

TREATMENT OF SUGAR INDUSTRY WASTEWATER BY HYBRID REACTOR

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Abstract - Water is one of the most important elements involved in the creation and development of healthy life. Since water is such a vital resource for survival of both plants and animals, it is our responsibility to manage this resource, not only as a social, industrial and commercial good but also for the sustainable benefit of all present and future living matter.

The results presented in this paper are from studies on a laboratory-scale Hybrid reactor treating sugar industry wastewater at different HRTs. The experiments were performed at hydraulic retention times of 6, 12, 24, 48, 72 hrs based on empty reactor volume 28lts, and the performance of the reactor was evaluated based on the removal of COD, BOD, TS, TDS, TSS and pH. The average initial values COD and BOD were, 5000 mg/L and 2300 mg/L respectively and pH value changes from 6.2 to 7.2 with 56% of treatment. This paper intends to provide an overall vision of the multi-media filter technology an alternative method for treating wastewater.

Keywords: BOD (Bio Chemical Oxygen Demand), COD (Chemical Oxygen Demand), HRT (Hydraulic Retention Time), Filter media.

1. INTRODUCTION

In India Sugar are an essential item of mass consumption and the cheapest source of energy, supplying around 10% of the daily calorie intake.

Sugar industries development is backbone to economic development of the nation. In India, Sugar industry is the second largest agricultural-based industry and it contributes significantly to the socio-economic development of the nation. Sugarcane is the key raw material for the producing of sugar in India. Two different raw materials sugarcane and beet are the extracted from the sugar; both produce identical refined sugar. Sugar growing in semi-tropical region is two-third of world sugar production. The balance the one third of beet is grown in temperate climate.

The Indian sugar industry producing more than 15% of the world sugar production in last 5 years. India had 380 sugar factories as on January 31, 2015. These factories highly concentrated on rural areas of the nation. Co-operative societies are promoted by sugarcane farmers 50% of the sugar factories.

Factors determining sugar production in India:

- Area under sugarcane production (Max. acreage of 4.43 million hectare)
- Sugarcane yield per hectare (Max. yield of 71.3 tons per hectare)
- The production of sugarcane that is crushed by sugar factories in relation to the total sugarcane production (Max. drawl percentage = 69%)

When all the above parameters are concurrently at the peak, India's sugar production will aggregate to 22.85 million tones. Out of that 328 sugar factories have distillery facility, while remaining 210 have own co-generation power plants. Sugarcane produces 300-350 MMT, white sugar 34-36 MMT and 6-8 MMT jaggery and khandasari per annum in India for fulfill the demand of the sugar users. The ISI producing 2,300 Mega Watt (MW) power, around 2,700 million liters of alcohol and other allied products. The Indian sugar market exports around 1,000 of power to grid after convening its captive power necessarily. Sugar industry is also involved to make avail of sugar complexes by manufacturing sugar, bio-electricity, bio-ethanol, bio-manure and chemical. These contribute about 1 per cent to National GDP. The major sugar producing states are Maharashtra, Uttar Pradesh and Karnataka in India.

1.1 Statements of Problems:

In India, sugar industry is one of the major Agriculturally based industries. Treatment and safe disposal of sugar industry wastewater has been causing of concern for many decades because of its high pollution potential.

The sugar industry effluent contains high Chemical oxygen demand. The typical Chemical oxygen demand (COD) of 5000 mg/L and High BOD. Considering all the problems a low-cost efficient treatment is essential for sugar industry.

2. OBJECTIVES:

- Treatment of sugar industry wastewater by hybrid reactor
- To study the hybrid reactor for treatment of sugar industrial wastewater.
- To study the variation of COD with respect to different HRT.

- To study the variation of BOD with respect to different HRT.
- To study the variation of TS with respect to different HRT.
- To study the variation of pH during treatment period with respect to HRT.
- To get the optimum HRT.

Table 2.1: CHARACTERISTICS OF SUGAR INDUSTRY WASTEWATER.

Characteristics	Values
COD	600-4380mg/L
BOD	300-2000mg/L
TS	870-3500mg/L
pH	4.6-7.1

3. MATERIAL AND METHODOLOGY

Hybrid reactor is a combination of two reactors. Wastewater treatment by hybrid reactor system has become wide spread has it provides advantage of both the suspended and attach growth phase at the same time it may used to treat some rate limiting substrate, priority pollutants, volatile organic compound etc. as well as nitrification.

Here Aerobic hybrid reactor a combination of baffle wall reactor and trickling filter has been deigned. Hybrid reactor is made of Acrylic sheet 5mm thick and PVC pipes 1/2" diameter.

3.1 BAFFLE WALL REACTOR

Baffle wall reactor consists of compartments which baffled to force the in-corning wastewater up through a series of sludge blankets, thereby minimizing the loss of biomass. In this reactor one baffle wall has been provided inside the reactor to make two separate chambers. Baffle wall has been provided for stabilizing an Aerobic batch reactor during the start-up period and to eliminate shock loading regimes would lead to harsh conditions in the initial compartments of the reactor and to provide sufficient substrate for the aerobic bacteria in the final compartments of the reactor.

3.2 TRICKLING FILTERS

Trickling filters are conventional aerobic biological wastewater treatment units, such as active sludge or rotating biological contractors. The advantage of all these systems is that they are compact (i.e. applicable in densely populated urban settings) and that they efficiently reduce organic matter however, they are high-tech and generally requires skill staff for construction as well as for operation.

Trickling filters are a secondary treatment after a primary setting process (see also septic tank or pre-treatment).

The trickling filter consists of a tank and is filled with a high specific surface area material, such as rocks, gravels, shredded PVC bottles, or special pre-formed plastic filter media. A high specific surface provides a large area for biofilm formation. Organisms that grown in the thin biofilm over the surface of the media oxidize the organic load in the wastewater to carbon dioxide and water, while generating new biomass. This happens mainly in the outer part of slim layer. The incoming pre-treated wastewater is 'trickled' over the filter, e.g., with the use of the rotating sprinkler. In this way, the filter media goes through cycles of being dosed and exposed to air. However, oxygen is depleted within the biomass and the inner layer may be aerobic or anaerobic.

Table 3.3: DETAILS OF HYBRID REACTOR

SL.NO	PARAMETERS	DETAILS
1	Total height of reactor	70cm
2	Width of reactor	20cm
3	Volume of reactor	28Liters
4	Baffle wall	At 5cm
5	Type of filter media in baffle wall	Plastic beads
6	Specific gravity of Plastic beads	0.858
7	Height of trickling filter	35cm
8	Type of filter media in trickling filter	Pal rings 2.2cm diameter
9	Depth of collecting tank	5cm

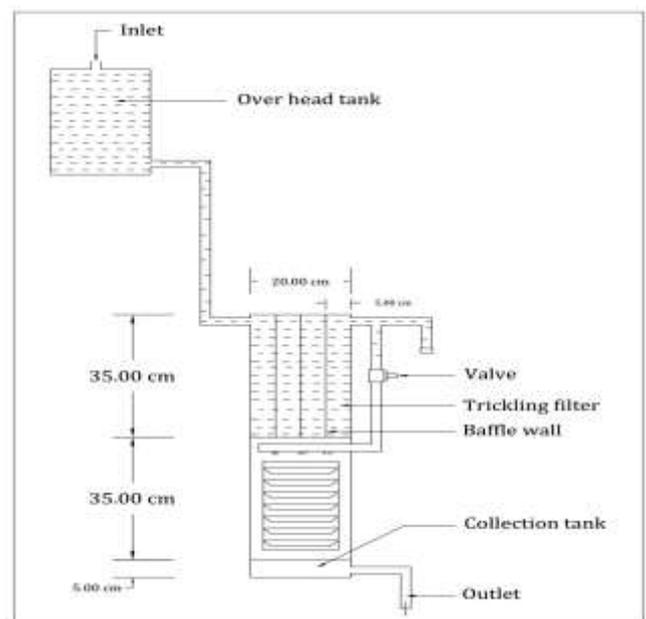


Fig 3.4: Schematic Diagram of Hybrid Reactor

4. RESULTS

The results obtained revealed that, at 24hrs HRT there is effectively Reduction in COD, BOD, TS and TSS and increment in pH value.

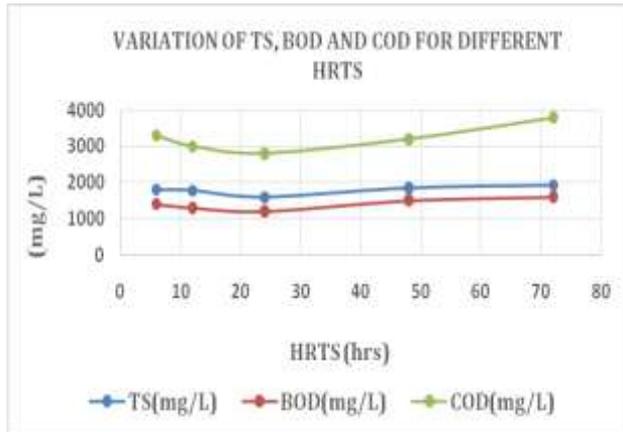


Chart 4.1: Variation of COD, BOD and TS for different HRT.

- The reactor was started at 72hrs HRT initially, the initial TS of wastewater fed into the reactor was 1925mg/L, when the HRT of the reactor was reduced from 72 to 48, 24, 12 and 6. The observed TS of treated wastewater was 1850mg/L, 1600mg/L, 1780mg/L and 1800mg/L respectively.
- The reactor was started at 72hrs HRT initially, the initial BOD of wastewater fed into the reactor was 1600mg/L, when the HRT of the reactor was reduced from 72 to 48, 24, 12 and 6 hrs. The observed BOD was 1500mg/L, 1200mg/L, 1300mg/L and 1400mg/L respectively.
- The reactor was started at 72hrs HRT initially, the initial COD of wastewater fed into the reactor was 3800mg/L, when the HRT of the reactor was reduced from 72 to 48, 24, 12 and 6. The observed COD was 3200mg/L, 2800mg/L, 3000mg/L and 3300mg/L respectively.

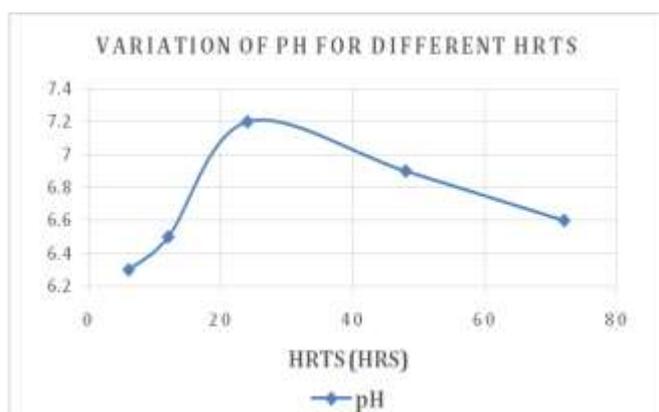


Chart 4.2: Variation of pH for different HRT.

- The reactor was started at 72hrs HRT initially, the initial pH of wastewater fed into the reactor was 6.6, when the HRT of the reactor was reduced from 72 to 48, 24, 12 and 6. The observed pH was 6.9, 7.2, 6.5 and 6.3 respectively.

5. CONCLUSIONS AND SCOPE FOR FUTURE.

5.1 CONCLUSIONS:

The industrial wastewater was treated itself repeatedly in hybrid reactor, which involves simple reliable biological process. The hybrid reactor had sufficient reduction in the velocity of the flow, sufficient air circulation naturally. Handling of excess sludge is not a problem because the amount of sludge produced / in fed is small. Therefore, method of industrial wastewater treatment with respect to removal of COD.

1. From our results we have observed that the COD is reduced from 5000mg/L to 2800mg/L at 24 hrs HRT, the BOD is reduced from 2300mg/L to 1200mg/L at 24 hrs HRT, the TS was increased to 1600mg/L and the pH is increased to 7.2 at 24 hrs HRT, hence the optimum HRT of the hybrid reactor is 24 hrs.
2. The efficiency of the hybrid reactor is about 56%.
3. Hence the sugar industry wastewater can be efficiently treated by Hybrid reactor

5.2 SCOPE FOR FUTURE STUDY

1. By changing the filter media used.
2. By varying the depth of filter media.
3. By varying the concentration of loading.
4. Varying the HRT.
5. Varying the dimension of the reactor.

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BIOGRAPHIES



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