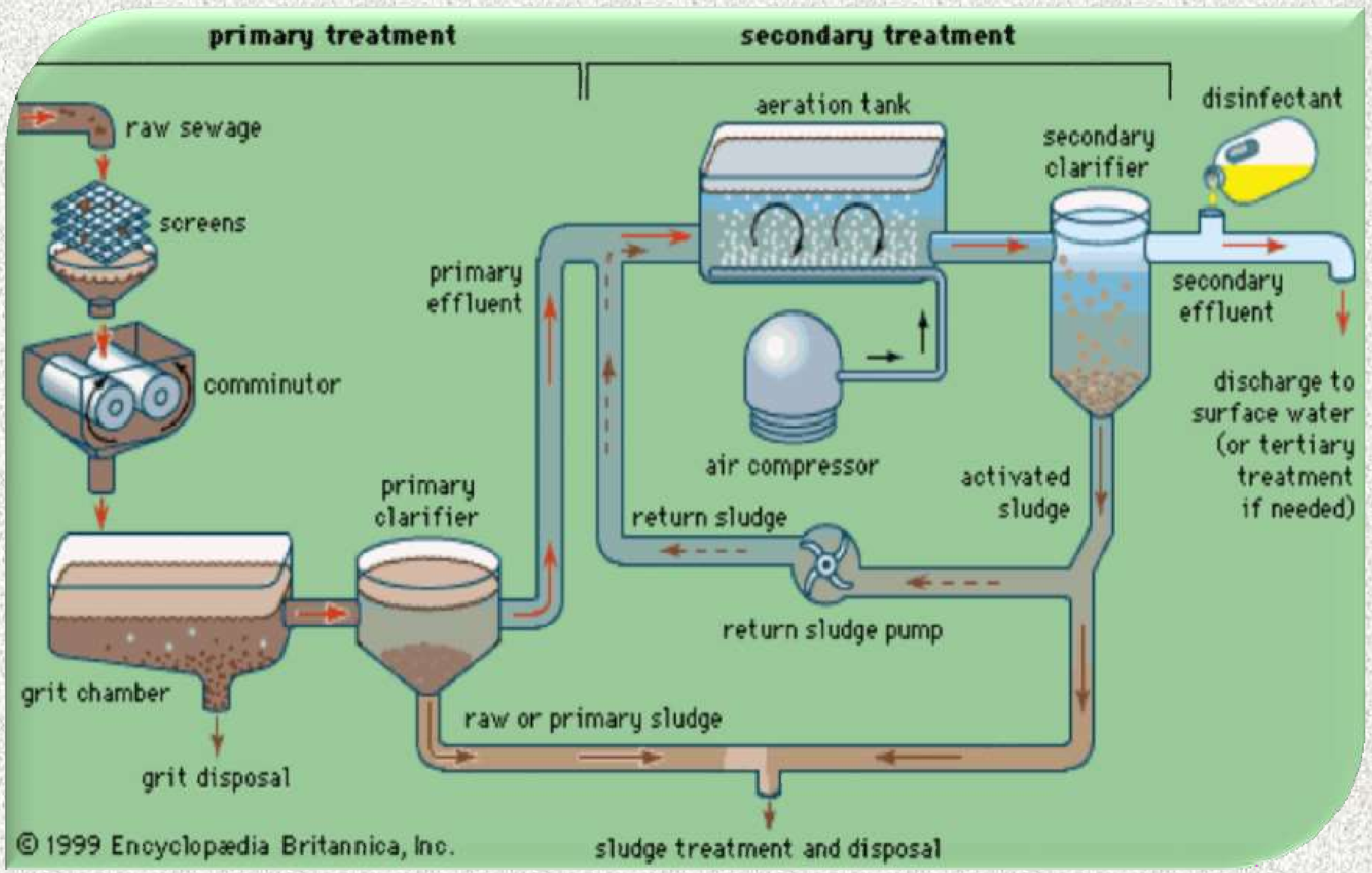
Secondary Treatment Units

WASTE WATER TREATMENT PROCESS

Waste Water Treatment Process



Secondary Treatment

Secondary Treatment Process for Wastewater Applications:

- Aeration Systems
- Biological Treatment Systems
- Sludge and Bio solids Processing Systems

Secondary treatment consists of following processes.

- Activated Sludge Process
- Oxidation Ponds and lagoons
- Trickling Filter

Tertiary Treatment

Removal of residual suspended solids (after secondary treatment), usually by granular medium filtration or micro screens. Disinfection is also typically a part of tertiary treatment. Nutrient removal is often included in this definition

Tertiary Treatment

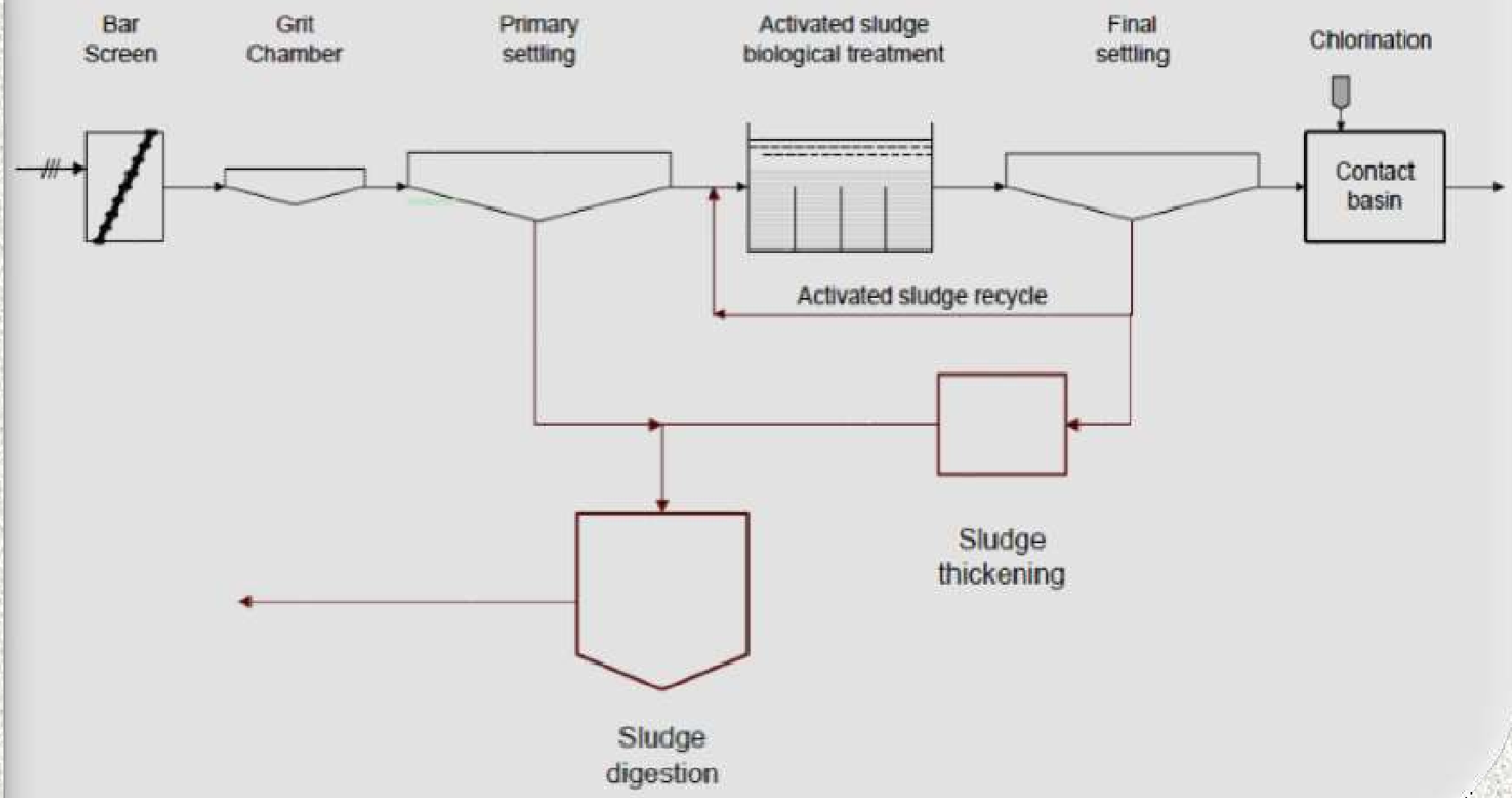
Tertiary treatment consists of following processes and units.

- Membrane Filtration and Separation
- Dechlorination and Disinfection Systems
- Reverse Osmosis (RO) Systems
- Ion Exchange
- Activated Carbon Adsorption
- Physical/Chemical Treatment

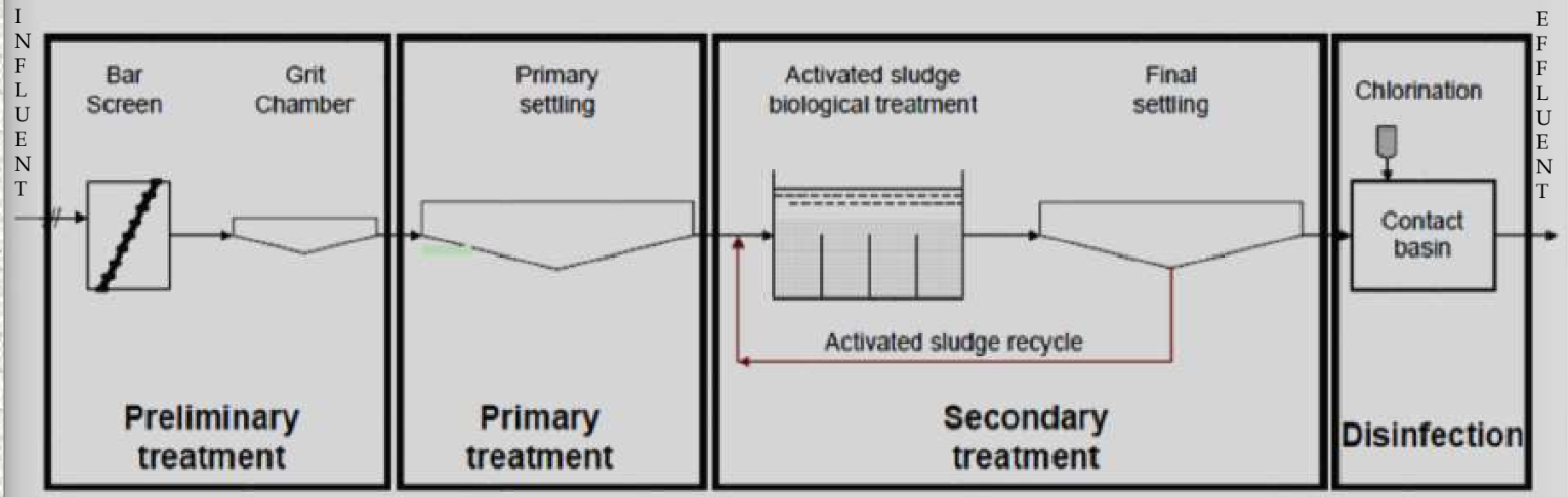
Functions of Water Treatment Units

Screening	Floating matter
Sedimentation	Suspended matter
Coagulation	Suspended matter, a part of colloidal matter and bacteria
Chemical methods	Iron, Manganese, etc.
Filtration	Remaining colloidal dissolved matter, bacteria
Disinfection	Pathogenic bacteria, Organic matter and Reducing substances
Softening	Hardness
Aeration, chemicals use	Colour, Odour, Taste

Typical wastewater treatment plant



Typical wastewater treatment plant



Can also have tertiary treatment to remove nutrients and other pollutants

Plan of a Typical Waste Water Treatment Plant

Unit Process and Unit Operations

- **Unit Process:** Methods of treatment in which physical forces predominate are known as unit operations.
- **Unit Process:** Methods of treatment in which chemical/biological activities are involved are known as Unit process.
- **Types of Unit operations and Processes**

Physical Unit operations

Chemical Unit Process

Biological Unit Process

Activated Sludge

In the activated sludge process, the dispersed-growth reactor is an aeration tank or basin containing a suspension of the wastewater and microorganisms, the mixed liquor

The contents of the aeration tank are mixed vigorously by aeration devices which also supply oxygen to the biological suspension

Aeration devices commonly used include submerged diffusers that release compressed air and mechanical surface aerators that introduce air by agitating the liquid surface

Hydraulic retention time in the aeration tanks usually ranges from 3 to 8 hours but can be higher with high BOD_5 wastewaters

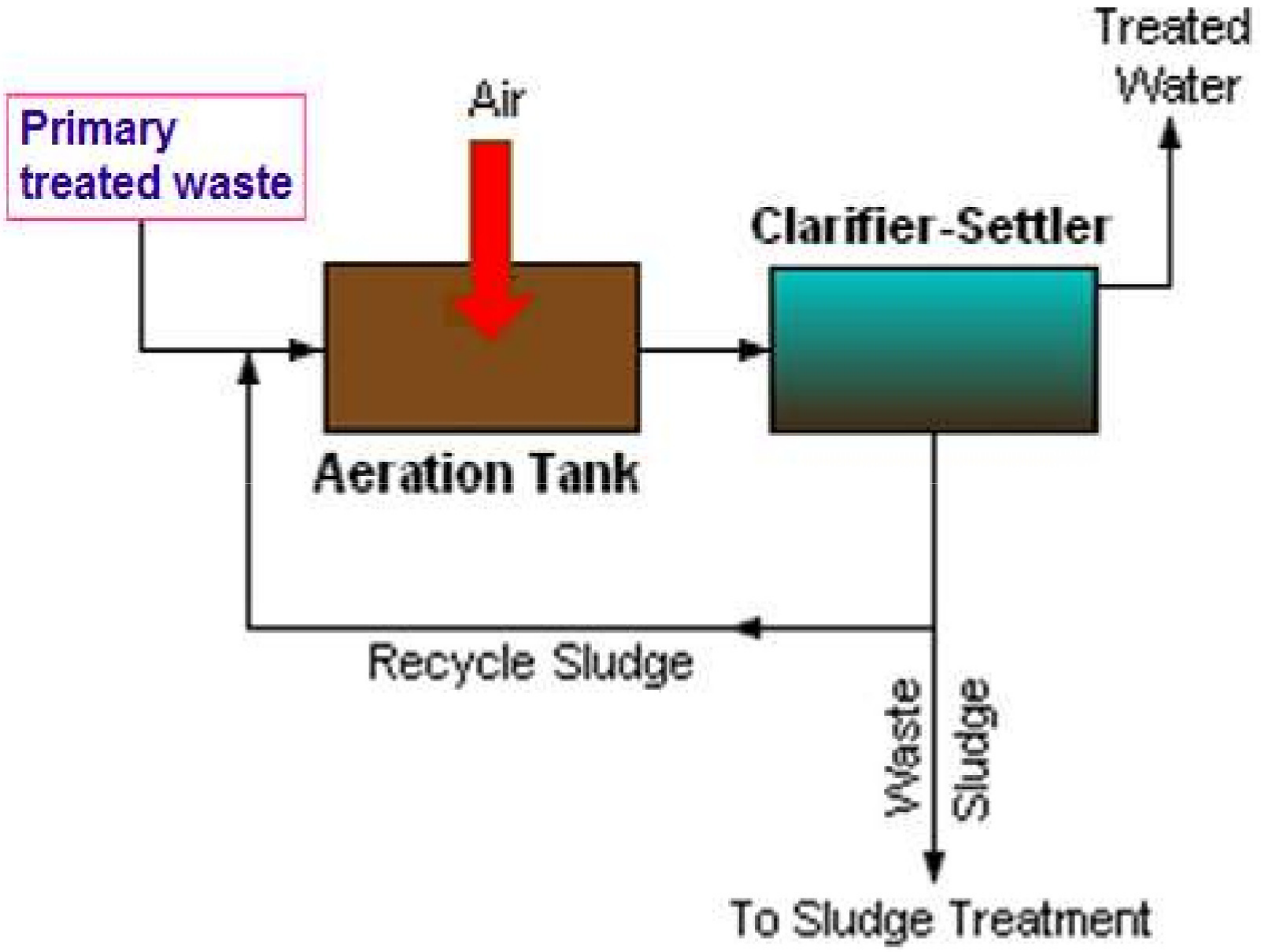
Following the aeration step, the microorganisms are separated from the liquid by sedimentation and the clarified liquid is secondary effluent

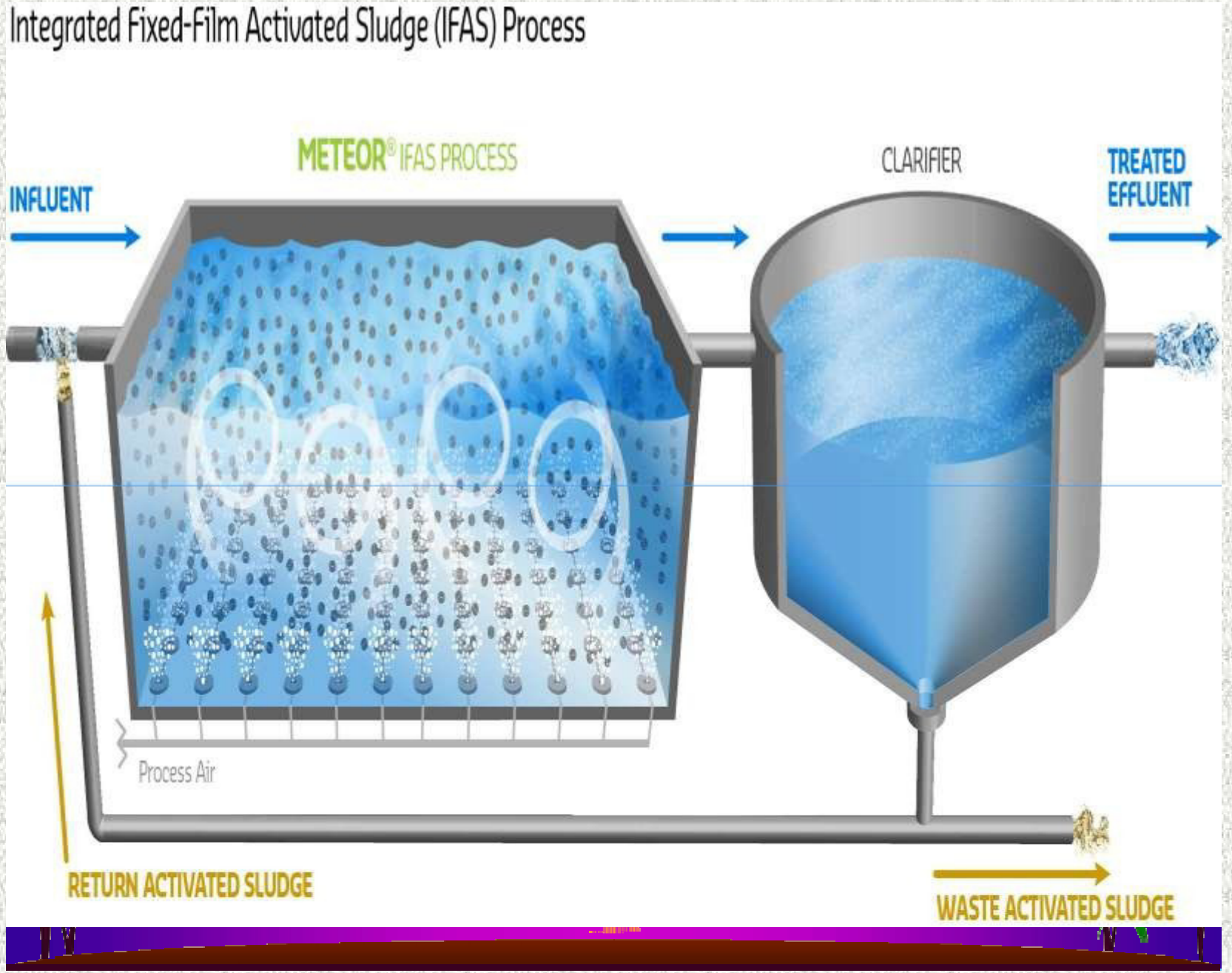
A portion of the biological sludge is recycled to the aeration basin to maintain a high mixed-liquor suspended solids (MLSS) level

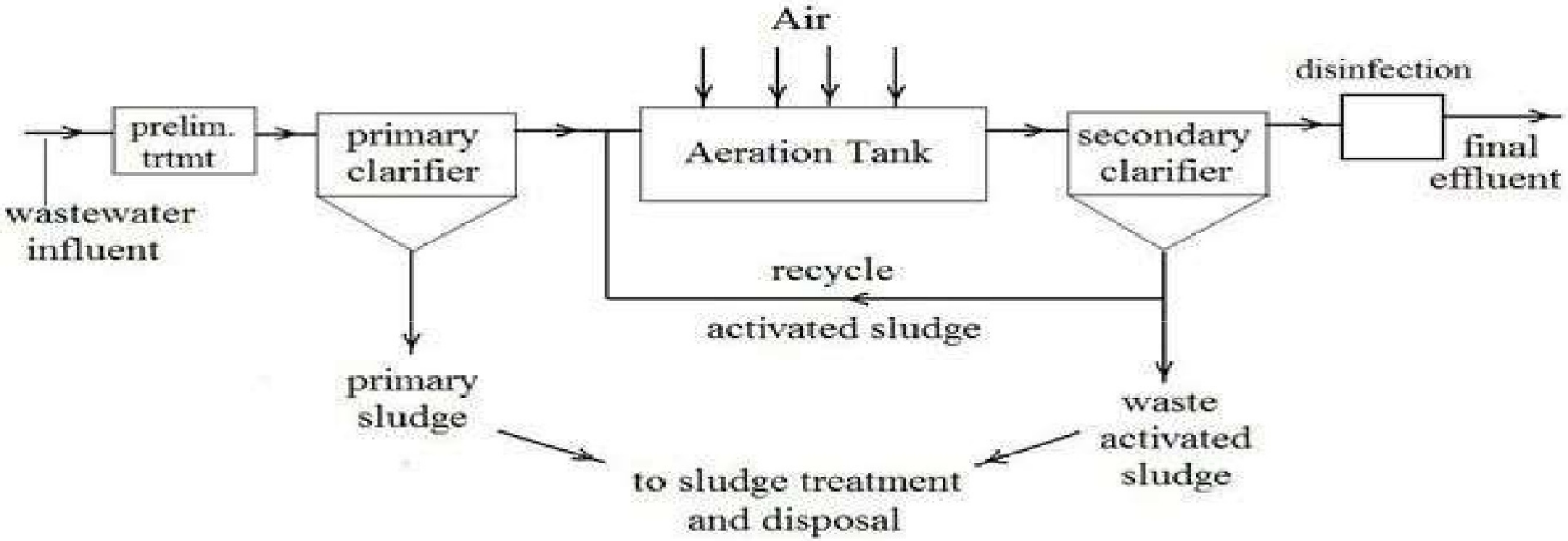
The remainder is removed from the process and sent to sludge processing to maintain a relatively constant concentration of microorganisms in the system

- The general arrangement of an activated sludge process for removing carbonaceous pollution includes the following items:

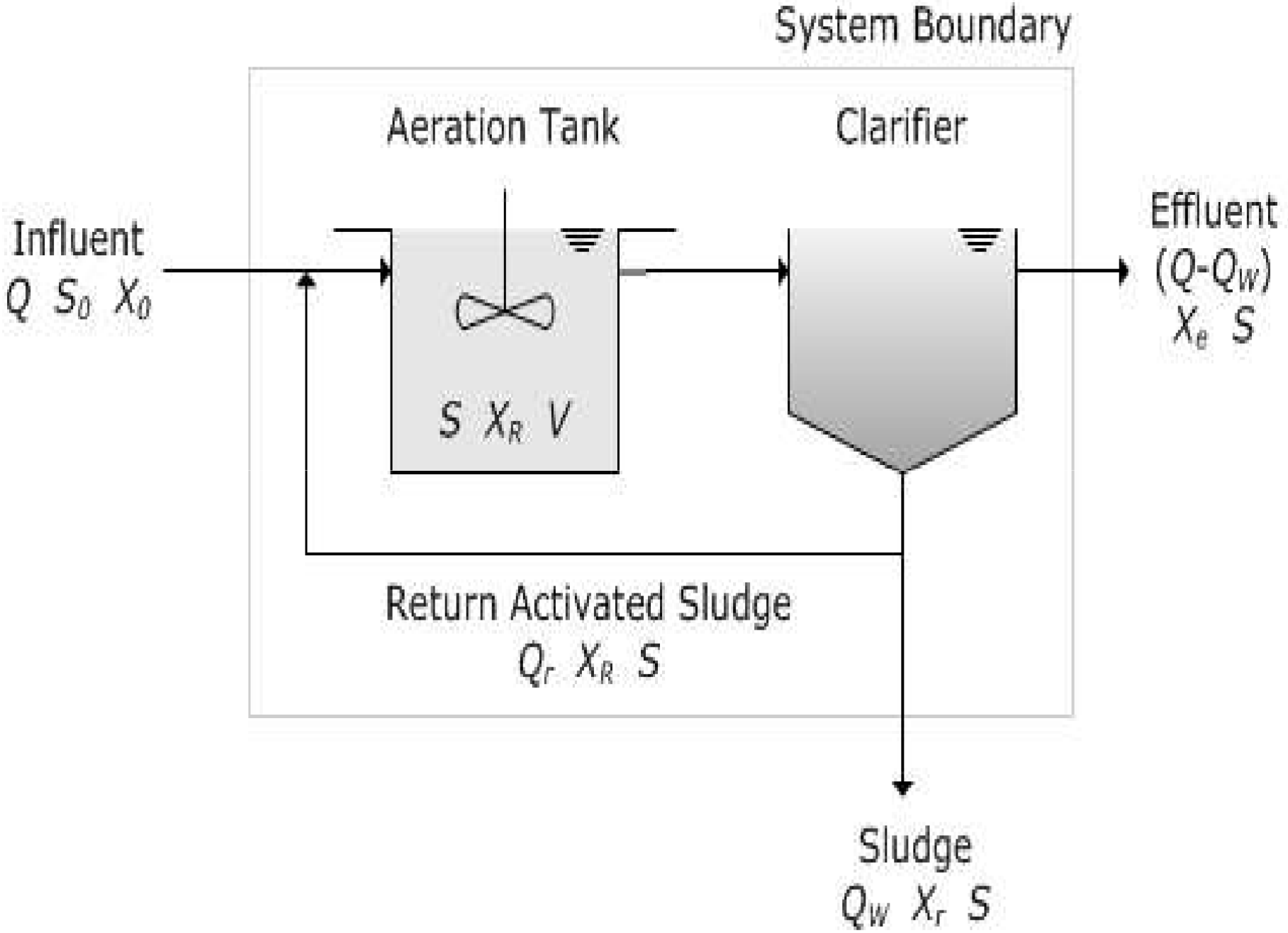
1. Aeration tank where air (or oxygen) is injected in the mixed liquor.
2. Settling tank (usually referred to as "final clarifier" or "secondary settling tank") to allow the biological flocs to settle, thus separating the biological sludge from the clear treated water.


Primary
treated waste
Air
Treated
Water
Clarifier-Settler
Aeration Tank
Recycle Sludge
Waste
Sludge
To Sludge Treatment


Integrated Fixed-Film Activated Sludge (IFAS) Process
METEOR® IFAS PROCESS
CLARIFIER
INFLUENT
TREATED EFFLUENT
Process Air
RETURN ACTIVATED SLUDGE
WASTE ACTIVATED SLUDGE



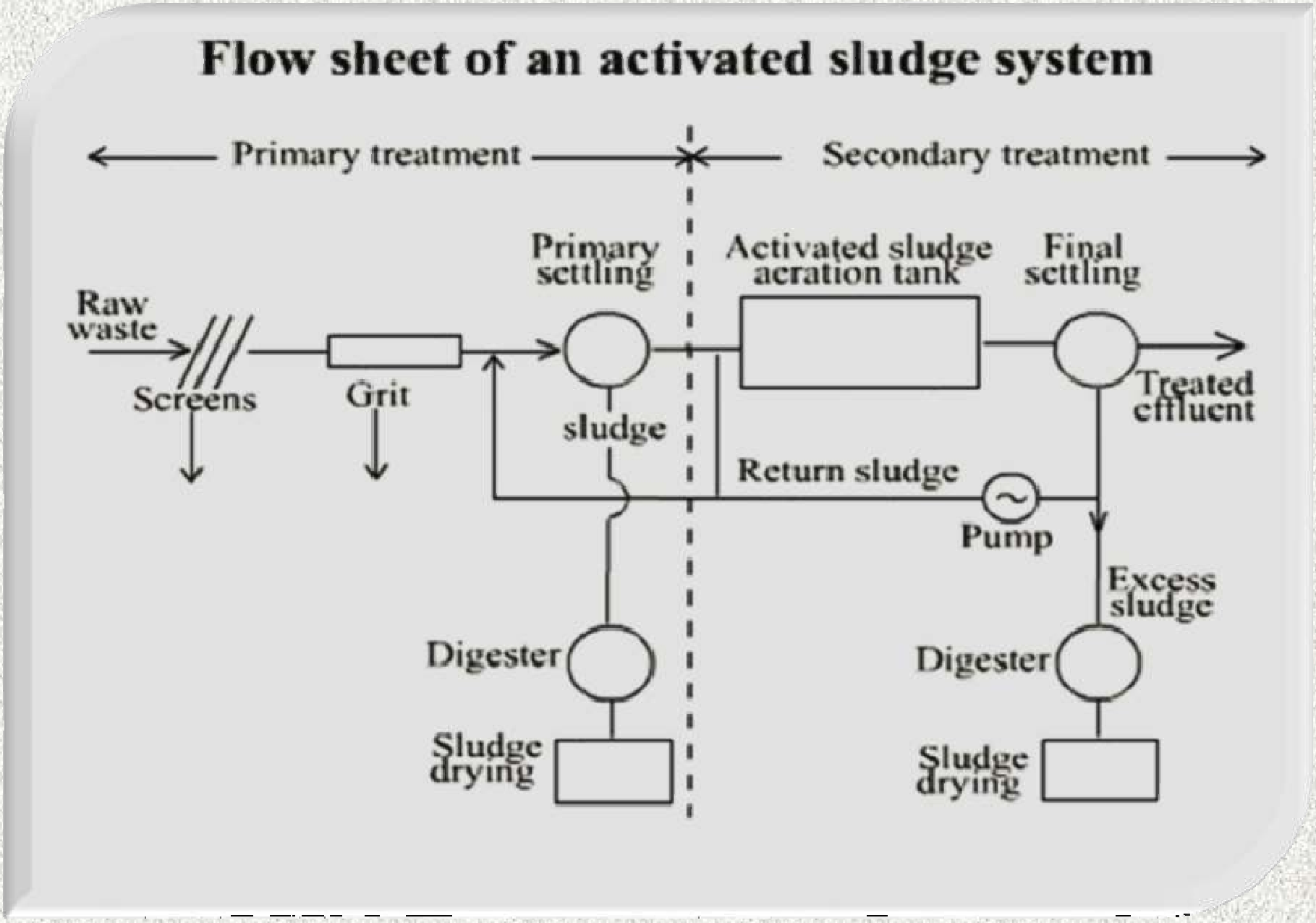
Activated Sludge Wastewater Treatment Flow Diagram


System Boundary
Aeration Tank
Clarifier
Influent
Q S0 X0
S XR V
Effluent
(Q-QW)
Xe S
Return Activated Sludge
Qr XR S
Sludge
QW Xr S

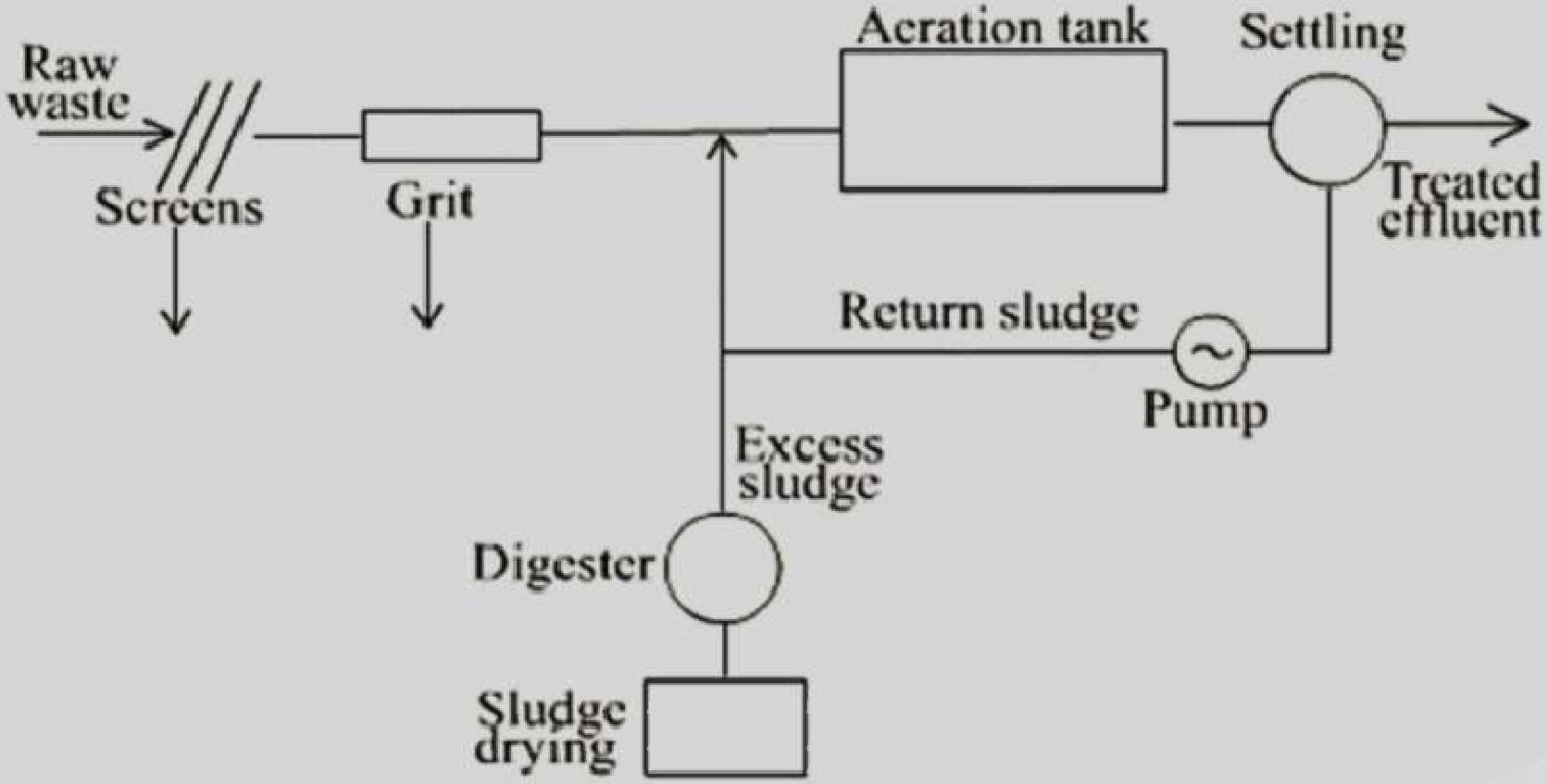
Removal Efficiency of Activated Sludge Process :

Metal	Removal Efficiency
Al	<20%
Mo	<20%
As	<20%
Pb	20-50%
Mn	20-50%
Ag	20-50%
Cd	>50%
Fe	>50%
Cr	>50%

Flow sheet of an activated sludge system



Flow sheet of an extended aeration system



There are a number of factors that affect the performance of an activated sludge treatment system. These include:

- Temperature
- Return rates
- Amount of oxygen available
- Amount of organic matter available
- pH
- Waste flow rates
- Aeration time
- Wastewater toxicity

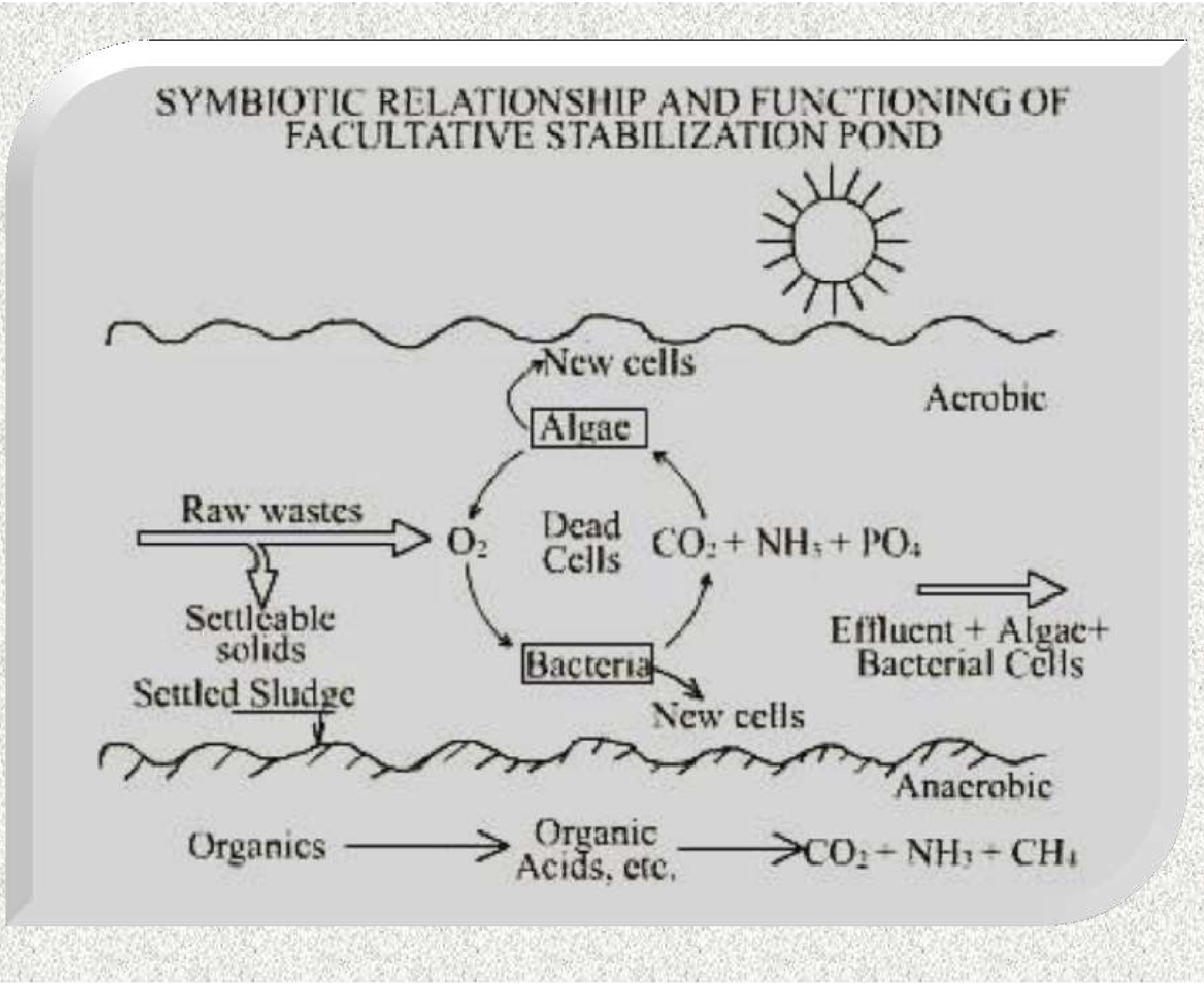
Classification of Stabilization Ponds

Stabilization ponds may be aerobic, anaerobic or facultative.

Aerobic ponds are shallow ponds with depth less than 0.5 m so as to maximize penetration of light throughout the liquid depth. Such ponds develop intense algal growth.

Anaerobic ponds are used as pre-treatment of high strength wastes. Such ponds are constructed with a depth of 2.5-5m as light penetration is unimportant.

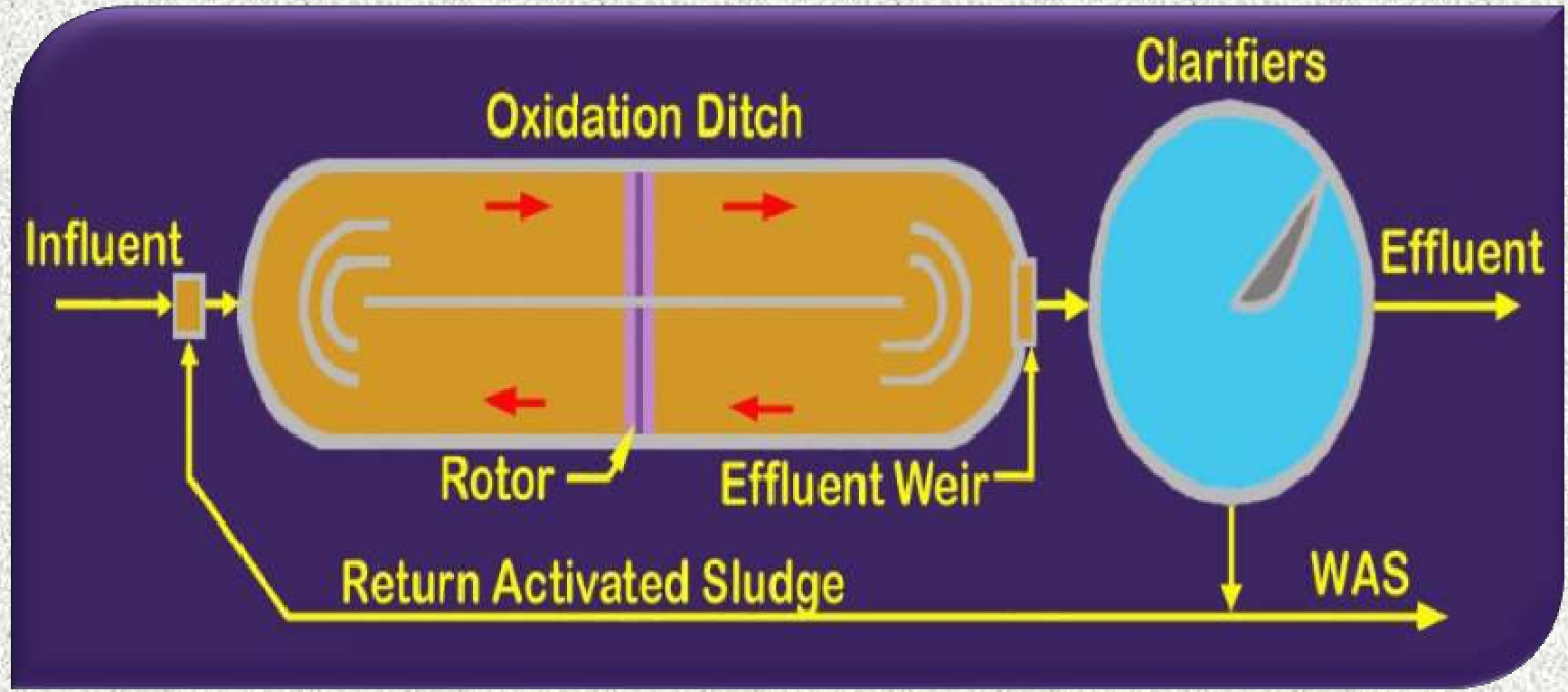
Facultative pond functions aerobically at the surface while anaerobic conditions prevail at the bottom. They are often about 1 to 2 m in depth. The aerobic layer acts as a good check against odour evolution from the pond.


SYMBIOTIC RELATIONSHIP AND FUNCTIONING OF FACULTATIVE STABILIZATION POND
New cells
Aerobic
Algae
Raw wastes
O_2
Dead Cells
$CO_2 + NH_3 + PO_4$
Settleable solids
Settled Sludge
Bacteria
Effluent + Algae+ Bacterial Cells
New cells
Anaerobic
Organics
Organic Acids, etc.
$CO_2 + NH_3 + CH_4$

Oxidation Ditch

The oxidation ditch is a modified form of "extended aeration" of activated sludge process. The ditch consists of a long continuous channel oval in shape with two surface rotors placed across the channel.

A Typical Oxidation Ditch



A View of Oxidation Ditch

Trickling Filter is an attached growth process i.e. process in which microorganisms responsible for treatment are attached to an inert packing material.

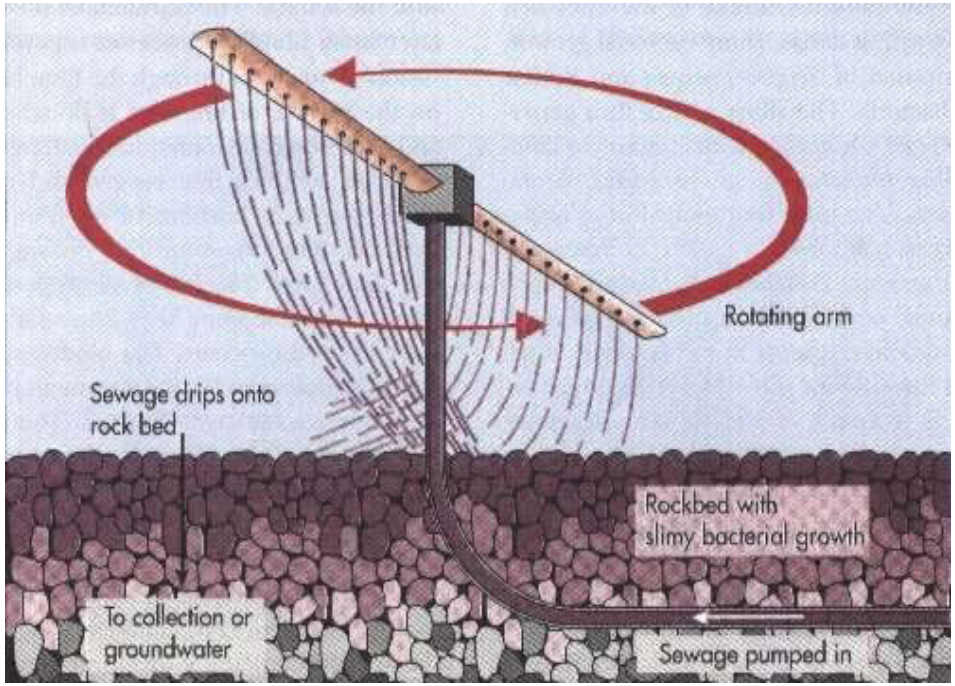
- Trickling filters enable organic material in the wastewater to be adsorbed by a population of microorganisms (aerobic, anaerobic, and facultative bacteria; fungi; algae; and protozoa) attached to the medium as a biological film or slime layer.

- The organic material is then degraded by the aerobic microorganisms in the outer part of the slime layer.

The sewage slowly moves through the porous bed and the effluent is collected at the bottom.

As the sewage drains through the porous bed, this microbial community absorbs and breaks down dissolved organic nutrients in the sewage; this reduces the BOD.

The sewage may need to be re circulated several times through the filter in order to reduce the BOD sufficiently.



ADVANTAGES

- Simple, reliable, biological process
- Low power requirement
- Moderate level of skill and technical expertise needed to manage and operate the system.

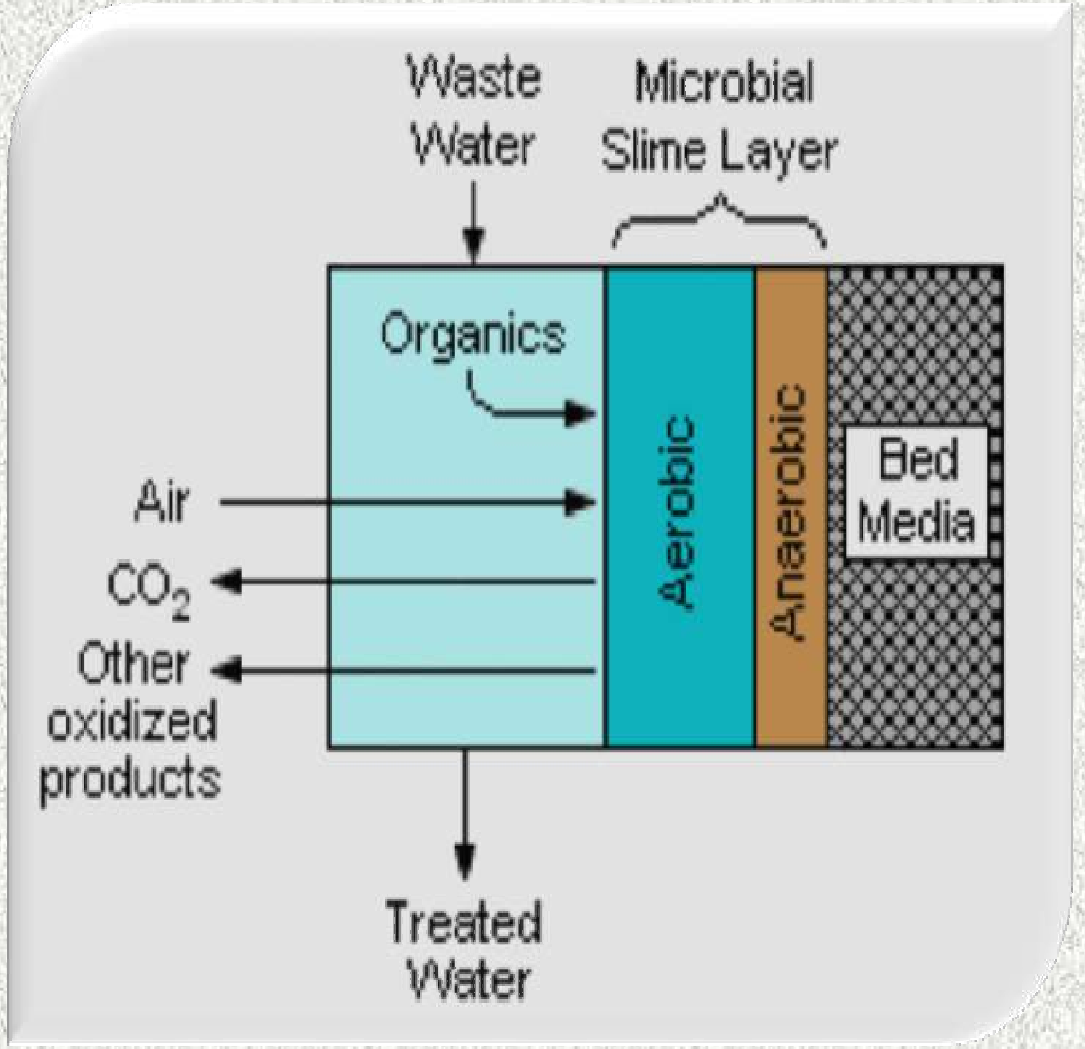
DISADVANTAGES

- Additional treatment may be needed to meet more stringent discharge standards.
- Vector and odour problems.
- Requires regular operator attention.

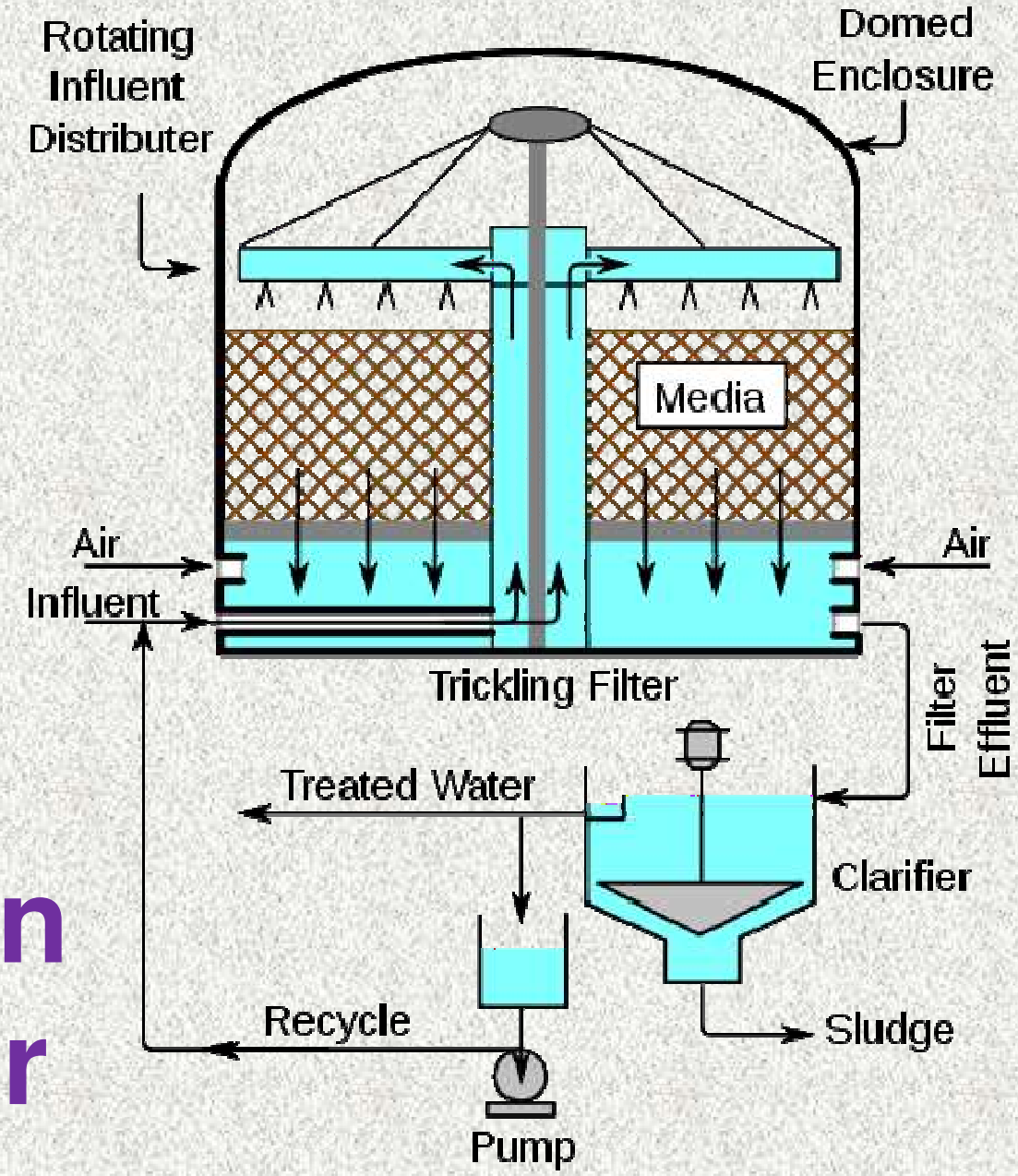
Removal Efficiency of Trickling Filter

The Removal efficiency of Total Organic Carbon (T. O. C.) from Trickling Filter is greater than 90%

Working of Trickling Filter



Tricklin g Filter



Top view of Trickling Filter