Biological Processes for wastewater treatment

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OUTLINE OF PRESENTATION

- An overview of biological wastewater treatment.
- Important aspects in microbial metabolism.
- Principal organisms responsible for wastewater treatment.
- key factors governing biological growth and waste treatment kinetics.

- Application of fundamentals and kinetics of biological process.
- Different options for suspended growth and fixed film systems, their application and limitations

BIOLOGICAL PRINCIPLES OF WASTE WATER TREATMENT

Biological TP: a method of contact between microbes and substrate. Suitable temperature, pH, nutrients etc. are required for microbial growth. Such a growth results into the ‘removal’ of substrate.

Objective of biological treatment:

- Coagulate and remove the non-settle able colloidal solids .
- Stabilize the organic matter.
- Reduce the organic matter.
- Remove the nutrients.

In short, stabilize organic matter: convert organic matter to nonbiodegradable form so that it does not exert oxygen demand.

Microbes

- Virtually every environmental niche
- Extremes of pH and salinity
- Extremes of temperature and pressure
- Without air (Anaerobic)
- Growth on many chemical substrates
- Attached to surfaces in biofilms
- Geothermal vents and subterranean deposits

MICROBIAL METABOLISM

- General nutritional requirements -:
- CARBON SUBSTRATE (org. or inorg.)
- ELECTRON DONOR
- ENERGY SOURCE
- Need for molecular oxygen.
- Basic elements required-C,O ,N,H, P,S
- Inorganic elements: K,Mg,Ca,Fe,Na,Cl

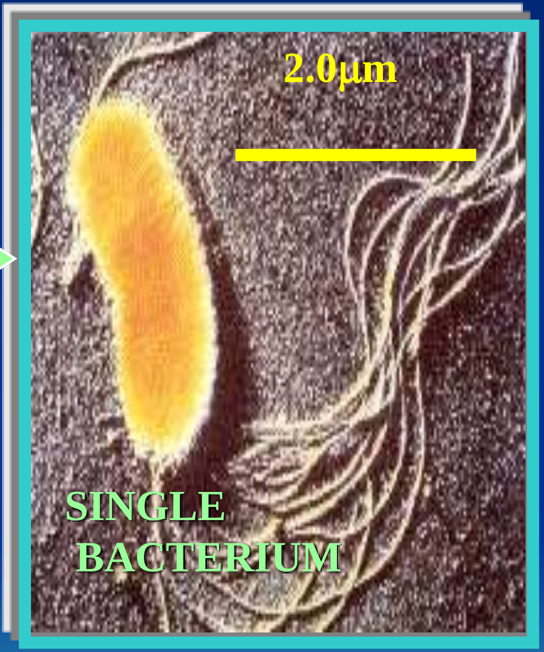
Role of microbes

-

O_2 consumption

GROWTH - CELL DIVISION
INCREASE IN BIOMASS
(assimilation)

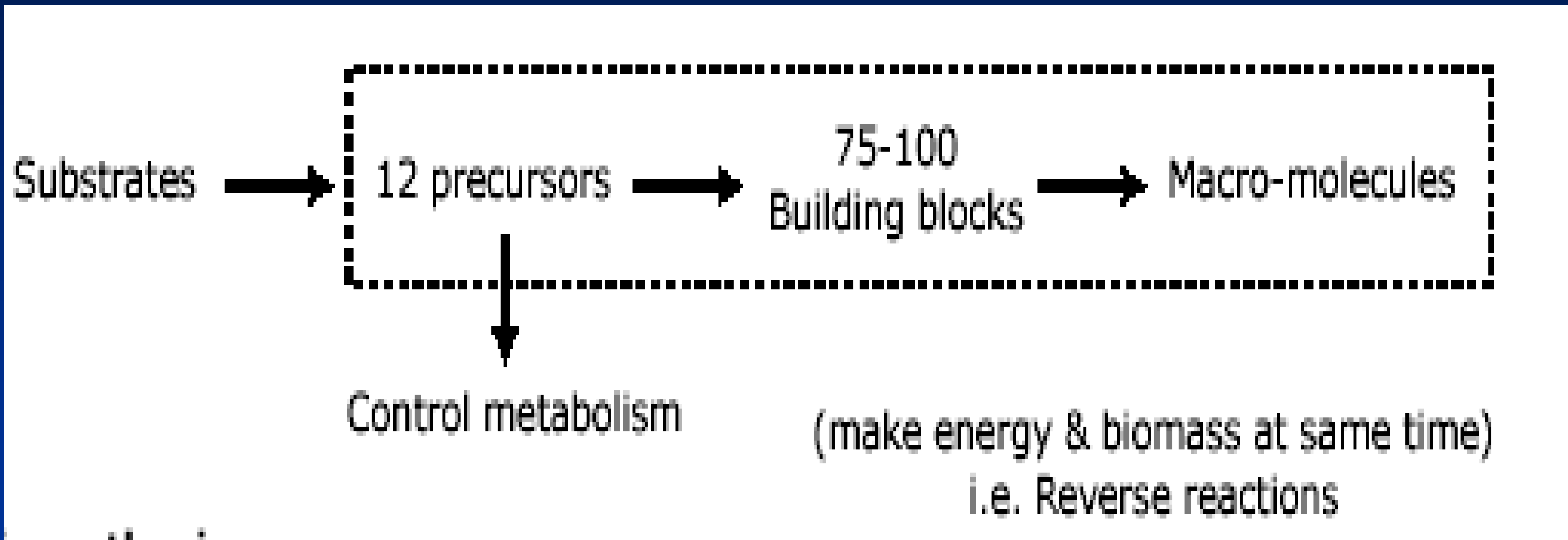
ORGANIC POLLUTANT AND NUTRIENTS (C,P,N,O,Fe,S…)



CO_2 evolved (dissimilation)

Controlled release of energy
Slow Burning!

Basic growth

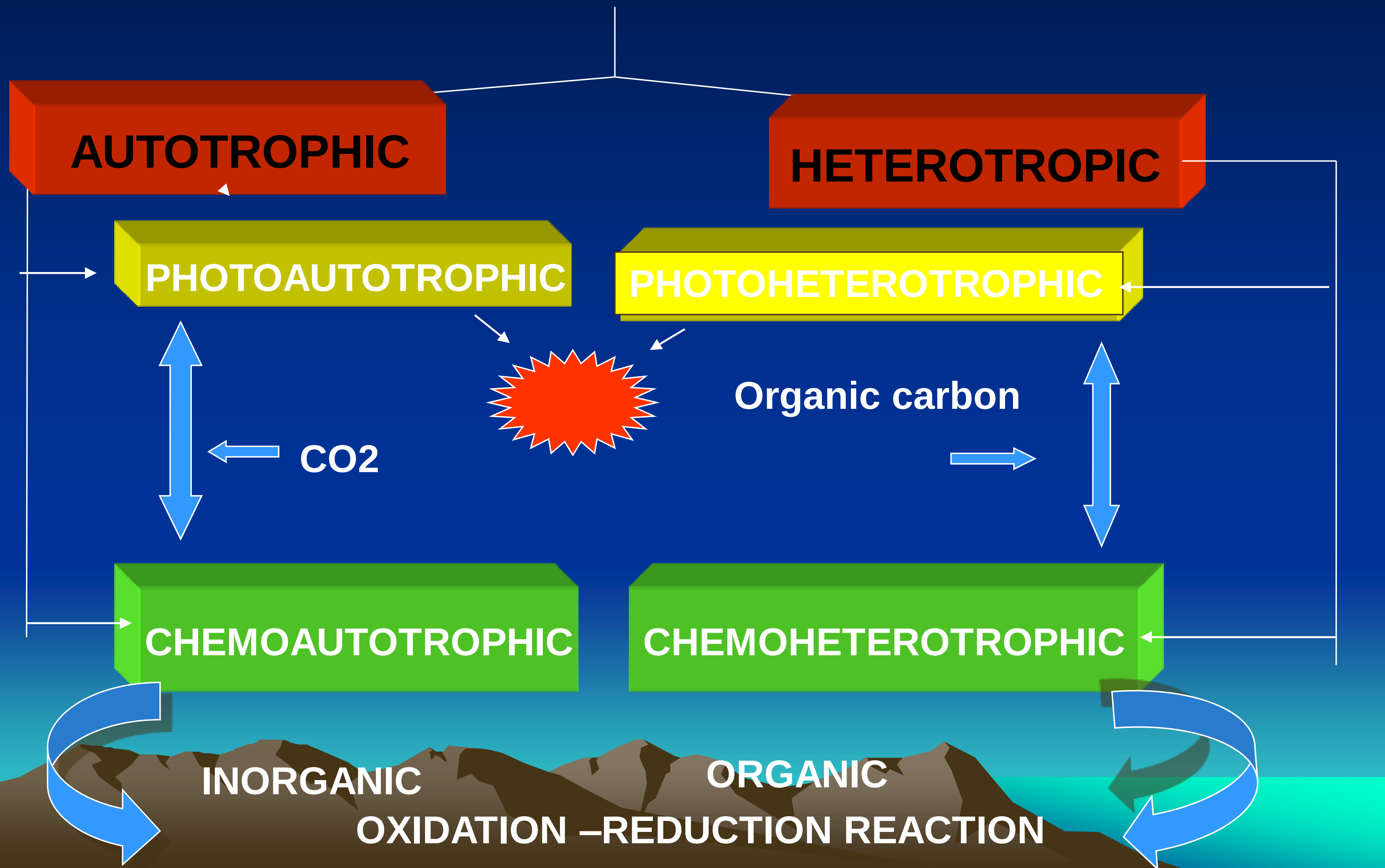


Types of microbes

Depending on the energy and carbon source

- **AUTOTROPHS**: microbes requiring inorganic carbonaceous compounds.
- **HETEROTROPHS**: microbes requiring organic compounds .
- **PHOTOTROPHS**: microbes consuming light as energy source .
- **CHEMOTROPHS**: microbes obtaining energy from oxidation of org. or inorg. Compounds.
- **ORGANOTROPHS**: organic compounds as source of electron.
- **LITHOTROPHS**: inorganic compounds as source of electron.
- E.g. –nitrifying bacteria is an example of **chemolitho-autotrophs.**

CLASSIFICATION OF MICROORGANISMS



Microbes

- By relationship to oxygen
  - obligate aerobes: need oxygen, use it as terminal electron acceptor
  - obligate anaerobes: cannot grow in the presence of oxygen
  - facultative anaerobes: under certain conditions can grow in the absence of oxygen

Energetics

Energy currency: ATP

Between CM and e^- transport chain (want oxidized form)

want reduced form

Electron carriers: NADH (fueling reactions) & NADPH (biosynthesis reactions)

- NAD^+/NADH → often is half reaction in the oxidation of C-substrates inside the cell
- $NADP^+$/NADPH → reductant in biosynthesis

Central Metabolism

- Basically the working in a microbial cell is more or less like a tower by which energy generation through a various combination of substrates is detected.
- EMP (Glycolysis and TCA /Krebs Cycle).

C6

↓

2C3(2ATP,2 NADH,2 pyruvate)

↓

(2NADH & $2CO_2$) 2C2 → TCA → $4CO_2$, 6NADH ,2ATP & $2FADH_2$

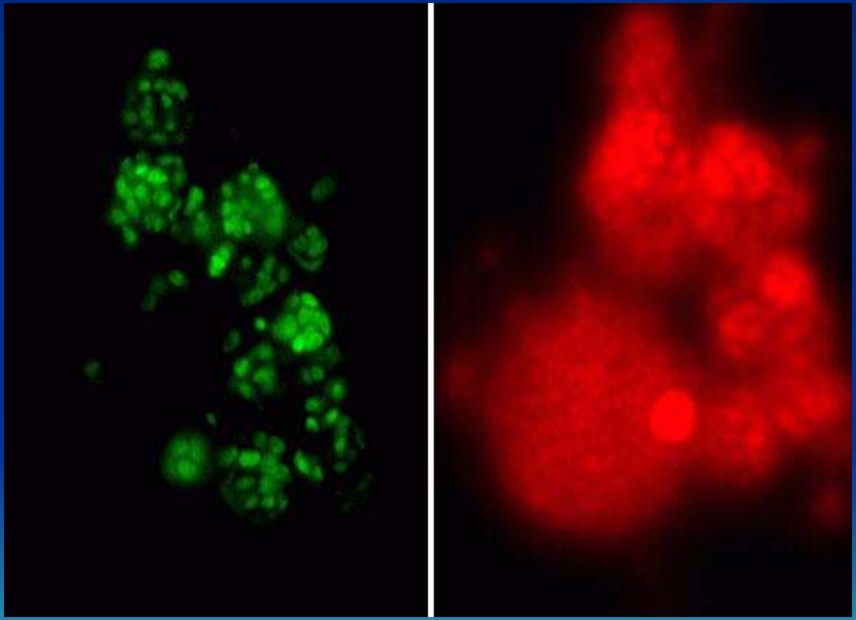
Net Energy

Most of the usable energy is being converted to-:

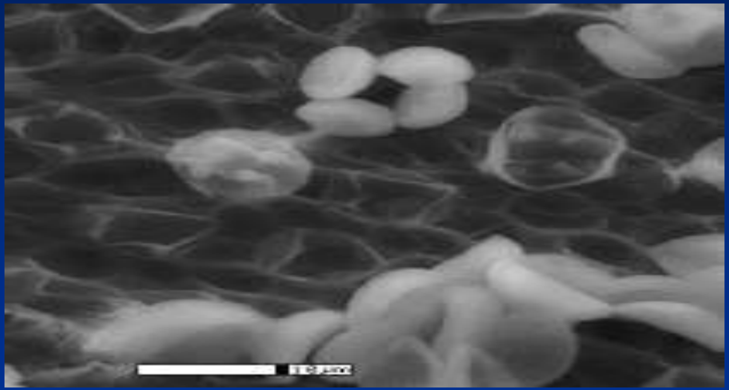
1. 10 Molecules of NADH (two from glycolysis, two from the transition stage, and six from the Krebs cycle)
2. 2 molecules of $FADH_2$
3. 4 Molecules of ATP (net gain is only of 2ATPs)

Important organisms in w/w treatment

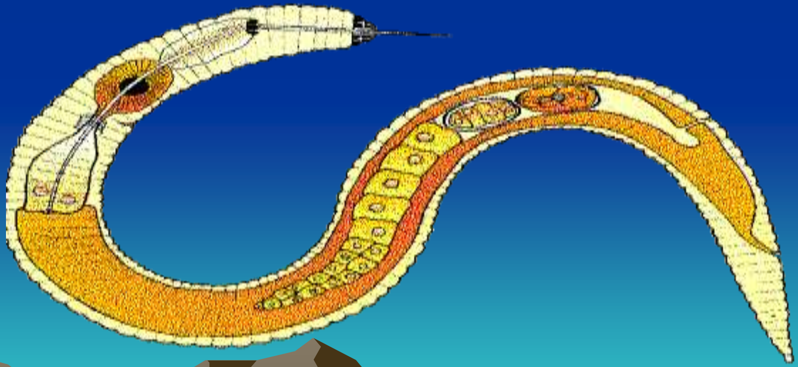
- Bacteria



- Fungi



- Nemotodes



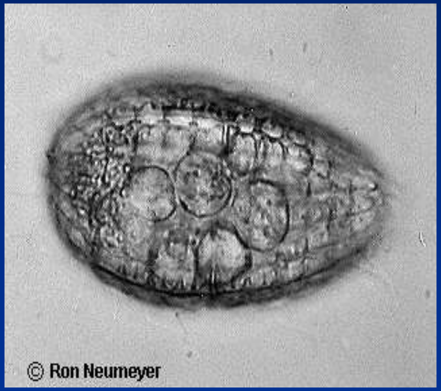
Important organisms in w/w treatment

- Algae

Important organisms in w/w treatment

- Protozoa
- Rotifers, ciliates, crustaceans

Stentor



Celops

Paramecium

BASIC REQUIREMENTS FOR EFFECTIVE DESIGN OF TP

- Environmental conditions that affect microbial growth.

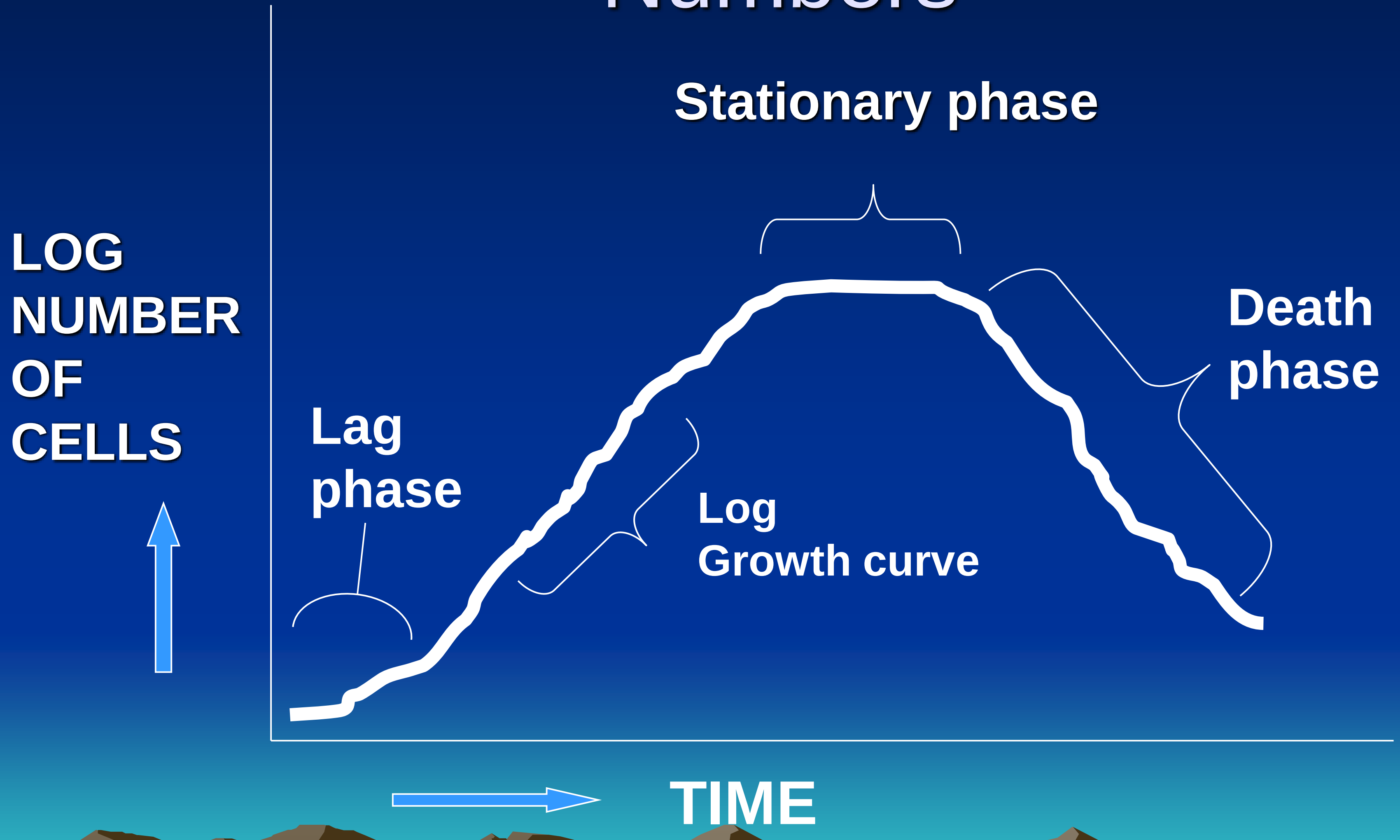
1. pH   2. Temp   3. Nutrients

4. Subs conc. & composition

5. D.O.   6. Contact / extent of mixing

- Method of contact between microbes and substrate.
- Quantification of growth and substrate removal
- Method of separation of microbes and substrate after desired substrate removal is achieved

Bacterial Growth curve in terms of Numbers



BACTERIA MULTIPLICATION:

- $dx/dS = Y$
- REPRODUCED BY BINARY FISSION

GROWTH RATE:

$$dx/dt = \mu x - K_d\, x$$

x = microbial cell mass

S= Substrate, t = time

Y= Growth Yield coefficient

K_d = decay rate

μ = specific growth rate coefficient

GROWTH LIMITING NUTRIENT

- MONOD EQUATION:

$$\mu = \mu_m S/(k_s + S)$$

where:

μ=specific growth rate coff.

μ_m =maximum growth rate coeff.

s =conc. of limiting nutrient.

k_s =half saturation coeff.

$$\boldsymbol{dS/dt = k\, X\, S/}\ (k_s + S)$$

- K= maximum specific substrate utilization rate

EFFECT OF TEMPERATURE:

- Influences metabolic activities of microbes

Effect of temperature on reaction rate of a biological process:

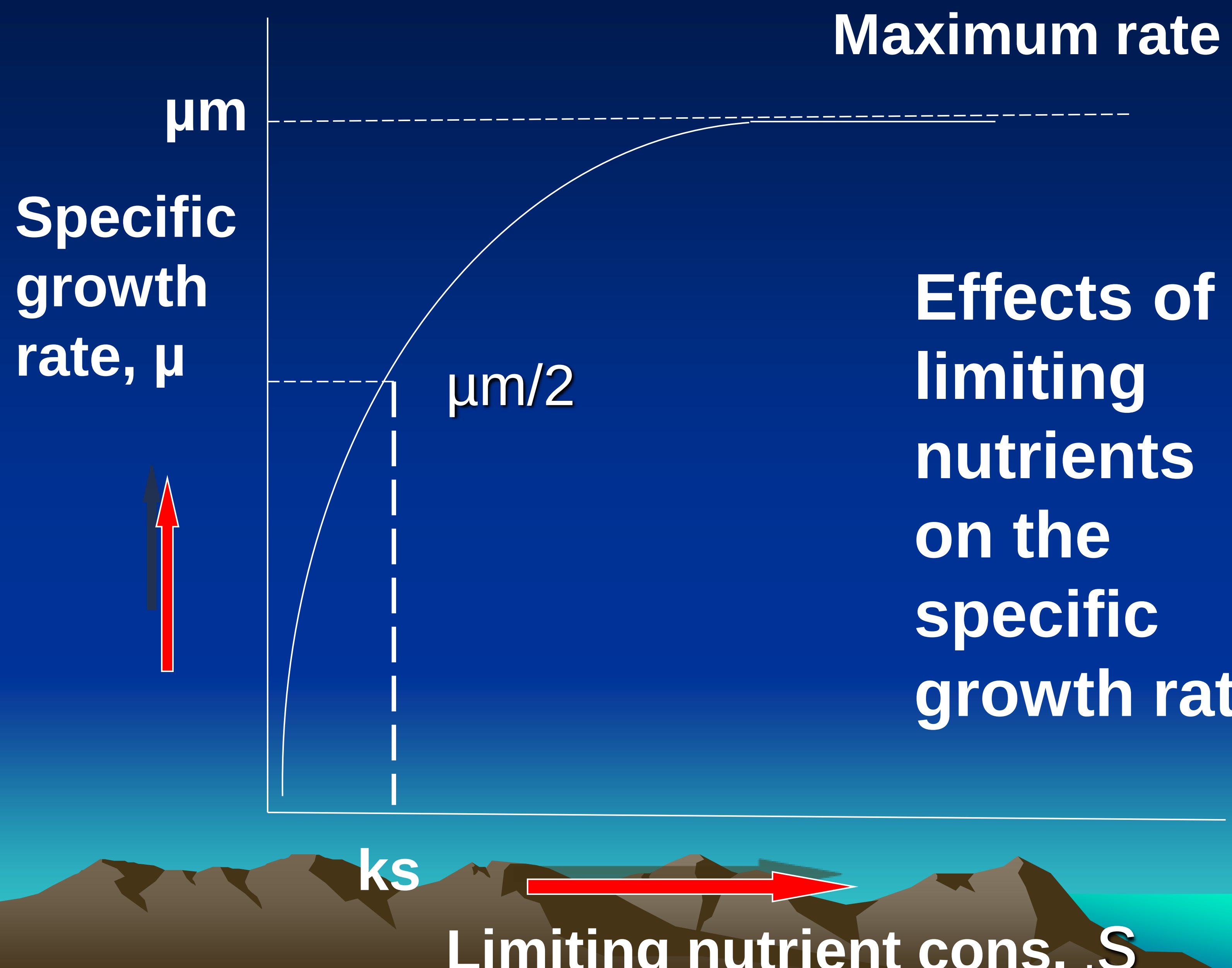
$$K_t = K_{20}\,\theta^{(t-20)}$$

K_t = reaction rate at (t) degree Celsius

K_{20} =reaction rate at (20)degree Celsius

θ = temperature activity coefficient

t = temperature in degree Celsius



Effects of a limiting nutrients on the specific growth rate

Kinetic design approach

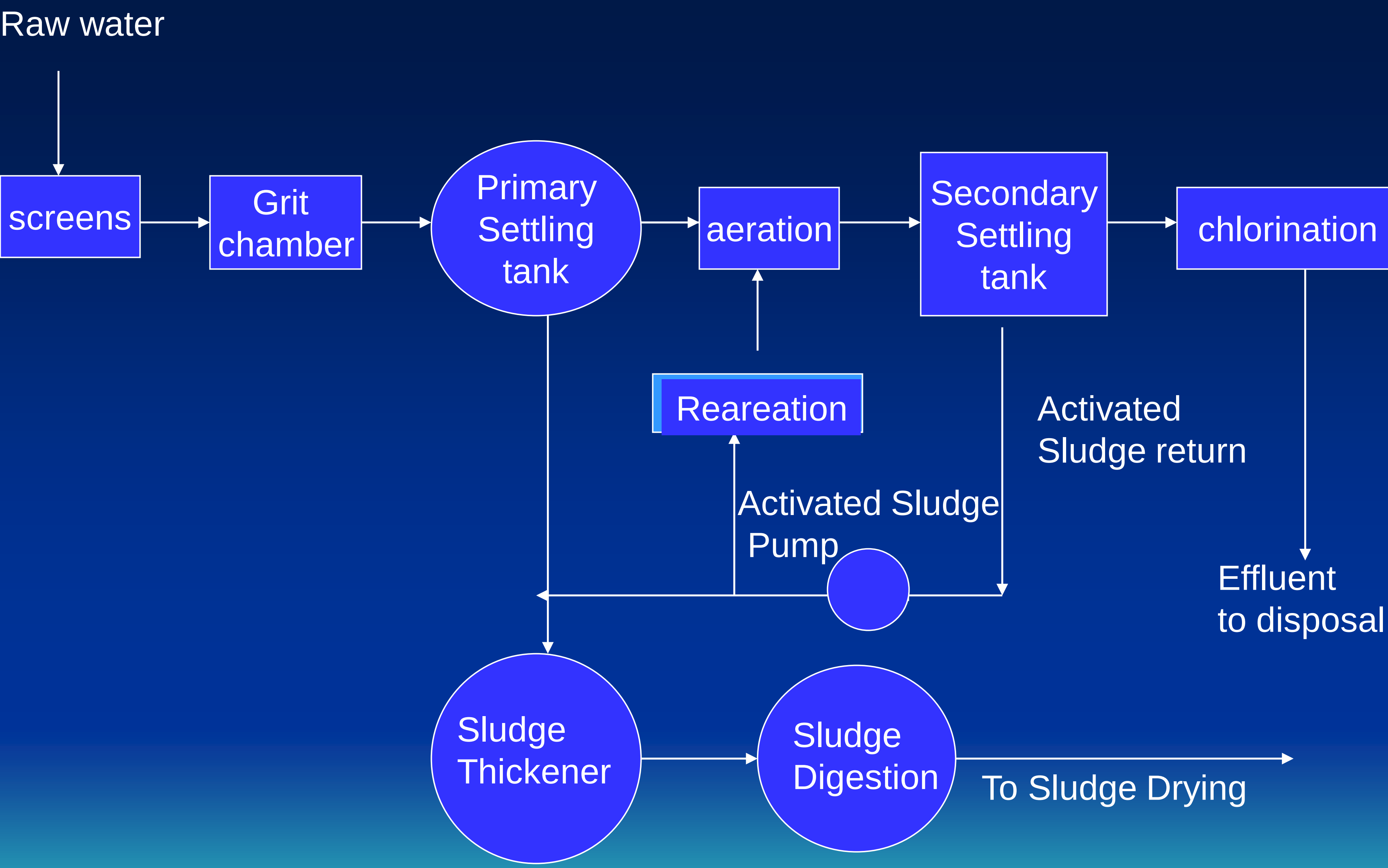
- Mass balance of MO at dX/dt=0 i.e., steady state growth
- Mass balance of substrate at dS/dt =0 i.e., steady state substrate removal
- Above equations are required to be "performed" over the "reactor" and "separator" system

μ, $\mu_{m,}$ K, $k_{s,}$ k_d etc. are obtained experimentally before designing.

Activated Sludge Process

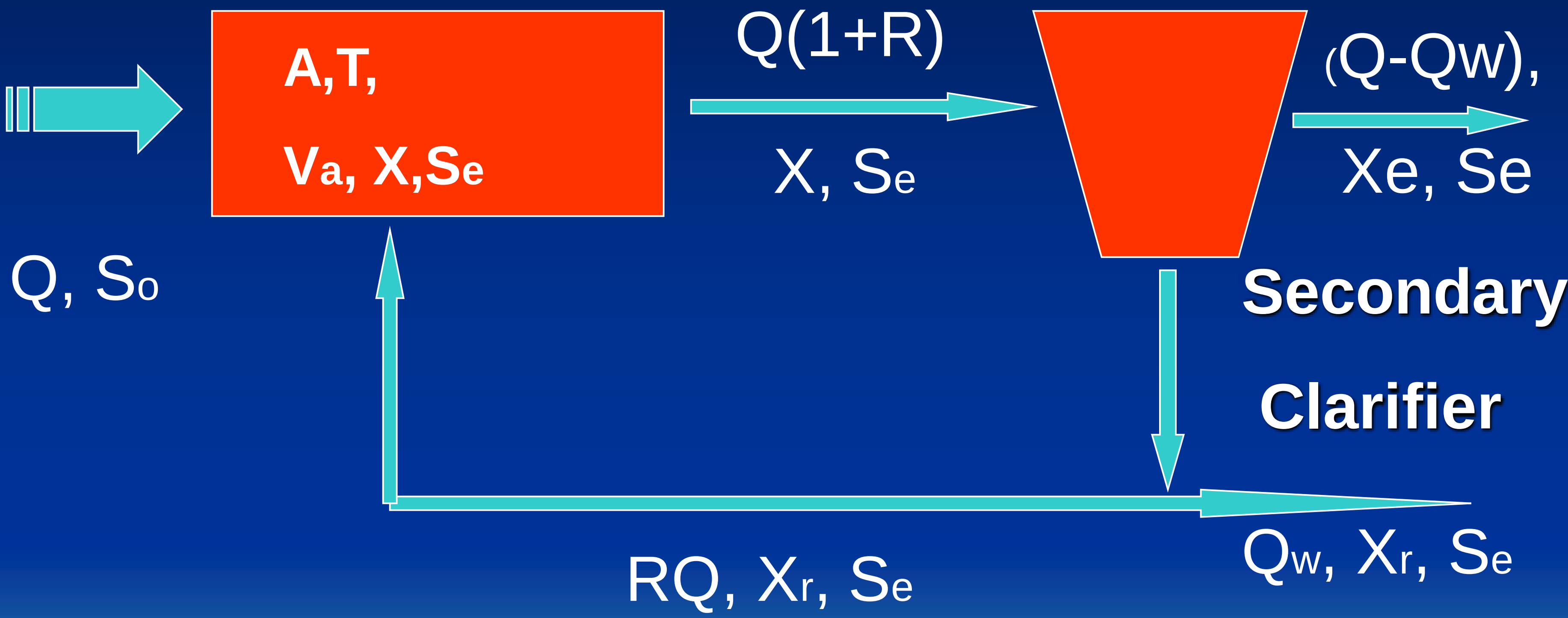
Activated Sludge Process is the suspended-growth biological treatment process, based on providing intimate contact between the sewage and activated sludge.

The Activated Sludge is the sludge obtained by settling sewage in presence of abundant O_2 so as to enrich with aerobic micro-organisms.



Flow Diagram of ASP

ACTIVATED SLUDGE KINETIC MODEL



Microorganism and Substrate Mass Balance

Rate of accumulation of biomass in system = Biomass in + Biomass growth - biomass out

$$(dX/dt)V = QX_o + V\,[r_g - k_d X\,] - QX$$

$$r_g = \mu_m XS/(K_s+S)$$

$$(dX/dt)V = QX_o + V[\mu_m XS/(K_s+S) - kdX\,] - QX$$

r_g = Growth rate of biomass

K_d= Endogenous decay coefficient.

Mean Cell Retention Time

The time for which the cells remain in the system. It is given as-

$$\theta_c = \frac{\text{Mass of solids in system}}{\text{Mass of solids leaving system/day}}$$

$$\theta_c = VX/(Q_w X_w + Q_e X_e)$$

Substrate Balance Equation

$$(dS/dt)V = QS_o - QS - V[\mu_m XS/ Y(K_s+S)]$$

Y=Decimal fraction of Food mass converted to biomass

For Steady State

$$dS/dt = Zero$$

$$(S_o - S) = \theta[\mu_m XS/Y(K_s+S)]$$

Effluent concentration

$$X = \mu_m(S_o - S)/K(1+k_d\theta)$$

$$X = Y(S_o - S)/(1+k_d\theta)$$

Effluent substrate concentration

$$S = K_s(1+\theta k_d)/\theta(Yk - k_d)-1$$

MICROBIOLOGICAL PROBLEMS, THEIR CAUSES & CONTROL IN ASP

INTRODUCTION

- The real "heart" of the activated sludge system is the development and maintenance of a mixed microbial culture (activated sludge) that treats wastewater and which can be managed.
- The best approach to troubleshooting the activated sludge process is based on microscopic examination and oxygen uptake rate (OUR) testing to determine the basic cause of the problem or upset and whether it is microbiological in nature.

MICROBIOLOGY PROBLEMS AND THEIR CAUSES

- Bulking sludge
- Rising sludge
- Foaming
- Poor floc formation, pin floc and dispersed growth.
- Toxicity

BULKING SLUDGE

- It is a stage in which an over abundance of filamentous organisms is present in the mixed liquor in the activated sludge.
- Types of sludge bulking

➢ *Zoogloea bulking* - Zoogloea occur at high F/M conditions and when specific organic acids and alcohols are high in amount due to septicity or low oxygen conditions.

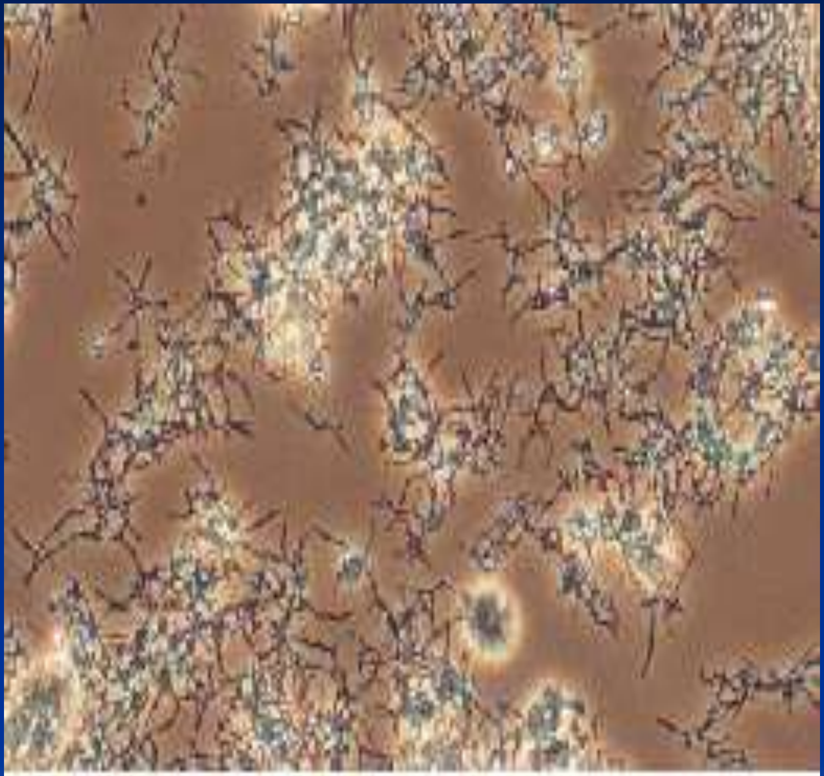
➢ *Viscous bulking* – it is the result of excessive extracellular polymer substances by biomass, causing poor compaction and settling of biomass in secondary clarifiers, increased effluent BOD and poor sludge dewaterability.

- *Filamentous bulking* – over growth of filaments effect both the zone settling velocity and sludge compaction.

RISING SLUDGE

- Sludge rise occurs when bacteria common in the activated sludge floc respire using nitrate in place of free oxygen when it is lacking and release nitrogen gas as a by-product. This gas is only slightly soluble in water and small nitrogen gas bubbles form in the activated sludge and cause sludge blanket flotation in the final clarifier.

FOAMING



Nocardia Foam (200X)

- Nocardia and microthrix parcivella are two main filamentous organisms cause foaming.

DESCRIPTION AND CAUSES OF ACTIVATED SLUDGE FOAMS

Foam Description	Cause(s)
thin, white to grey foam	low cell residence time or "young" sludge (startup foam)
white, frothy, billowing foam	once common due to nonbiodegradable detergents (now uncommon)
pumice-like, grey foam (ashing)	excessive fines recycle from other processes (e.g. anaerobic digesters)
thick sludge blanket on the final clarifier(s)	denitrification
thick, pasty or slimy, greyish foam (industrial systems only)	nutrient-deficient foam; foam consists of polysaccharide material released from the floc
thick, brown, stable foam enriched in filaments	filament-induced foaming, caused by *Nocardia, Microthrix or type 1863*

POOR FLOC FORMATION, PIN FLOC AND DISPERSED GROWTH

- Floc-forming species share the characteristic of the formation of an extracellular polysaccharide ("slime") layer, also termed a glycocalyx.
- Floc-forming species may grow in a dispersed and non-settleable form if the growth rate is too fast. This condition, termed dispersed growth, occurs often in industrial waste treatment, generally due to high organic loading (high food to microorganism ratio (F/M) conditions).
- No flocs develop and biomass settling does not occur, resulting in a very turbid effluent.
- Small, weak flocs can be formed that are easily sheared and subject to hydraulic surge flotation in the final clarifier. These small flocs, termed pin floc, consist only of floc-forming bacteria without a filament backbone, usually <50um in dia.

TOXICITY

- The washing of cement or lime trucks to a manhole, dumping of congealed diesel fuel to the sewer system, and overload of small systems with septage (which contains a high amount of organic acids and sulfides which can be toxic).
- Sulfide toxicity to activated sludge is more common than currently recognized. Sulfide may originate from outside the activated sludge system, from septic influent wastewater or from septage disposal, or it may originate "in-house", from anaerobic digester flows or from aeration basins or primary or final clarifiers with sludge build-up and anaerobic conditions.

- Hydrogen sulfide toxicity is highly pH dependent, due to the H_2S form being the toxic agent and not HS^-.

CONTROL METHODS FOR BULKING AND FOAMING

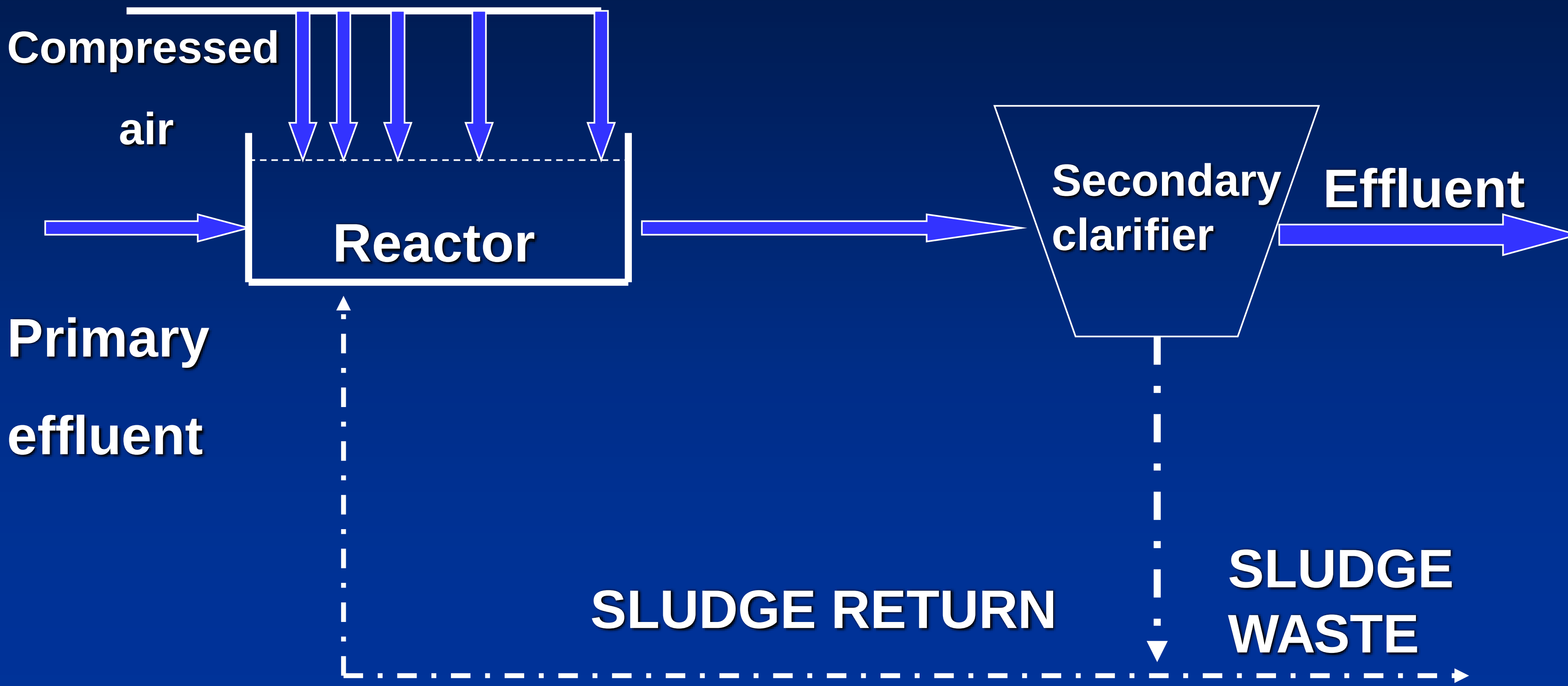
- Sludge Juggling
- Polymer and Coagulant Addition
- Chlorination
- Low Dissolved Oxygen Problems
- Low F/M Problems and Selectors
- Nutrient Deficiency
- Foaming Control

Modifications of ASP

Conventional plug flow:- Settled water and recycled activated sludge enter the head end of the aeration tank and are mixed by diffused air or mechanical aeration. During the aeration period adsorption, flocculation and oxidation of organic matter occurs.

Modified aeration:- It is similar to conven- -tional plug flow except that shorter aeration time and higher F/M ratio are used.

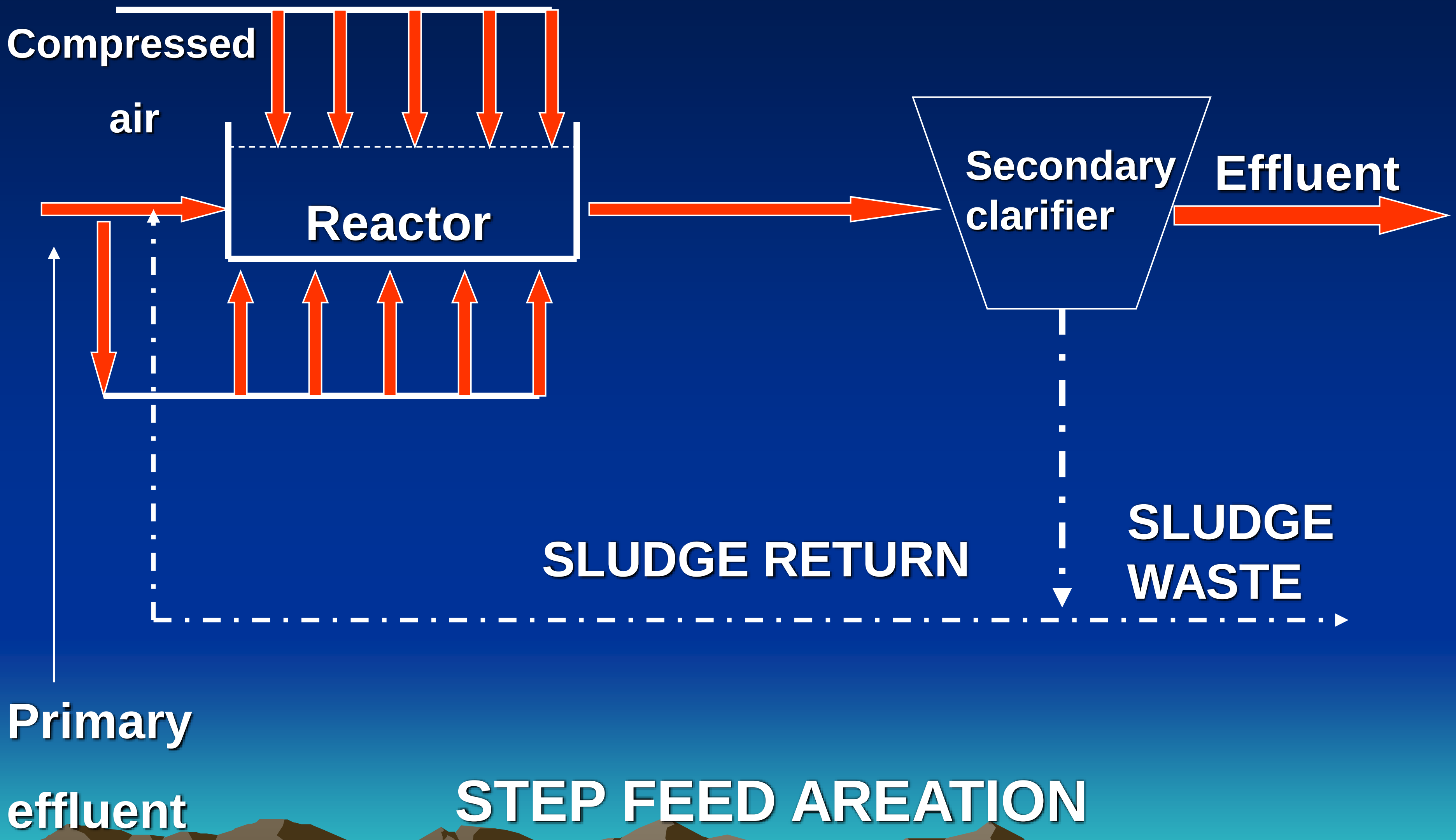
Tapered aeration:- Varying aeration rates are applied over the tank length depending on the oxygen demand. Greater amounts of air are supplied to the head end of the aeration tank, and the amount diminish as the mixed liquor approaches the effluent end.



Tapered aeration

Step feed aeration

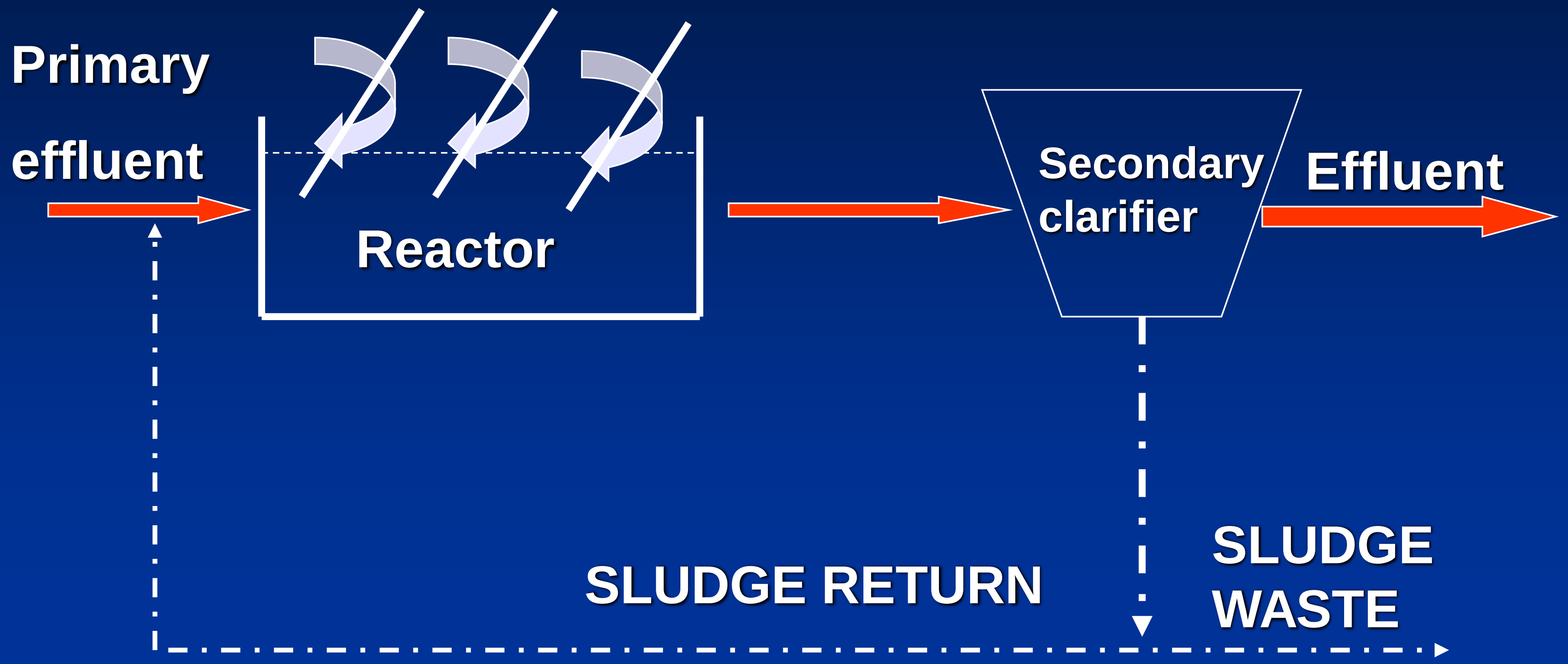
Generally three or more parallel channels are used. The settled waste water is introduced at several point in the aeration tank to equalize the F/M ratio, thus lowering peak oxygen demand.



STEP FEED AREATION

Extended aeration :-

It operate in the endogenous respiration phase of the growth curve, which requires a low organic loading and long aeration time.



Extended Aeration

Deep shaft process

- It is a Process having a mechanism of great depth aeration (depth of 40 to 150 m as an aeration tank) and it is practiced where land is in short supply.

- It can treat the waste water at higher rate.

- It is also known as a space efficient and energy efficient biological process.

Deep shaft…

- It is a high intensity aerobic liquid effluent treatment process, having a single vertical shaft.

- Vertical shaft is divided in up-flow and down-flow sections known as the riser and down comer.

- The effluent circulates rapidly in the shaft driven by the injection of compressed air which provides a differential density in the riser and down comer.

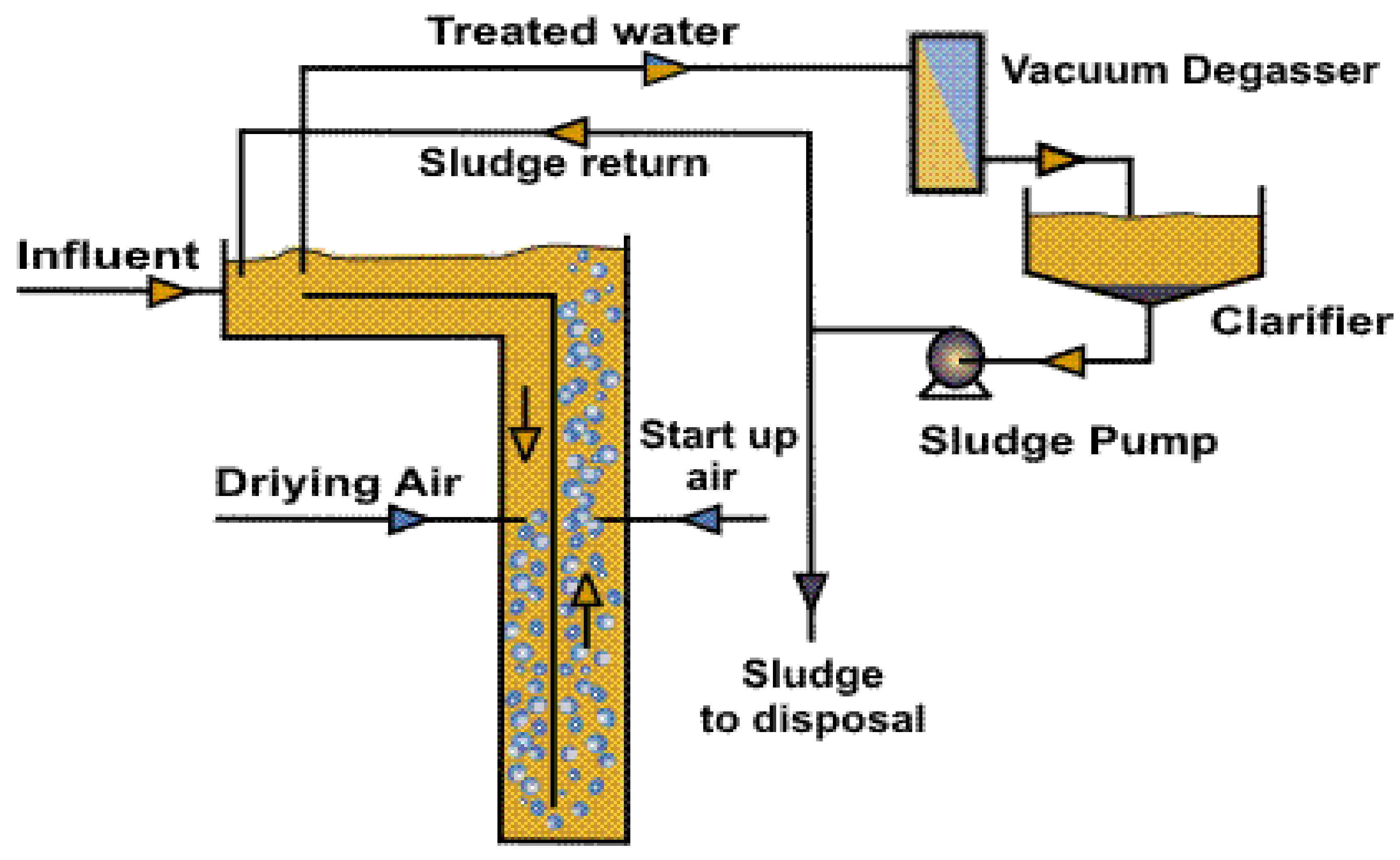
- The resultant turbulent flow provides intense mixing of gas, liquid and biomass.

Description:

- The liquor typically takes between 2 to 6 minutes to circulate once around the shaft and head tank and on average it circulates 20 to 40 times before discharge.

- The low ratio of the feed to the re-circulation flow means that the feed is rapidly diluted and mixed with the entire mass of activated sludge in the system.

- Typically shaft, is between one and eight metres in diameter and surmounting the shaft is gas disengagement head tank.


Treated water
Vacuum Degasser
Sludge return
Influent
Clarifier
Sludge Pump
Start up
air
Driying Air
Sludge
to disposal

Deep Shaft Advanced Biological Treatment Process:

- High intensity aerobic liquid effluent treatment process with oxygen transfer rate typically 10 times higher than conventional process.

- Well suited for treatment of high strengths wastes with low operating and capital cost

Performance and Characteristics:
(Examples for paper-manufacturing)

BOD removal rate: >90% (215mg/l -> 10mg/l)

COD removal rate: >80% (260mg/l -> 37mg/l)

BOD volumetric load: 3.7kg/(m^3 d)

Retention time: 1hour

Operational advantages of Deep Shaft:

- Oxygen rate transfer is 10 times higher than for conventional processes.
- Full automation possible with minimal instrumentation.
- Resistance to changes in flow rates, BOD loadings and toxins results in robust and reliable performance.
- Capable of treating a wider range of liquor strengths (typically 1 - 30 kg BOD/m^3 day compared with 0.4 -1.3 for conventional plants).
- Can operate at higher MLSS concentration (3-10 g/l compared to 2-5 g/l) for conventional plants.

- Design sludge loading (kg BOD per day/kg of MLSS) is higher, (0.7 to 3.5 compared with 0.1 to 0.5), and this reduces reactor size.
- Limited growth of filamentous organisms means improved sludge settling and smaller clarifiers.
- Less sludge produced per kg BOD removed.
- No moving parts with low maintenance costs.
- Overall cost effective high performance.

General advantages of Deep Shaft:

- Proven and reliable technology with more than 80 plants in operation.
- Low capital and operating costs.
- Low land area requirements.
- Mechanical simplicity.
- High energy efficiency i.e. 1-4Kg BOD/kwhr.
- Environmental friendly.

- Primary treatment not required.
- High BOD removal rates.
- High oxygen intensity (up to 2.5 Kg/M^3/hr compared to 0.1 to 0.3 for conventional processes).
- High efficiency of oxygen utilization.
- Process reamains unaffected by change in temperature.

Applications:

- Pulp paper paper-product manufacturing industry
- Food industry
- Chemical industry
- Sewage industry

LAGOONS

LAGOONS

- Lagoons are deep waste stabilization ponds -like bodies of water or basins designed to receive, hold, and treat wastewater for a predetermined period of time by artificial means of aeration.
- In the lagoon, wastewater is treated through a combination of physical, biological, and chemical processes.

TYPES OF LAGOONS

According to the microbial activity in the aerated lagoons-

→ Aerobic aerated lagoons.

→ Facultative aerated lagoons.

AEROBIC AERATED LAGOONS

- Dissolved oxygen is present throughout much of the depth of aerobic lagoons.
- They tend to be much shallower than other lagoons.
- They are better suited for warm, sunny climates, where they are less likely to freeze.
- HRT = 3 TO 6 days.

FACULTATIVE AERATED LAGOONS

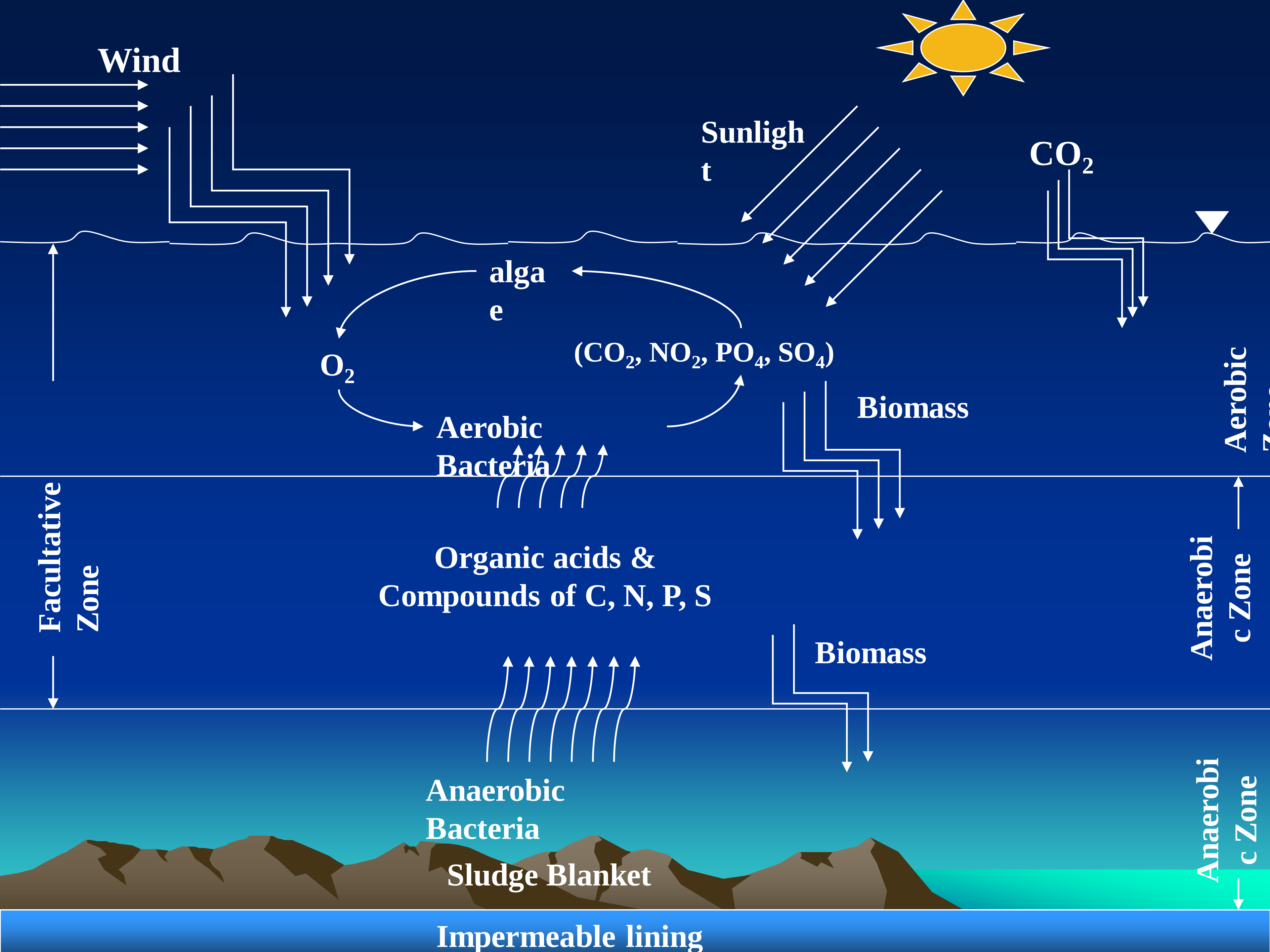
- Three types of zones are present

  Aerobic Zone.

  Anaerobic Zone.

  Facultative Zone.

- HRT is higher than aerobic lagoons because time requires for the solids to settle and for many pathogens viruses to either die off or settle out.



Wind
Sunligh
t
CO_2
alga
e
O_2
(CO_2, NO_2, PO_4, SO_4)
Biomass
Aerobic
Bacteria
Aerobic
Zone
Facultative
Zone
Organic acids &
Compounds of C, N, P, S
Anaerobi
c Zone
Biomass
Anaerobic
Bacteria
Anaerobi
c Zone
Sludge Blanket
Impermeable lining

Two, Three, or Four Lagoons Are Better Than One

- Each lagoon cell has a different function to perform, and a different kind of lagoon design may be used for each cell.

In Series

When lagoons operate in series, more of the solid material in the wastewater, such as algae, has an opportunity to settle out before the effluent is disposed of.

In Parallel

This system design is particularly useful in cold climates or where lagoons are covered with ice for parts of the year

Applicability

Type of Lagoon	Application
Aerobic Lagoon	Municipal and industrial wastewaters of low to medium strength.
Facultative Lagoon	Treated raw, screened, or primary settled municipal wastewater and biodegradable industrial wastewaters.

Operation And Maintenance

For Facultative Lagoons

- Most facultative **lagoons** are designed to operate by gravity flow. The system is not maintenance intensive and power costs are minimal because pumps and other electrically operated devices may not be required.

- Earthen structures used as impoundments must be inspected for rodent damage.

Operation And Maintenance

For Aerobic Lagoons

- Any earthen structures used as impoundments must be periodically inspected. If left unchecked, rodent damage can cause severe weakening of lagoon embankments.
- In submerged diffused aeration, the routine application of HCl gas in the system is used to dissolve accumulated material on the diffuser units
- The use of submerged perforated tubing for diffused aeration requires maintenance and cleaning on a routine basis to maintain design aeration rates

Limitations

For Aerated Lagoons

- Aerated lagoons may experience ice formation on the water surface during cold weather periods
- Reduced rates of biological activity also occur during cold weather
- Formation of ice on Floating Aerators.

For facultative Lagoons

- The inability of the process to meet a 30 mg/L limit for TSS due to the presence of algae in the effluent.
- Odors may be a problem in the spring and fall during periods of excessive algal blooms and unfavorable weather conditions

Attached-Culture Systems

- Trickling Filter
- Rotating Biological Contactors
- Bio-Towers

NEXT

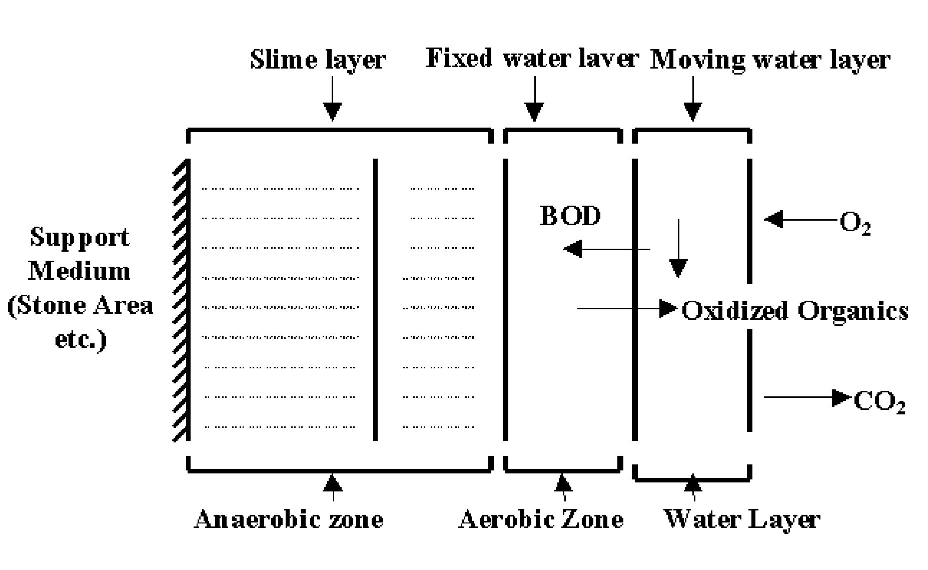
BACK NEXT

Trickling Filter

Biofilm or bacterial film or biomass is grown or developed on solid medium. Such as rocks, stone pieces, synthetic medium etc. This media is randomly packed in reactor. Wastewater is applied on the top through a rotating arm and it trickles down of the bottom. In its travel to the bottom of TF, wastewater is brought into the centre of biofilm attached to the medium. The process may be depicted as shown below.

HOME

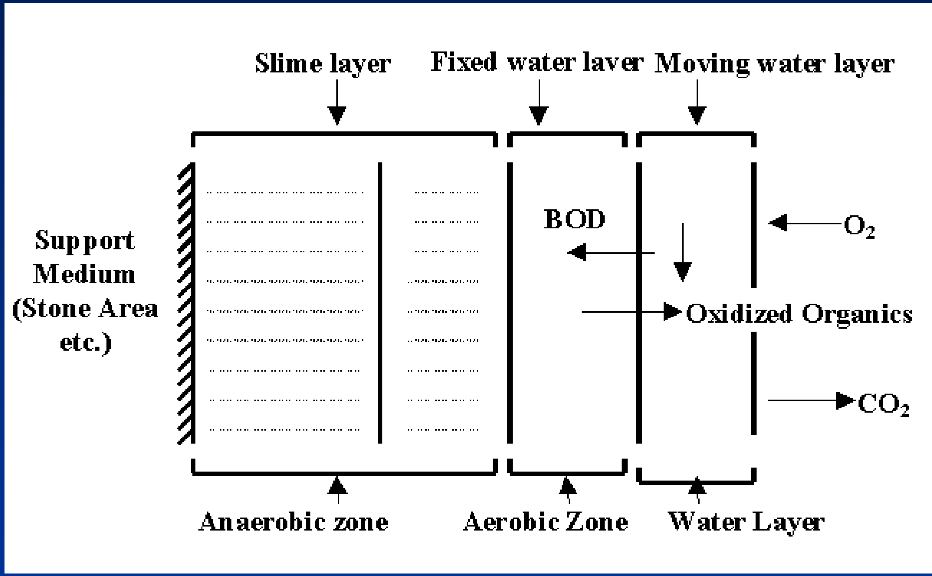
How does it work?



1. O_2 and Nutrients (BOD etc) are transferred to the fixed film by diffusion
2. Energy of oxidation helps build the microbial film through synthesis

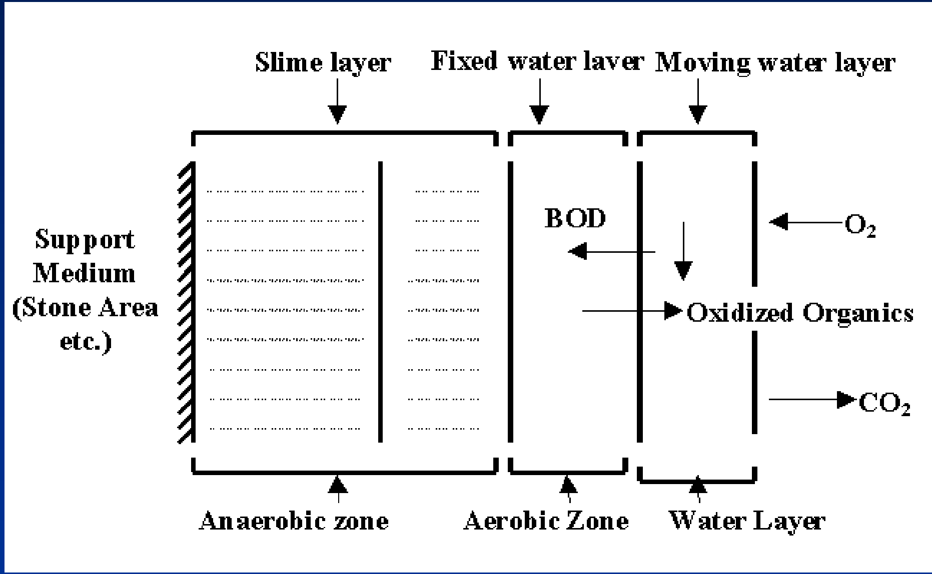
Continue…..How does it work?

HOME BACK NEXT



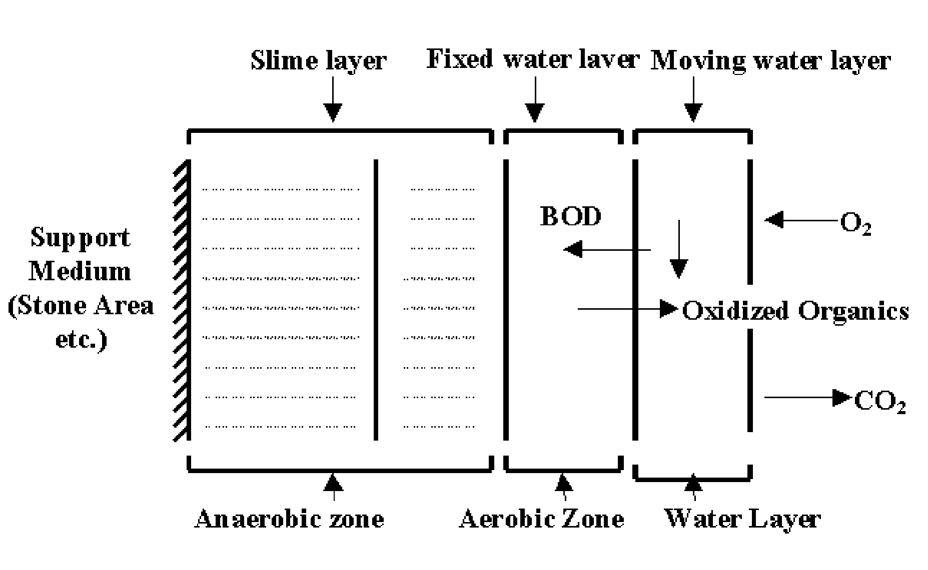
3. Bacteria metabolise contents of the fixed film.
4. Biofilm grows or get thickened.
5. As its thickness increases, inner layer becomes anaerobic.

Continue…..How does it work?



6. Outer bio layer remains aerobic.
7. With more thickening of biological layer, cells in inner layer die and their lyses can generate acidic conditions.

Continue…..How does it work?



8. The bio film gets slough off and is being carried away by the wastewater.

9. In SST, biofilm material is separated.

Sludge in Trickling Filter:

- Sludge in TF = 100 day (long θ_c endogeous decay, low X, more stablised Sludge)
- Actual Biomass is difficult to analyse
- Overall yield coefficient is 60 – 80% of AST Process
- High rate TF produce more Sludge

Air Supply in TF:

- Natural draft : Temperature difference in air & wastewater

IIf wastewater temp. < Ambient temp. : downward flow of air ,

If Wastewater Temp. > Ambient Temp. : Upward Flow of Air.

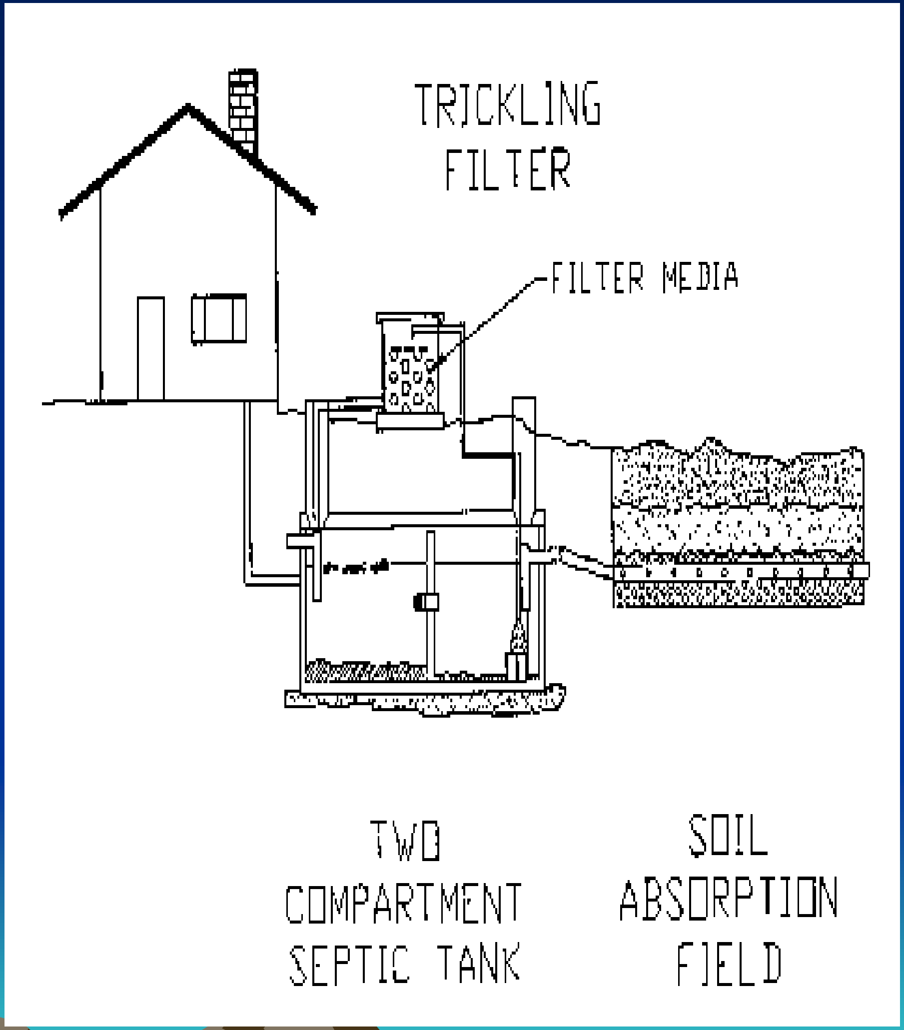
- Under drains & collecting systems should be designed to flow no more than half to allow force air passing
- 1 m^2 for every 250 m^2 of filter area

Hydraulics of Trickling Filter:

- Rotating arm: ½ - 2 rpm
- Peripheral Speed: 0.5 – 3.7 m/min (two arm system)
- Arm length : 4.5 – 70m
- Ports : 95mm in dia.
- 15cm above media.
- Flow velocity in arms > 0.3 – 0.6 m/s to prevent deposition of particulates
- Size of parts is generally same.

Application of Trickling Filter

- Onsite Treatment
- House Hold



Classification of filters

- Low-rate filters
- Intermediate-rate filters
- High-rate filters
- Super –rate filters

Parameter	Low Rate Filter (LRF)	Intermediate Rate Filter (IRF)	High rate Filter (HRF)
H--- Hydraulic loading m^3/m^2 -d	1 – 4	4 – 10	10 – 40
Uol. loading kg/m^3 – d	0.08 – 0.32	0.28 – 0.48	0.32 – 1.0
Depth, m	1.5 –3.0	1.25 – 2.5	1.0 – 2.0
Recirculation Ratio	0	0 – 1	1 – 3
Power Requirements $kw/10^3\ m^3$	2 – 4	2 – 8	6 – 10

Each area ------- the does at least at 5 min intervals.

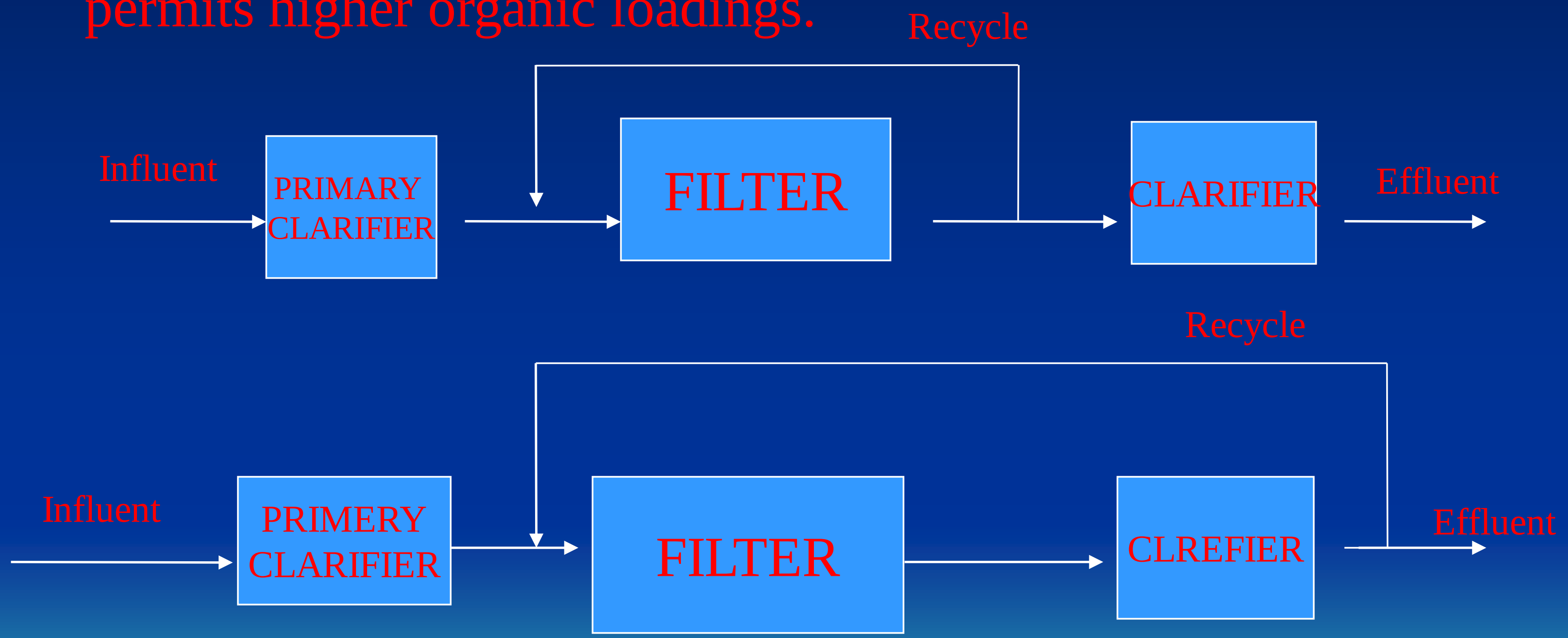
Low-rate filters

A constant hydraulic loading is maintained by suction-level controlled pumps or dosing siphon.

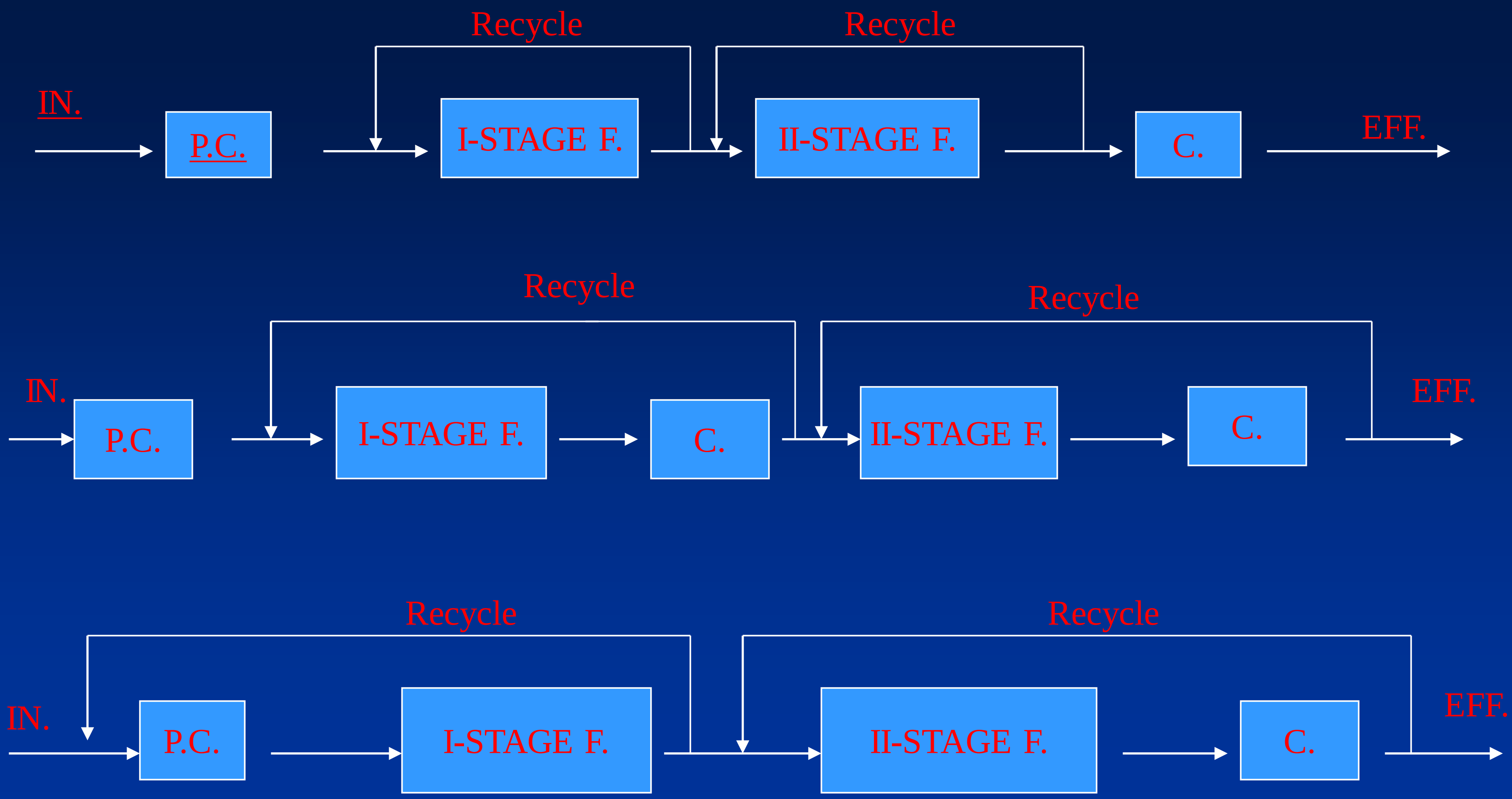
- Dosing tanks are small having 2 min detention time.
- In low-rate filters the top 2 to 4 ft of the filter medium will have appreciable biological slime.
- Low-rate filters provide good BOD removal but highly nitrified effluent.
- Odors are a common problem with low- rate filter in warm weather.

Intermediate-rate and high -rate filter

- In these filters recirculation of the filter effluent permits higher organic loadings.



Single-stage filters with various recirculation



Trickling-filters flow sheets with various recirculation patterns

Two- stage filters

Intermediate Rate and High Rate Filters

- Recirculation of filter effluent around the filter results in the return of viable organisms.

- This method of operation improves treatment efficiency

- Recirculation also helps to prevent ponding in the filter and reduce the nuisance from odors and flies.

Super-rate filters

- These filters have various types of synthetic and wood packing media.

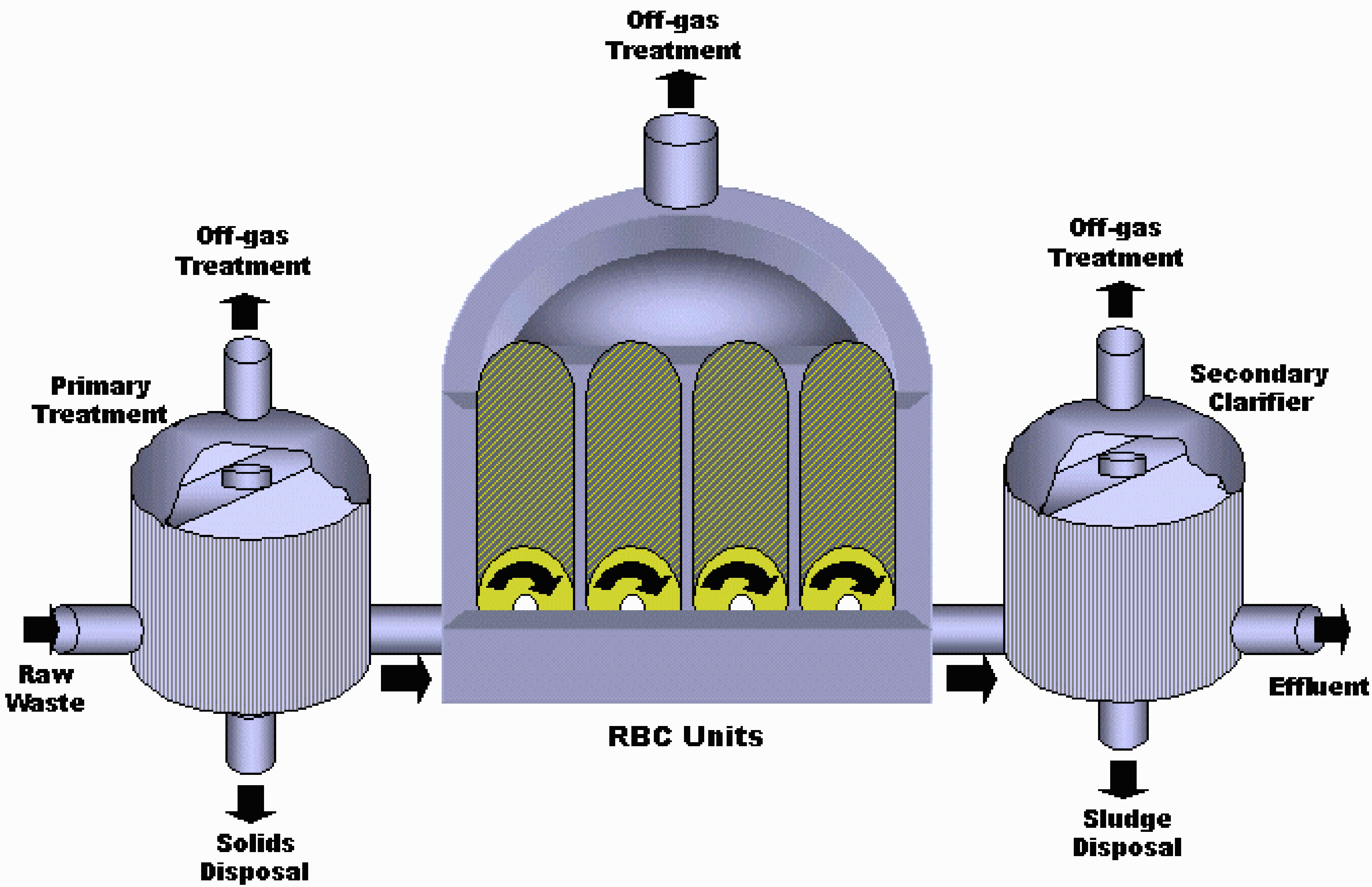
- Application – high strength wastes and roughing units.

- High surface area per unit volume synthetic media filter

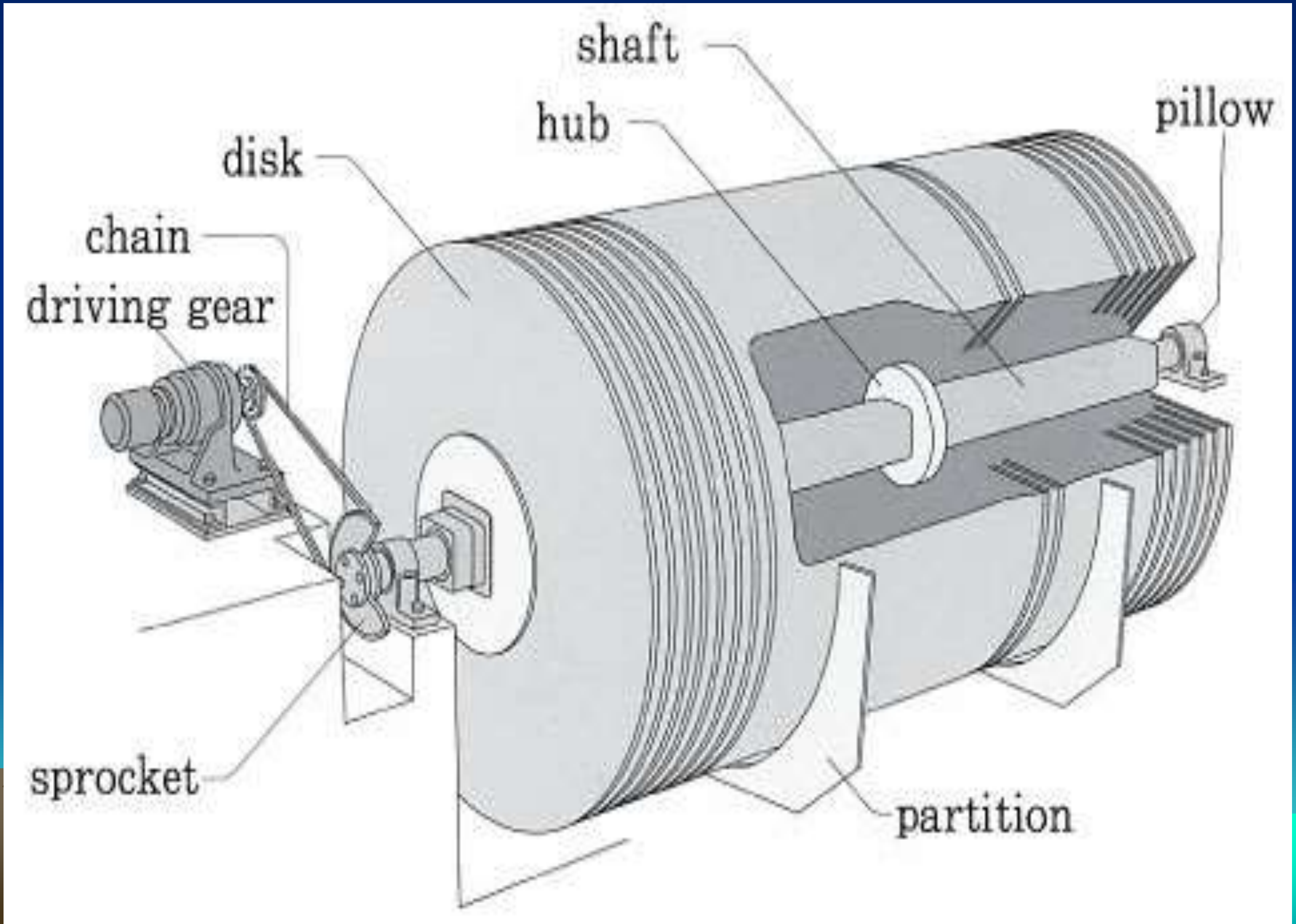
- Used to achieve the nitrification of treatment effluent at extremely loading rates.

Rotating Biological Contactors

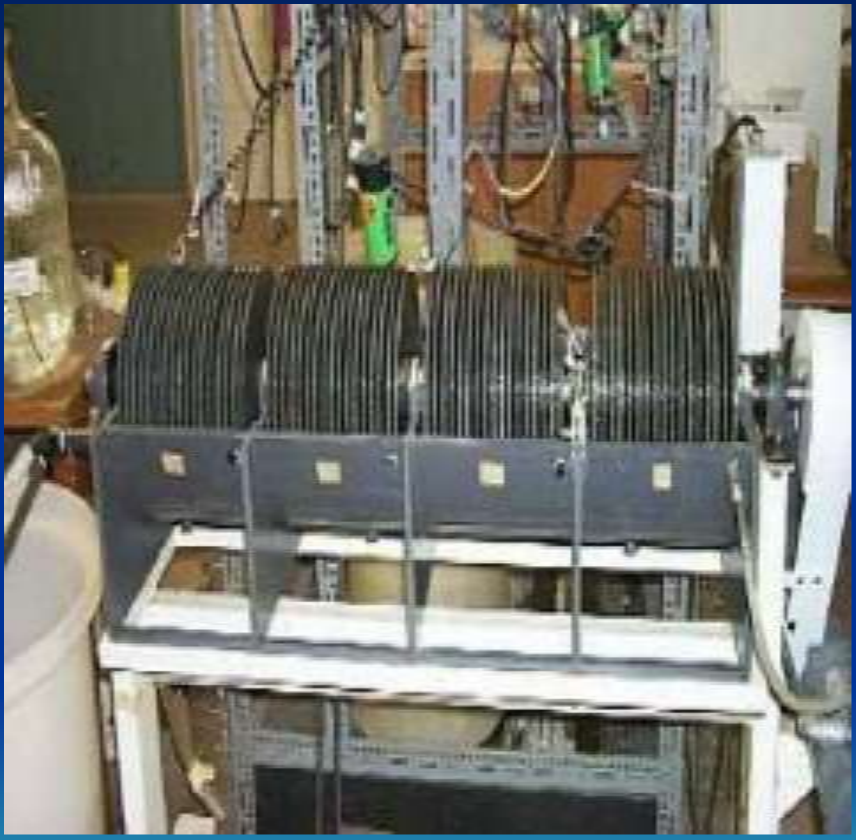
- Rotating biological contactors, commonly referred to as RBC's, are less prevalent than trickling filters. However, RBC's produce a high quality effluent and waste water operators should be familiar with them.


Off-gas Treatment
Off-gas Treatment
Off-gas Treatment
Primary Treatment
Secondary Clarifier
Raw Waste
Effluent
RBC Units
Solids Disposal
Sludge Disposal

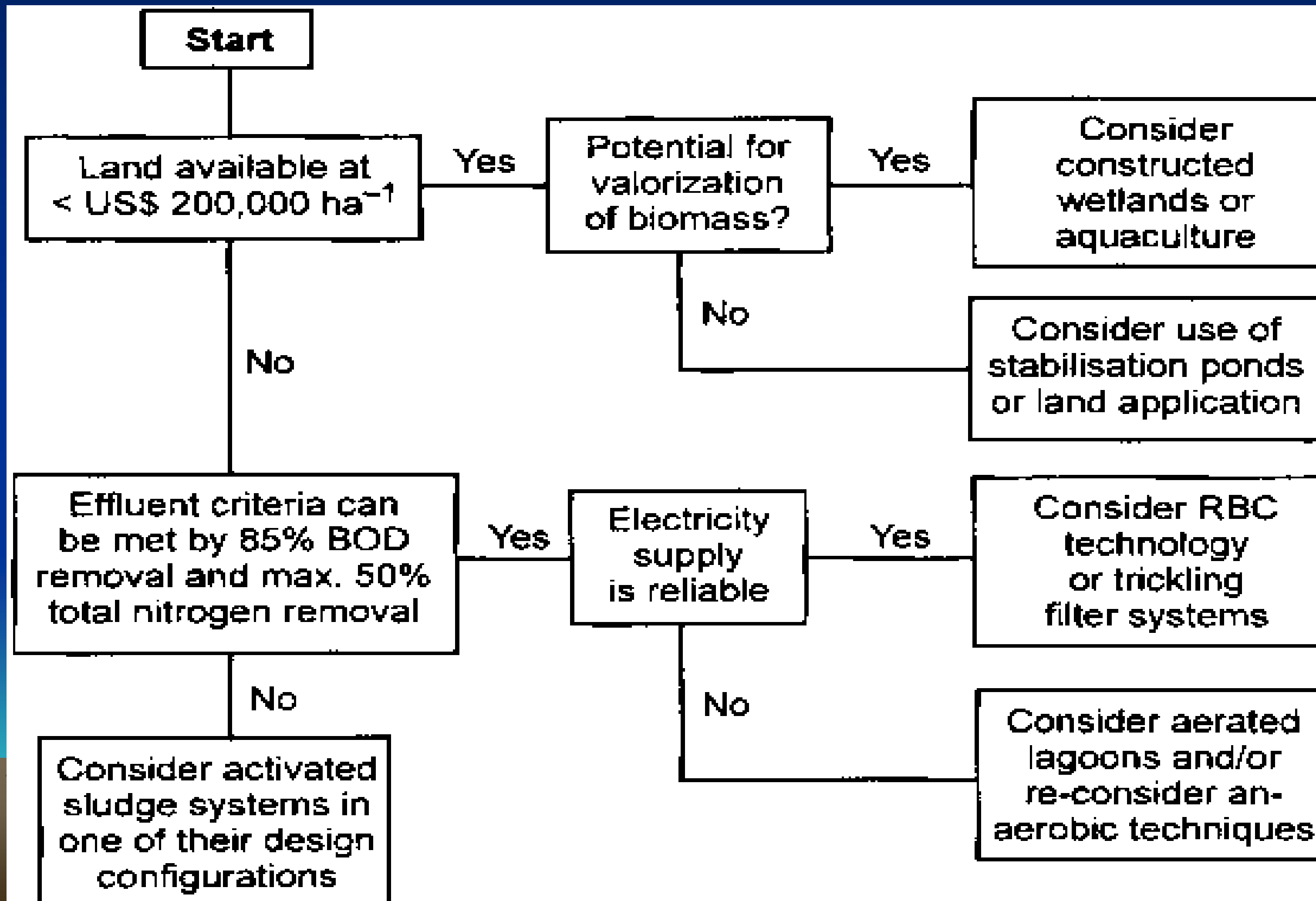
Nomenclature:



...........RBC.......



When do we use what:



Design aspects:

- Area of plates :

  A= [Q(S_0-Se)/P(Se/Ks+Se)]

  A= □(r_0^2-r_u^2)

❑Submergence ~ 40% of total disc area

❑Motor hp for rotation 2-5

❑RPM 2-5

Process operation:

- Pretreatment :
  - To prevent accumulation of solids & settling in trough.
  - To protect RBC from shock/ toxic loads
- Flow equalisation :
  - Low retention time in RBC is offset by high conc. of biomass
- Staging :

- 2-4 stages – BOD removal
- 6 or more – Nitrification

- Hydraulics :
  - Minimum head loss
  - No recycle / recirculation method
- Flow distribution
  - Not very critical, mixing due to rotation is very effective
- Enclosures:
  - Useful against rain/ snow
  - Limit heat loss
  - Limit direct exposure to sunlight and hence growth of algae limits
- Protect the disk from deterioration due to UV

Advantages of RBC

- Low food to micro-organism ratio resulting in higher efficiency of organic matter removal
- Low hydraulic retention periods minimizing tank volume and capital costs
- Low head loss and lower power requirement
- Inherent simplicity and low operational and maintenance cost
- Ability to resist shock loads
- Ability to lend itself to modular fabrication to suit required effluent quality

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- The RBC is a fixed media filter in which the microorganisms are housed on a series of large discs. These discs are supported on a single shaft which is slowly rotated through the wastewater by an air or electric driven motor. The RBC is covered by a removable fibreglass housing which has access portals at each end.

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- The discs are covered with a thick coating of slime. This slime is the microorganisms, both aerobic and anaerobic, which treat the wastewater. RBC's act much like a trickling filter in that the contactors perform well at removing BOD.

.....RBC…

- Radius of discs varies from 1.5 to 2.00 mtr.
- Thickness of plate or disc is 10 mm to 30 mm.
- Spacing is generally 2-3 cm to prevent ‘bridging’ between growth on two adjacent plates.
- Rpm of shaft is kept as 4 to 6 rmp.

Major draw back of this system is shaft failure, due to torque caused due to 60 % dry and almost 40% area submersed in in the waste water.