



# **BIOGAS GENERATION FROM DISTILLERY WATER BY USING HYBRID REACTOR**

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## **ABSTRACT**

**The Indian distillery units use sugarcane molasses as a preferred raw material because of its easy and large scale availability for alcohol production. In this paper to describing the hybrid reactor in the anaerobic treatment process of distillery water for generation of biogas has been studied. In this process is very useful for biogas production and less amount of sludge production. The distillery water are should to be characterized the basic parameters like  $p^H$ , Temperature, BOD, COD and total solids. The hybrid reactor is the best one such an anaerobic system it treats the distillery water having higher organic content to achieve a gas in a short time period. The total volume of the reactor is 4.791 liters. The working volume of the reactor is 4.241 liters. The gas escape valve and other probes are provided properly. The distillery sludge is also used for nutrient of the reactor. The distillery water was evaluated for both suspended and attached growth process by Hybrid reactor. The startup period of the reactor is 25 days. The reactor was designed and fabricated by using PVC pipe. The main objective of this paper is to reduce BOD and COD content in the distillery water. The above concept is mainly used for treating the water, generating biogas and it can be also reused for agricultural purposes.**

**Keywords: Hybrid reactor, Distillery water, Chemical oxygen demand, Biological oxygen Demand, Biogas**

## **Introduction**

Distilleries are one of the 17 most polluting industries listed by the Central Pollution Control Board (CPCB) of India (CPCB, 2003). The distillery industries are categorized by 'Red category' by the Ministry of Environment and forests (MoEF), Government of India. Indian distilleries employ various forms of primary, secondary and tertiary treatments of wastewater. There are about 579 sugar mills and 325 distilleries in India. Currently, about 45.72 million  $m^3$  of spent wash is generated annually from distilleries alone in India. The production and characteristics of spent wash are highly variable and dependent on feed stocks and various aspects of the ethanol production process. The spent wash is acidic, dark brown liquid with high BOD and COD and emits obnoxious odor. Although it does not contain toxic substances, its discharge without any treatment brings about immediate discoloration and depletion of dissolved oxygen in the receiving water streams, posing serious threat to the aquatic flora and fauna. Membrane based separation processes like Ultra filtration (UF), Nano filtration (NF), Reverse osmosis (RO) and membrane Bioreactor (MBR) have been applied for treating distillery effluent. The typical treatment sequence is screening and equalization, followed by bio-methanation, fertilization and Irrigation and biocomposting with sugarcane press mud are the most widely used options for effluent disposal. However,

these methods are highly energy intensive and hence quite expensive. These disadvantages emphasized the need for further research using novel separation methods.

**Effect of distillery waste water on environment**

First, the highly colored nature of distillery water can block out sunlight from rivers and streams, thus reducing oxygenation of the water by photosynthesis and hence becomes Problem to aquatic life.

Secondly, it has a high pollution load which would result in eutrophication of contaminated water sources.

**Need for distillery water treatment**

To prevent,

- Water pollution
- Water scarcity
- Air pollution
- Field level impact
- Impact on soil health
- Solid waste management

**Biogas**

At present our country is facing various problems which become more serious in next coming years. Demand of petroleum products is increasing, India has spending a big budget for importing these products and on the other hand our country faces serious problems like environmental pollution, disturbance in weather and global warming. The two main products of the biogas plants are enriched compost manure and methane where as compost manure helps to meet the fertilizer requirements of the farmers in a more economical and efficient manner and boost agricultural production. Biogas is used for cooking and lighting purposes and in larger plants, as motive power for driving small engines. Few years back KVIC and other agencies related to installation of bio gas plant installed two types of Biogas plant one was fixed dome and second was floating dome.

**Composition of biogas**

- Methane gas (CH<sub>4</sub>) - 50 to 75%
- Carbon dioxide (CO<sub>2</sub>) - 25 to 50%

- Nitrogen (N<sub>2</sub>) - 0 to 10 %
- Oxygen (O<sub>2</sub>) - 0 to 0.5%
- Hydrogen (H<sub>2</sub>) - 0 to 1%
- Hydrogen sulfide (H<sub>2</sub>S)- 0 to 3%

**Anaerobic treatment system**

Anaerobic treatment system is a collection of process in which the microorganisms break down the organic material by the absence of oxygen. It is widely used for the source of renewable energy. This process is producing the product of a biogas.

Comparison of aerobic and anaerobic treatment systems,

SL.NO.	Aerobic System	Anaerobic system
1.	Presence of oxygen	Absence of oxygen
2.	Absence of carbon dioxide	Presence of carbon dioxide
3.	Loss of electrons	Gain of electrons
4.	Sludge production is high	Sludge production is low
5.	Required energy is low	Required energy is high

**Objectives of the study**

- To review the existing literature regarding biogas production.
- To treat the distillery waste water and to give a solution for its disposal.
- To analyze the amount of biogas produced in the hybrid reactor.
- To utilize the biogas produced in the industrial treatment process in order to reduce the energy consumption.

**Hybrid Reactor**

Hybrid reactor is an anaerobic system which its combines an UASB and a packing media. This combination is gives better solid retention time in the treatment of distillery water. The packing media is also act as filtering of a gas. The packing

media was fixed as the top of the reactor. In this reactor is containing both suspended and attached growth process.

Advantages of the reactor:

- Bio mass developed in the packing media.
- It improves the stability of biomass.
- Packing media is also used for GLS separator.

## Materials and methods

### Wastewater Collection

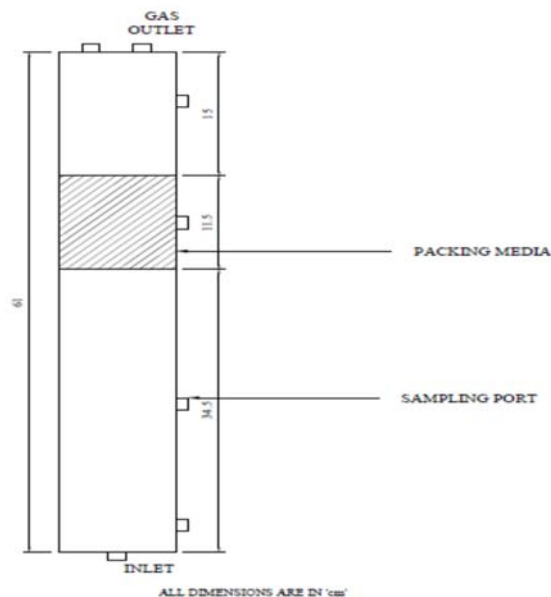
The untreated distillery water and distillery sludge is collected from sugar industry. The collected sample was taken in plastic cans and is stored at 4°C in a deep freezer.

### Seeding sludge

The distillery sludge was also collected from the sugar industry. This was used as inoculum of the reactor. The distillery sludge was taken by the middle of the aeration tank. This sludge is had more number of bacteria. These bacteria are helpful to achieve gas in a short time period.

### Experimental set up

The lab scale hybrid reactor was fabricated by using PVC pipe with an internal diameter 10 cm and its overall height of 61cm. The bottom and top of the reactor was attached by 12cm dummy. Total volume of the reactor is 4.790 Litre and its working volume is 4.241 Lit. The top of the reactor was filled with pleated PVC spiral rings. These rings are act as a packing media of the reactor. The sampling ports were located at proper intervals. The reactor was manufactured by three parts. These parts are connected by using the flange and half inch bolts. The reactor was finally coated by fiber reinforced plastic resins.



Hybrid reactor

### Inlet and outlet distribution system

The 15 mm diameter plastic check valve is provided for inlet and outlet distribution system. At the bottom, the feed inlet pipe of 15mm diameter was provided which is connected to peristaltic pump, through 1/2inch check valve and nylon tubing arrangement, for pumping the feed.

### Sampling ports

There are three no's of sampling ports was fixed within the reactor. The sampling ports are also having 15 mm diameter. It is useful for identifying the sludge concentration profile.

### Packing media

The packing media was provided at the top of the reactor. The packing media have an 11.5 cm height. It is fixed 15 cm at the top of the reactor. There are 82 no's of the pleated PVC spiral rings are used for packing media of the reactor.



Packing Media

### Gas collection setup

The gas is collected through the opening is provided at the top of the reactor. The amount of gas is displaced from the mad rid bottle by using the pinch sodium chloride in the distilled water. This collected gas was measured by using water displacement method.

### Start up of the reactor

Initially the reactor was filled with 400ml of distillery sludge and 1600 ml of distillery water (i.e. 1:4 ratio). After 25 days the remaining volume is filled with distillery water in the reactor. Here, the distillery sludge is used for the inoculum of the hybrid reactor. Both distillery water and distillery sludge are filtered by using a cheese cloth.



### Operation and Monitoring

The reactor was operated by different flow rates. The  $P^H$  of the sample is always maintained properly. The  $P^H$  range was found in the reactor 7.5 to 8.5

### Results

The untreated distillery water and distillery sludge was collected from the sugar industry. From this study results shows that the following basic parameters were tested and their ranges tabulated as follows,

### Characteristics of distillery water

From this results shows that the basic characteristics of distillery water,

S.no.	Parameter	Ranges (mg/l)
1.	pH	3.7*
2.	COD (mg/l)	1,22,400
3.	BOD(mg/l)	42,300
4.	TS(mg/l)	1510
5.	TDS(mg/l)	78,500
6.	TSS(mg/l)	1540
7.	Sulphates	3570
8.	Chlorides	7250
9.	Colour	Dark Brown

\*Value indicates on pH Scale

### Characteristics of distillery sludge

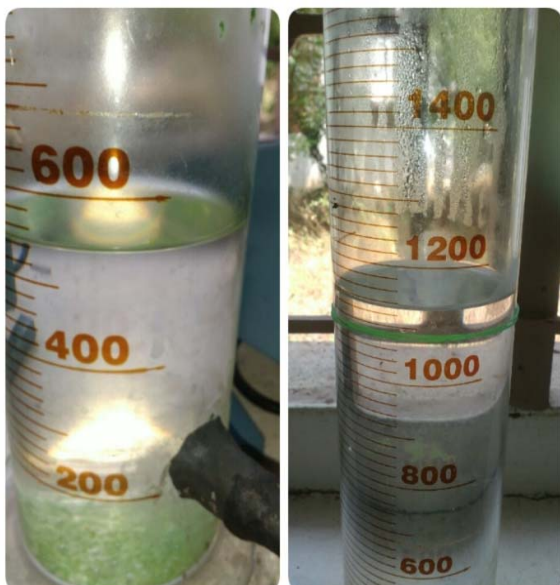
From this results shows that the basic characteristics of distillery sludge,

S.no	Parameters	Values(mg/l)
1.	pH*	5.4
2.	TS	107600
3.	VS	55400
4.	TSS	8510
5.	TDS	98520

All the values are in mg/lit except  $P^H$

### Gas production

The amount of gas production is measured by using water displacement jar. The figure shows the initial and final water level in the displacement jar. The increasing water level derives the volume of gas production.



**Intial and final water level**

### Discussion

The characterization of untreated distillery water, distillery sludge and reactor were studied. The distillery wastewater collected from sugar industry is tested for its physical and chemical characteristics. The anaerobic reactor for treating the wastewater is studied and found out that hybrid reactor is best suited for distillery wastewater treatment and cost effective too. The hybrid reactor is designed for its inlet and outlet arrangements, gas outlet, and other components. The project has started up with in the distillery sludge. The BOD and COD content should to be reduced. The anaerobic digestion which takes long time for reacting the steady state condition and its gas production.

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