SLUDGE TREATMENT AND DISPOSAL

What is Sludge

The bulk of residual generated from wastewater by **physical** primary and biological (secondary) treatment processes

Source of Sludge

Primary clarifier

Secondary clarifier

Waste stabilization pond (FP, MP)

Aerated Lagoon (AL, MP)

Septic tank

Characteristics – Primary Sludge

3 – 7 % solids

60 – 80 % organic

Gray, fairly coarse, **strong** odours

More condensed and coarse in texture compared to the sludge from the secondary sedimentation tank

Characteristics – Secondary Sludge

Mainly **microorganisms**

Brownish, flocculent appearance and **earthy** odour

Depends on the growth of microorganisms

Attached - big and condensed

Suspended – fine and light/less dense

Why Treat Sludge

Still biodegradable

Can exert oxygen demand

May contain hazardous microbes

Sludge Treatment

1. Thickening
2. Stabilization
3. Drying
4. Disposal

Sludge Thickening

To reduce the sludge volume

Thickening Method

Gravity thickener and/or air floatation

Sludge still in **liquid** form

The % of solid volume increased twice

Applied for sludge to be **biologically stabilized**

Gravity Thickener

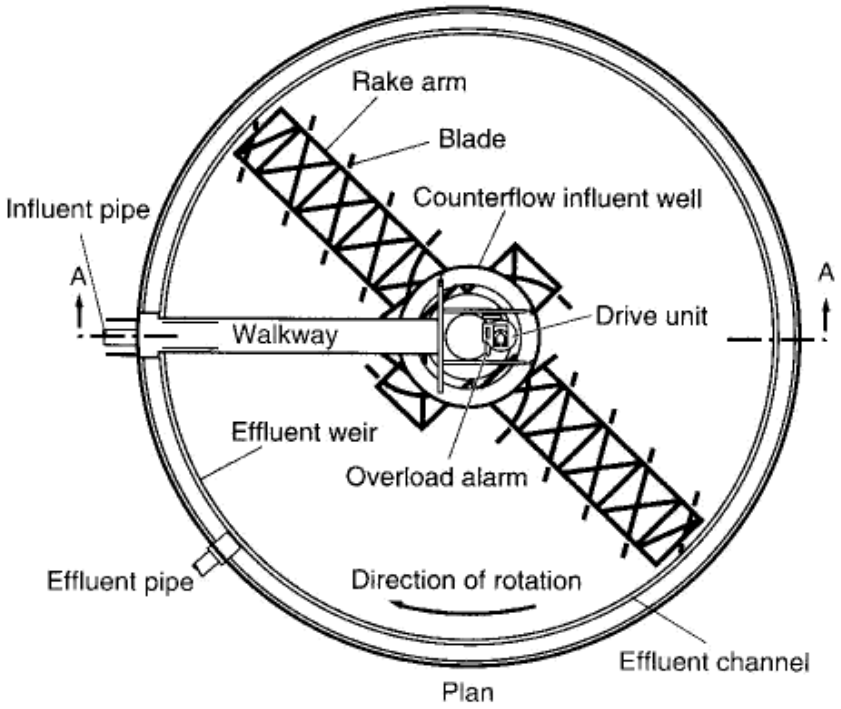
For sludge from **attached growth**

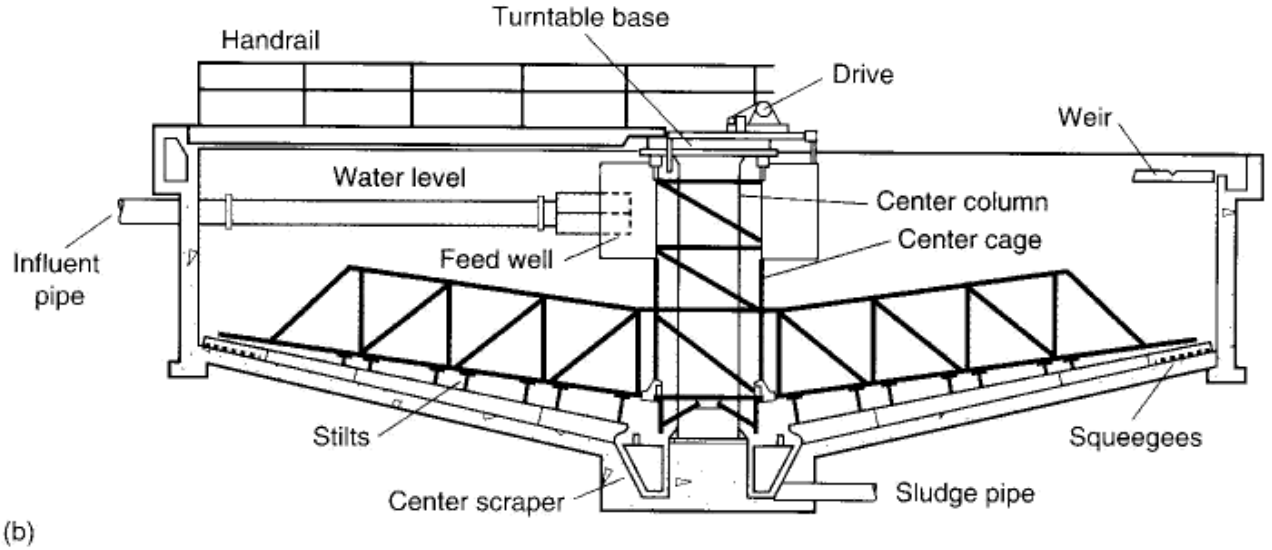
Use **gravity forces** for solid separation

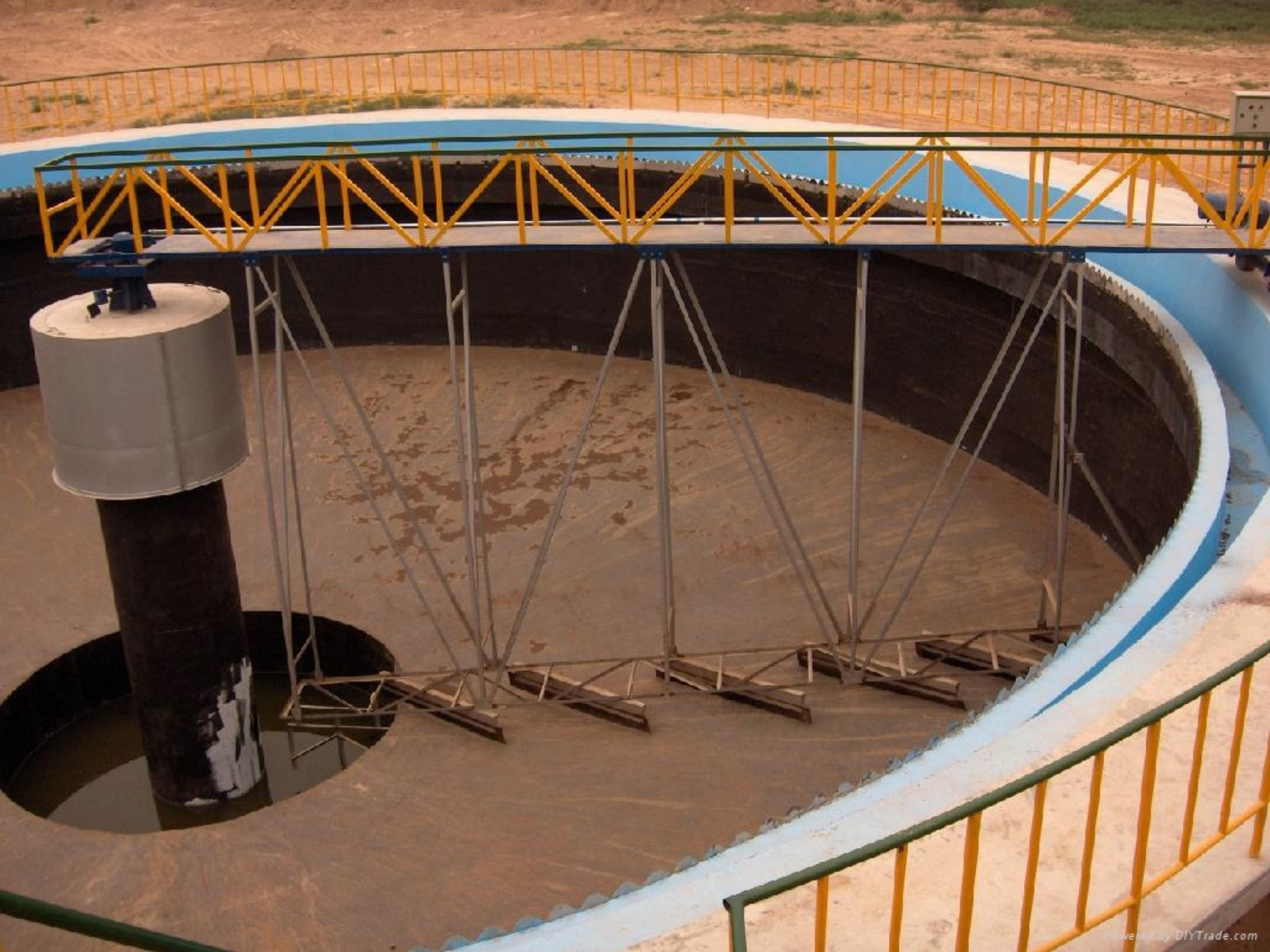
Similar in design to conventional sedimentation tank

Figure 14–11

Schematic diagram of a gravity thickener: (*a*) plan and (*b*) section.







Dissolved Air Floatation (DAF)

For sludge from **suspended growth**

Separates solids from the liquid in an **upward direction** by attaching fine bubbles to particles of suspended solids which then float

Thickened sludge is skimmed off at the top of the tank

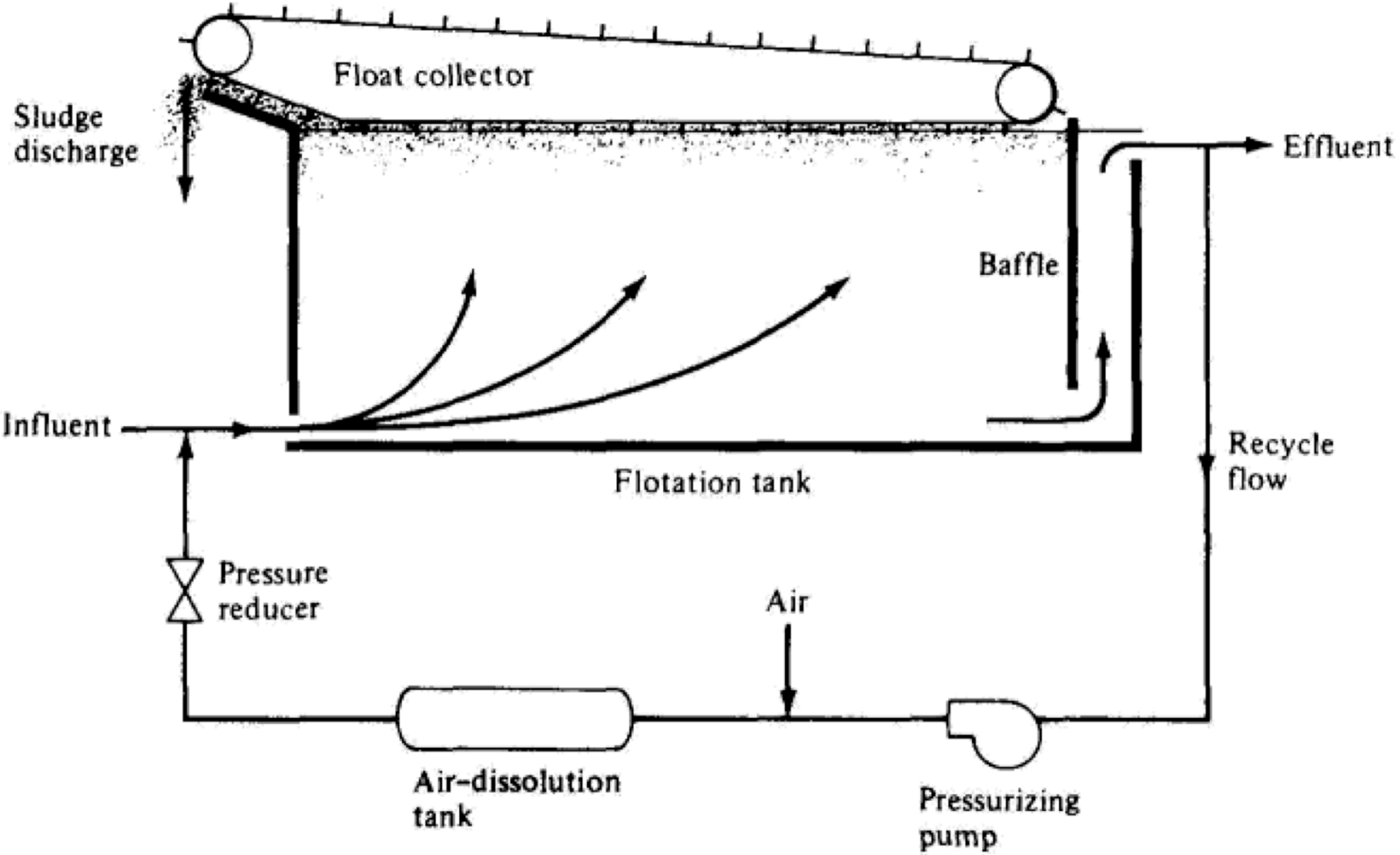


Figure 13.10 Schematic diagram of a dissolved-air flotation system.

Mechanical Thickener

For sludge to be **incinerated**

The sludge will become **semi-solid**

Vacuum filter and centrifuge

Sludge Stabilization

To convert the organic solids (in sludge) to a more **refractory or inert materials**

Biological Stabilization

Anaerobic digestion

Aerobic digestion

Anaerobic Digestion

One of the oldest and most widely used

End product are liquid and gases

% of biomass transformed from organic is minimum

For 50 – 60% decomposition of organic substances, only less than 10% of biomass is formed

Anaerobic Digestion

Require **proper** maintenance

Produce gases, **methane** which is later used as source of energy for the plant

65 – 70% - methane
(1 m^3 gas/ 1 kg solid sludge)

25 – 30% - CO_2

Anaerobic Digestion Process

Common digestion rate

t = 30 – 60 d

Sedimentation occurred **in reactor**

Anaerobic Digestion Process

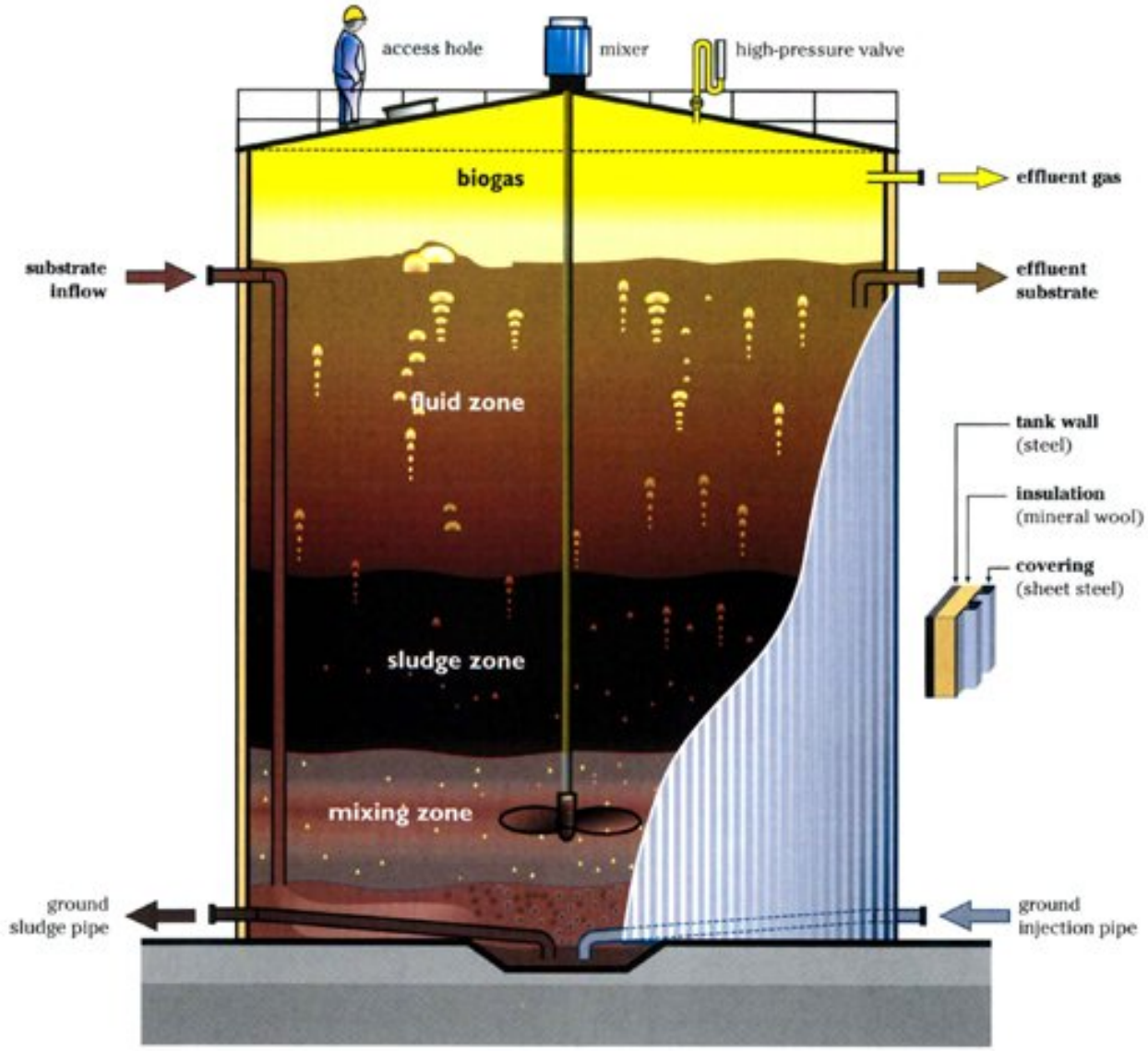
High digestion rate

t = 10 – 20 d

More effective

Smaller

Sedimentation process in **different** reactor


access hole
mixer
high-pressure valve
biogas
effluent gas
substrate inflow
effluent substrate
fluid zone
tank wall (steel)
insulation (mineral wool)
covering (sheet steel)
sludge zone
mixing zone
ground sludge pipe
ground injection pipe

Aerobic Digestion

Use for **secondary** sludge only

Endogenous respiration occurred for microorganisms

Easier for maintenance

Difficult for releasing the water


8. 30. 2004

Incineration

- Another method of stabilization
- The sludge is required to be **dried**
- Required source of **fuel** for burning

Drying Process

To **reduce** the water content before the sludge been disposed

Methods

Drying bed

Lagoon / pool

Vacuum filter

Centrifuge

Pressure filter

Drying Bed

Remove moisture by
natural **evaporation** and **gravity**

10-23 cm of **sand** placed over
a 20-50 cm layer of **gravel**

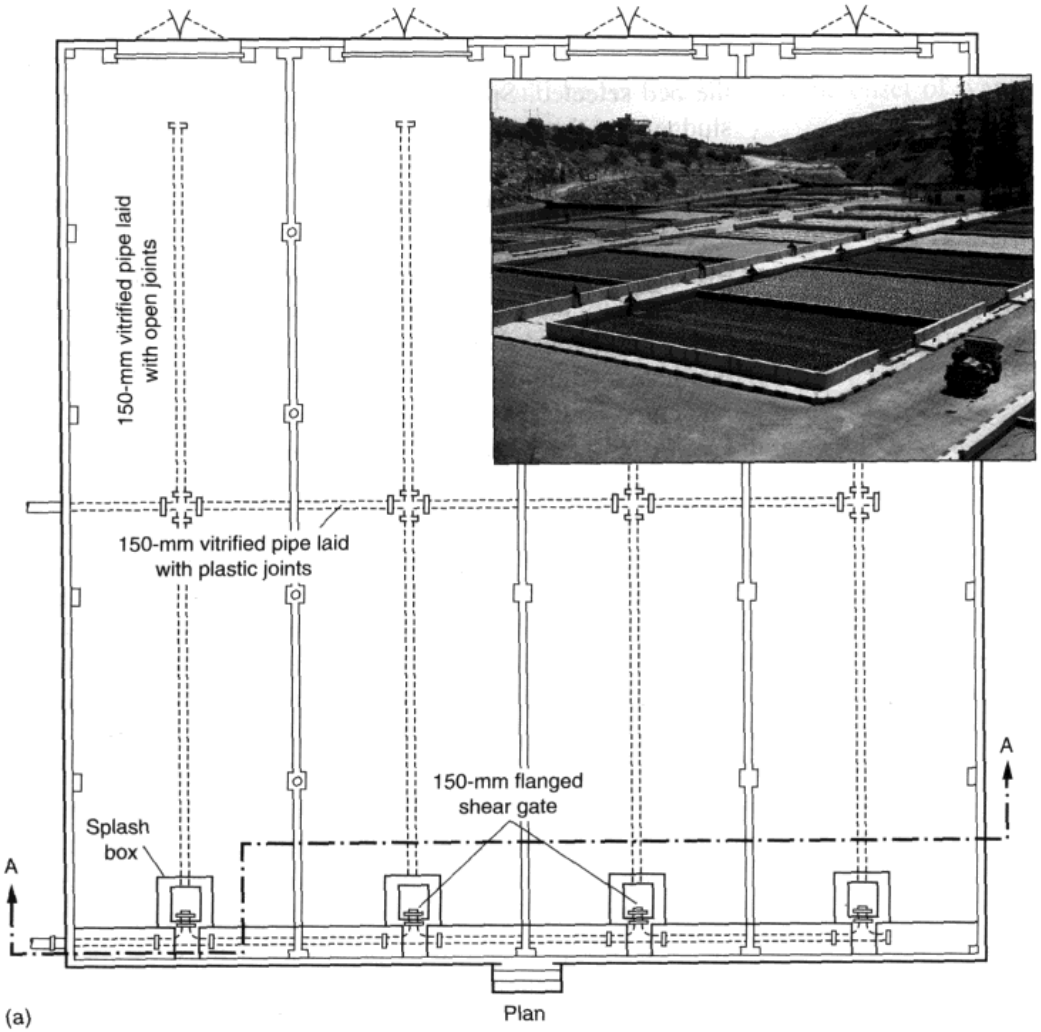
Underdrain system that consist of
perforated pipe

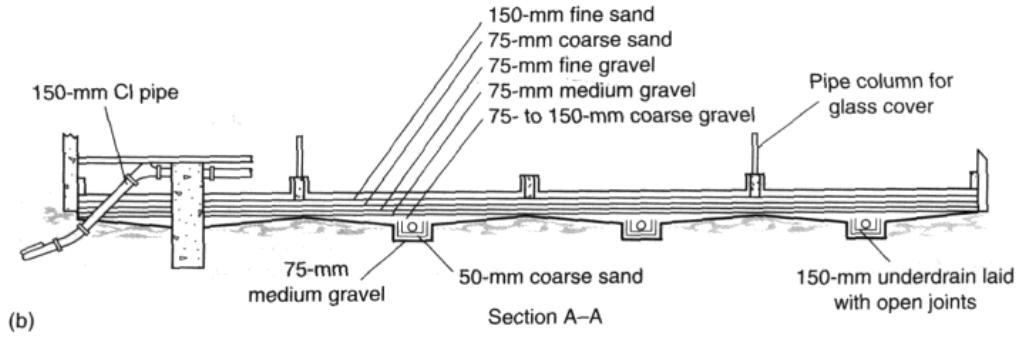
Drying Bed

The digested sludge is discharged on the bed in a 30-45 cm layer and allowed to dewater by drainage through the sludge mass and supporting sand and by evaporation from the surface exposed to air

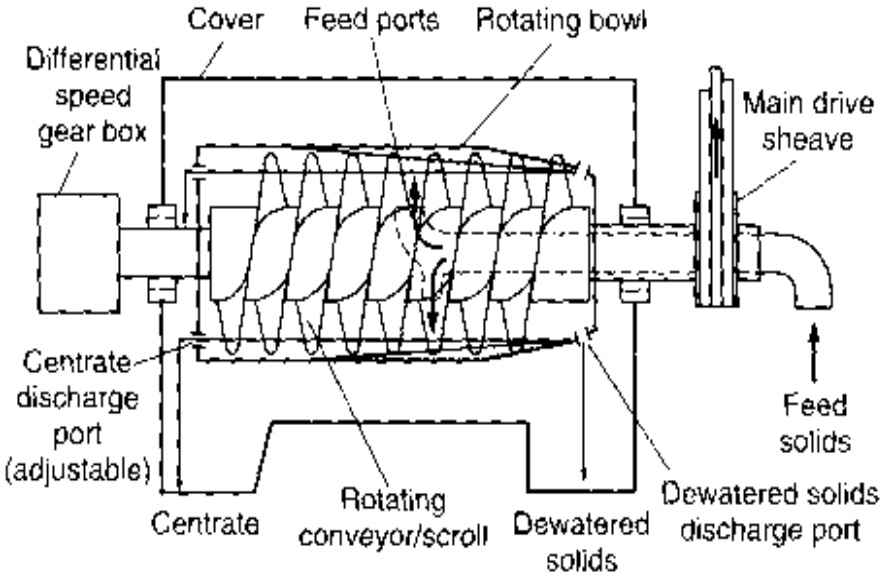
Figure 14–45

Typical conventional sand drying bed: (*a*) plan and pictorial views and (*b*) cross-sectional view. Insert—view of sludge drying beds with sludge in various stages of dryness.





Centrifuge



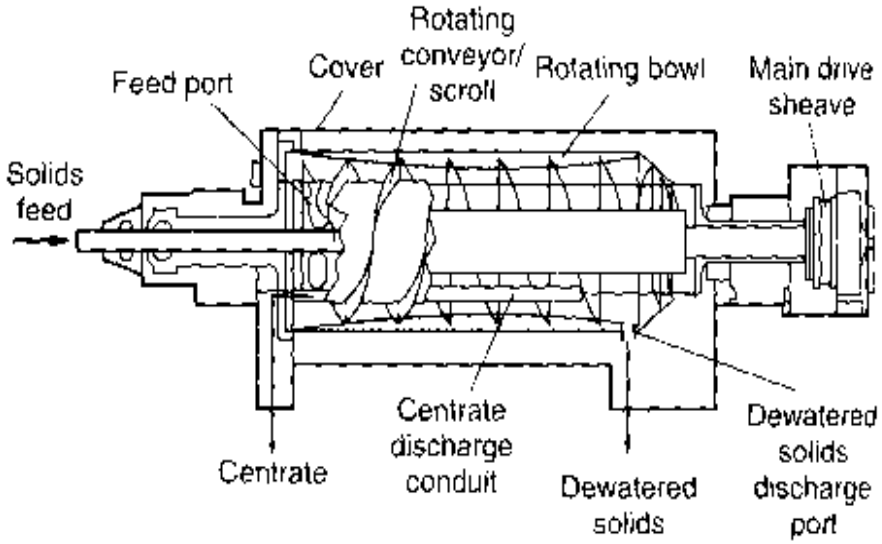


Figure 14–40

Schematic diagrams of two solid-bowl centrifuge configurations for dewatering sludge: (a) countercurrent and (b) cocurrent.

Belt-press

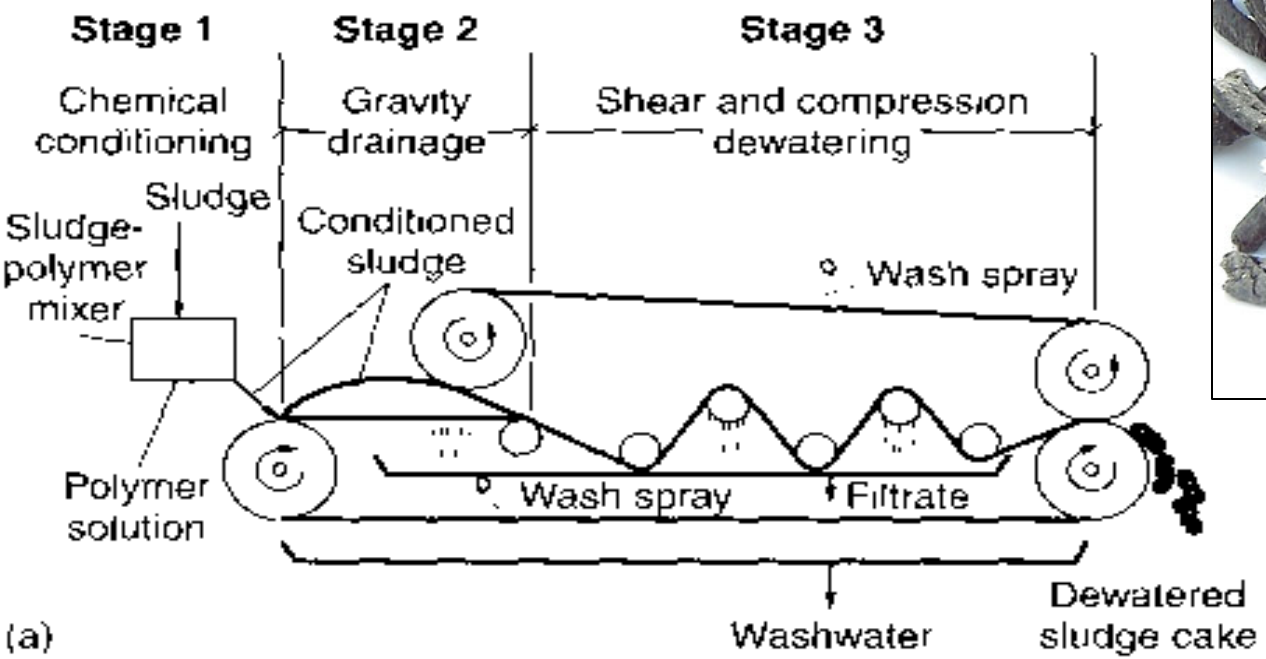


Figure 14–41

Belt-press dewatering: (a) three basic stages of belt-press dewatering,

Press Filter

Figure 14–43

Typical fixed volume, recessed-plate filter press used for dewatering sludge: (*a*) schematic, (*b*) pictorial view of a typical installation.

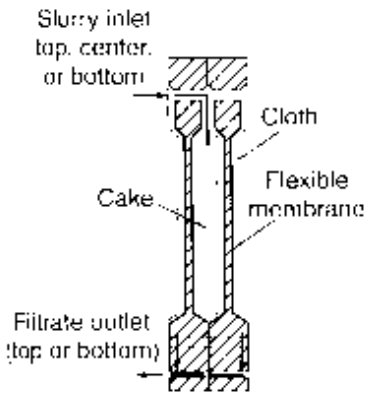
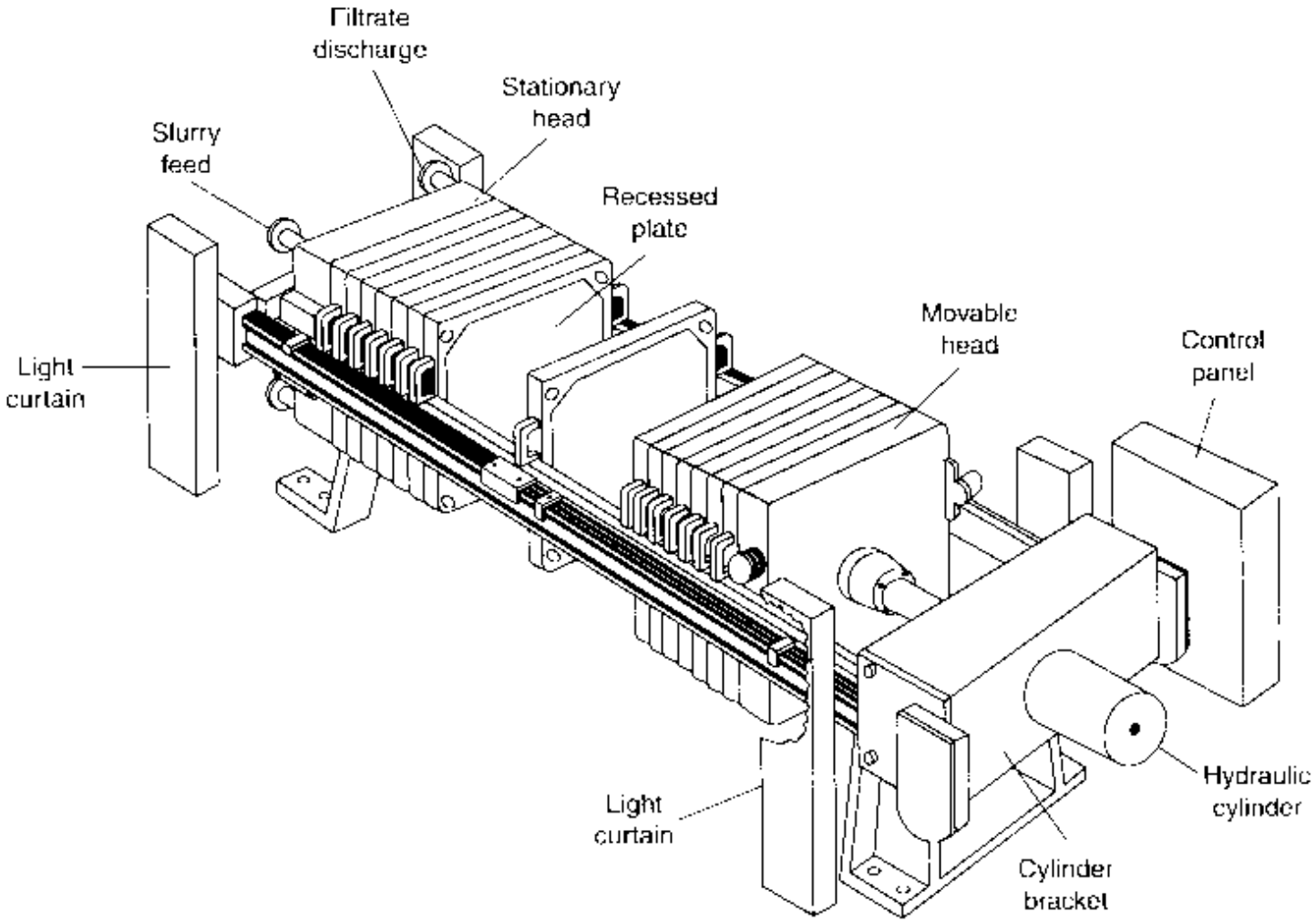


Figure 14–44

Cross section of a variable volume recessed-plate filter press.



Sludge Disposal

Sludge Disposal

Disposal site

Composting

Disposal Site

Sludge need to be **stabilized**

Sanitary landfill

Leachate –
must be controlled and treated

Composting

Transforming sludge into fertilizer or soil conditioner

Dry form

Limitation – toxic compound