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PERFORMANCE OF HYBRID UP-FLOW ANAEROBIC SLUDGE BLANKET REACTOR FOR THE TREATMENT OF SUGAR MILL WASTEWATER

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Abstract - *Energy, an urging need of the daily life is going on depleting while the demand for is increasing with time. Biogas technology provides an alternative source of energy and hails as an archetypal appropriate technology that meets the basic need for cooking fuel in Rural India. The laboratory scale HUASB reactor was fabricated with a height of 61cm having a working volume of 4.24liters, which is operated at ambient temperature. The packing media used in this reactor was pleated PVC rings, which were filled in the top one-third of the HUASB reactor. Initially the reactor is in start-up phase, it has been loaded with 1 liter of enriched seed sludge. Remaining volume is periodically feed with sugar mill wastewater, the initial characteristics of sugar mill wastewater were studied. The laboratory scale HUASB reactor was designed and fabricated and gas collections are noted.*

Key Words: HUASB reactor, sugar mill wastewater, Seed sludge, Biogas.

1. INTRODUCTION

Sugar mills are associated with effluent characterized by biological oxygen demand and suspended solids, the effluent is high in ammonium content. India is the largest producer of sugar in the world and per capita consumption of sugar in the country is 13.4/kilograms per annum, there are about 500 operating sugar mills, located mainly in the state of Uttar Pradesh, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu. Our inland waters have become polluted mostly due to industrial growth, urbanization and unlimited exploitation of nature by various activities of human beings. Such, chemical pollution of surface water can create health risks, because these waterways are often used directly as drinking water sources or connected with shallow wells used for drinking water, in addition waterways have important roles for washing and cleaning, for fishing and fish farming and for recreation.

Such harmful chemicals may enter waterways from a point source or a non-point source, former type of pollution is due to discharges from a single source; such as an industrial site while later type of pollution involves many small sources that combine to cause significant pollution. Sugar mills consume around 1,500-2,000 litres of water and generate about 1,000 litres of wastewater for per tonne of cane crushed. The effluent is mainly floor washing wastewater and condensate water, leakage in valves and glands of the pipeline add sugarcane juice, syrup and molasses in the effluent.

The sugar mill effluent has a BOD of 1,000-1,500mg/litre, but appears relatively clean initially however after stagnating for sometimes it turns black and start emitting foul odour. If untreated effluent is discharged in water courses, it depletes dissolved oxygen in water and makes the environment unfit for aquatic life. If untreated effluent is discharged on land, decaying organic solids, oil and grease clog the soil pores.

BIOGAS

At present our country is facing various kinds of problems which become more serious in next up coming years. Demand of petroleum and its products is increasing every year. India has spending a large amount of budget for every year these products. On the other hand our country faces severe problems like environmental and its pollution, disturbance in climatic condition, global warming and ozone layer depletion.

Generally, India is an agriculture-based country and there is an availability of resources. But these sources are not to be properly used and commercialized. In spite of all the technologies and developments are available yet the rural people facing the shortage of energy. The prime challenge for our country is to provide the minimum energy services to allow the village area peoples to achieve decent standards of living.

The biogas plant is an important boon to the Indian farmers. The two main products of the biogas plants are containing enriched compost manure and methane whereas compost manure helps to meet the fertilizer requirements of the farmers. It is more economical and efficient manner and boost agricultural yields. Biogas is generally used for cooking and lighting purposes and in bigger plants. The biogas is also used for the motive power for driving small engines.

Indian government has been installed gobar gas plants in the year 1980.Which are approximately 12, 00,000 small, 3, 40,000 medium, and 4,500 big gobar gas plant. If 2,000 gobar gas plants of 120 m3 has been installed then approximately 6852 Lakhs Rupees. We can save of diesel or petrol products for some purposes. But, this project is failed in past few years, nobody have to think that why this project is failed.

Few years before KVIC and other agencies related to installed of gobar gas plants. The gobar gas plants are installed by two different types. One was fixed dome type and another one was floating dome type. Fixed dome type digester was covered by concrete with a gas holder. While

floating dome type digester was made up of metal (iron) sheets with a gas holder. Fixed dome type digesters require one month for installation process. After sometimes these types of digesters faced more problems of scum deposition on the upper surface layer which cannot be removed easily, ultimately biogas production should be affected. In these plants are requiring a high amount of maintenance cost for removing the scum. On the other hand floating type gas holder (metal sheet) was corroded due to contact with water and hydrogen sulphide. Because it containing a metal sheet.

Second problem was that at the time feeding small amounts of mud particles was present within the feed, gradually this mud deposited in the bottom portion of the digester. Due to these problems causes digestion and gas formation of the reactor. Following problems are keeping in mind, we designed a small amount of cost, easy to install and quick to install, durable, easy to manage and anticorrosive type of biogas plant.

In case of mercantile biogas plants, the digester is huge as its diameter may reach 25 to 30 meters. Therefore, the concrete structure should be reinforced. Hence, the iron rods are mainly used to build two iron grids to reinforcing the digester wall starting from the digester at bottom of the plate. The standard length of iron rods are 12m to 15 m. The standard iron rods are cut to smaller iron rods, and they are used to build up the tank. Subsequently, either wood panels or pre-constructed metal sheets are widely used to enclosing the iron grids and to form a container for fluids in concrete.

When the digester wall is to be constructing, about one third of the internal wall of the tank is covered by a protection layer in order to protecting the internal face of the wall against corrosion.

In case of household units, burnt clay type bricks are used to building the digester and they should to be able to tolerating the amount of pressure up to 100.00 kg cm-2 owing to the fact that the walls of the digester which are exposed to the soil pressure and the equipment nearby placed to the digester. A mortar of cement and sand mixture containing the ratio 1:4 is used. The constructions works are mainly depending on the appropriate height, and the entry or exist holes of the pipes are blocked by a filling material.

Anaerobic digestion process stages

The anaerobic digestion process will be produced by four different important stages. The process are hydrolysis, acidogenesis, acetogenesis and methanogenesis. The overall process can be briefly described by under the chemical reaction of the reactor, where the organic substance such as glucose is digested into carbon dioxide (CO2) and methane (CH4) by the presence of anaerobic microorganisms.

$$C6H12O6 \rightarrow 3CO2 + 3CH4$$

Hydrolysis

The complex organic compounds of a high amount molecular mass are first hydrolysed into low molecular compounds suitable to be used as a source of energy and cell carbon by the microorganisms. This is carried out by enzyme moderated transformations. The biomass is made up of large amount of organic polymers. For the bacteria in the anaerobic digesters to admitting the energy potential of the material, these chains must first be break down into their smaller parts.

These constituent parts or monomers, such as sucrose, are easily available to other different types of bacteria. The process of breaking this organic matter and dissolving the smaller molecules into solution is called as hydrolysis process. Therefore, hydrolysis process containing high amount of molecular components is the necessary first step in anaerobic digestion. Through hydrolysis is the complex organic molecules that are break down into simple sugars, amino and fatty acids. Acetate and hydrogen are mostly produced in the first stages of biogas production. It can be used directly by methanogenesis phase. Other molecules, such as volatile fatty acids (VFAs) of acetate must first be catabolised into compounds that can be directly used by methanogenesis bacteria.

Acidogenesis

Low molecular compounds resulting from hydrolysis are converted by fermentation into identifiable intermediate volatile acids like acidic, propionic and fatty acids by the facultative and anaerobic bacteria are called as acid formers. In this step, very little stabilization of BOD or COD is realized. It is resulting in the breakdown of the remaining compound by fermentative bacteria. This process is generally followed by milk sours.

Acetogenesis

The third stage process is acetogenesis. Here, simple molecules are created through the acidogenesis phase and that are further digested by acetogens to producing a large amount of acetic acid. It contains carbon dioxide and hydrogen.

Methanogenesis

The intermediate acid compounds formed by acid formers are converted to simpler end products like CO2 and CH4 through stabilization by strictly anaerobic bacteria generally known as methane formers.

These methane forming bacteria are most sensitive to environmental conditions like temperature and pH than the acid formers. Therefore, methane formation is usually the rate controlling step in this process. Also, the rule stabilization of organic materials occurs in this step. Methanogenesis is sensitive to both high and low pH and occurs between pH 6.5 and pH 8.

2. MATERIALS & METHODOLOGY

Characteristics of waste water

Some of the generalized parameters are to be tested to determine the performance and evaluation of sugar mill effluent treatment plant. Sampling is one of the most important procedure and important steps in the collection of wastewater sample from the effluent discharged to the treatment plant. The laboratory analysis and tests depends upon the sampling methods. The factor involved in the proper selection of sampling site is generally depends on the objective of the study. The volume of sample between 2 and 3 liters is normally sufficient for a complete analysis. The total number of samples will depends on the objectives of the monitoring process. During this study, the samples were collected in clean polyethylene containers.

HUASB Reactor

HUASB 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 sugarcane wastewater. 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. In this reactor the biomass is developed in the packing media. This packing media is improves the stability of biomass in the reactor and it also acts as a GLS separator.

Gas collection set up

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 HUASB reactor

Initially the reactor was filled with 1 litre of seed sludge. Start-up of the reactor is in initial phase, since it is an anaerobic digestion process which takes long time for reaction the steady state condition and gas production. After the remaining volume is filled with sugar mill wastewater in the reactor. Here, the seed sludge is used for the inoculum of the HUASB reactor.

Both sugar mill wastewater and seed sludge are filtered by using cheese cloth. seed sludge is mixed with water and it is filtered by using cheese filter. The filtered seed sludge is then feed into the HUASB reactor. The filtered sludge in order to avoiding obstacles in the reactor during reaction.

Operation and monitoring

The operation and monitoring was done in order to finding the HUASB reactor. The reactor was operated in continuous mode for different types of flow rates per day. The pH of the HUASB reactor is always maintained properly by adding required solutions.

3. RESULTS AND DISCUSSION

General

From this study, it is found that the sugar mill wastewater is having high content of BOD and COD. To reduce this content the water is tested for its preliminary parameters.

Characteristics of sugar mill wastewater

The sugar mill wastewater is tested for its basic parameters like pH, COD, BOD, TSS and TDS. From this study the results are shown in below:

Table 1: Characteristics of Sugar mill wastewater

S.NO.	PARAMETER	RANGES (mg/l)
1.	pH*	4.4
2.	COD	4850
3.	BOD	1715
4.	TS	2900
5.	TDS	2150
6.	TSS	750
7.	Colour(Hazen unit)	Dark Brown

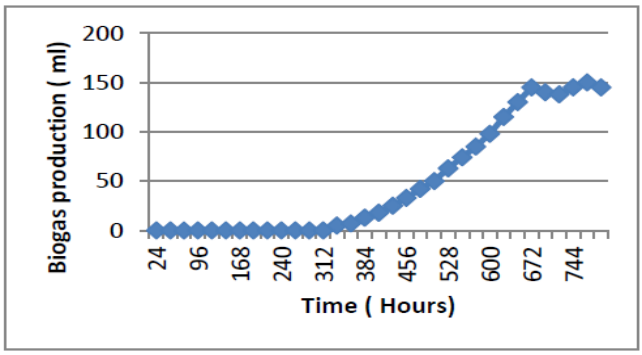

Fig.1: Biogas production

In the above graph is discussed about the rate of biogas production. The graph is plotted between Time (hours) and biogas production in HUASB (ml). The maximum amount of biogas produced in the time of 768 hours. The initial gas production in the reactor should be start-up at the time of 336 hours.

4. CONCLUSION

The characterization of sugar mill wastewater and it sludge were studied. The sugar mill wastewater collected and tested for its physical and chemical characteristics. The anaerobic reactor for treating the wastewater is studied and found out that HUASB reactor is best suited for sugar mill wastewater treatment and cost effective too. The HUASB reactor is designed for its inlet and outlet arrangements, gas outlet, and other components. The project has started up

with the sugar mill sludge. It was also characterized basic parameters. The initial gas production should be done during in this phase.

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