Specifications of different materials in drinking water (ICMR and WHO)

S. No.	Parameter/Material	WHO Standards/ppm	ICMR/BIS Standards/ppm
1	Colour	Clear	Clear
2	Odour	Pleasant	Pleasant
3	Turbidity	2.5	2.5
4	pH	6.0 – 8.5	6.0 – 8.5
5	TDS	300	500
6	Total Hardness as $CaCO_3$	200	300
7	Calcium	75	75
8	Chlorides	200	200
9	Sulphates	200	200
10	Fluoride	0.5	1.0
11	Mercury	0.006	0.001
12	Cadmium	0.003	0.01
13	Arsenic	0.01	0.02
14	Chromium as hexavalent	0.01	0.1
15	Lead	0.01	0.01
16	E.Coli	No colony Should be present in 100 mL water	No colony Should be present in 100 mL water

ICMR = Indian Council of Medical Research
BIS = Bureau of Indian Standards

WHO = World Health Organization

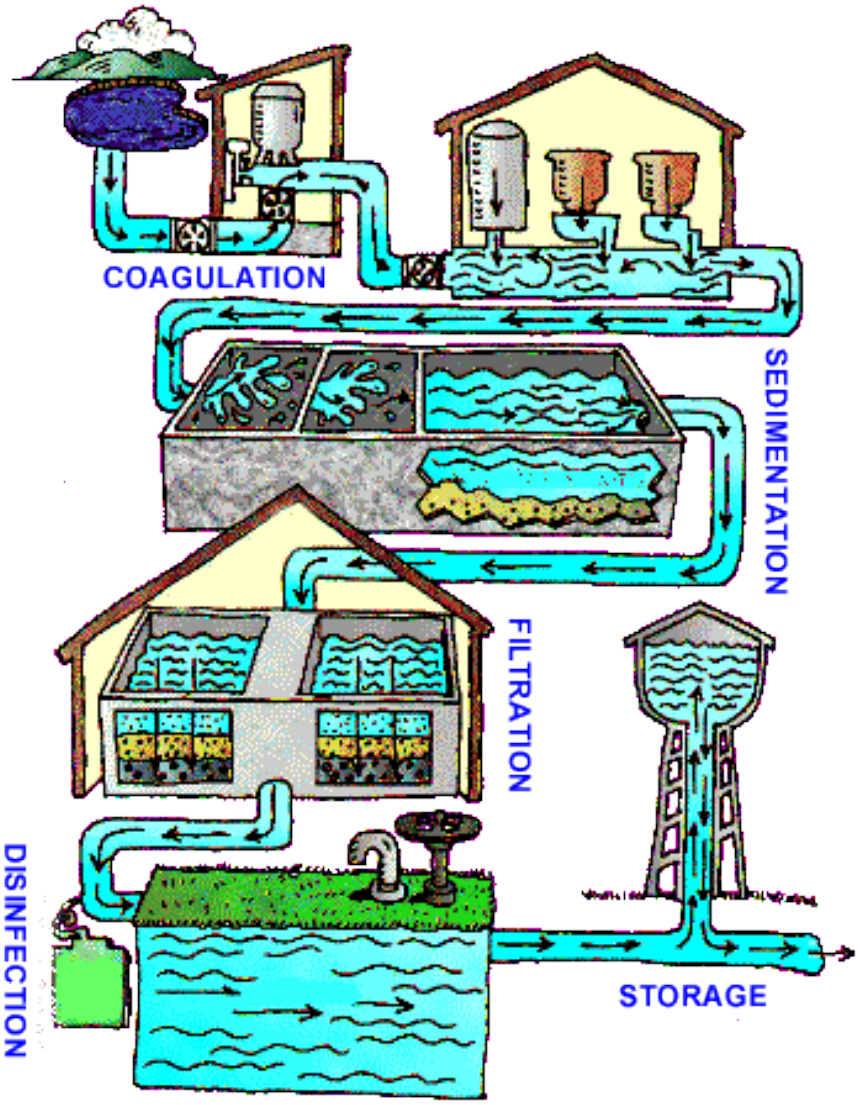
Drinking water or Municipal water

Should satisfy the following requirements

1. It should be sparkling clear and odourless
2. Pleasant taste
3. Perfectly cool
4. Turbidity level should not exceed 10 ppm
5. Free from objectionable dissolved gases like H_2S
6. Free from objectionable minerals such as lead, arsenic, chromium and manganese salts
7. Alkalinity should not be high (pH ~8)
8. It should be reasonably soft
9. Total dissolved solids should be less than 500 ppm
10. Free from disease producing micro-organisms

Purification of Municipal Supply

- Screening
- Coagulation
- Flocculation
- Sedimentation
- Filtration
- Chlorination
- Supplementary treatment



Purification of Municipal Supply

Purification of water for domestic use

Removal of
A. Suspended impurities; B. Microorganisms

Suspended Impurities

1. Screening
   - Water is passed through screens , having large number of holes

2. Sedimentation

   Allowing water to stand undisturbed in big tanks (~ 5 m deep)
   Most of the suspended particles settles down at the bottom, due to the force of gravity

   when water contains fine clay particles and colloidal matter its necessary to apply sedimentation with coagulation

Sedimentation with coagulation

Removing suspended and colloidal impurities by the addition of requisite amount of chemicals (coagulants)

Coagulant (Alum or Ferrous sulphate)

When added to water , forms an insoluble gelatinous, flocculant precipitate, which descent through water, adsorbs and entangles very fine suspended impurities forming bigger flocs, which settle down easily

1. Alum ($K_2SO_4 . Al_2(SO_4)_3, 24H_2O$

Alum reacts in water in the presence of alkalinity of water. If the water is not alkaline, sufficient amount of lime should be added

$$Al_2(SO_4)_3 + Ca(HCO_3)_2 \longrightarrow 2\,Al(OH)_3 \downarrow + 3CaSO_4 + 6CO_2$$

coagulant — Present in water — Flocullant ppt.

2. Sodium Aluminate ($NaAlO_2$)

treating water having no alkalinity (pH <7)

$$NaAlO_2 + 2H_2O \longrightarrow Al(OH)_3 \downarrow + NaOH$$

Gelationous flocculant

$$MgSO_4 + 2NaOH \longrightarrow Mg(OH)_2 \downarrow + Na_2SO_4$$

3. Copperas or Ferrous sulphate [$FeSO_4 . 7H_2O$]

$$FeSO_4 + Mg(HCO_3)_2 \longrightarrow Fe(OH)_2 \downarrow + MgCO_3 + CO_2 + H_2O$$

$$4Fe(OH)_2 + O_2 + 2H_2O \longrightarrow 4Fe(OH)_3 \downarrow$$

dissolved oxygen — ferric hydroxide

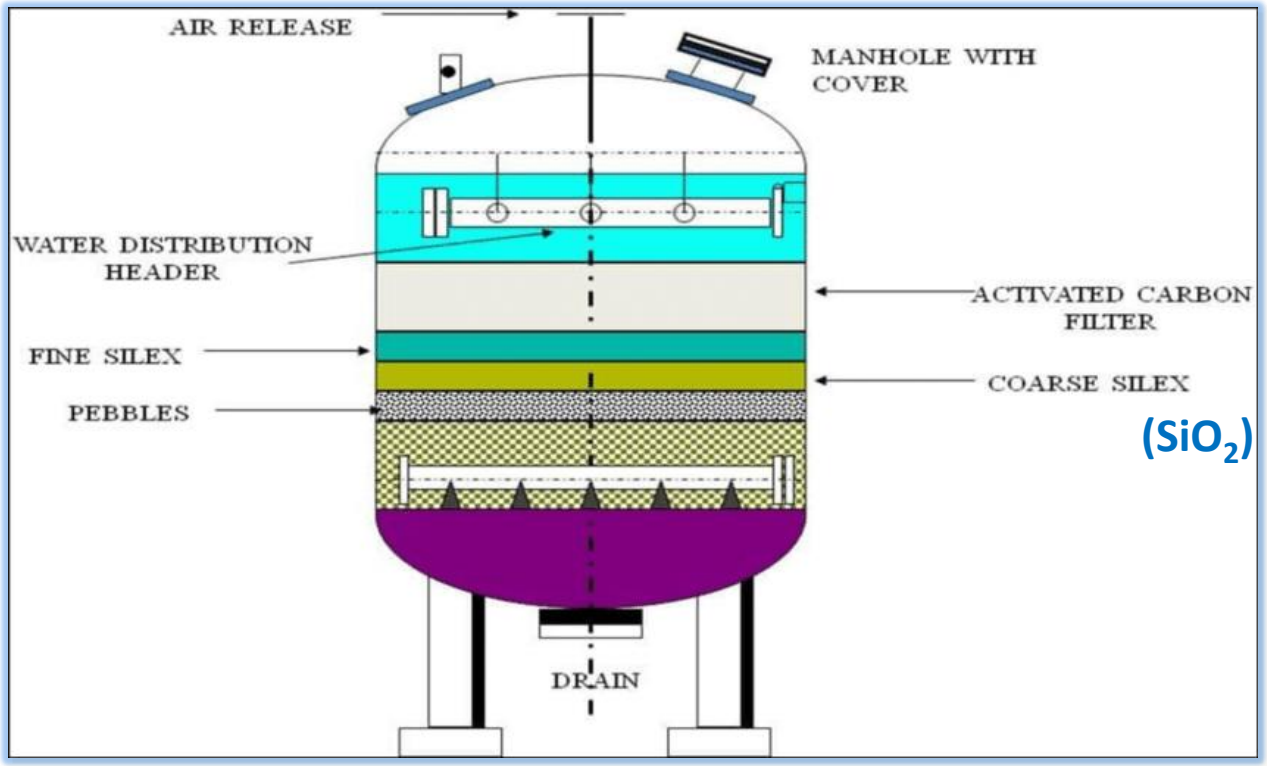
Above pH = 8.5, if alkalinity is not present, lime should be added

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 proper sized granular materials

Activated Carbon Filtration

- **Activated carbon filters** are generally used in the process of removing organic compounds and/or extracting free chlorine from water.
- Coconut shells and coal (anthracite or bituminous) are both organic sources of activated carbon.



Working Mechanism in the fabrication of Activated Carbon

- Carbon forms when an organic source is burned in an environment without oxygen. This process leaves only about 30% of the organic mass intact, driving off heavy organic molecules.

- Prior to being used for water treatment, the organic mass must then be "activated by either Steam Activation (800°C-1000°C) or Chemical Activation (a powerful dehydrating agent like phosphoric acid (P_2O_5) or zinc chloride ($ZnCl_2$)."

- The process of activation opens up the carbon's massive number of pores and further drives off unwanted molecules. The open pores are what allow the carbon to capture contaminants, through **adsorption**.

- **The rate of adsorption for a surface area of a just one pound (0.45 kg) of Activated Carbon is equal to 60-150 acres!**

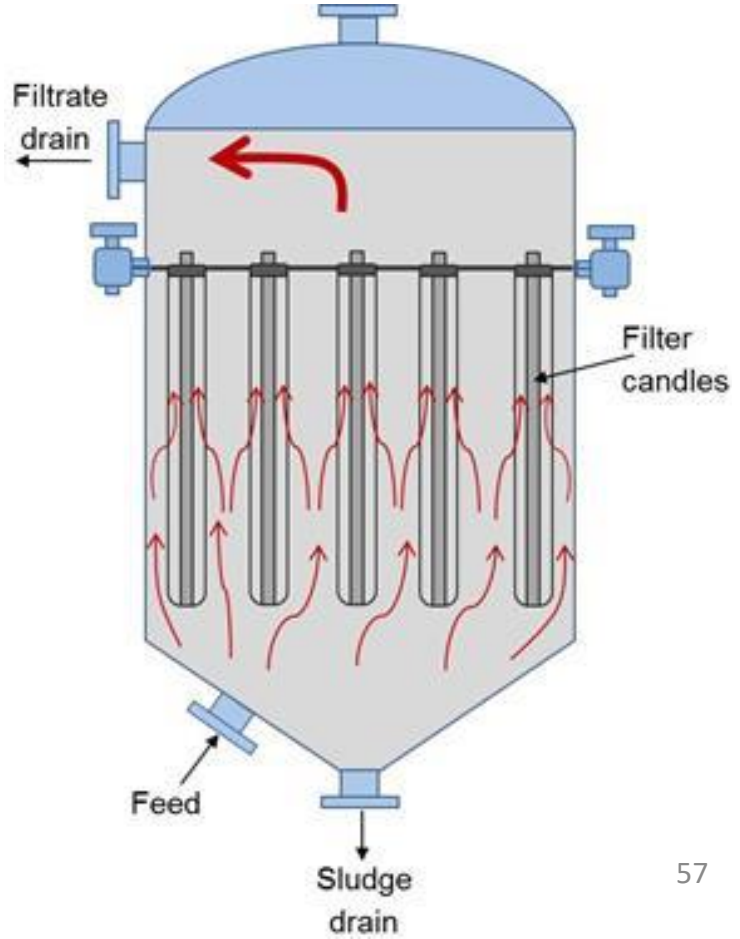
Candle Filtration

The Candle Filters are, like all pressure filters, operating on a batch cycle and may be seen in process lines handling titanium dioxide, flue gas, brine clarification, red mud, china clay, fine chemicals and many other applications that require efficient low moisture cake filtration or high degree of polishing.

The Candle Filter consists of three major components:

- **The vessel**
- **The filtering elements**
- **The cake discharge mechanism**

- **Candle Filters are very well suited for handling flammable, toxic and corrosive materials.**



Candle Filtration

Advantages

- Excellent cake discharge.
- Adapts readily to slurry thickening.
- Minimum floor space.
- Mechanically simple since there are no complex sealing glands or bearings.

Disadvantages

- High headroom is required for dismantling the filtering elements.
- The emptying of the vessel in between cake filtration, washing and drying requires close monitoring of the pressure inside the vessel to ensure that the cake holds on to the candles.