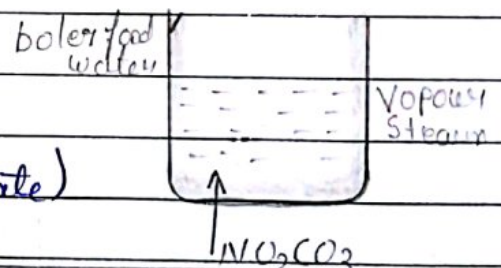
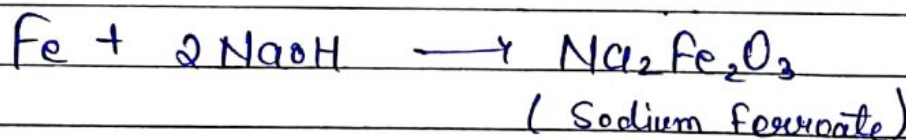


Caustic Embrittlement :-

" Caustic embrittlement is the phenomenon during which boiler material becomes brittle due to the accumulation of caustic substance.

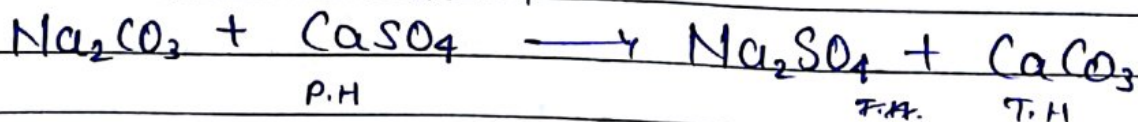


It is a type of boiler corrosion. It is caused by the use of Na_2CO_3 containing water in boiler. In this phenomenon Na_2CO_3 react with H_2O & form NaOH . This NaOH react with boiler material (iron, Fe) & form $\text{Na}_2\text{Fe}_2\text{O}_3$ (Sodium ferrate) which is brittle in nature & boiler gets brittle.



Internal treatment of water softening :-

- 1) Calogen Treatment :- Soda hexmeta phosphate
- 2) Carbonate condition :-



Makes scale

makes sludge which can be removed by blowdown operation.

- 3) Radio active Tablet :- It doesn't make scale.

4). Sodium phosphate.

5). Colloidal conditioning is ~ We add organic substances like, kerosene, agar-agar, tannin which doesn't make scale.

Disadvantages of hardness is ~

a). Domestic - washing, bathing, cooking.

b). Industrial - 1) In sugar industry we use hardwater. Then sugar is of yellow color. The manufactured sugar is very easily deliquescent, crystallisation is also affected.

2) Textile Industry - unwanted colour.

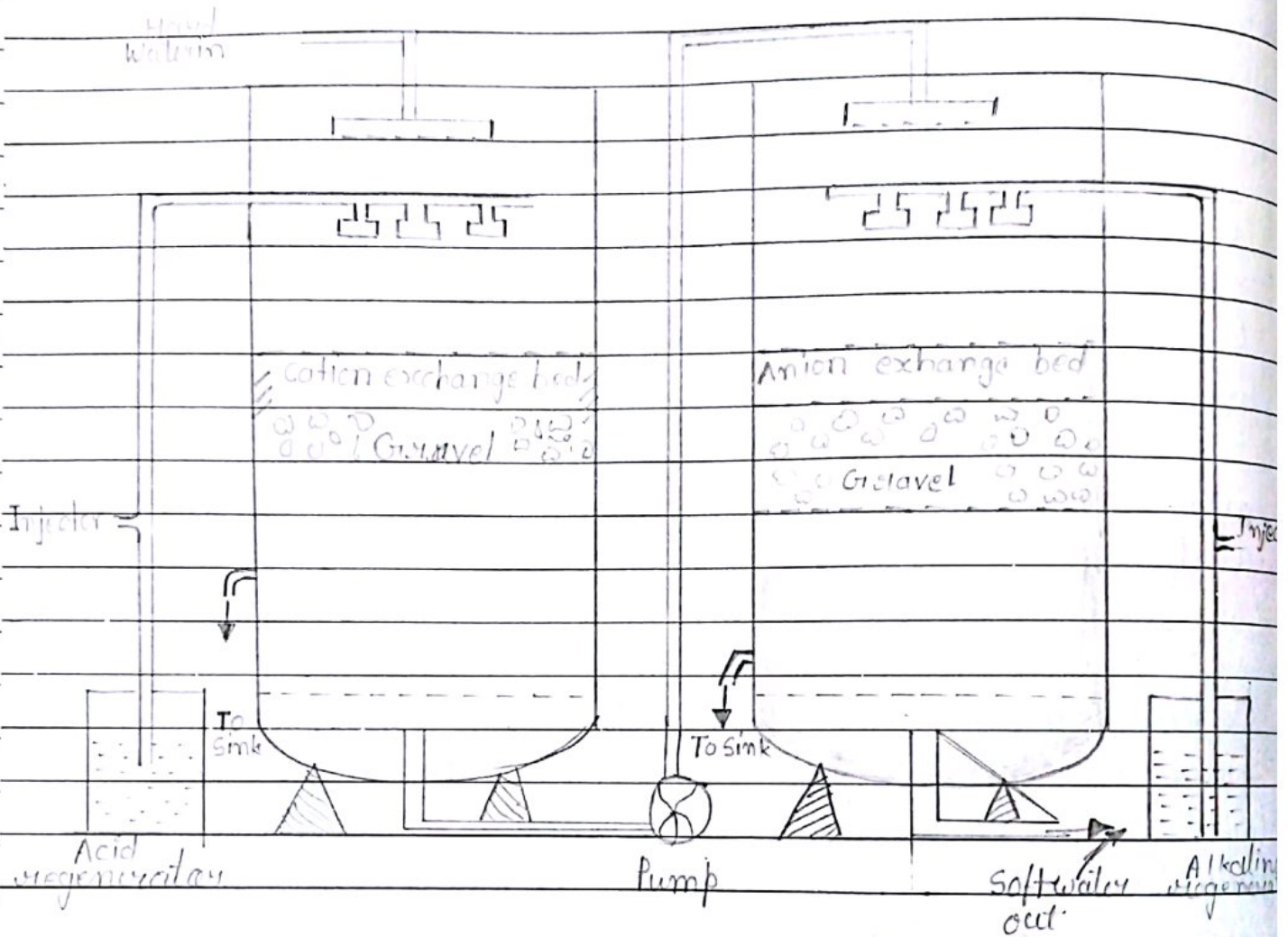
3) Paper Industry - Bell, weak, low lustre.

4) Pharmaceutical Industry - Quality of medicine is low.

5) Industry where boiler make scale, sludge, stress industry priming forming.

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*3 Ion exchange Method :- (or) Deionization or Demineralization



Demineralization of water

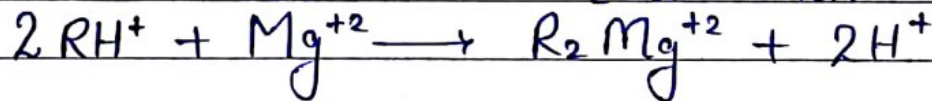
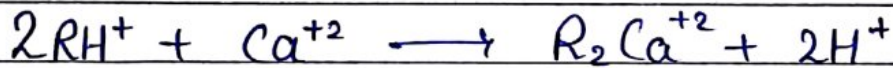
It is a process by which ions held on a porous, ~~an~~ essentially insoluble solid are exchanged for ions in solution that is brought in contact with it.

Ion-exchange Resin: An ion-exchange resin is a crosslinked organic polymer network. Having some ionisable group.

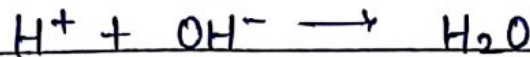
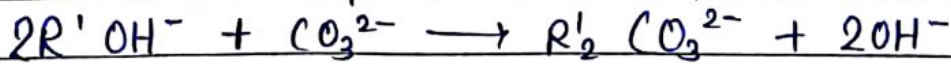
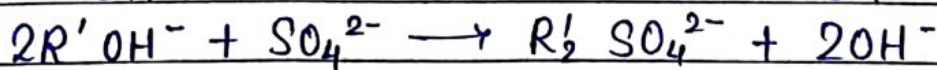
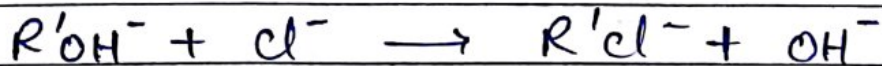
- i) Cation Exchange Resin or cation exchanger.
- ii) Anion Exchange Resin or Anion exchanger.

process:

In this process first we passed hard water through cation exchange column, which removes all the cations & H^+ ions are released to water.



After this process, hard water is passed through anion exchange column which removes all the anion & OH^- are released from this column to water.



The water coming out from the exchanger is free from cations as well as anions. Ion-free water is known as a deionized or demineralized water.

Hard Water :-

Water which doesn't produce lather and contain various type of salts of calcium & mg magnesium ion like $CaCO_3$, $MgCO_3$, $Ca_2(CO_3)$, $Mg(CO_3)$, $CaCl_2$, $MgCl_2$.

Q. - What are the type of hardness ?

Ans- There are two type of hardness.

i) Temporary hardness

ii) Permanent hardness.

i) Temporary Hardness :-

Temporary hardness can be remove by boiling of water. It is caused by carbonate & bicarbonate of calcium & magnesium ion $CaCO_3$, $MgCO_3$, $Ca(HCO_3)_2$, $Mg(HCO_3)_2$

ii) Permanent hardness :- Permanent hardness is

caused by chloride & sulphate of calcium & magnesium. In this type of hardness can not be removed by boiling of water. Some special methods are used for removal of permanent hardness like. Lime-soda. zeolite ion exchange method.

The main causes of Permanent hardness- $CaCl_2$, $MgCl_2$, $CaSO_4$, $MgSO_4$.