Ethylene diamine tetra acetic acid (EDTA)

EDTA Complex with Manganese
Priming

- When a boiler is steaming rapidly some particles of the liquid water are carried along with the steam. It's called priming.
  - Presence of large amount of dissolved solids
  - Sudden boiling
  - Improper boiler design

Foaming

- It is the production of persistent foam or bubbles in boilers, which do not break easily. It is due to the presence of oil. Priming and foaming occur together

Priming can be avoided by

- Fitting mechanical steam purifier
- Avoid rapid change in steaming rate

Foaming can be avoided by

- Adding anti-foaming agent like castor oil
- Removing oil from boiler water by adding compounds like sodium aluminate

Caustic Embrittlement

- It's a kind of boiler corrosion, caused by using highly alkaline water in the boiler

\[
\text{Na}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{CO}_2
\]

This causes embrittlement of boiler parts particularly stressed parts (bends, joints, rivets, etc.)
Ion-exchange

- Ion-exchange resins are soluble, cross-linked, long chain organic polymers with a microporous structure and the functional groups attached to the groups are responsible for the ion-exchanging properties.

Styrene-divinyl benzene copolymers, which on sulphonation or carboxylation, become capable to exchange their hydrogen ions with the cations in the water.
2. Sodium Aluminate (NaAlO₂)

   treating water having no alkalinity (pH <7)

   NaAlO₂ + 2H₂O → Al(OH)₃ ↓ + NaOH

   MgSO₄ + 2NaOH → Mg(OH)₂ ↓ + Na₂SO₄

3. Copperas or Ferrous sulphate [FeSO₄, 7H₂O]

   FeSO₄ + Mg(HCO₃)₂ → Fe(OH)₂ ↓ + MgCO₃ + CO₂ + H₂O

   4Fe(OH)₂ + O₂ + 2H₂O → 4Fe(OH)₃ ↓

   dissolved oxygen   ferric hydroxide

Above pH = 8.5, if alkalinity is not present, lime should be added

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**Filtration**

A process of removing colloidal matter and most of the bacteria, micro-organisms etc., by passing water through a bed of fine sand and other properly sized granular materials.
Osmosis

Selectively Permeable Membrane

Low Sugar Concentration
High Sugar Concentration

High Water Concentration
Low Water Concentration

Super filtration
15-40 kg cm$^2$

Advantages
- Removes colloidal silica
- Long life
- Can be replaced within few minutes

Reverse Osmosis

Piston

Sea water
Stout semi-permeable membrane

Pure water

Pressure
Reverse osmosis cell

Advantages
- Removes colloidal silica
- Long life
- Can be replaced within few minutes

Cellulose acetate
Polysulfone
Polysulfone amide
Polyamide
Poly-acrylonitrile