

Original Research Article

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## Hybrid UASB Reactor: A Research Evaluation for Treatment of Pharmaceutical Industry Wastewater

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### ABSTRACT

India has tremendous improvement in pharmaceutical industry. The heaps of MNCs are there, and the Vapi is one the pharmaceutical centre point of Gujarat. Anaerobic innovation is a development and it has lots of advantages. Here the reactor was structure of 1210 mm tall, 152.4 mm distance across and shining framework for bay. The 5 inspecting point are put with 180 mm stature contrast the tallness of bay tank is 1500 mm. At the highest point of reactor there is a gas valve and Sludge channel at the base. Here likewise microbial examination was finished utilizing anaerobic container and gram Staining. With the fruitful start-up utilizing the Pharmaceutical's wastewater, the outcome is taken in COD, BOD, TSS, VSS, and alkalinity. The COD was greatest 71% and in the scope of 6% to 71% and BOD is additionally as same TSS and VSS are in the scope of 300 to 12000 it is increment because of microbial movement. The response is acidic in this way, that the pH is diminishing and alkalinity is diminishing these are in the scope of 7.9 to 6.8 and 35000 to 1000 mg/L. So it very well may be reasoned that the reactor has effectiveness of 70 %.

#### Keywords

Pharmaceutical wastewater; Hybrid UASB

#### Article Info

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### Introduction

Drugs and Pharmaceutical manufacturing industry plays a key-role to the Society as a whole. The foundation of Modern Indian Drugs and Pharmaceutical Industry in the country was laid in the beginning of this century. Pharmaceutical products refer to a group of chemicals used for diagnosis, treatment, or prevention of diseases and/or health conditions. Pharmaceutical manufacturing industries generally employ batch operations for manufacture of most basic drugs and their derivatives are Formulation, Extraction and Fermentation.

Regular pharmaceutical measurement shapes are: Aerosols, cases, creams, emulsions, gels, inserts, inward breaths, infusions, water systems, salves, glues, powders, arrangements, suspensions, tablets. Around 70% of the medications devoured are strong oral dose structure (tablets and containers).

### Pharma wastewater: Generation and standards

#### The UASB technology

The Upflow Anaerobic Sludge Blanket (UASB) reactor is the most imperative

anaerobic treatment innovation which was created in the late 1970s in The Netherlands by Lettinga and his associates. The cross breed Upflow anaerobic ooze cover (HUASB) reactor is another idea which is the hybridized adaptation of a UASB reactor with an arbitrary pressing average help media at the highest point of the reactor. HUASB reactor has a few focal points over UASB reactor, for example,

Higher effectiveness in the treatment of an assortment of waste waters including high quality waste water at high OLR and lesser HRT

Expanded maintenance of granular slop and counteractive action of washout of microbial populace and so on.

The UASB procedure comprises of an Up-flow of wastewater through a thick ooze bed with high microbial movement. In the reactor, the solids profile shifts from exceptionally thick and granular particles with great settling ability near the base (slop bed), to increasingly scattered and light slime particles near the top (muck cover). The UASB reactor can be partitioned into four segments: the ooze bed, the ooze cover, the gas-solids-fluid separator (for example 3-stage separator) and the optional settling compartment over the separator.

The slop bed is arranged in the base of the reactor and comprises of a thick slime with excellent settling attributes; it is in this way kept in the reactor. Over the muck bed is the slop cover, with solids introducing lower fixations and settling speeds. The slime cover comprises of ooze particles in a blend with the biogas framed, and is in this way held in suspension. It is in these two compartments, the slop bed and the slime cover, that the approaching wastewater is naturally corrupted.

## **Materials and Methods**

The wastewater was gathered from a Pharma Industry Named MegafinePharma, Vapi, Gujarat, India (Table 1). The business is it's sort of in India for the assembling of pharma based items and pharma intermediates.

The reactor was inoculated with dynamic biomass got from the anaerobic digester of Emami Healthcare Ltd., Vapi, Gujarat, which is in task in the current treatment offices situated at the business ETP. A little amount of jiggery was added to the reactor with water as supplement. The clarified set-up comprised of cross breed UASB reactor, made of a PVC material with a round and hollow segment of 152.4 inner distance across; 1210 mm stature absolute volume of 0.021 m<sup>3</sup>; powerful volume of 0.018 m<sup>3</sup>. The chose pressing material was situated at the best 33% of the reactor. The reactors were sustained from the influent tank through PVC tube by methods for a gravitational stream. A metal check valve of 25 mm size was fixed at the base of the reactor to encourage the ooze withdrawal. Five inspecting ports were introduced along the tallness of the reactor at various zones viz., muck bed zone, sludge cover zone and settling zone. The influent tank was given of 20 liters. This outlet was associated through a silicon cylinder to a wet gas meter.

In this study, locally available PVC support media is used. The PVC spiral packing media comprises of numerous windings (or) S-shaped portions.

### **Characteristic of the waste water**

### **Characterization of microorganisms**

### **Culturing anaerobes**

Microscopic organisms will just develop in a domain that contains a suitable convergence

of oxygen. For instance, commit aerobes become just within the sight of oxygen, though commit anaerobes become just in a sans oxygen condition. Refined of microorganisms hence requires development under an air that underpins their development (Table 2).

Anaerobic container  
Shake culture technique.  
Chemical reducing agents.

### **Start Up**

The primary target to be accomplished in the start-up of any high rate anaerobic reactor is to achieve a palatable and predictable immobilization of anaerobic creatures. Start-up routine of the above reactor can be considered as the second compelling piece of the constant method of activity, the first being the acclimatization in the cluster method of activity. A generally low volumetric stacking rate is prescribed for the essential start-up of HUASB reactor.

The HUASB reactor was seeded from acclimatized seed ooze got from the bunch mode activity. At first around 30-40% of the reactor volume was topped off with dynamic muck.

## **Results and Discussion**

### **Microbial analysis**

From the laboratory analysis of the sludge of the reactor using standard analytical techniques the low volume sample has negative result and all other are in positive (Table 4 and 5).

### **pH**

pH values gently increase with decrease in time of operation and found to be in the range of 7.89- 6.7 is shown in graph 3-5.

### **Alkalinity**

Alkalinity concentration is decreases with time in 1<sup>st</sup>& 2<sup>nd</sup> recycling but there is variation in continuous flow system. The values are in range of 11519-35008.5 which is shown in the graphs given below.

### **TSS and VSS**

Suspended solid concentration is increasing absolutely with time period because of biomass activity. The value of TSS and VSS of effluent is 300 mg/L and 362 mg/L which is increased to 5355 mg/L and 4444 mg/L at maximum reduction

### **COD removal**

COD removal percentage also increases with time of operation and is in the range of 6.18 % to 71.99% and the maximum efficiency of 71.99% is obtained which can be expressed in graphs as given below.

In conclusion, anaerobic debasement of the pharmaceutical business squander water is completed in the half breed UASB reactor. Based on the outcomes we can reason that the UASB reactor and the adjustment done in the reactor can be utilized for the pharmaceutical business squander water. Here the reactor additionally delivers adequate measure of the methane gas which can be utilized as fuel, which is potential wellspring of the vitality. It likewise gives high productivity for the reactor so it tends to be utilized for the treatment.

The greatest COD evacuation effectiveness is 71.99 % with normal profluent COD fixation as 62000 mg/l. The normal BOD evacuation effectiveness in first and second reusing framework it is 37.23%. What's more, it is 71.9% most extreme in both constant frameworks (Table 5a-5c).

**Table.1** Wastewater generation in pharma industry

Sr. No	Source of wastewater Generation	Range of average characteristics except pH	Effluent in mg/l
1	Sterile products	BOD TSS	50 to 100 20 to 260
2	Syrup preparation	COD Cl-	150 to 2500 20 to 150
3	Malt preparation	BOD So4-	300 to 2,000 20 to 200
4	Pastilles preparation	BOD Heavy metals TSS pH	2,000 to 2,500 1 to 20 100 to 300 to 8.0

**Table.2** Dimensions of the lab scale reactor

Physical Parameter		Size
<b>Height</b>	Total Height	1210 mm
	Effective Height	1020 mm
	Packing Material Height	90 mm
<b>Diameter</b>	Inner Diameter	152.4 mm
	Outer Diameter	153.1 mm
<b>Volume</b>	Total Volume	0.021 m <sup>3</sup>
	Effective Volume	0.018 m <sup>3</sup>
<b>Sampling port Height (From Base)</b>	1- Sludge Bed Zone	200 mm
	2 – Sludge Blanket Zone	380 mm
	3 - Sludge Blanket Zone	560 mm
	4 – Settling Zone	740 mm
	5 – Settling Zone	920 mm

**Table.3** Characteristic of water

Parameter (mg/L)	Result
pH	11.55
Ammonical Nitrogen	138.5
BOD	18328
COD	54821.4
Chloride as Cl <sup>-</sup>	488.9
Oil & Grease	8.1
Phenolic Compound	1.4
Sulphate SO <sub>4</sub> <sup>-</sup>	70
Alkalinity as Methyl Orange	33312.5
Total Dissolved Solid	1992
Total Suspended Solid	2

**Table.4** Result growth of Microorganism

Batch No	Source of Culture	Type of medium	Result
1st Batch	Supernatant of Emami sludge	N-Broth	- ve
		N-Broth	+ ve
		N-Broth	+ ve
2nd Batch	From 1st Batch	N-Broth	+ ve
		N-Broth	+ ve
3rd Batch	From 1st Batch	N - Agar slant	- ve
		N - Agar slant	+ ve
		N - Agar slant	+ ve
	From 2nd Batch	N - Agar slant	+ ve
		N - Agar slant	- ve
		N - Agar slant	+ ve
	From 1st Batch	N - Agar Plate	+ ve

**Table.5a** Result of 1st and 2nd recycle

COD mg/L	% Removal	BOD mg/L	pH	TSS mg/l	Gas m3/d
57612	6.18	19780	7.89	362	0.002
47112	23.28	15590	7.78	1789	0.008
39324.2	35.96	13275.2	7.56	2764	0.012
31739	48.31	10601.4	7.65	3713	0.017
26585.6	56.70	9050	7.33	4358	0.019
56060	8.70	19132	7.85	669	0.003
46874.6	23.66	15905	7.69	1819	0.008
37328	39.21	12785	7.55	3014	0.013
25210.8	58.94	8615.2	7.23	4530	0.020
20496	66.62	6985.7	6.98	5120	0.023

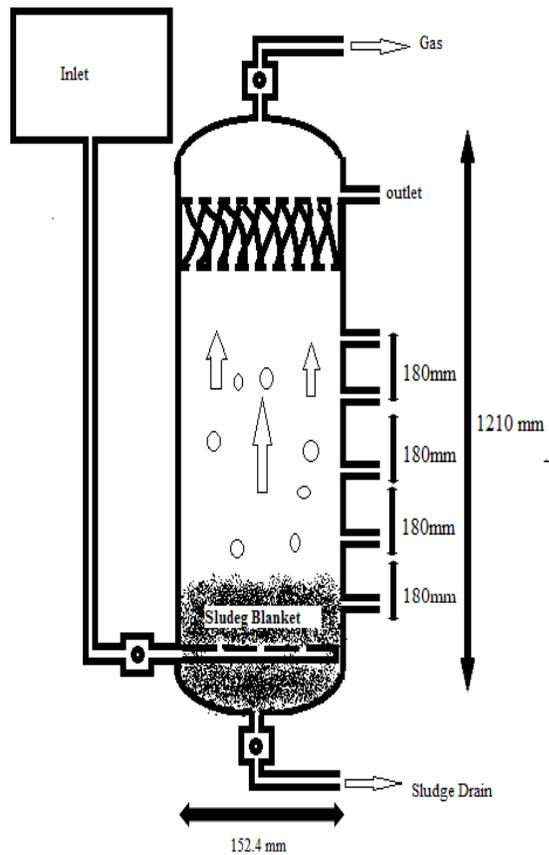
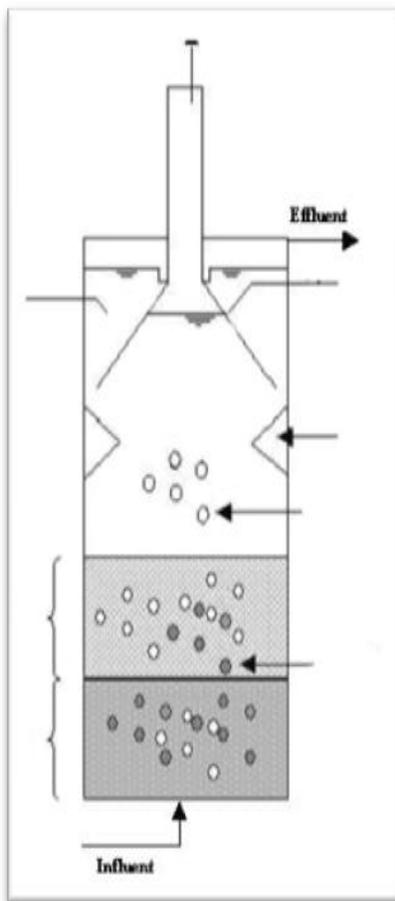
**Table 5b** Result of 1<sup>st</sup> Continuous System

COD mg/L	% Removal	BOD mg/L	pH	TSS mg/l	Gas m3/d
21578	64.86	7375.8	7.12	4985	0.022
21456	65.06	7305.09	7.45	5000	0.022
22645	63.12	7785.92	7.3	4851	0.022
21815.3	64.47	7400	7.01	4955	0.022
20476.2	66.65	6905	6.98	5123	0.023
20112	67.25	6875	7.2	5168	0.023
19548.2	68.17	6649	7.15	5239	0.023
20145.5	67.19	6875.17	7.03	5164	0.023
18478	69.91	6208	7.08	5373	0.024
18541.1	69.81	6310.8	7.06	5365	0.024

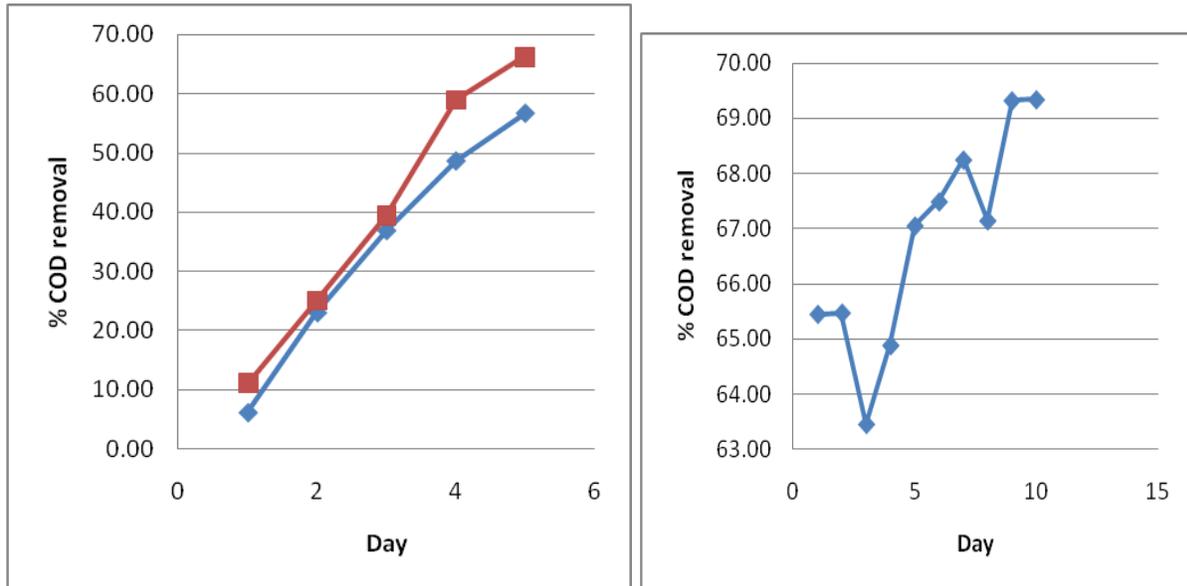
**Table.5c** Result of 1<sup>st</sup> Continuous System

COD mg/L	% Removal	BOD mg/L	pH	TSS mg/l	Gas m3/d
18595	69.72	6330	6.99	5358	0.024
17995	70.69	3125	6.85	5433	0.024
17585.3	71.36	5975	6.82	5485	0.025
18566	69.76	6330	6.78	5362	0.024
18783.3	69.41	6380	6.66	5335	0.024
19225	68.69	6542	6.72	5279	0.024
18124.2	70.48	6158	6.8	5417	0.024
18535	69.82	6305.7	6.75	5366	0.024
18825.2	69.34	64010	6.7	5330	0.024
18956.6	69.13	6420	6.72	5313	0.024

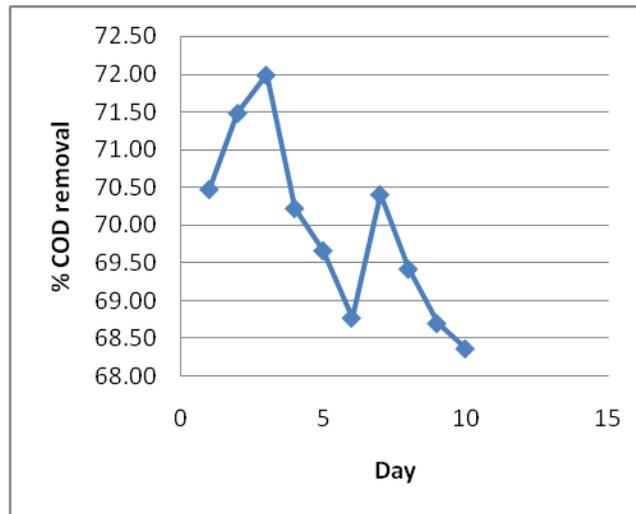
**Fig.1&2** UASB reactor & The sketch of lab scale hybrid UASB Reactor



**Fig.3&4** Reduction of COD in 1st& 2nd recycle & Reduction of COD in 1st Continuous system



**Fig.5** Reduction of COD in 2nd Continuous system



It is diminished most extreme to 5975 mg/L from normal in familiar BOD 19000 mg/L. Alkalinity of the emanating water is diminished to 35000 mg/l normal to 10935 at greatest. Here TSS and VSS is expanding from 300 mg/L and 362 mg/L to 5355 mg/L and 4444 mg/L at greatest dimension. The underlying pH of the influent was normal 8.5, and the last gushing pH was diminished to

6.9. There was a truly ideal difference in the pH after the organic response.

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