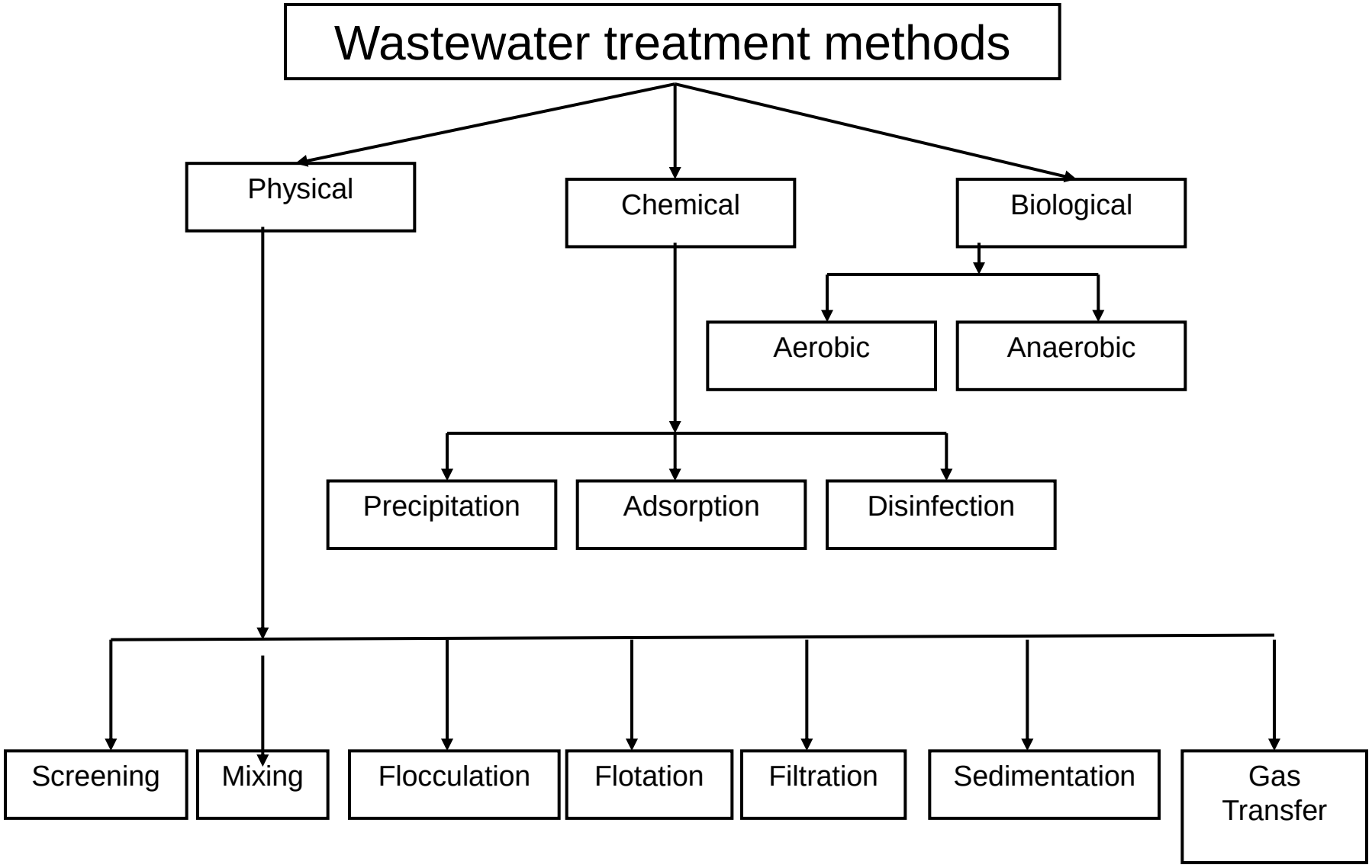
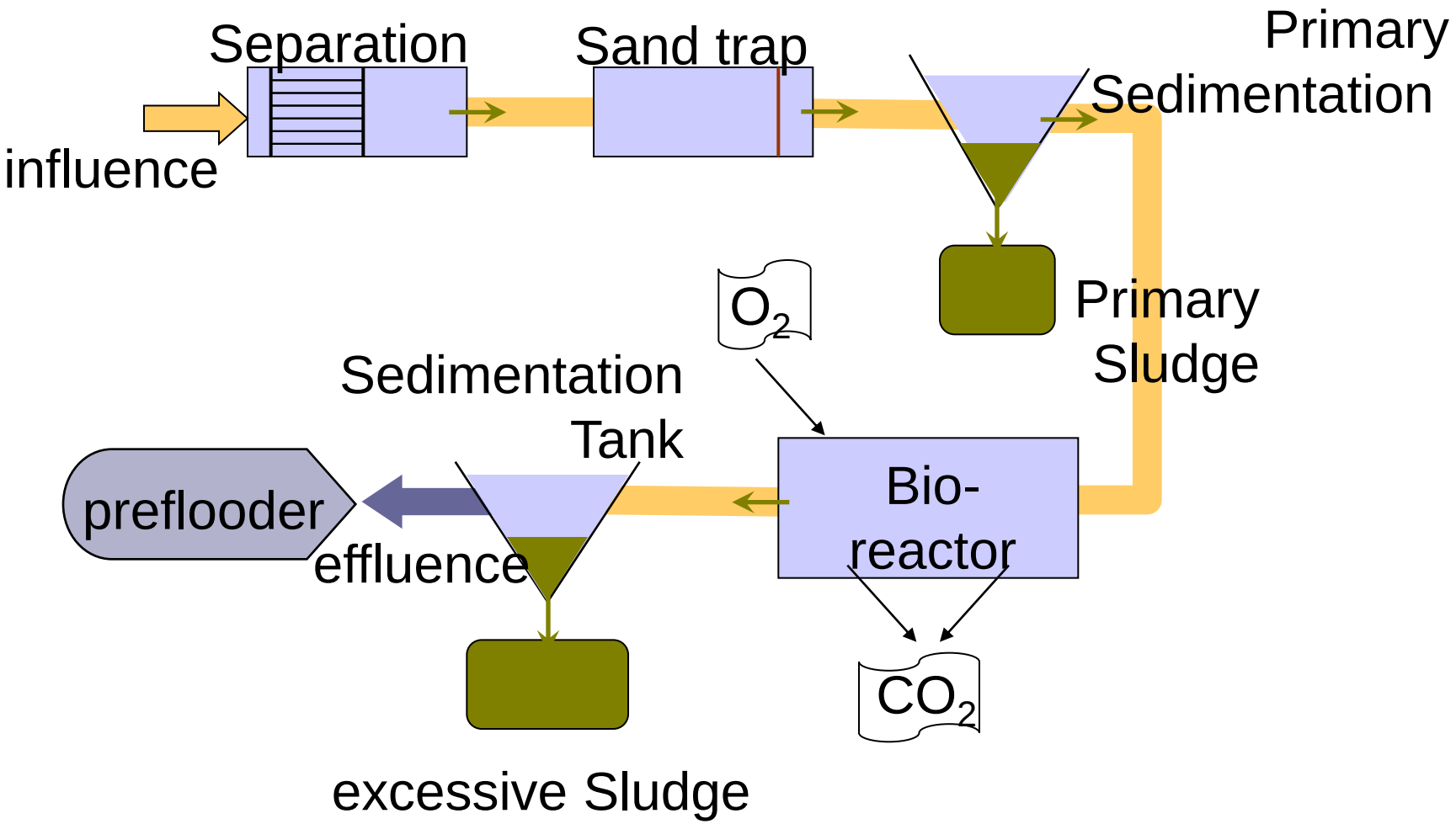
Wastewater Treatment Processes

Lecture 6

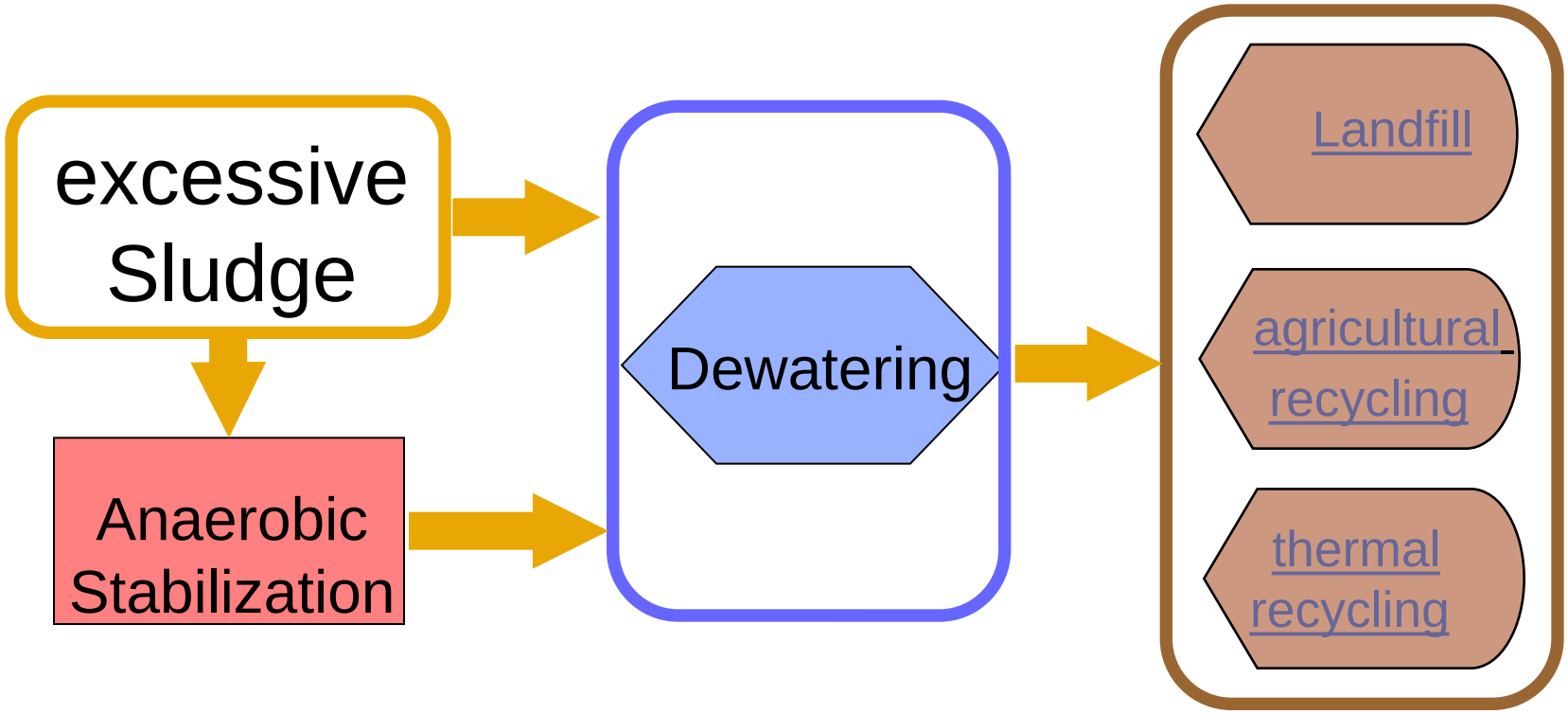
Wastewater treatment Processes



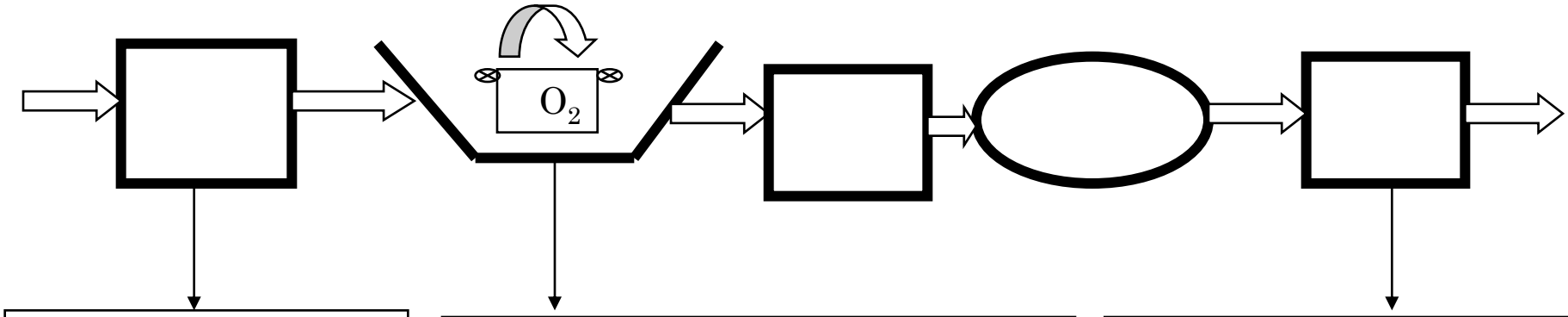
wastewater treatment plants



Sludge treatment



Wastewater Treatment Processes



Primary treatment

- screening
- grit removal
- removal of oil
- sedimentation

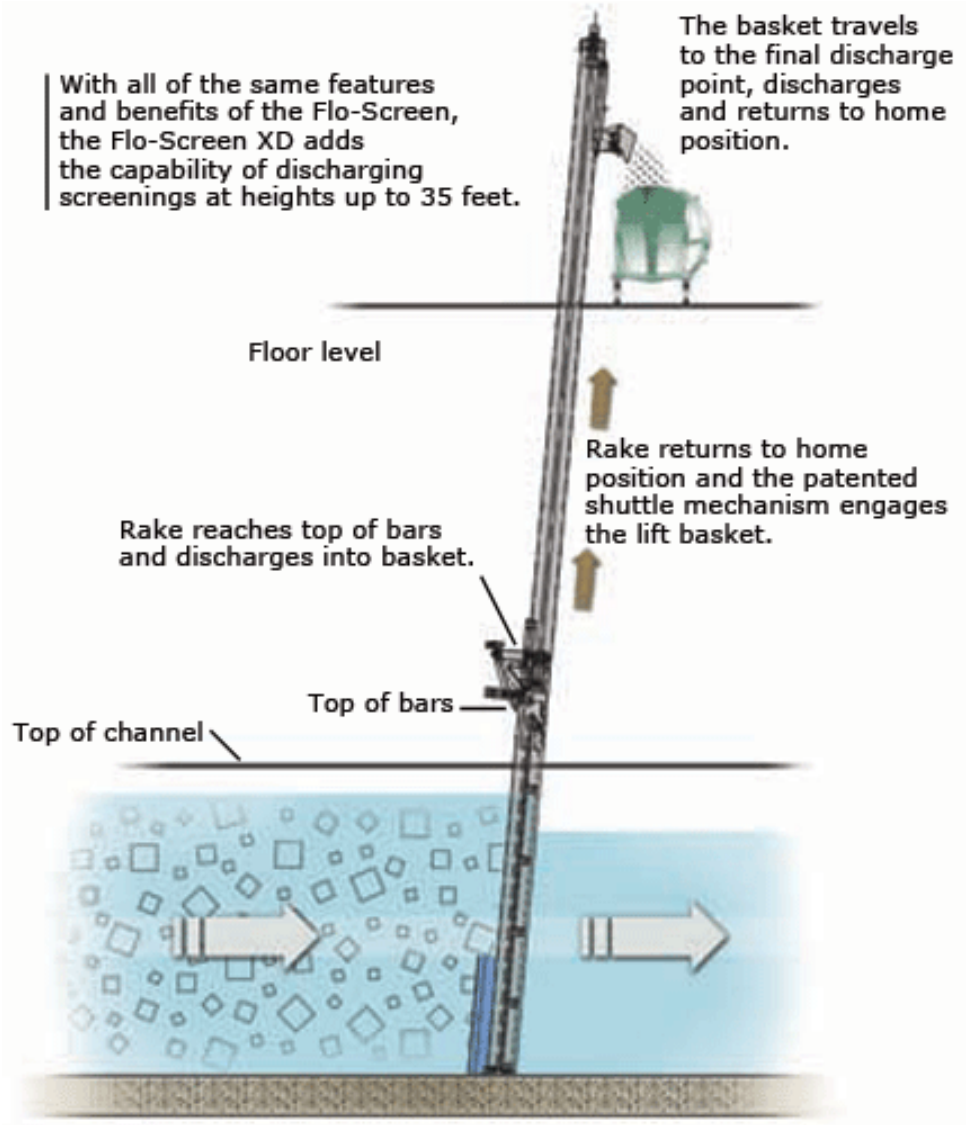
Secondary treatment

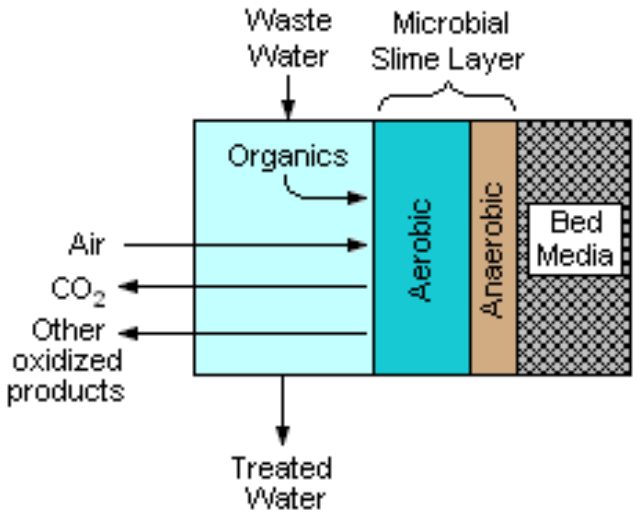
- Aerobic, anaerobic lagoons
- Trickling filter- activated sludge-oxidation ditch
- Mostly BOD removal technology

Tertiary treatment

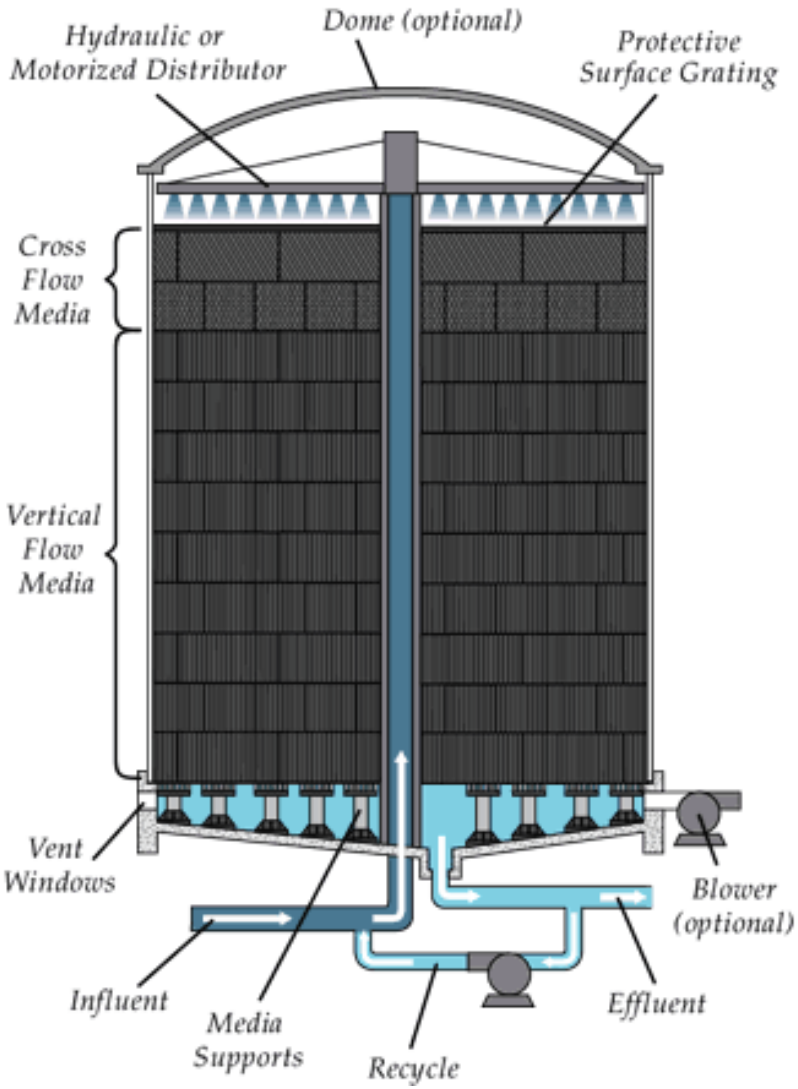
- Nitrate removal
- Phosphorus removal
- Disinfection

Bar Screen

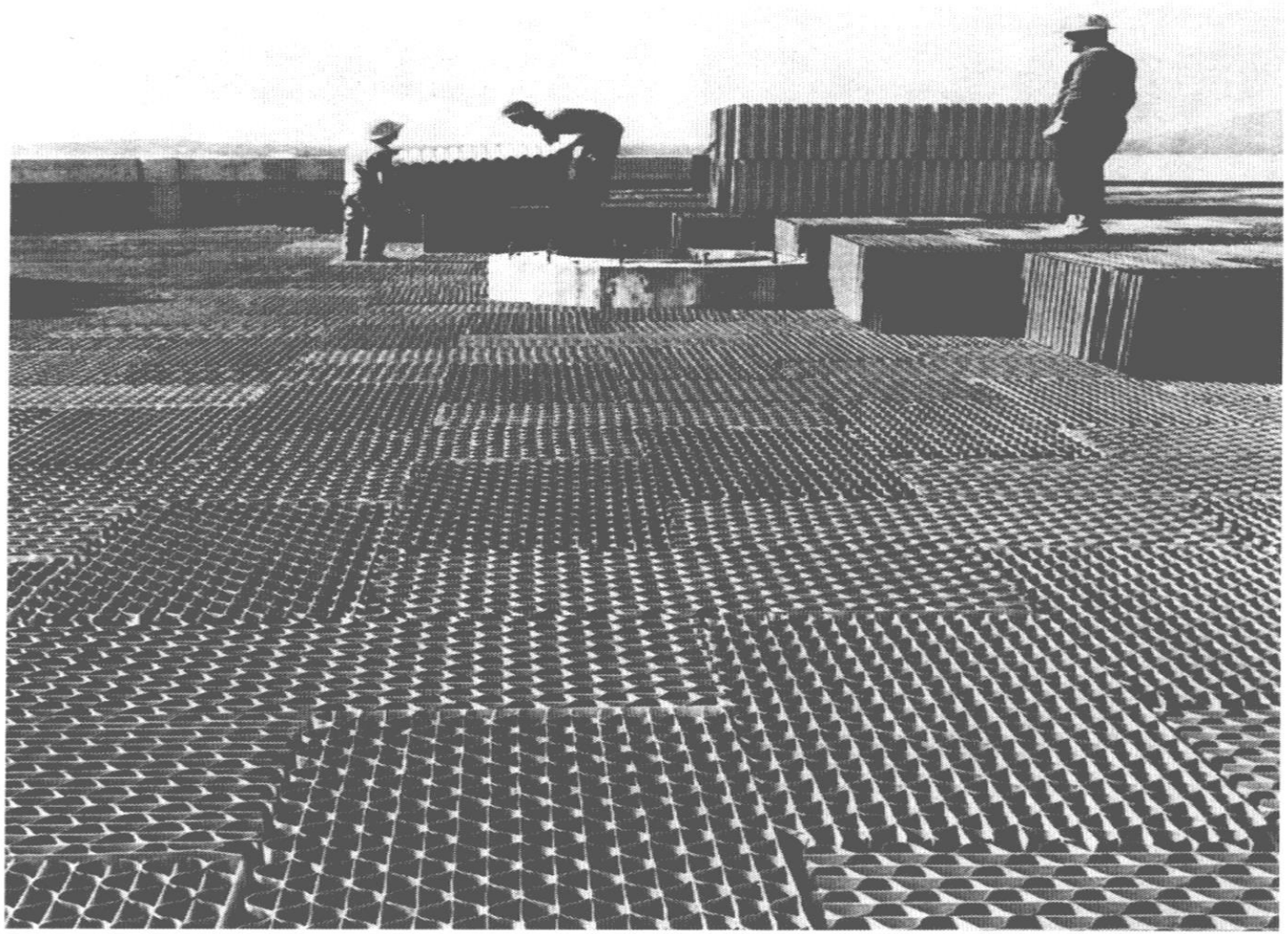

With all of the same features and benefits of the Flo-Screen, the Flo-Screen XD adds the capability of discharging screenings at heights up to 35 feet.
The basket travels to the final discharge point, discharges and returns to home position.
Floor level
Rake returns to home position and the patented shuttle mechanism engages the lift basket.
Rake reaches top of bars and discharges into basket.
Top of bars
Top of channel



Bio film in trickling filter



Fill Pack



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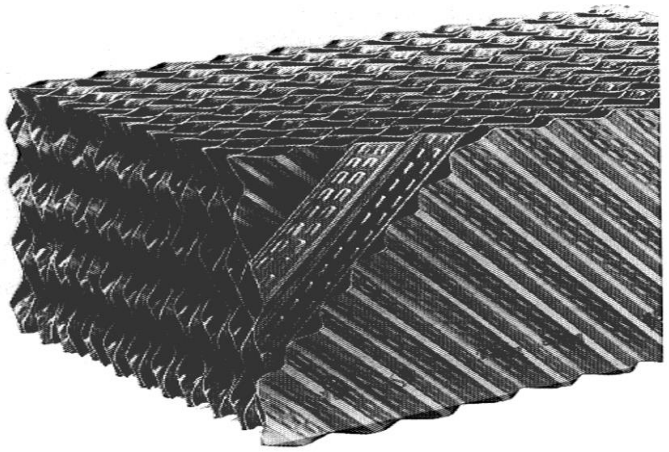
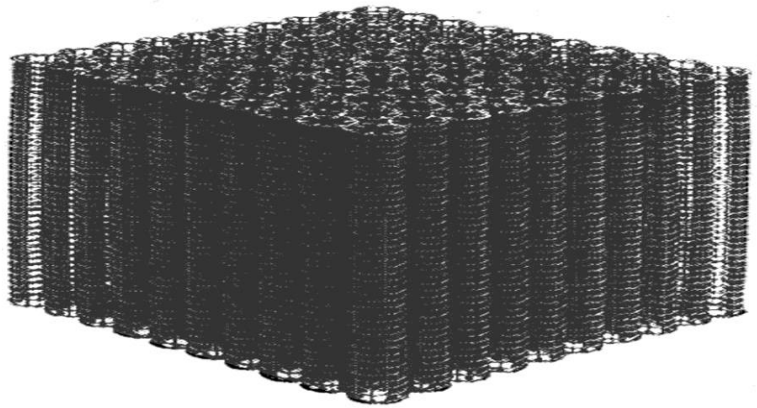
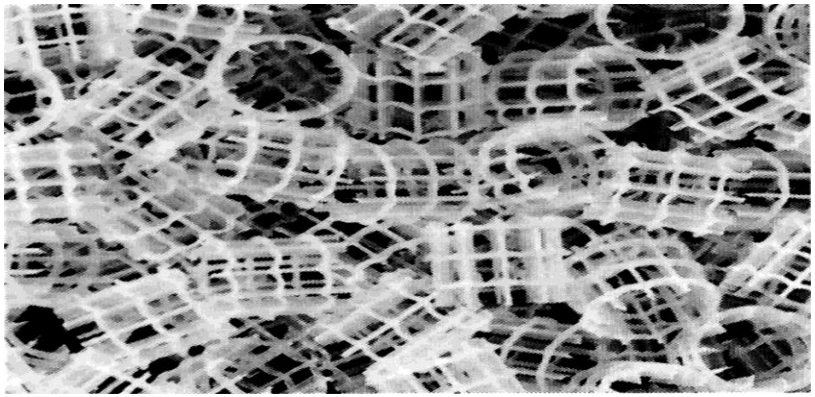
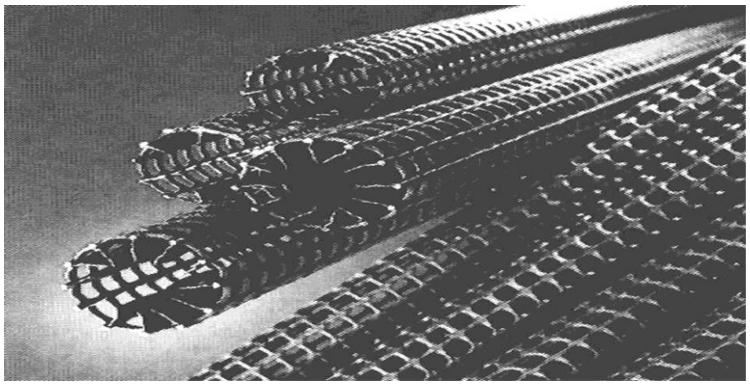




Rashing rings





Domestic Wastewater Characteristics

Parameter	Concentration (mg/l)		
	Strong	Medium	weak
BOD	400	220	110
COD	1000	500	250
Org-N	35	15	8
NH3-N	50	25	12
Total N	85	40	20
Total P	15	8	4
Total Solids	1200	720	350
Suspended solids	350	220	100

Industrial Wastewater Characteristics

pH	6-10
Temperature	40 C
Suspended solids	400 mg/l
Total toxic metals	10 mg/l
Cadmium	0.1 mg/l
Cyanide	2 mg/l
Sulphate	1000 mg/l
Oil, grease	100 mg/l

Primary Treatment

- Primary treatment is often called clarification, sedimentation or settling.
- This is the unit process where the wastewater is allowed to settle for a period **(~2h)** in a settling tank to produce a clarified liquid effluent in one stream and a liquid-solid sludge (called primary sludge) in a second stream.
- The benefits of primary treatment include:
  - Reduction in suspended solids
  - Reduction in BODs
  - Reduction in the amount of waste activated sludge (WAS) in the activated sludge plant .
  - Removal of floating material .
  - Partial equalization of flow rates and organic load

Primary Treatment

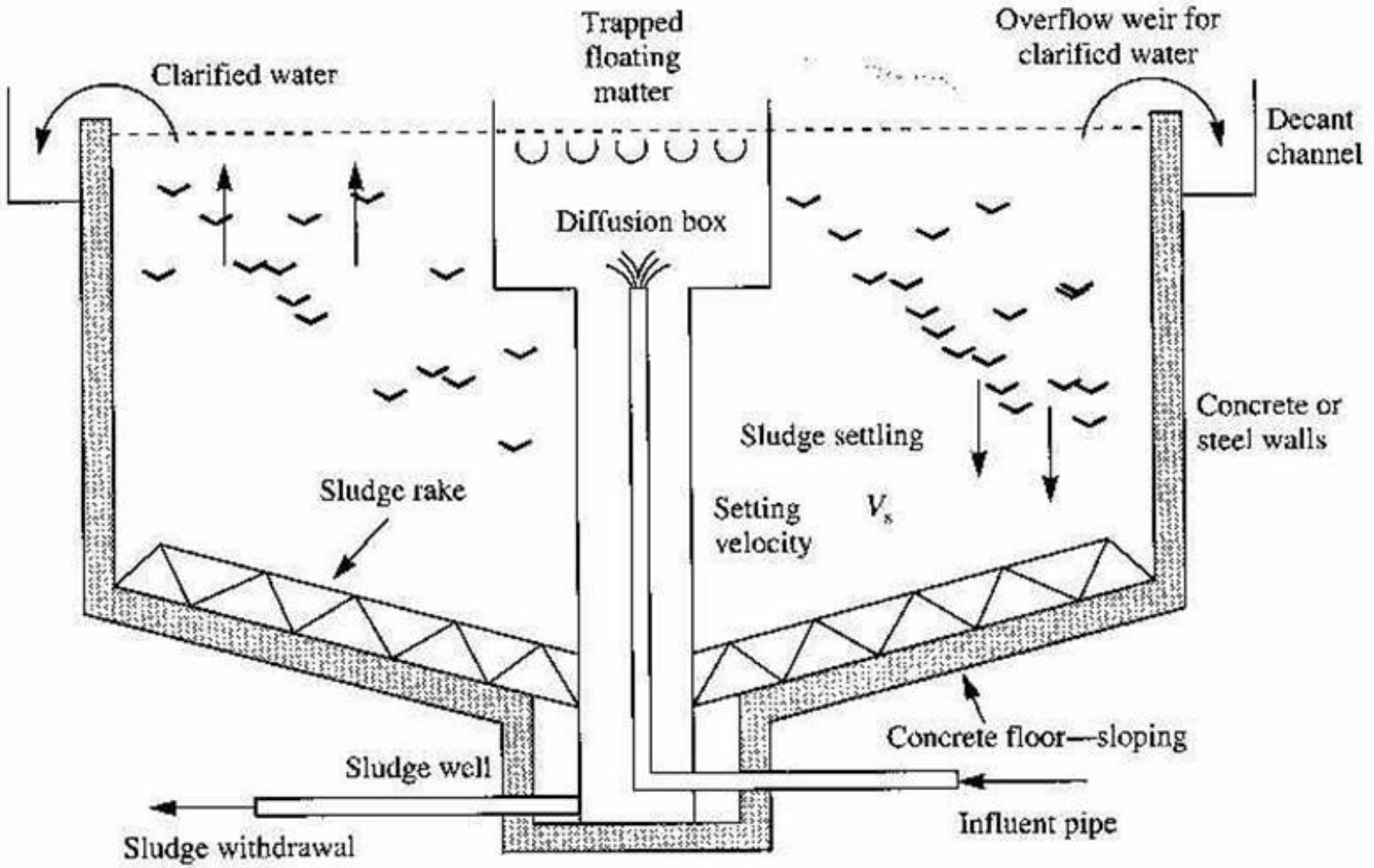
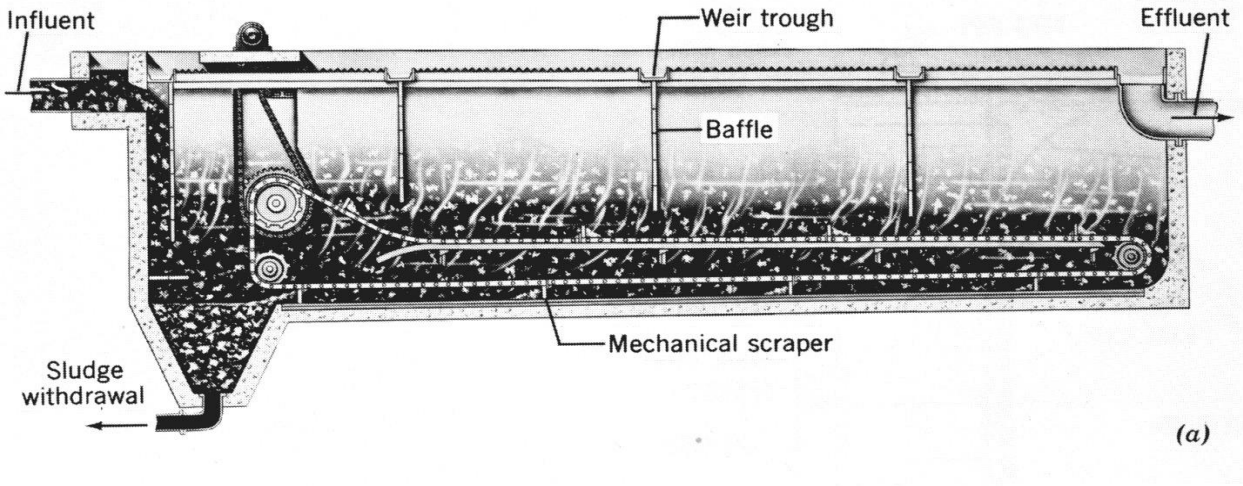
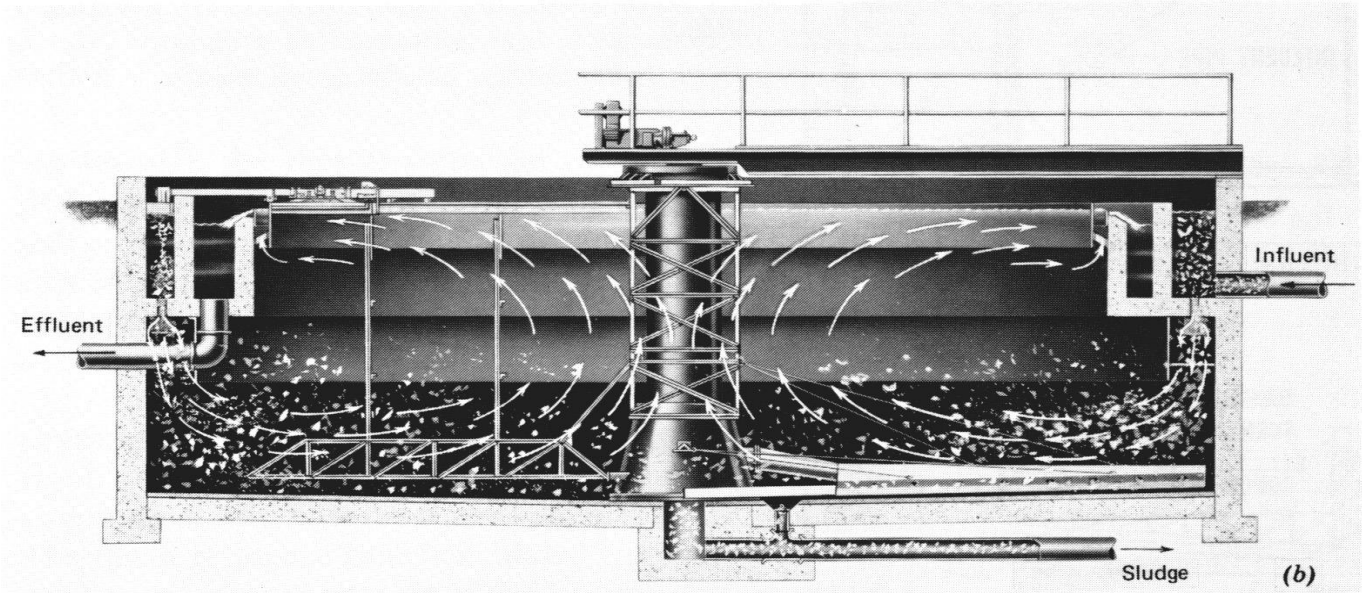


Figure 12.14 Typical circular primary settling tank.

Cross-sectional diagramms of rectangular and circular sedimentation tanks





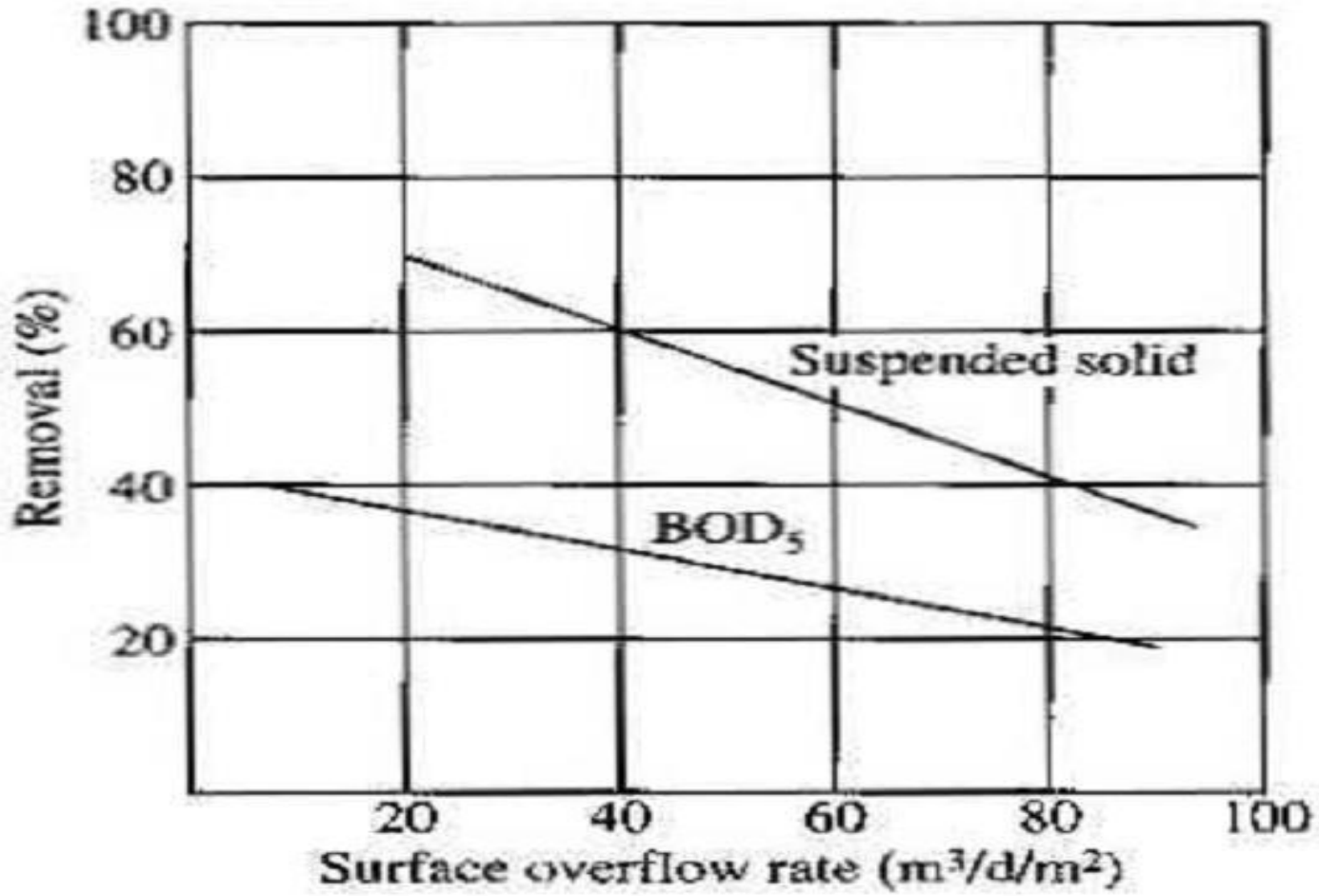
Primary Treatment

Table 12.12 Comparison of pollutant removal efficiencies for primary sedimentation with and without coagulation

	Removal efficiencies of primary settling	
Parameter	With coagulants (%)	Without coagulants (%)
TSS	60–90	40–70
BOD_5	40–70	25–40
COD	30–60	20–30
TP	70–90	5–10
Bacteria	80–90	50–60

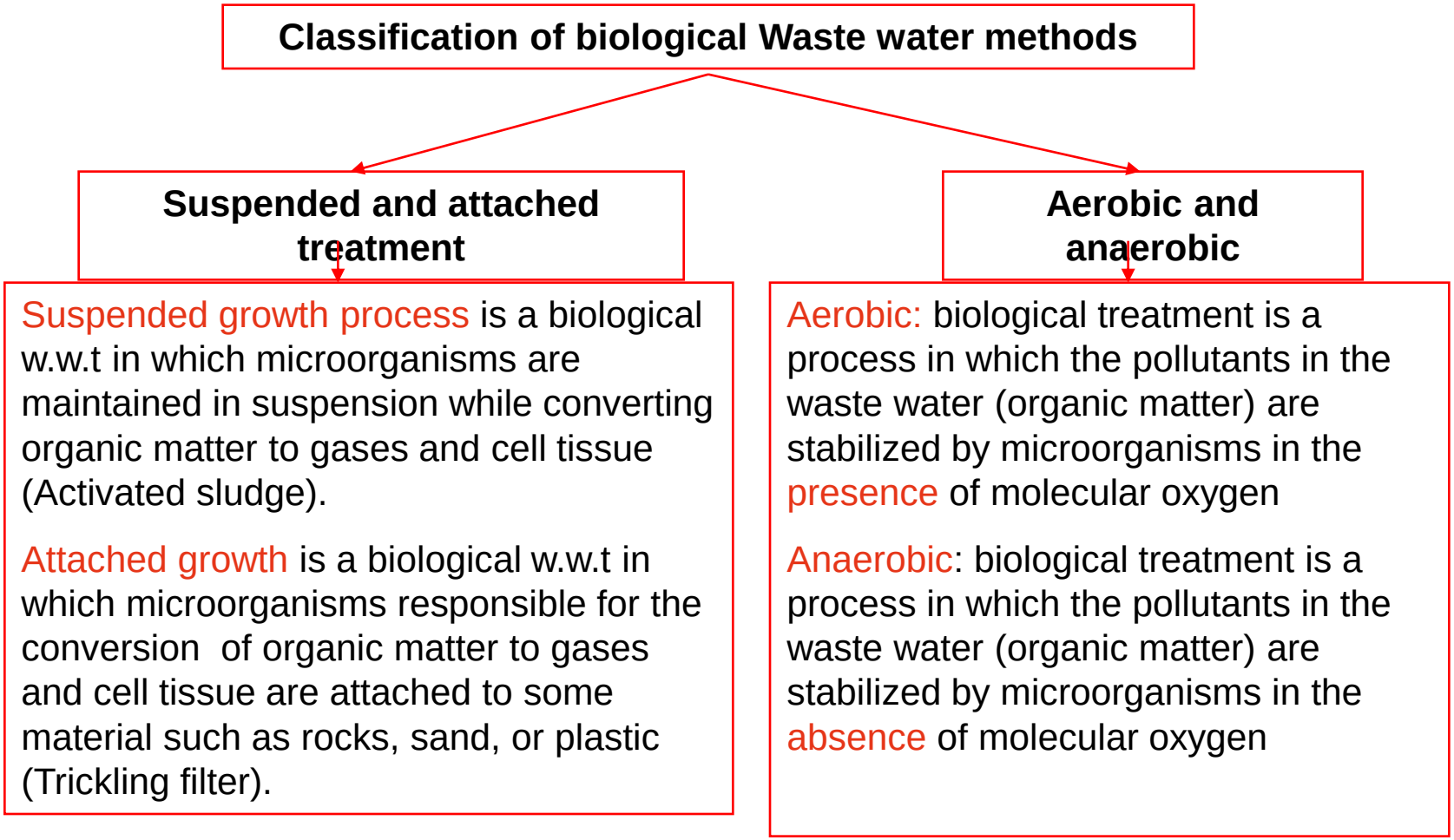
Adapted from Harleman, 1991

Primary Treatment



Biological waste water treatment

1. **It is a type of waste water treatment in which microorganisms such as bacteria are used to remove pollutants from waste water through bio-chemical reaction.**



Activated Sludge System

Process Description:

- **It is aerobic suspended growth biological wastewater treatment method in which dissolved organic and inorganic matter can be removed.**

- **This treatment is achieved in tanks called aeration tanks. Oxygen is supplied to these tanks to allow aerobic biochemical reaction to occur.**

- **In the aeration tank, the microorganisms feed on dissolved solids mainly organic matter and produce large amounts of bacteria (colonies). This means that microorganisms convert dissolved solids into suspended solids (the bacterial colonies).**

Activated Sludge System

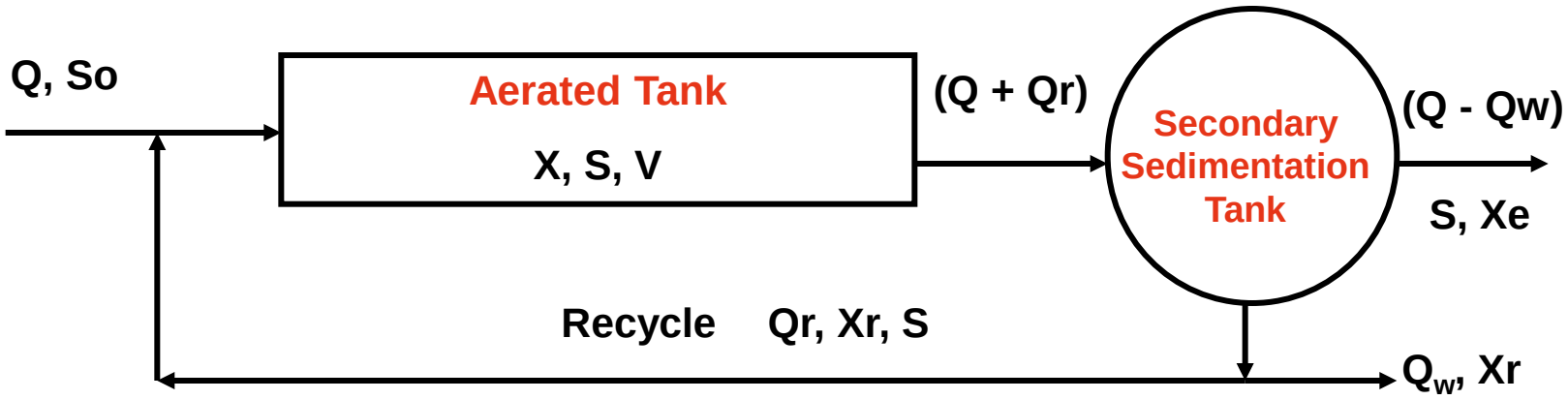
Process Description:

- After the aeration tank, a secondary sedimentation tank is installed to separate the bacteria from liquid

- The separated bacteria is called activated sludge. Part of the sludge is wasted and the remaining part is returned back (Recycle) to the aeration tank. The recycle of the sludge to aeration tank is very important to keep a specific concentration of the bacteria in the system to perform wastewater treatment.

- The mixture of wastewater with bacteria in the aeration tank is called mixed liquor suspended solids (MLSS)

Principal of activated sludge



Q = waste water flow rate

X = the mixed liquor suspended solids concentration (MLSS) bacteria concentration

Xr = concentration of recycled activated sludge

Xe = effluent suspended solids concentration

Qw = waste sludge flow rate

Qr = return sludge flow rate

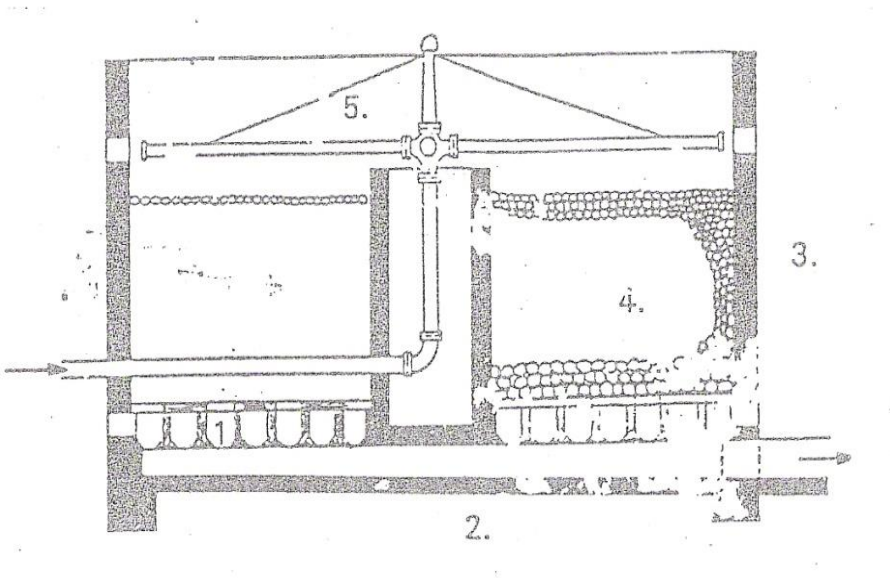
So = concentration of pollutants such as BOD

S = concentration of dissolved pollutants in the aerated tank and the effluent

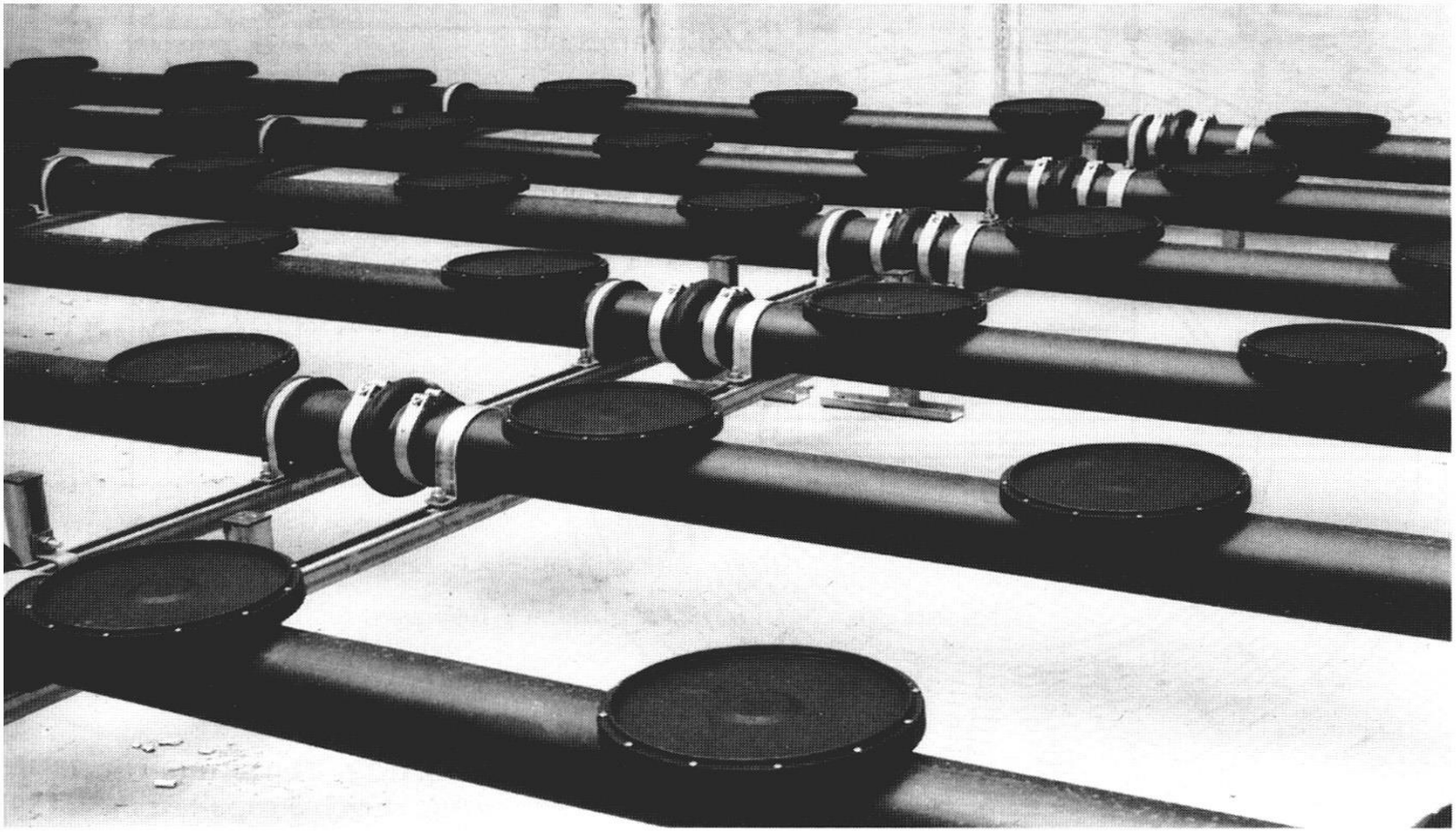
V = volume of the aerated tank

Principal of Trickling Filter

1. Trickling filter is an aerobic attached growth biological system
2. The major components of the trickling filter are:
   - The tank
   - Rotary distributor
   - Filter media (crushed stones, gravel, plastic)
   - Under drain system
   - Ventilation



Ventilator



Principal of Trickling Filter

3. Biological process

- The bacteria is attached to the filter media forming a biological layer called also bio-film
- Sprinkled wastewater over the filter media forms liquid film including food and dissolved oxygen.
- The bacteria (bio-film) absorbs the organic matter and oxidized it producing CO_2, H_2O, NH_3 and new cell
- The biological layer consists of aerobic and anaerobic partitions.
- When the mass of the bio-film increase the lower layer will be anaerobic with lower food supply which will lead to the decrease of the attaching force between the bio-film and the filter media. In this case the bio-film is sloughed out (disconnected) and flows out with the wastewater to the final sedimentation tank where it settles.