

COD Optimization for Zero Discharge Mills- UASB Approach & Its Pre-treatment

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Abstract: *With many daunting challenges like changing market dynamics, need to improve product quality with degrading resources, pressure of optimization product mix as well resources one of the biggest challenge Industry facing is to cope up with environment. One & all are aware that natural recourses are limited and to be consumed with responsibility to maintain the Environment sustainability. Various regulatory bodies are on their toes with various suggestions & strict norms to delay the inevitable conflict between Civilization & need. Recently one of the Paper PSU in Kerala has been shut down last week by CPCB for not disposing the Sludge.*

With all these challenges the Growing Paper Market- Packaging, Tissue & Coated Paper and emerging new technologies are the tools to handle the situation also in last couple of decade our focus on 3R has fetched us impressive dividends and Water consumption has gone down remarkable & Industry is confident to face these daunting challenges. In order to imply regulation our Process & Paper Properties too have started buckling and the High COD & TDS values have started impacting the brittleness and Bad Order. As there is constant Evaporation TDS is being Build up in system and increased Recycling has forced us to stop the Wet end additive as inorganic Coagulant and roll of "Size Press" has become more prominent than earlier. This help build up Turbidity affecting the Paper quality.

Frequently mills are facing wrath and recently one Central public sector company, produces newsprint for the Indian and international markets, Stopped functioning last month for very same reasons. The closure order was issued after the mill failed to rectify the pollution concerns that were brought to its notice nearly one year ago. The company was asked to remove the sledge that had accumulated in its water treatment plant. Moreover, the total suspended solid particles were found exceeding the permissible levels in the effluents. Paper is going to deal in all these issues focusing COD – Its Cause, Source, Effect and treatment using UASB.

Key words: COD Optimization, Zero Discharge Mills, Pulp and Paper

CONTENTS

- COD- Source and Impact on Paper Property
- Pre Optimization on Machine or Pre- treatment
- UASB- Feasibility, Type
- Advantage & Disadvantage
- Conclusion!

COD is total measurement of all Chemicals in Waste Water that can be oxidised. TOC- Total Organic Carbon is measurement of Organic Carbon.

BOD is supposed to measure the amount of food (or Organic Carbon) that Bacteria can oxidize.

BOD/COD ratio may go up to 4 depending on types of Effluent. In case of COD 50 mg/L, BOD is close to Zero.

Source of COD could be residuals of Furnish Mix, lignin Present in it & Chemicals additive, including Inorganic & Organic. Degraded Cellulose too contributes to enhance BOD/COB.

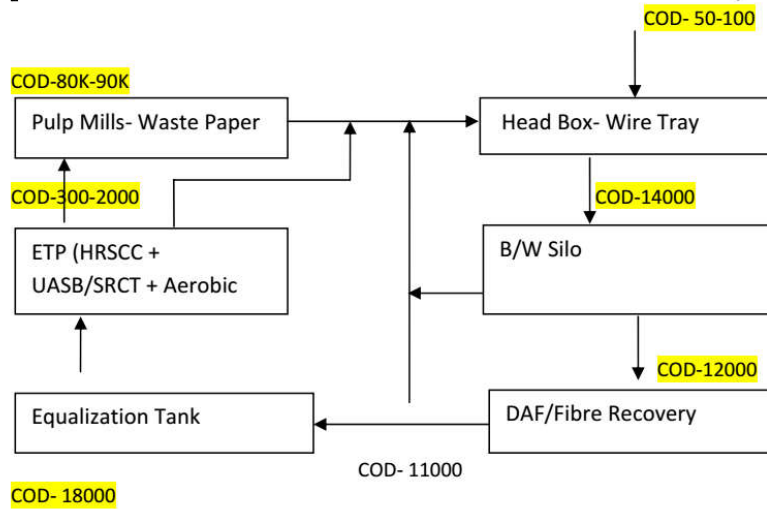
So detailed analysis of the effluent is needed to designed correct sequence, apart from it is important to have variation in process known which is expected considering the flex of furnish in use & its source.

Maintaining proper Process parameters is essential to reduce COD load in later part of the system. For example running machine at optimum retention level not only reduces load by retaining organic matter but also boosts financial prospect. Apart from, this decreases Turbidity of system to contribute in drainage by destabilizing Colloidal hence lower TSS, BOD & COD.

One should target to run machine not less than 3000 back water ppm must or lower, which is not the case in many of mills. We must work to reach level and it worth to do some work on this.

As explain below Anaerobic reactions occurs in absence of O₂ and in presence of certain microbes nutrients, which results in to hydrolysis of organic material with help of fermentation & respirations.

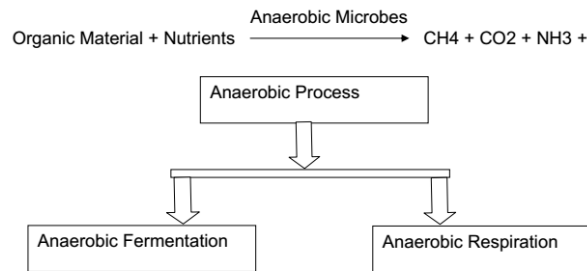
Typical COD Distribution for Waste Paper Based Mills is shown as following:



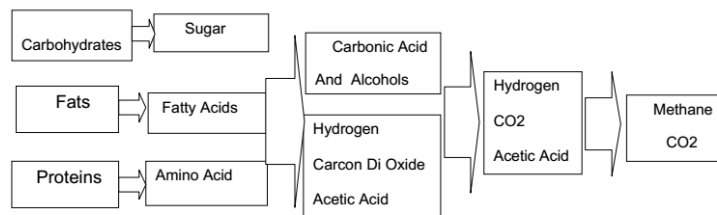
Final Product is CH₄ & CO₂ while Methonozenisis stage.

Anaerobic treatment Process

Anaerobic treatment is a biological Process carried out in absence of Oxygen (O₂) Stabilization of organic material by conversion to CH₄ and Inorganic end – products such as CO₂ & NH₃.



Biological & Chemical Stages in Anaerobic Treatment



Schematic Working Diagram

Equalize effluent shall be collected in UASB feed tank. Effluent from the UASB feed tank shall be pumped to UASB. If required, nutrients (DAP & Urea) shall be added in the UASB feed tank.

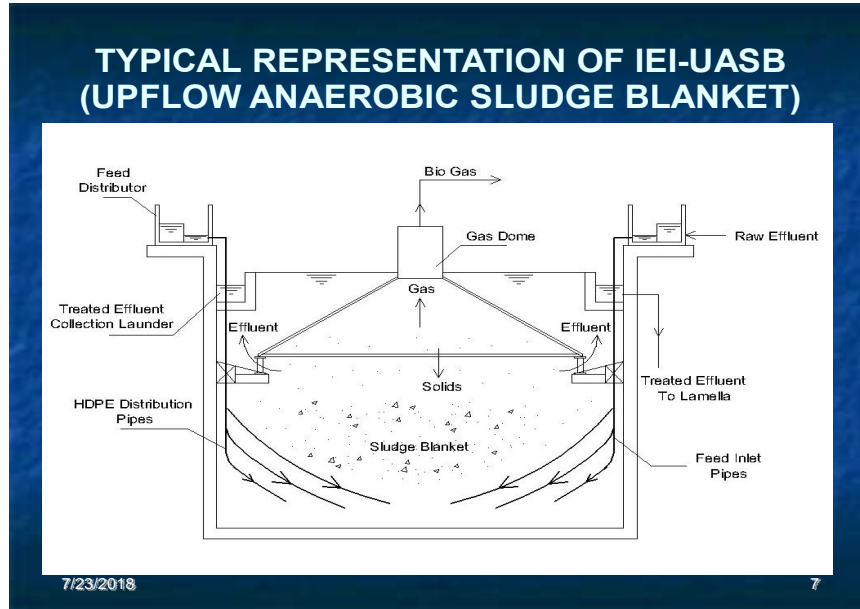
In UASB reactor, Waste water will enter the reactor through “Well Designed effluent Distribution System” and shall be distributed equally over the bottom of the reactor.

Within the UASB reactor Pollutants are degraded through a series of Bio Chemicals reactions Vig. Hydrolysis, Acidogenesis, Acitogenesis & Methonozenisis and produces Methane, Carbon Di Oxide and Biomass as the by products.

Within the UASB reactor Biomass Conglomerate & form Granules, this has very good settling properties. The Solid generated in the Process settles down and add to the sludge Blanket.

Subsequently, Waste Water rises in an upflow mode through an expended Bed of Anaerobic Active Methanogenic slude and leaves the reactor after 3 phase separator where Solid, Liquid & Gasses are separated.

The Gas Liquid separators are placed on the top of the UASB reactor.



Advantage of UASB

- Low Energy and Land requirement
- Production of Valuable Methane Gas which can be used for electricity generation or as Bio fuel.
- Productions of Highly Stabilized Sludge, which can be used for Manure Provided low carry over chemicals.
- Low (CTSR) /High (TR) Skilled requirement for operation/Supervision.

Disadvantage

- Less Flow variation in Inlet Effluent
- Low Ca⁺⁺ & SO₄⁻ ion in Feed to Scale & Efficiency.
- Skilled Man Power for Operation particularly Toll Reactor.
- Uncertainties concerning operation/maintenance due to low availability of Know how & Process Knowledge.

Comparison of UASB

Sr. No.	INDION UASB – TR	INDION UASB Conventional	CSTR – Conventional
1	Organic Loading Rate High loaded System	Low loaded system	Low loaded system
2	Internals Two stages of 3-phase separators made of Engineered PP No internal moving parts	Only one stage of 3-phase separators No internal moving parts	Several Moving internals Mixers, Agitators with high motor rating
3	Recirculation No recirculation of sludge involved	Recirculation from external Lamella clarifier	Recirculation from external Lamella clarifier
4	Scaling Effect No scaling on INERT PP internals	Relatively less scaling as the 3-phase separator are made of FRP	All internals like mixers and agitators can get scaled due to external recirculation of effluent which absorbs O ₂ and precipitates as CaCO ₃
	(no moving parts and no recirculation of Anaerobic effluent that would contain hardness	But external recirculation can cause scaling	

	causing ingredients		
5	Footprint area		
	Least - 1650 m ³	7700m ³	8500m ³
6	Sludge requirement		
	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
7	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
8	Capital Cost (including Civil/ MS Bolted Tanks Construction)		
	20% lower than conventional CSTR	10% Lower than conventional CSTR	20% higher than <i>Indion</i> UASB - TR
9	Energy Input		
	Least	Relatively Low	Highest

CASE STUDY- 500 TPD

This case study is of waste Paper mills running at Zero discharge with high COD values and presence of heavy metals. Proposed program is of Toll Reactor with pre treatment for TSS & heavy metals.

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/d				
Hence, provide gas holder		4 m dia x 6.5 m depth				
Electricity generated from gas =		0.28 x COD removal effi x COD in				
		4010.0 KWH/Day				
HBT – with 1 hr HRT						

Conclusion

- 1) Optimization of Process Parameter as Retention etc. to reduce the load on later stage.
- 2) Need to focus on Turbidity & TDS Values
- 3) UASB an option
- 4) Extensive pre-treatment feasibility study before installation
- 5) Focus on Skilled Man Power