CHAPTER: 11
High rate settlers

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HIGH RATE SETTLERS

→ High rate settlers

  parallel-plate settlers

  tube settlers

increase the available area for solids settling

→ In a detention time of less than 20 min they have settling efficiency comparable to that of a settling tank with a minimum 2 hr detention time.

→ Existing clarifiers can be upgraded to higher loading rates by the installation of a tube module or lamella.
**Tube settlers**

- Water to be clarified passes upward through the tubes.
- As settling occurs, the solids are collected on the bottom of the tubes.
- Tubes are inclined at an angle of $45^0$ to $60^0$, which is steep enough to cause the settled sludge to slide down the tubes.
- The sludge falls from the tubes to the bottom of the clarifier where it is removed by sludge rakes.
- Tube cross section: square or rectangular.
- Higher overflow rates (three to six times as those used for conventional settling) can be used to achieve the same degree of treatment with conventional settlers.
- Laminar flow is necessary for efficient settling.
FIGURE 7-8

MODULE OF STEEPLY INCLINED TUBES

(Courtesy Neptune Microfloc, Inc.)
FIGURE 7-11
TUBE SETTLERS – FLOW PATTERN
Figure 3-16 Basic tube settler configurations. (a) Horizontal tube settler; (b) steeply inclined tube settler. After Culp et al., 1968. Reproduced with permission from the American Water Works Association.
**Lamella Separators**

→ Similar to the inclined-tube settlers except that inclined plates are used to form the settling compartments

→ Sludge and water flow is cocurrent (same direction)

→ Flow entering a lamella separator flows downward between the plates depositing the sludge as it travels

→ In a horizontal flow tank, the front one-quarter length of the basin is generally free from settler modules to allow for better inlet flow conditions.
FIGURE 7-10
PLAN VIEW OF MODIFIED CLARIFIER
Upflow Clarifiers (Solid Contact Units)

This units combine flocculation & sedimentation into a structural single unit

Upflow solid contact clarifier combine:
- Mixing
- Coagulation
- Flocculation
- Liquid-solid separation
- Sludge removal

into a single unit process

Types of upflow clarifiers:
- Solids – contact
- Sludge blanket type
Solids – Contact Clarifier

→ Raw water is drawn into the primary mixing zone where initial coagulation & flocculation take place

→ Secondary mixing zone is used to produce a large number of particle collisions so that smaller particles are entrained in the larger floc

→ Water passes out of the inverted cone into the settling zone, where solids settle to the bottom and clarified water flows over the weir
Inverted cone within the clarifier;

- Produces an increasing cross-sectional area from the bottom of the clarifier to the top.

- Upward velocity of water decreases as it approaches to the top.

At some point; the upward velocity of water exactly balances the downward velocity of a solid particle

- PARTICLE IS SUSPENDED

Heavier particles suspended closer to the bottom

As the water containing flocculated solids passes up through this blanket, the particles are absorbed onto the layer floc

- Floc size increases and drops it down to a lower level
- It eventually falls to the bottom of the clarifier.