

CHEMICAL PLANT UTILITIES

WATER

1.1 Water Resources

Life is possible on earth due to the presence of water. Nearly three-fourths of the earth's surface is covered with water. Water is also found below the earth's surface. It is present in air in the form of water vapour. About 70 per cent of the human body is water. The bodies of all plants and animals contain water.

Sources of Water:

Rainwater, oceans, rivers, lakes, streams, ponds and springs are natural sources of water. Dams, wells, tube wells, hand-pumps, canals, etc, are man-made sources of water.

Rain Water:

Rain water collects on the earth in the form of surface water and underground water

Surface Water:

Water present on the surface of the earth in the form of oceans, rivers, lakes, ponds and streams is called surface water. The water in rivers and lakes comes from rain and melting of snow on mountains. Rivers flow into the sea.

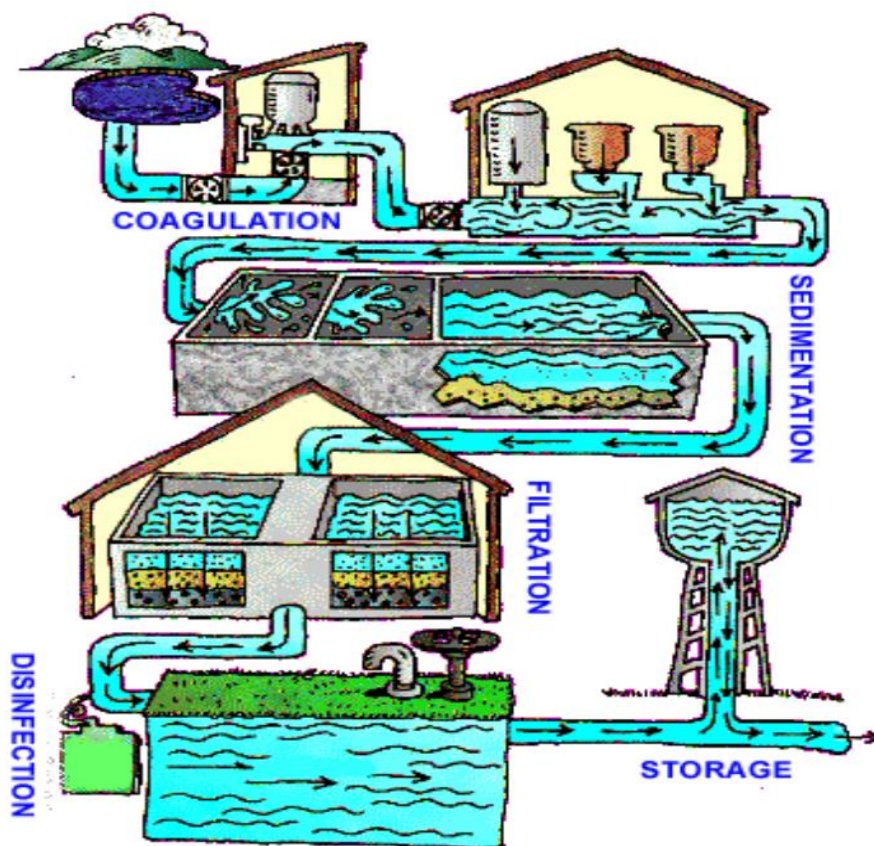
Underground Water:

Some of the rainwater seeps through the soil on to the non-porous rocks below. This is underground water. Sometimes due to high pressure, this water sprouts out in the form of springs. It can be obtained by digging wells, sinking tube wells, etc.

1.2 Water Treatment

Drinking water sources are subject to contamination and require appropriate treatment to remove disease-causing agents. Public drinking water systems use various methods of water treatment to provide safe drinking water for their communities. Today, the most common steps in water treatment used by community water systems (mainly surface water treatment) include:

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- **Coagulation and Flocculation**

Coagulation and flocculation are often the first steps in water treatment. Chemicals with a positive charge are added to the water. The positive charge of these chemicals neutralizes the negative charge of dirt and other dissolved particles in the water. When this occurs, the particles bind with the chemicals and form larger particles, called floc.

- **Sedimentation**

During sedimentation, floc settles to the bottom of the water supply, due to its weight. This settling process is called sedimentation.

- **Filtration**

Once the floc has settled to the bottom of the water supply, the clear water on top will pass through filters of varying compositions (sand, gravel, and charcoal) and pore sizes, in order to remove dissolved particles, such as dust, parasites, bacteria, viruses, and chemicals.

- **Disinfection**

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After the water has been filtered, a disinfectant (for example, chlorine, chloramine) may be added in order to kill any remaining parasites, bacteria, and viruses, and to protect the water from germs when it is piped to homes and businesses.

1.2.1 Flocculation

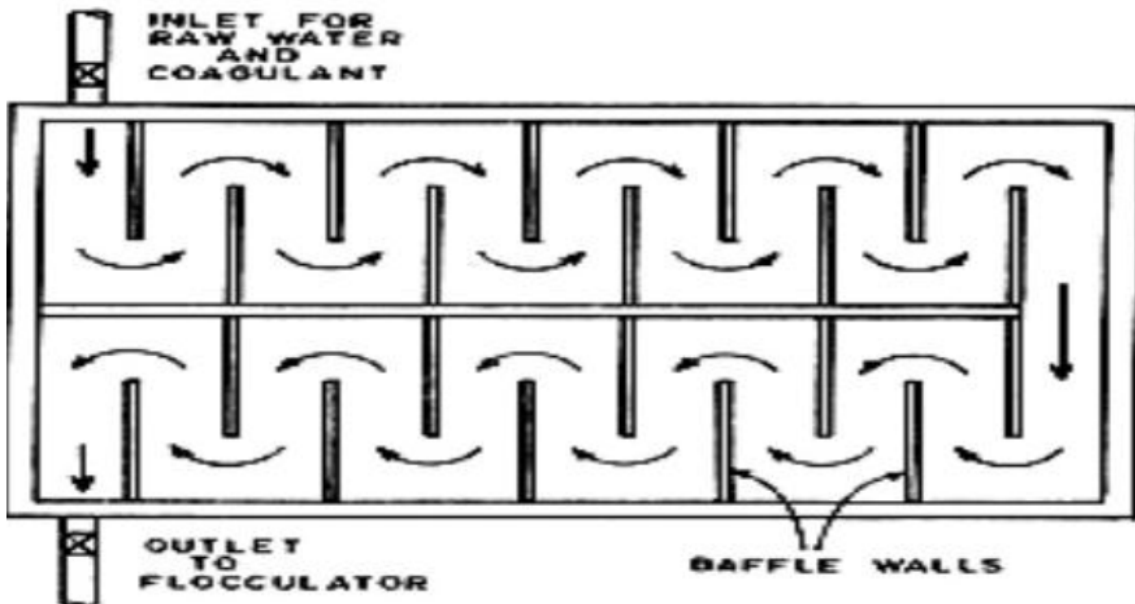
Flocculation is stimulation by mechanical means to agglomerate destabilized particles into compact, fast settleable particles (or flocs). Flocculation or gentle agitation results from velocity differences or gradients in the coagulated water, which causes the fine moving, destabilized particles to come into contact and become large, readily settleable flocs. It is a common practice to provide an initial rapid (or) flash mix for the dispersal of the coagulant or other chemicals into the water. Slow mixing is then done, during which the growth of the floc takes place.

Rapid or Flash mixing is the process by which a coagulant is rapidly and uniformly dispersed through the mass of water. This process usually occurs in a small basin immediately preceding or at the head of the coagulation basin. Generally, the detention period is 30 to 60 seconds and the head loss is 20 to 60 cms of water. Here colloids are destabilised and the nucleus for the floc is formed.

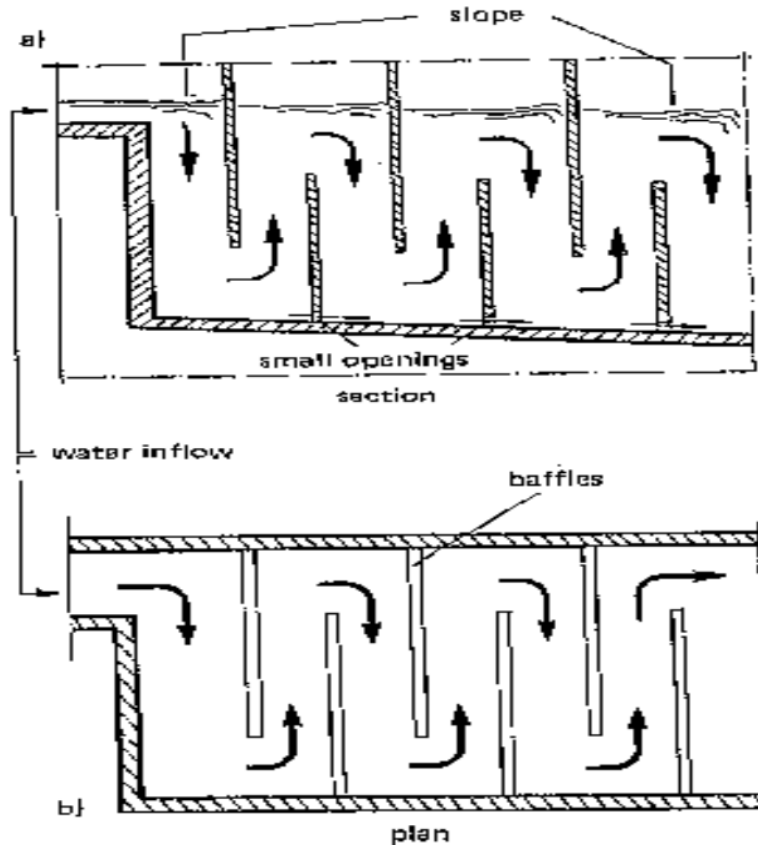
Slow mixing brings the contacts between the finely divided destabilised matter formed during rapid mixing.

Mixing basin with baffle walls

i. Horizontal or round end type:



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1.2.2 Settling

Solid liquid separation process in which a suspension is separated into two phases –

- Clarified supernatant leaving the top of the sedimentation tank (overflow).
- Concentrated sludge leaving the bottom of the sedimentation tank (underflow).

Purpose of Settling

- To remove coarse dispersed phase.
- To remove coagulated and flocculated impurities.
- To remove precipitated impurities after chemical treatment.
- To settle the sludge (biomass) after activated sludge process / tricking filters.

Principle of Settling

- Suspended solids present in water having specific gravity greater than that of water tend to settle down by gravity as soon as the turbulence is retarded by offering storage.
- Basin in which the flow is retarded is called **settling tank**.
- Theoretical average time for which the water is detained in the settling tank is called the **detention period**.