SEDIMENTATION TANK:

It is the process in which the suspended solids are made to settle by gravity under still water conditions is called plain sedimentation.

PLAIN SEDIMENTATION

By plain sedimentation the following are the advantages.

- Plain sedimentation lightens the load on the subsequent process.
- The operation of subsequent purification process can be controlled in better way.
- The cost of cleaning the chemical coagulation basins is reduced.
- No chemical is lost with sludge discharged from the plain settling basin.
- Less quantity of chemicals are required in the subsequent treatment processes.

The amount of matter removed by sedimentation tank depends upon the factors.

- Velocity of flow
- size and shape of particles
- Viscosity of water

The particles which do not change in size, shape or mass during settling are known as the discrete particles. The velocity of descrete particles with dia less than 0.1 mm is given by

$V = 418 (S - S1) d2 (3T + 70)$ ---------- ---------- (1)

Where V → Velocity of settlement in mm/sec

S → Specific gravity of the particle

S1 → Specific gravity of water

D → dia of the particle in mm

T → Temperature in °C

If the dia of the particle is greater than 0.1mm then the velocity is measured by

$V = 418 (S - S1) d (3T + 70)$ ---------- ---------- (2)

In practice settling of the particles governed by the resultant of horizontal velocity of water and the vertical downward velocity of the particle.

DESIGN ASPECTS OF SEDIMENTATION TANKS

The design aspects of sedimentary tanks are

- Velocity of flow
- Capacity of tank
- Inlet and outlet arrangements
- Shapes of tanks
- Miscellaneous considerations.

(1) Velocity of flow: The velocity of flow of water in sedimentation tanks should be sufficient enough to cause the hydraulic subsidence of suspended impurities. It should remain uniform throughout the tank and it is generally not allowed to exceed 150mm to 300mm per minute.

(2) Capacity of tank: capacity of tank is calculated by

i) Detention period

ii) Overflow rate

(i) Detention period: The theoretical time taken by a particle of water to pass between entry and exit of a settling tank is known as the known as the detention period. The capacity of tank is calculated by

C = Q x T where C → Capacity of tank

Q → Discharge or rate of flow

T → Detention period in hours

The detention period depends on the quality of suspended impurities present in water. For plain sedimentation tanks, the detention period is found to vary from 4 to 8 hours.

(ii) Overflow Rate: in this method it is assumed that the settlement of a particle at the bottom of the settlement of a particle at the bottom of the tank does not depend on the depth of tank and depends upon the surface area of the tank.

Distance of descend D

Surface overflow rate, V

C L x B x D L x B

Where L → Length of tank

B → Breadth of tank

D → Depth of tank = Side water depth = S.W.D

C → Capacity of tank

T → Detention period

U → Discharge or rate of flow

V → Velocity of descend of a particle to the bottom of tank

Surface overflow rate = S.O.R

(3) INLET AND OUTLET ARRANGEMENTS

The inlet is a device, which is provided to distribute the water inside a tank, and the outlet is a device, which is meant to collect outgoing water. These arrangements should be properly designed and located in such a way that they do not form any obstruction or cause any disturbance to the flowing water.

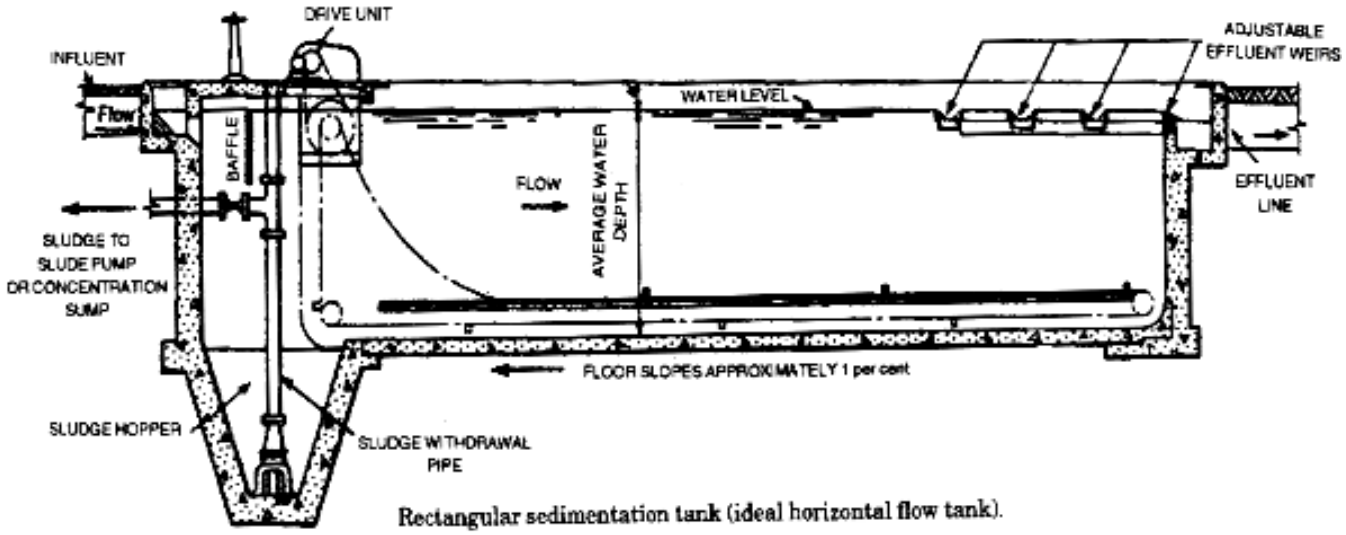
(4) SHAPES OF TANKS

Following are the three shapes of settling tank.

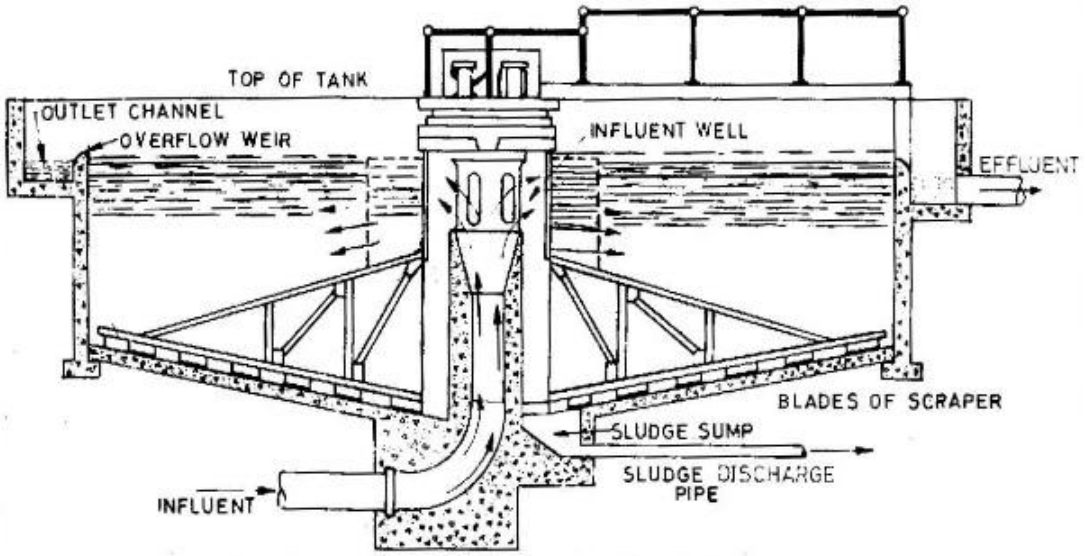
(i) Rectangular tanks with horizontal flow

(ii) Circular tanks with radial or spiral flow

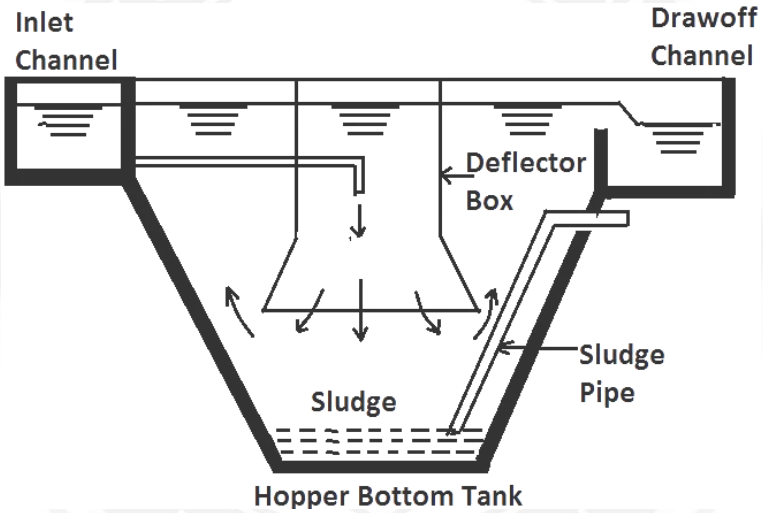
(iii) Hopper bottom tanks with vertical flow



Rectangular sedimentation tank (ideal horizontal flow tank).



Circular sedimentation tank (central feed) with radial flow.



The following are the parameters for satisfactory performance.

- Detention period ….. 3 to 4 hours for plain settling.
  2 to 21/2 hours for coagulant settling
  1 to 11/2 hours for up flow type
- Overflow rate …… 30 – 40 m3/m2/day for horizontal flow
  40-50m3/m2/day for up flow
- Velocity of flow…….. 0.5 to 1.0 cm/sec
- Weir loading……... 300m3/m/day
- L:B …….. 1:3 to 1:4
- Breadth of tank…….. (10 to 12m) to 30 to 50m
- Depth of tank……. 21/2 – 4m
- Diameter of circular tank…. upto 60m
- Solids removal efficiency….. 50%
- Turbidity of water after sedimentation – 15 to 20 N.T.U.
- Inlet and Outlet zones……. 0.75 to 1.0m

- Free board…… 0.5m
- Sludge Zone……. 0.5m

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.

Types of Settling:

Type I: Discrete particle settling - Particles settle individually without interaction with neighboring particles.

Type II: Flocculent Particles – Flocculation causes the particles to increase in mass and settle at a faster rate.

Type III: Hindered or Zone settling –The mass of particles tends to settle as a unit with individual particles remaining in fixed positions with respect to each other.

Type IV: Compression – The concentration of particles is so high that sedimentation can only occur through compaction of the structure.