Environmental Biotechnology

Industrial Wastewater Characteristics

Industrial wastewater is a type of wastewater produced by industrial activity, such as that of factories, mills and mines.

It is characterized by its large volume, high temperature, high concentration of biodegradable organic matter and suspended solids, high alkalinity or acidity, and by variations of flow.
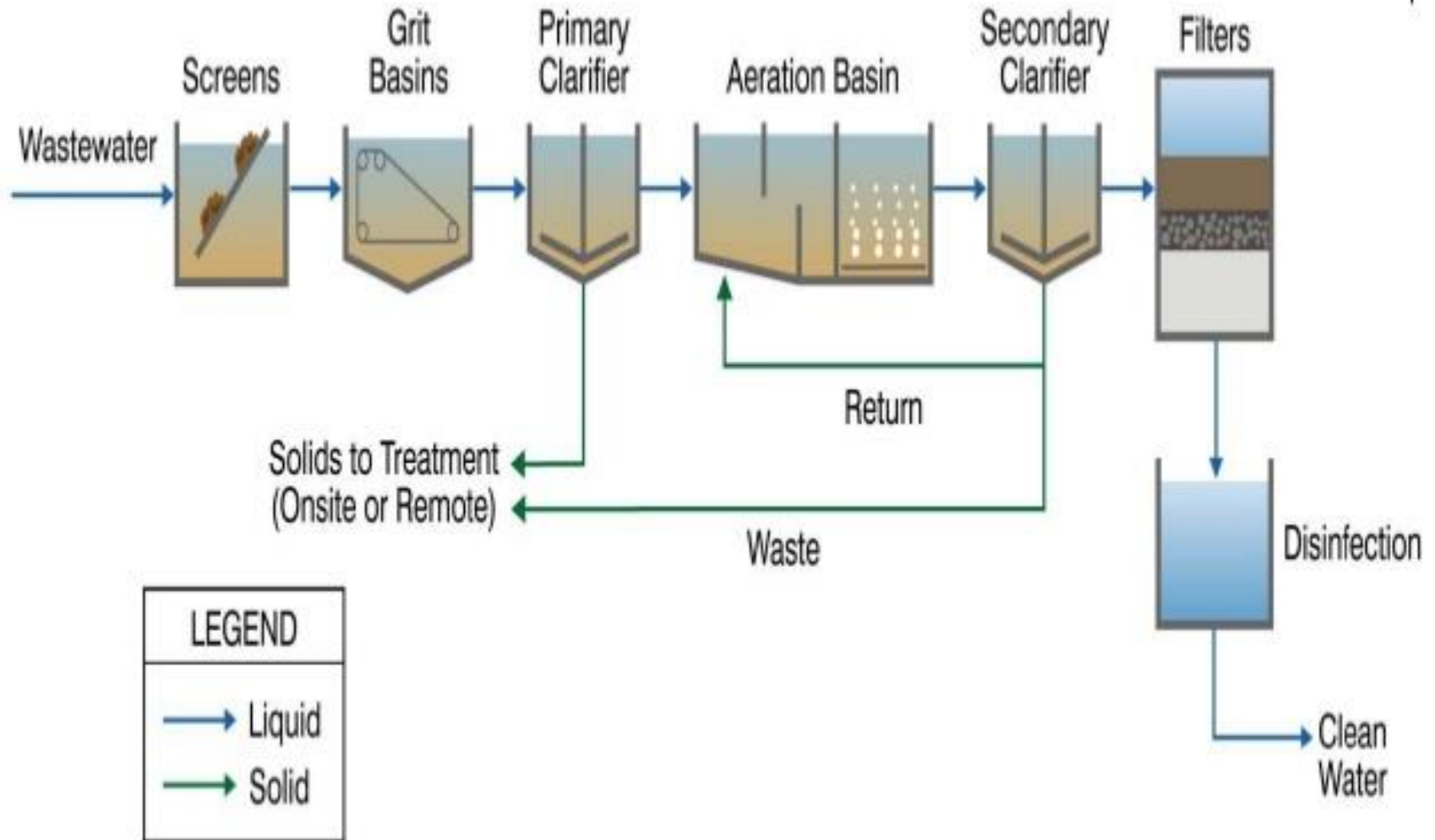
The degree of treatment varies according to the means of disposal, which may be to a municipal sewer system, a receiving body of water, such as a stream, an estuary, or a large body of fresh water, or recovery for reuse.

Benefits

- Used to develop method for the treatment of toxic compounds.

- Improving the design and operation of biomechanical treatment system used for degradation of toxic compounds.

- Improvement of public health, sanitation, soil integrity and the conservation of fresh water resources.

Overall Treatment Processes

Wastewater → Screens → Grit Basins → Primary Clarifier → Aeration Basin → Secondary Clarifier → Filters

Return

Solids to Treatment (Onsite or Remote)

Waste

Disinfection → Clean Water

LEGEND

→ Liquid

→ Solid

3 stages of treatment.

Primary.
This is only a physical separation to remove solid matter.
Effluent is allowed to settle for a few hours.

Secondary.
The organic and nutrient load is decreased by microbial activity
Up to 95% so that the effluent is of a quality
to be able to go into rivers.

Tertiary.
This is a complete treatment, but it is very expensive
and not used much.

Secondary Treatment.

Can be divided into

1. Anaerobic
2. Aerobic treatment processes

Anaerobic

Complex series of digestive and fermentative reactions by a
mixture of bacteria. It can remove 95% BOD.
This is the choice if there is a lot of insoluble matter
cellulose, industrial waste.
Degradation is carriead out in large tanks – sludge digestors or bioreactors.

Molecular components are digested and fermented to FA, H_2, CO_2.

FA then to acetate, CO_2 and H_2.

These are substrates for methanogenic bacteria to make methane.
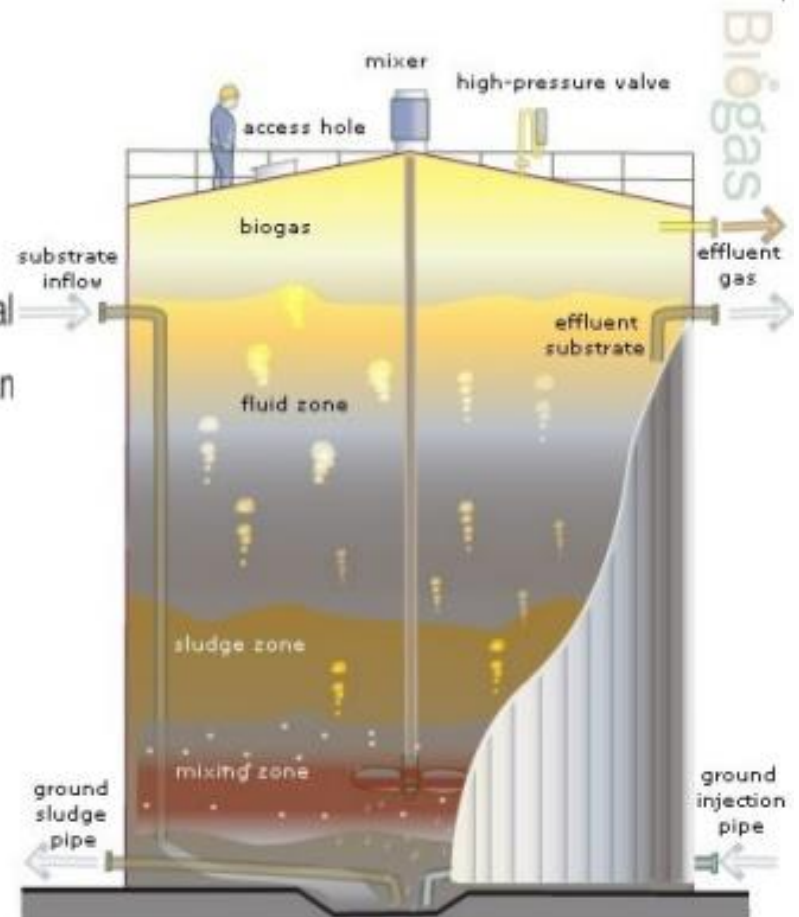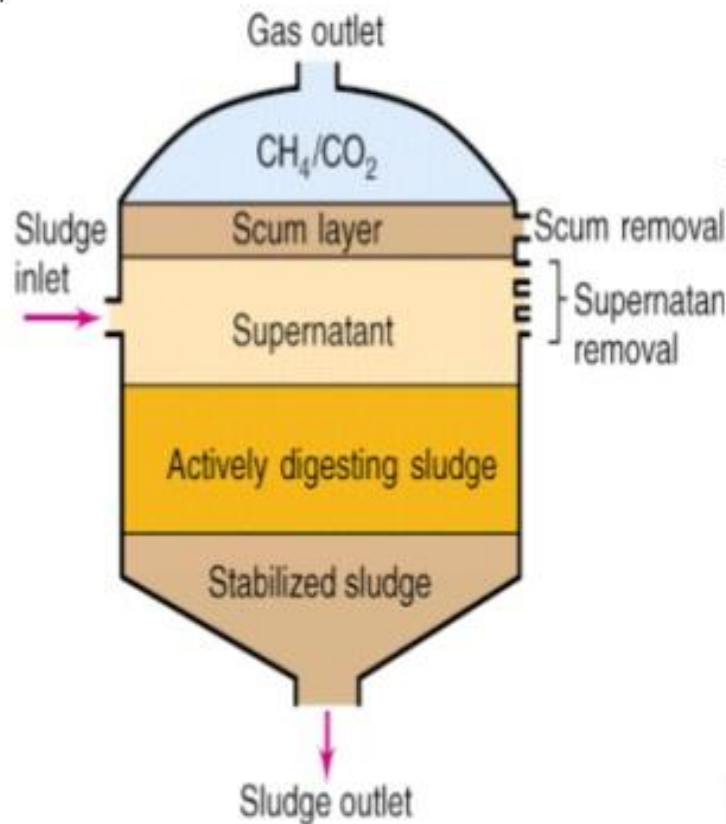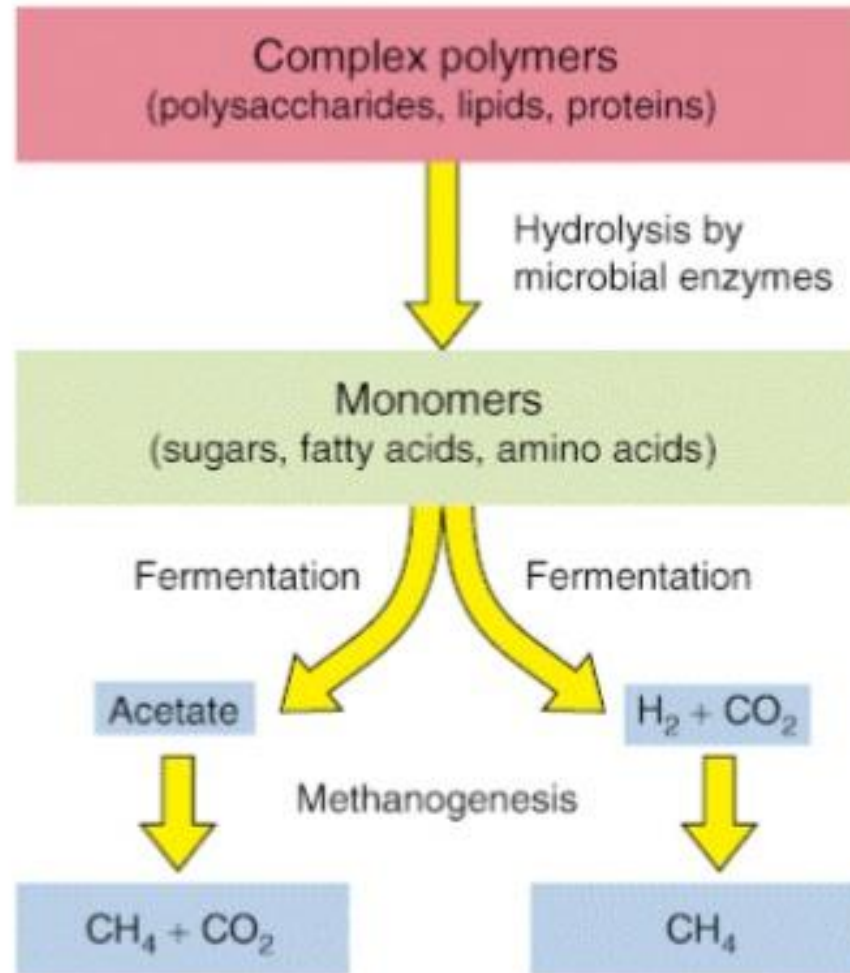Major products are methane and CO_2. Used or burnt off.

Anaerobic Sludge Digester

Anaerobic sludge digestion

Gas outlet

CH₄/CO₂

Sludge inlet

Scum layer — Scum removal

Supernatant — Supernatan removal

Actively digesting sludge

Stabilized sludge

Sludge outlet

mixer · access hole · high-pressure valve · Biogas

biogas · effluent gas

substrate inflow · fluid zone · effluent substrate

sludge zone

mixing zone

ground sludge pipe · ground injection pipe

Anaerobic sludge digestion

Aerobic

There are several kinds of aerobic decomposition processes.
Trickling filter and activated sludge are the most common.
Trickling filter is a bed of crushed rock, ~2m thick.
Wastewater is sprayed on the top (UWI plant).
Liquid slowly passes through the rock, organic matter absorbs to
the rock and microbial growth takes place.
Complete mineralization of organic matter takes place.

Most common is activated sludge.
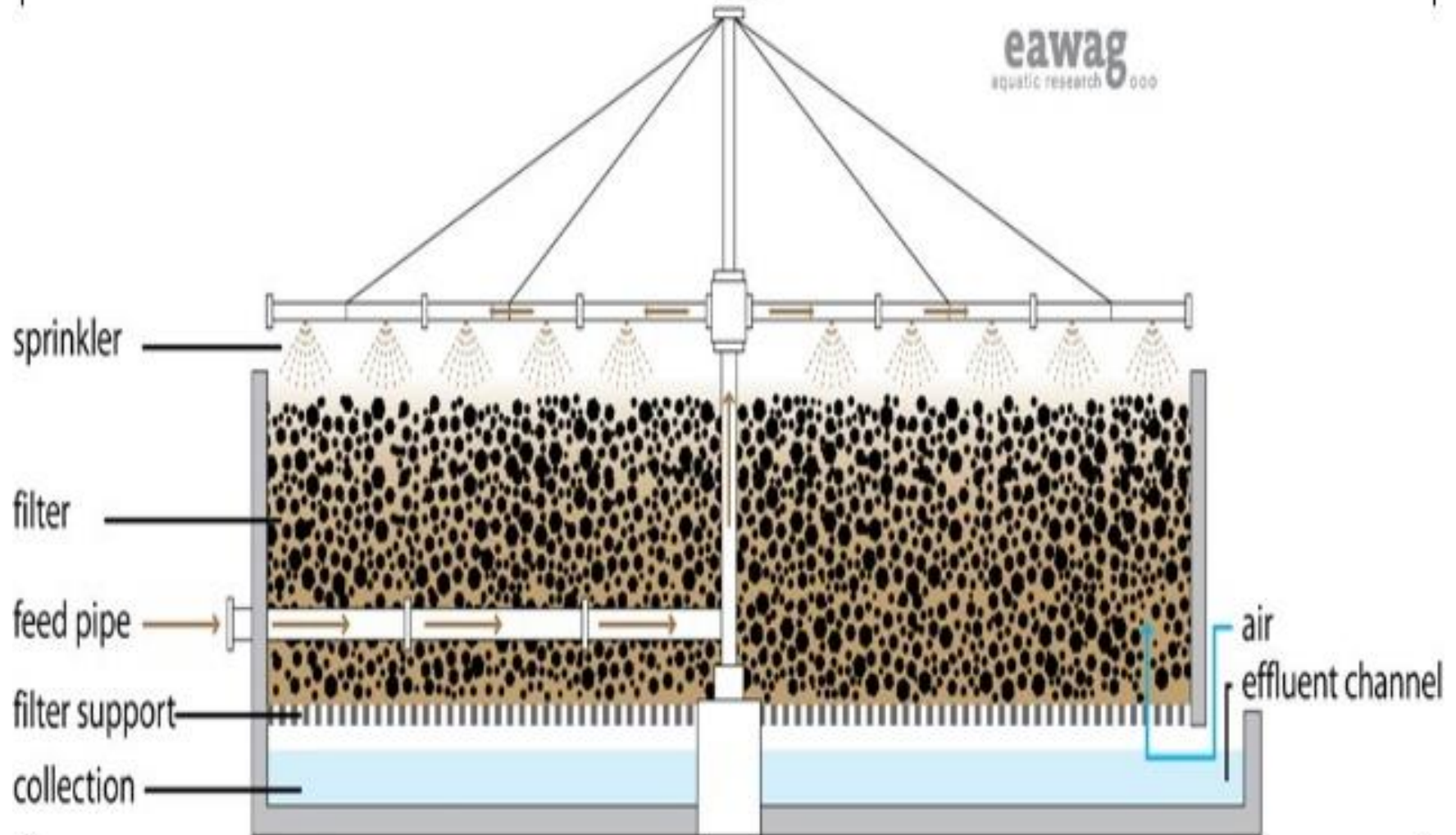Wastewater is mixed and aerated in a large tank
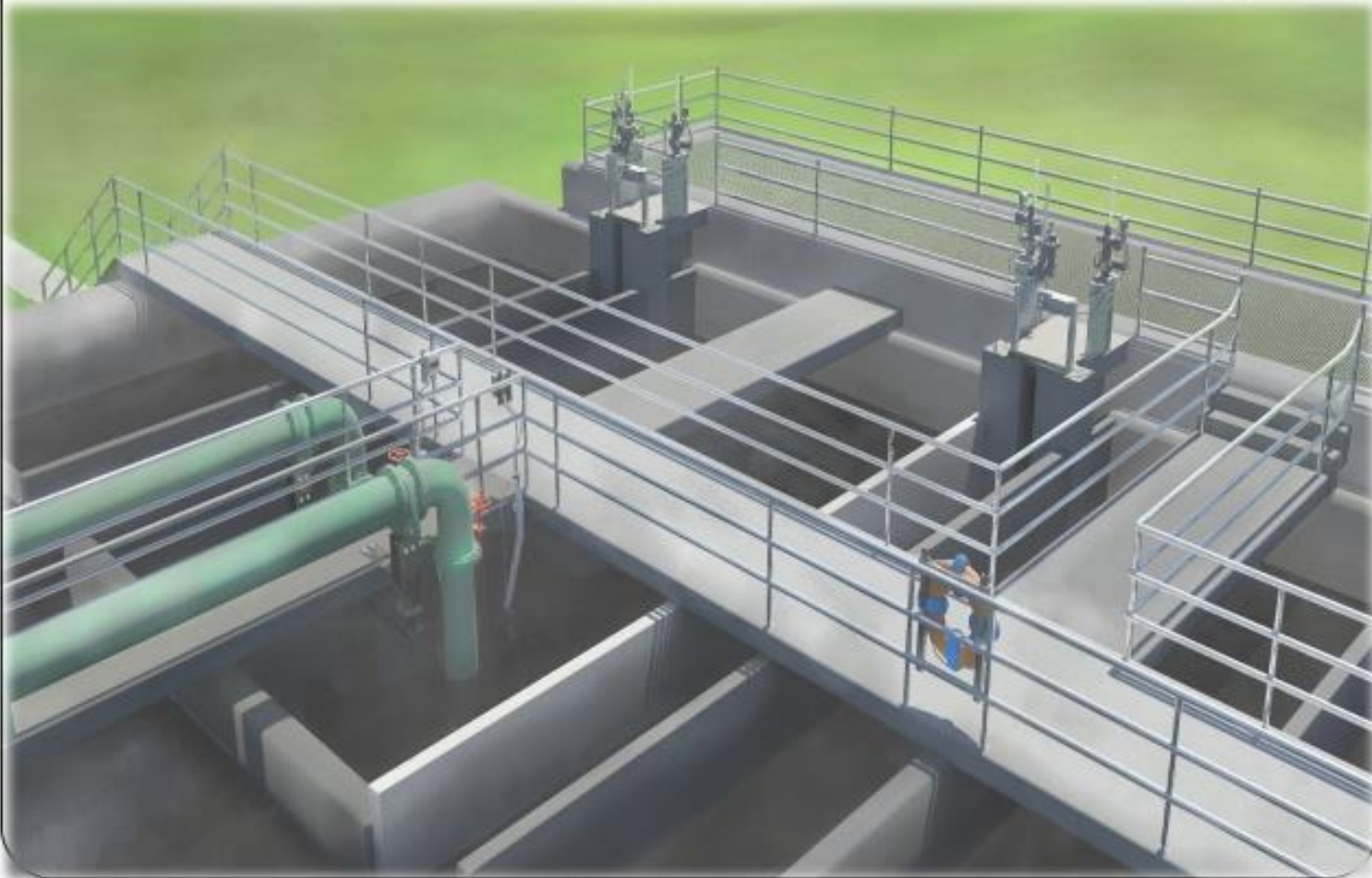
Trickling Filter

Trickling Filter

sprinkler

filter

feed pipe

filter support

collection

air

effluent channel

Aeration tank, activated sludge

Aeration Tank

Activated Sludge

Labels: Sludge collecting channel, Overflow weir, Effluent channel, Feed well, Sludge-uptake pipes, Waste sludge, Return activated sludge
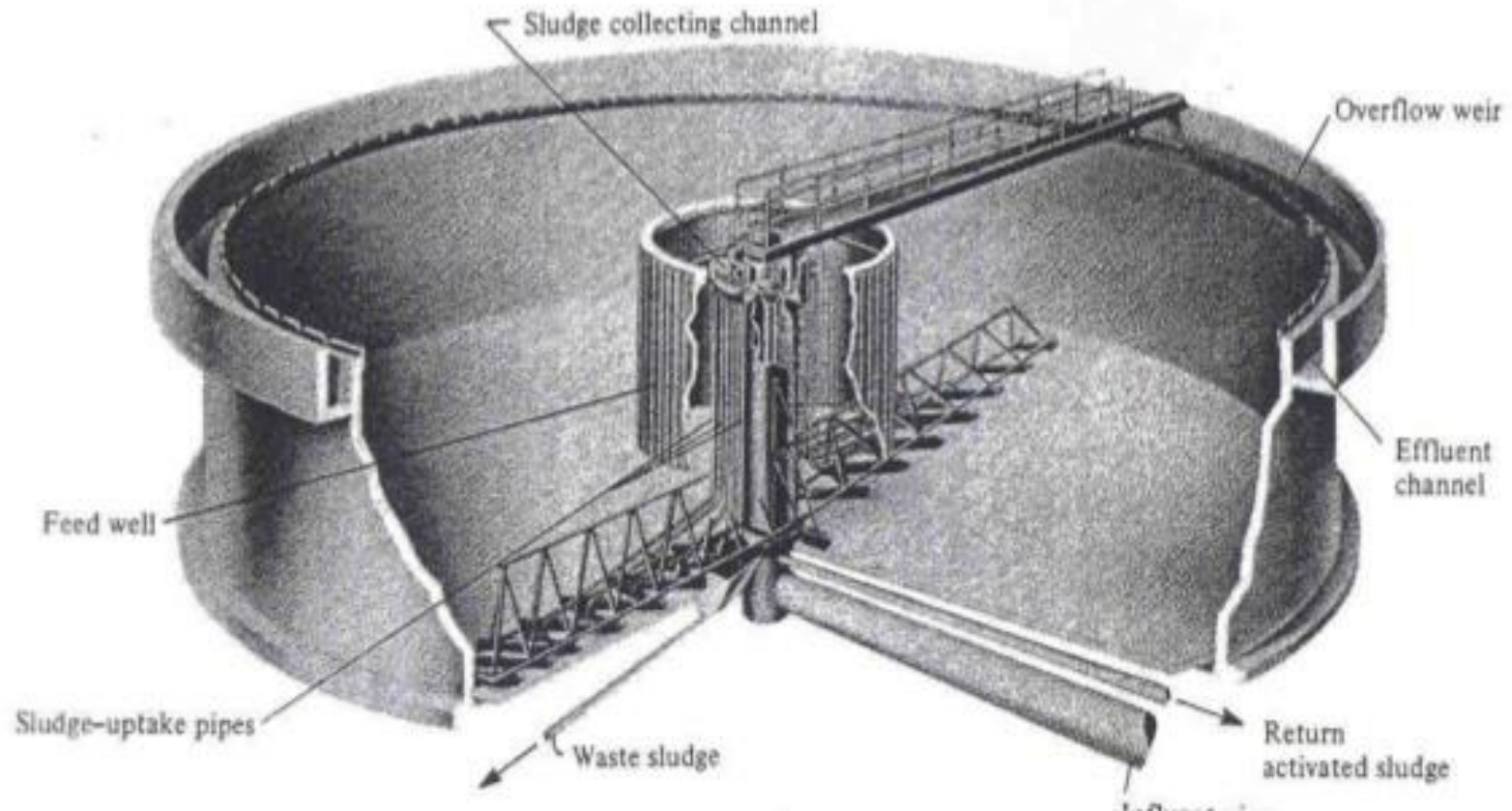
Microbial activity in activated sludge.

Slime forming bacteria like *Zoogloea* grow and form flocs.
Small animals and protozoa attach to these.
Process of oxidation is similar to the trickling bed.
Effluent containing flocs goes to settling tanks. Flocs settle.
Some floc material is recirculated.
Water spends 5-10 hours in sludge tank, too short for complete oxidation.
Main process is absorption of organic matter to the floc.
BOD of liq waste is reduced by ~95%.
Most BOD is in the flocs. BOD reduction then takes place
by digestion of the flocs in the sludge digestor.

Oxidation ponds or lagoons.

This is very simple treatment used in rural areas, particularly suited for tropical areas (Portmore sewage treatment Plant).
Take up a large area, are less than 3m deep (allow light to penetrate).
There are odour problems and the process can take over a week.

Three components are essential for the functioning of the oxidation pond. They are:

☐   Bacteria
☐   Algae
☐   Sunlight

Oxidation ponds or lagoons.

- The bacteria in the pond oxidise the various organic material producing carbondioxide, ammonia and water.

- The algae grow by utilizing the inorganic material and carbon dioxide in the presence of sunlight.

- The oxygen requirement for oxidation of the organic matter by bacteria is satisfied mainly by oxygen released by the algae. Also some oxygen is provided by the contact with the atmosphere. Sunlight is an important factor in the functioning of the oxidation pond

Lagoon