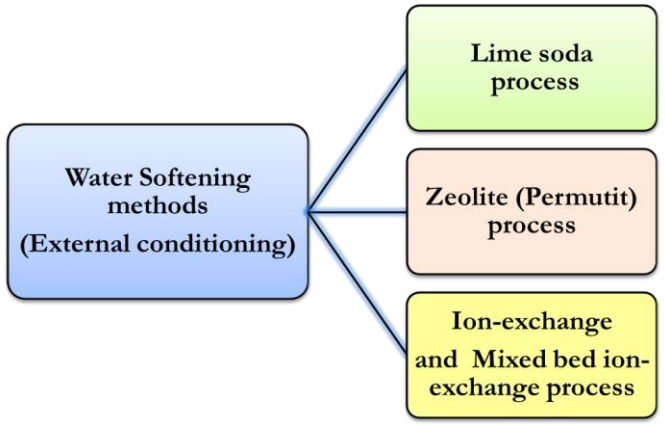
Module-2

Water Treatment

- **Internal conditioning methods**
  - Colloidal conditioning
  - Phosphate conditioning
  - Carbonate conditioning
  - Calgon conditioning
  - Treatment with sodium meta aluminate
- **External conditioning methods**
  - Lime Soda Process
  - Zeolite process
  - Ion exchange process



External conditioning methods

- **Lime Soda Process**
  - lime [$Ca(OH)_2$] and Soda [Na_2CO_3]
    - ❑ Batch process
    - ❑ Continuous process
    - ❖ Cold lime-soda process
    - ❖ Hot lime-soda process
- **Zeolite process**
  - Common Zeolite is $Na_2O{\cdot}Al_2O_3{\cdot}3SiO_2{\cdot}2H_2O$
    - ✓ **Natural** – non-porous & **Synthetic** – porous
  - Brine solution (aq. NaCl) for regeneration
- **Ion exchange process**
  - Cation exchange resin
    - ✓ H^+ replaces Ca^{2+} and Mg^{2+} - Acid for regeneration
  - Anion exchange resin
    - ✓ OH- replaces Cl^-, SO_4^{2-} and CO_3^{2-} - Base for regeneration
  - Mixed bed deionizer

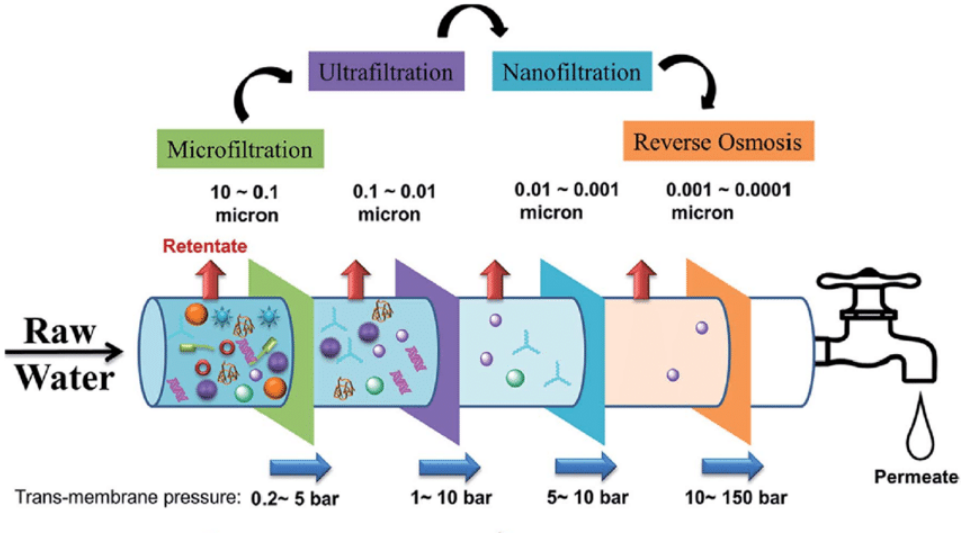
Purification of Municipal water supply

- **Screening**
  - Water passes through screens with larger holes
- **Sedimentation**
  - Allow water to stand undisturbed in big tanks
- **Coagulation and/or flocculation**
  - Alum, Sodium aluminate, copper or Ferrous sulphate
- **Filtration**
  - Sand filtration – (Coarse & Fine sand bed)
  - Activated carbon filtration – (Adsorption)
  - Candle filtration – (Ceramic materials)
- **Disinfection –** Factors influencing disinfection process
  - Chlorination
    - Bleach or gaseous chlorine (break-point of chlorination)
  - Ozonation (Oxidation using [O])
  - Ultraviolet light irradiation (Higher energy – DNA strand breaks)
- **Supplementary treatment**

Filtration

(Removal of particulate from water by forcing through a porous media)

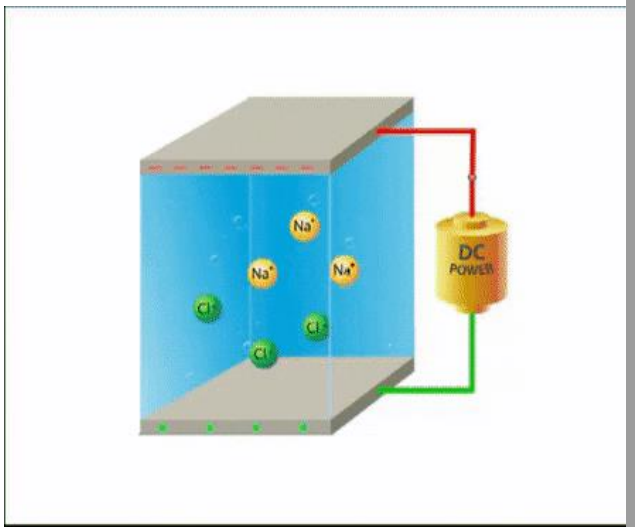
- **Micro filtration**
- **Ultra filtration**
- **Nano filtration**
- **Reverse Osmosis**

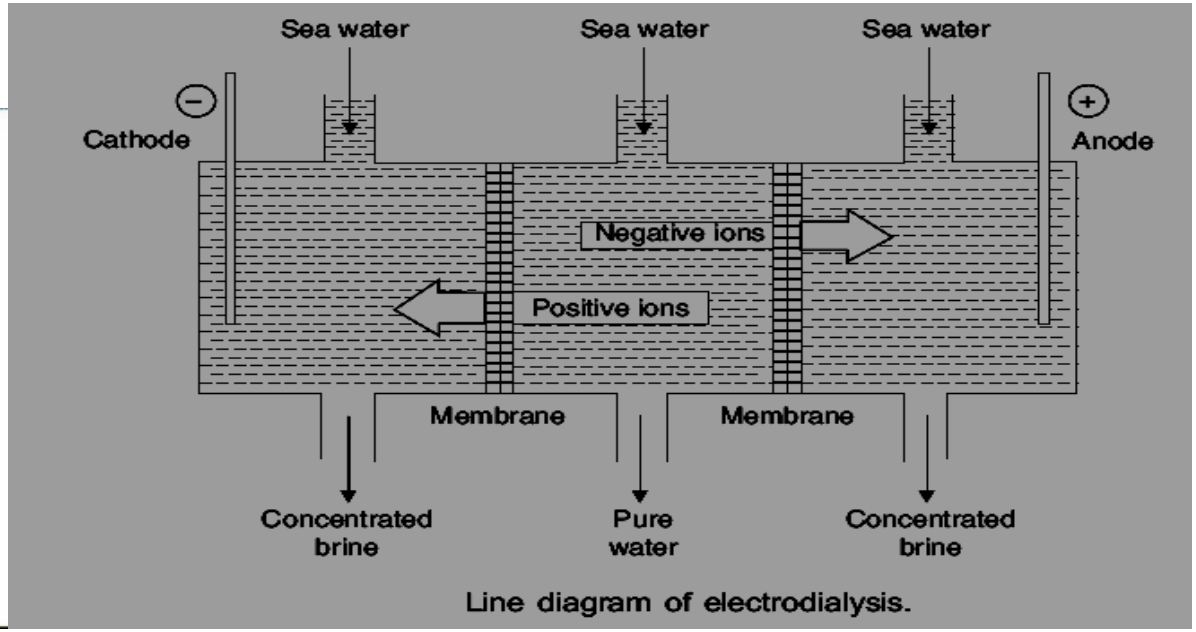


Filtration type	Pore size	Impurities removed
Microfiltration	0.1-10 μm	Suspended Particles, Microorganisms
Ultrafiltration	0.1 – 0.01 μm	Suspended solids, solutes of higher molecular weight
Nanofiltration	1-10 nm	Multivalent Cations, Organic Impurities
Reverse Osmosis	0.1 nm (< 1nm)	Removes most of the impurities (bigger than 0.1 nm)

Desalination of brackish water

- **Removal of common salts from water – desalination**
  - Sea water to drinking water
- **Electrodialysis** – By applying DC voltage
  - Na^+ ion move towards cathode
  - Cl^- ion move towards anode





Line diagram of electrodialysis.