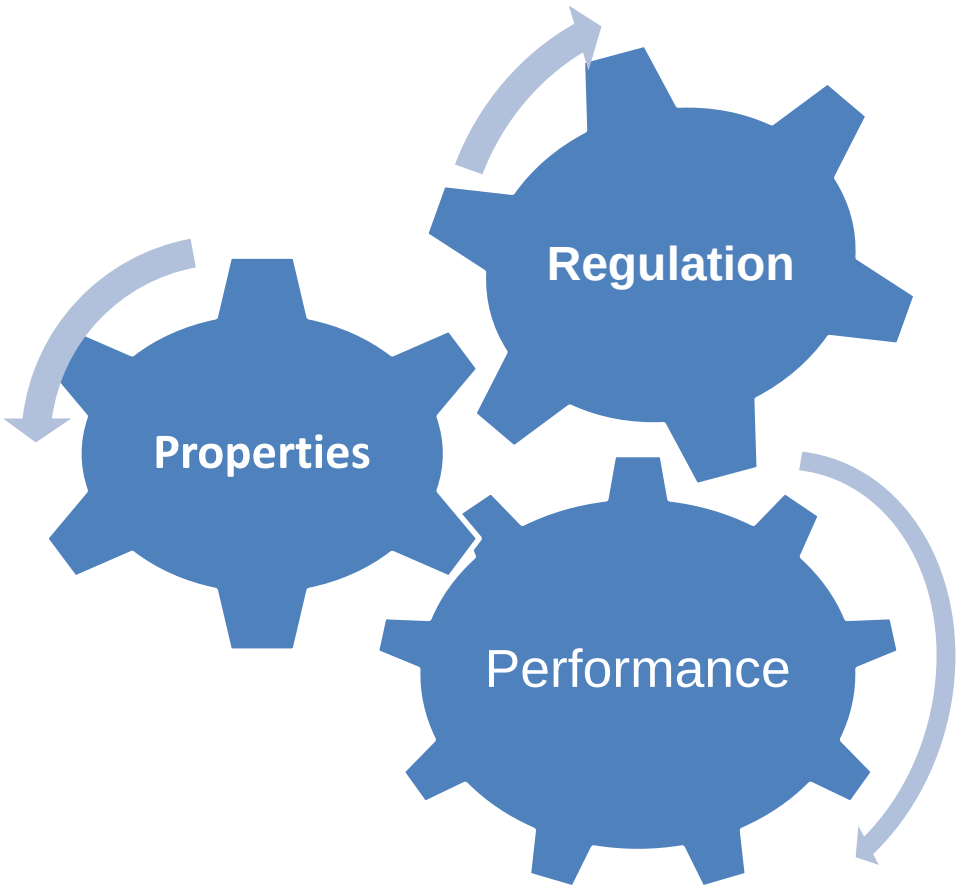
Optimization of COD – UASB and its Pre-treatment.

- Requirement
- Sources
- Optimization
- Pre-treatment- Load Reduction
- Anaerobic Treatment- Steps & Insight
- Process Selection
- Conclusion

Balancing Tools



Drivers

- Resource Cost
- Regulation
- Sustainability
- Monitoring

Inhibitors

- Variables
- TDS-Brittleness
- COD-Smell
- CAPEX/ OPEX

Reminder....

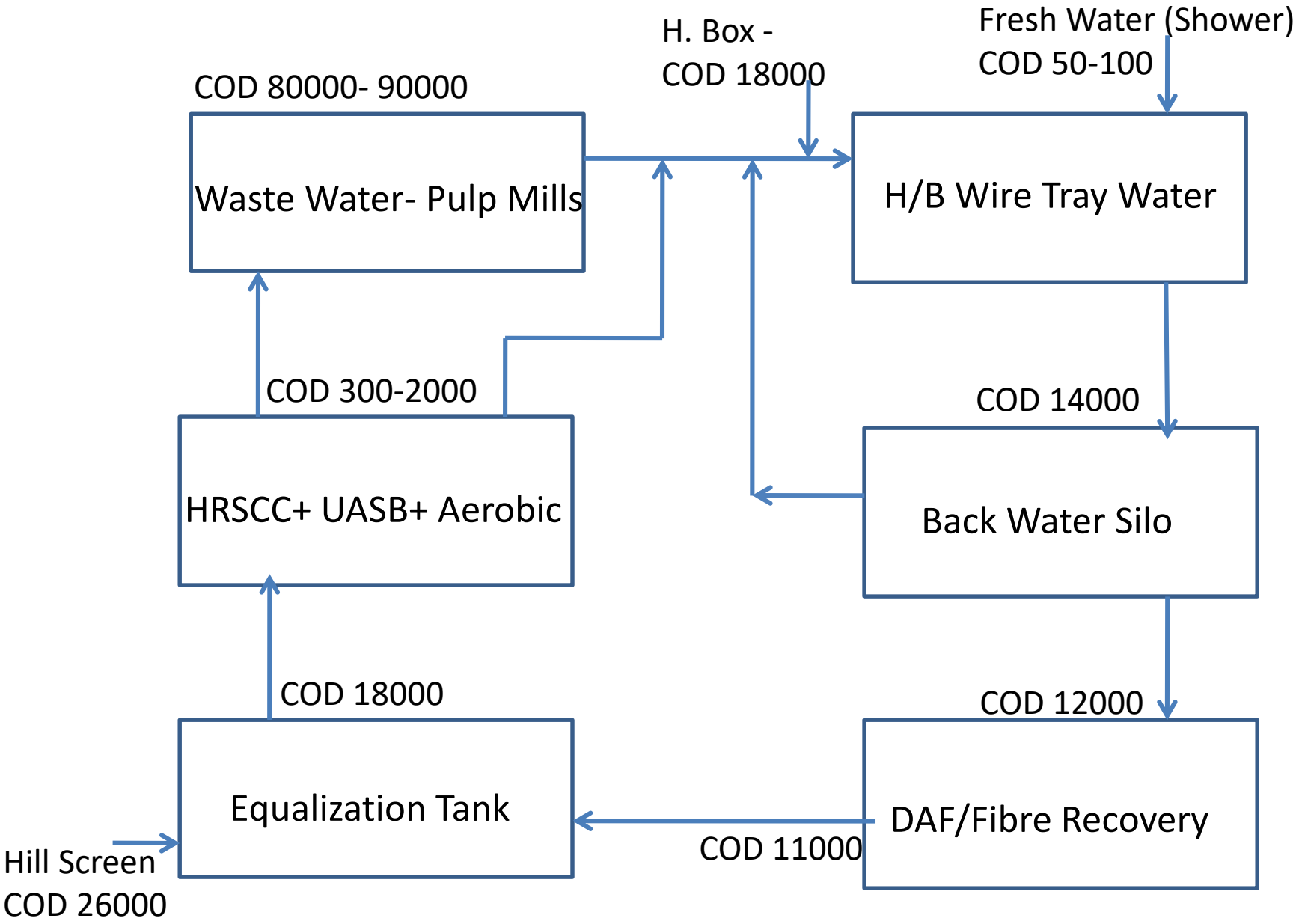
COD.....Measurement of Total Chemicals in Waste Water which can be Oxidized

Sources.....Furnish Mix, Organic & Inorganic Chemical additives, Starch, Lignin and Organic Sources

TOC.....total Organic Carbon

BOD.....amount of Organic Load can be consumed as food by Biomass Population

COD Balance for RCF Based Test Liner



Pre Treatment.....

- Optimum First Pass Retention

- Monitoring and Control

- Primary Treatment

1) Bar Screen and Oil & Gas Trap
2) Equalization Tank
3) High Rate Solid Contact Clarifier (HRSCC)

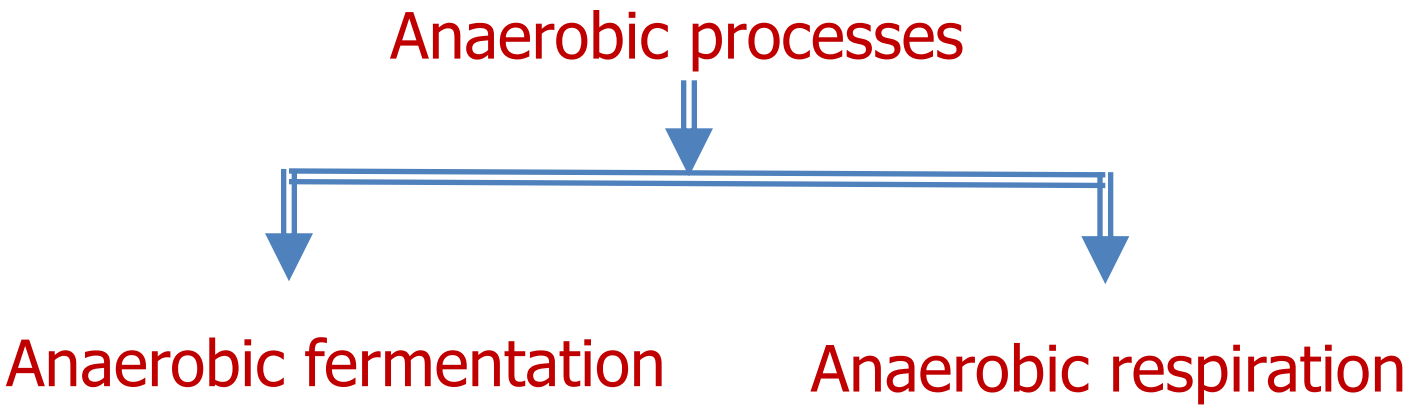
- Secondary Treatment

1) UASB Feed Tank- Buffer Tank
2) Neutralization Tank
3) INDION UASB Tall Reactor with inbuilt Lamella clarifier

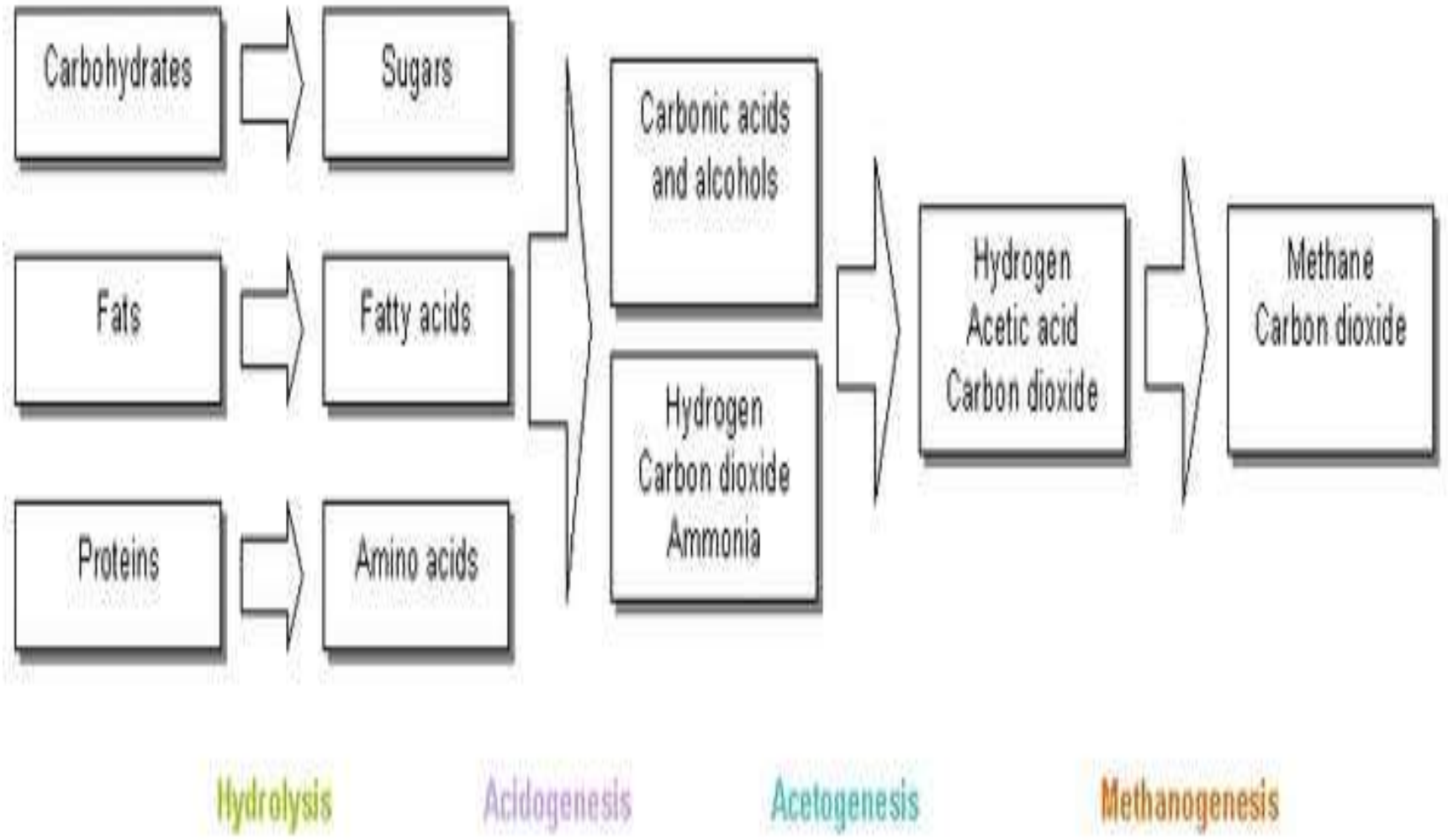
ANAEROBIC TREATMENT PROCESS

Anaerobic treatment is a biological process carried out in the absence of O_2 for the stabilization of organic materials by conversion to CH_4 and inorganic end-products such as CO_2 and NH_3

Organic materials + Nutrients —*Anaerobic microbes*→ ***CH_4 + CO_2 +NH_3 + Biomass***



BIOLOGICAL & CHEMICAL STAGES IN ANAEROBIC TREATMENT



BIOLOGICAL & CHEMICAL STAGES IN ANAEROBIC TREATMENT (Cont.)

Higher organic acids are transformed to acetate by Acetogenic bacteria (3rd Step). How ever in some cases energy Output of these conversions are not sufficient To run the reaction. For Example, conversion of Propionic Acid:

$$C_3H_5O_2^- + 3H_2O \longrightarrow C_2H_3O_2^- + HCO_3^- + H^+ + 3H_2 + 76\ kJ \ldots\ldots\ldots (3)$$

For reaction, Partial Pressure of H_2 is lower than 10^{-3} to 10^{-4}. Hence direct consumption of H_2 Partial Pr. is kept low to convert Propionic acid to Acetic Acid.

Methanogenesis belong to special group bacteria, the Archae- Bacteria, terminal members of anaerobic food chain, whose metabolic activity prevents the sequestering of large amount of organic material in anaerobic eco system.

Surplus hydrogen can be used by most of Methanogenic bacteria to convert to HCO_3^- to Methane according to:

$$4\ H_2 + HCO_3^- + H^+ \longrightarrow CH_4 + 3H_2O \qquad -135.6kJ \ldots\ldots\ldots\ldots (4)$$

Accumulation of Propionic acid can be avoided if methanogens and acetogenic bacteria are closely associated. Than the H_2 produced by acetogenic bacteria can be consumed by methanogens & converted to CH_4. Interspecies H_2 transfer:

$$C_3H_5O_2^- + H_2 \longrightarrow CH_4 + C_2H_3O_2^- \qquad -26\ kJ \ldots\ldots\ldots (5)$$

COD of water will reduce once CH_4 becomes free. Next step is carried out by two methanogens- Methanothrix soehngenii & Methanogens subspecies:

$$C_2H_3O_2^- + H_2O \longrightarrow CH_4 + CO_2 + OH^- \quad -62\ kJ \ldots\ldots\ldots (6)$$

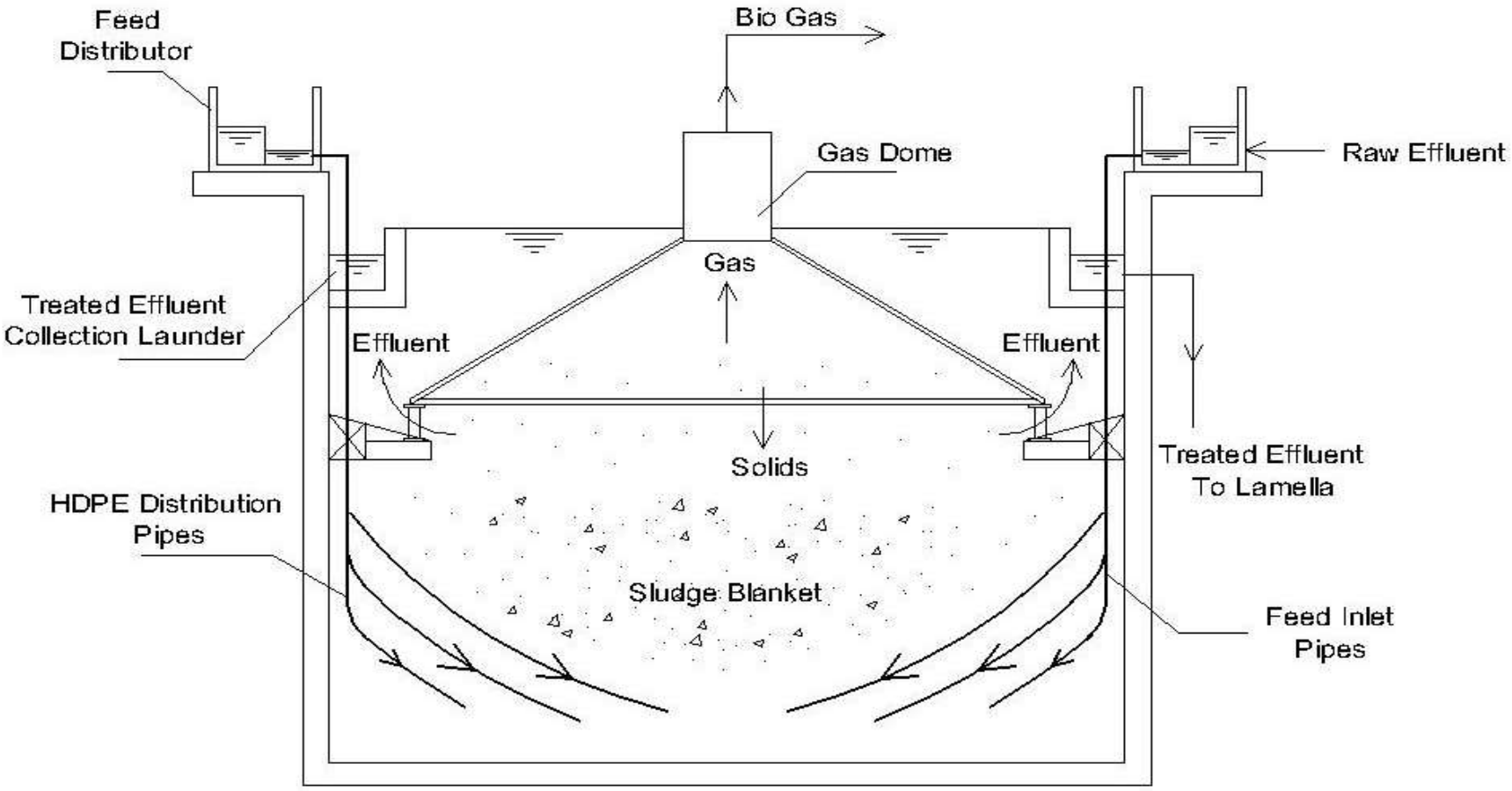
Methanogens II

In this step Acetate is converted in to biogas & is responsible for 70% of the biogas produced in Anaerobic process and again COD is removed from water with Methane.

ESSENTIAL PHYSICAL/CHEMICAL CONDITIONS EFFICIENT ANAEROBIC TREATMENT

- Constant Feed flow & limited Fluctuation in feed
- Absence of Ca & So4 ions
- Avoid excessive Air/O2 Exposure
- No toxic/inhibitory compounds present in the influent
- Maintain pH between 6.8 –7.2
- Sufficient alkalinity present (mainly bicarbonates)
- Low volatile fatty acids (VFAs)
- Temperature around mesophilic range (30-38 ^{o}C)
- Enough nutrients (N & P) and trace metals -Fe, Co, Ni, etc.

TYPICAL REPRESENTATION OF IEI-UASB (UPFLOW ANAEROBIC SLUDGE BLANKET)



Comparison – Conventional & TR

Variables	*INDION* UASB - TR	*INDION UASB - Conventional*	CSTR - Conventional
Organic Loading rate	High loaded System	Low loaded system	Low loaded system
Recirculation	No recirculation of sludge involved	Recirculation from external Lamella clarifier	Recirculation from external Lamella clarifier
Scale Effect	*Nil*	Low	Prone Due to O2
Foot Print Area	Least - 1650 m3	7700m3	8500m3
Slude Req.	Can use granular acclimatized sludge from existing ETP resulting in fast start-up	Requires sludge for start-up and acclimatisation	requires sludge for start-up and acclimatisation
Foam Control	There is no Foam formation in the reactor	There is no Foam formation in the reactor	Foaming occurs due to mixing on account of foam causing compounds
Capital Cost inc. Civil	20% lower than conventional CSTR	10% Lower than conventional CSTR	20% higher than *Indion* UASB - TR
Energy Input	Least	Relatively Low	Highest

CASE STUDY- 500 TPD- Zero Liquid Discharge with Heavy Metal

Amount of Gas generation & Conversion to Power using Turbine- ROI

Parameters	**Unit**	**Plant 1**	**Plant 2**	**Wtd. Average**	**Centrate**	**Total Flow rate to ETP**
		550	**450**	**1000**	**250**	1250
Ph		6.70	7.05			
COD	mg/liter	25000.0	23580.0	23258	8140.4	24000
BOD	mg/liter	8500.0	7800.0	8200	2600.0	7664
TSS	mg/liter	237	337	274	1000.0	445
TDS	mg/liter	15123	18632	17339	17339.2	17339
Turbidity	NTU	450.0	1260.0	950.0	980.0	990.0
Total Gas Generated	**6500.0 Cum/day**					
Provide Gas Holder	**dia x 6.5 m depth**					
Electricity generated from gas =	0.28 x COD removal efficiency x COD in					
	4010.0 KWH/Day					
With 1 hr HRT						

Conclusion.....

- Monitoring and data compilation
- Running Machine at Good retention Level
- Pre Treatment & Consistent Flow of Feed
- Selection of Proper Technology
- Skilled Operations

.....Thank You