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EXPERIMENTAL INVESTIGATION ON COAGULANTS BY USING UPFLOW ANAEROBIC SLUDGE BLANKET REACTOR

S.Devendran[1], K. Aarthi[2], Pon.Chandrakumari[3], R.Ishwarya ravindrapatil [4], N. Madhumitha[5]

[1] *Assistant professor, Dept. of Civil Engineering, Vivekanandha college of Technology for women, Tamilnadu, India*
[2,3,4] *UG Students, Dept. of Civil Engineering , Vivekanandha college of Technology for women, Tamilnadu, India*

Abstract - *Now a day's energy is a very essential one, biogas technology provides an alternative source of energy. The technology meets the basic need for cooking fuel in rural India, for producing biogas UASB reactor is used. Up flow anaerobic sludge blanket (UASB) reactor is one such anaerobic system that treats effluents having high organic content. An UASB system is an anaerobic wastewater treatment that produces biogas with low operation cost. The laboratory scale of using UASB reactor was fabricated with a height of 100cm having diameter 12.5cm, the packing media of UASB reactor. Sugar industry wastewater was treated in a UASB reactor seeded with non-granular sludge. Two type of coagulants are used to produce biogas in UASB reactor, the coagulants are chemical and natural coagulants are used. The both coagulants are experimentally investigated by separate UASB reactor. The ambient room temperature during the study period was between 29˚-37˚C. Initially the reactor is in start-up phase, it has been loaded with 1 liter of non-granular sludge. Remaining volume is periodically feed with sugar mill waste water, the initial characteristic of sugar mill wastewater was studied. Successful reactor start-up with granulation was achieved within 21-31 days of operation. The laboratory use of UASB reactor was designed and fabricated and gas collections are noted. The maximum methane content in the biogas was found to be between 73% to 82% at steady state conditions.*

Keywords: *UASB reactor, Sugar industry effluent, Non-granular sludge, coagulants, Biogas*

1. INTRODUCTION

In India, the sugar industry is one of the greatest industries, based on sugar cane. Presently India has nearly 650 sugar mills that produce about 15 million tons of sugar and 13 million tons of molasses annually. The high production of sugar generates high quantity of sugar industry wastes such as effluent, filter mud cake, vinasse, molasses, bagasse and bagasse ash. A few years ago, these by products were consider as a waste and were often disposed of causing environmental problems such as aquatic and terrestrial pollution. Recently it has been recognized that such by products shouldconsideredasausefulmaterial.Theseby products are of great agricultural interest because of their high organic matter, N and K contents and probably other elements Therefore, some of these sugar industries by products may represent an important source of nutrients and thereby could be usedasasubstituteforchemicaland organic fertilizer.

Use of wastewater in agricultural fields may be a viable method of disposal and would sustain agriculture in non- irrigated areas where the available products without paying any cost and rich in various plant nutrients.Although, metals like Cu, Fe, Ni, and Zn and other trace elements are important for proper functioning of biological systems, and their deficiency, or excess could lead to a number of disasters. But long-term irrigation with effluents increases accumulation of metals in soil and plants and increases chances of their entrance in food chain. Contamination of agricultural soils with metals can pose long term environmental problems and is not without health implications.

Biogas

Anaerobic is series of biological processes in which micro- organisms break down biodegradable materials in the absence of oxygen. One of the end products is biogas, which is combusted to generate electricity and heat can be processed into renewable natural gas andtransportation fuel.

Anaerobic Digestion Process Stages

The digestion process begins with the bacterial **hydrolysis** of the input material in soluble material of organic polymers, such as carbohydrates, are broken down to soluble derivatives that becomes available for other bacteria. **Acidogenic** bacteria that convert the sugar and amino acids into carbon dioxide, hydrogen, ammonia, and organic acids. In **acetogenesis**, bacteria convert the resulting organic acids into acetic acid, along with additional ammonia, hydrogen, and carbon dioxide. Finally, **methanogens** convert this product into methane and carbon dioxide.

2. STUDY AREA

In Tamil Nadu (India) there are large number of sugar mill industries are available. Even discharge of sugar mill effluents into natural water bodies without the proper treatment are prohibited by the government and also enforced by law, some industries remove only colour from the effluent using lime process and discharging it into the water bodies without any treatment process for removal of pollutants from the wastewater. Due to these reasons the natural water bodies which are being used as drinking water source are contaminated. The reason behind discharging the wastewater without treatment is because of the cost of treatment process. Sugar mill effluents were collected from a sugar mill industry, using a UASB reactor to produce biogas.

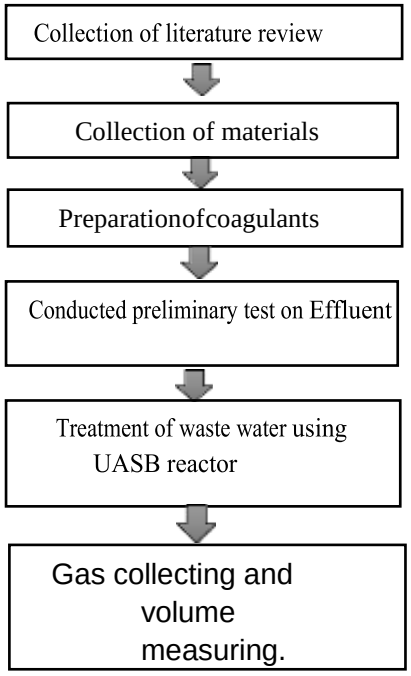
Objectives

- To generation of biogas from sugar mill wastewater using UASB.
- To produce biogas with low operation cost.
- To protect the environment from Air Pollution, Land Pollution and Water Pollution.

Scope

- To convert the waste effluent into useful (Biogas).
- To reduce the high content of BOD and COD.

3. METHODOLOGY



4. ADVERSE EFFECTS ON SUGARMILL EFFLUENTS:

According to the world health organization board, about 80- 90% of all occurrence disease in the world are due to the release of untreated water to the society.

- Sugar factory effluent has an obnoxious odour and unpleasant colour when released into the environment without proper treatment.
- Farmers have been using these effluents for irrigation and found that the growth, yield and soil health were reduced.
- Contaminants such as chloride, sulphate, phosphate, magnesium and nitrate are discharged with the effluent of various industries which create a nuisance due to physical appearance, odour and taste. Such harmful water is injurious to plants, animals and human beings.
- The effects of various industrial effluents on seed germination, growth and yield of crop plants have been captivated the attention of many workers.

5. MATERIALS AND METHOD

Preparation of Coagulants

Natural Coagulants Used

Natural coagulants are a naturally occurred plants-based coagulant that can be used in coagulation-flocculation process of wastewater treatment for reducing turbidity.

- Cow dung
- Cheese
- Poultry waste

Chemical Coagulants Used

Chemical coagulants are an important unit process in water treatment for the removal of turbidity. Its application in water treatment is followed by sedimentation and filtration.

- Sodium Bi Carbonate
- Ammonium Chloride
- Magnesium Sulphate
- Potassium Chloride

UASB Reactor

Up flow anaerobic sludge blanket reactor is one such anaerobic system that treats the effluent having high organic content. The laboratory UASB reactor height is 100cm and diameter is 12.5cm. The reactor was first filled with non- granular sludge. The sludge occupying one by third of the reactor volume. The sludge is used to screening the sugar mill effluent. Due to screening, the large particles are settled

down in the sludge bed, then the sugar mill effluent was slowly fed into the UASB reactor by using the pump. The inlet was provided in bottom of the reactor. In top portion of the reactor the gas collecting setup was provided.

Gas Collection Set Up

The gas was collected from UASB reactor by using mad rid bottle. The bottle was filled with pinch of sodium chloride and distilled water. After collecting the gas, the volume of the gas was determined by using water displacement method.

Water Displacement Method

Gases that are produced in the laboratory experiments are often collected by the technique called Water Displacement Method. A bottle is filled with water and placed upside/down in a pan of water. The reaction flask is filled with rubber tubing which is then fed under the bottle of water. As the gas is produced in the reaction flask, it exists through the rubber tubing and displace the water in the bottle. When the bottle is filled with full of the gas, it can be sealed with a lid. Because the gas is collected over water, it is not pure but is mixed with vapor from the evaporation of the water. Dalton's law can be used to calculate the amount of the desired gas by subtracting the contribution of the water vapor.

Operation and Monitoring

By closely monitoring and maintaining the UASB reactor, the substrate degradations is higher on the initial stage and the most of the substrate is consumed by microorganism of bacteria existing nearby granular surface. The Ph of the UASB reactor was maintained properly by adding required solution.

Characteristic of Sugar Mill Effluent

The sugar industry wastewater is characterized by its brown colour, low pH, high temperature, high BOD, high COD, odor problem, Total solids, and high percentage dissolved organic, sulphate, chloride and inorganic matter. The above general parameter is to be tested to determine the performance and evaluation of sugar mill effluent treatment plant.

6. EXPERIMENTAL METHODS

Determination Of pH

The pH was determined by using pH meter. pH is defined as the negative logarithmic of hydrogen ion concentration. **pH= -log[H+]**. The actual pH of industrial effluent is 6.5-8.5. The obtained pH value of raw sugar mill effluent is **7.12.**

Fig-1: pH meter

Determination of COD

In anaerobic treatment the bacteria convert organic compounds (COD) into biogas in an environment without the oxygen. For determining the COD, the reflux apparatus was used. The standard value of COD for effluent is 250 ppm. The obtained COD of taken effluent is **43 ppm**. Formulae used,

COD in the sample (mg/l) = (A-B) x N x 8000 / ml of sample taken
Where,
A = Volume of FAS used for blank solution. B = Volume of FAS used for blank solution. N = Normality of FAS

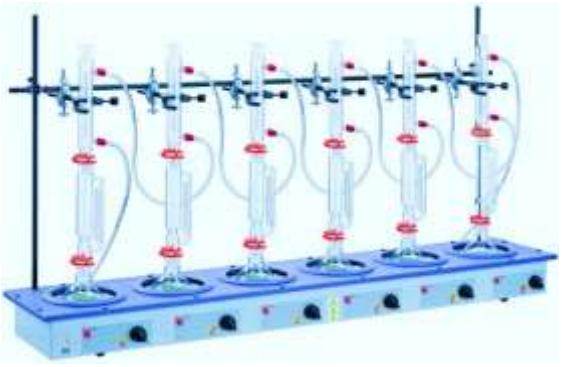


Fig-2: Reflux apparatus

Determination of BOD

Biologically oxygen demand is a measurement of the amount of dissolved oxygen (DO) that is used by aerobic micro organisms when de-composting with organic matter in water. BOD can be measured in real-time with our BOD analyzer to improve waste water process control and plant efficiency. The standard BOD value of sugar mill effluent is 25ppm. The obtained value of BOD is 18ppm. The formulae used to determine the BOD is,

BOD in 5 days = (blank value – titrated value of the sample) 300/ volume of the sample taken

Determination of Total Disolved Solids

Total dissolved solids (TDS) is a measure of the dissolved combined content of all inorganic and organic substance present in a liquid in molecular, ionized, or micro-granular (colloidal solids) suspended form. The standared value of TSD for industrial is 1360ppm. The obtained TSD is 1390 ppm.

Total dissolved solid (mg/l) = (final weight of dish – initial weight of the dish)□(10000□1000 volume of the sample taken)

Determination of Total suspended solids

Total suspended solids(TSS) is the dry weight of suspended particles, that are not dissolved, in a sample of water that can be trapped by a filter that is analyzed by using a filter paper. The standard value of TSS is 650 ppm. The obtained value of TSS is 3340 ppm. The formulae used, Total suspended solids = Total solids – total dissolved Solid

Determination of Total Solids

Total soilds are the sum of the total suspended solids and total dissolvedsolids.

Fig-3: Total solids

Determination of sulphate

Sulphate ions are precipitated with HCl and Barium Chloride. The precipitated Barium Sulphate is filtered and dried,ignitedandweighed as $BaSO_4$. The Sulphate content of natural waters is an important consideration in determining their suitability for public and industrial water supplies. Knowledge of Sulphate content of the sludge or waste fed to digestion units provides a means of estimating the H_2S content of the gas produced.

Determination of chloride

Chloride ion is determined by Mohr's Method. The water sample is titrated with standard Silver Nitrate in which Silver Chloride is precipitated at first. Potassium Chromate is used an indicator. The end of titration is indicated by formation of red Silver Chromate from excess Silver Nitrate.

$$AgNO_3 + Cl \text{----------} > AgCl + NO_3^-$$

$$2AgNO_3 + K_2CrO_4 \text{----------} > Ag_2CrO4 + 2\,KNO_3$$

7. RESULT AND DISCUSSION

Physical, chemical and biological characteristics of sugar mill industry waste water are evaluated before and after treatment of UASB Reactor by using natural and chemical coagulants. From the study, it is found that the sugar mill wastewater is having the content of BOD and COD. To reduce this content the water is tested for its preliminary parameters. `

Table - 1: Characteristics of sugar mill waste water in UASB Reactor after producing biogas–using chemical coagulants.

S.NO	parameters	Ranges
1	pH	7.12
2	COD	1562mg/l
3	BOD	735.36mg/l
4	TS	2010 mg/l
5	TDS	1360mg/l
6	DSS	650mg/l
7	Color	Dark brown
8	Sulphate	432mh/l
9	chloride	182mh/l
10	DO	1025mh/l

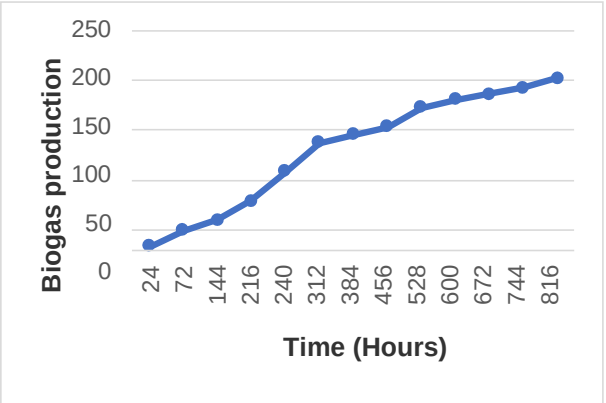


Chart-1: Biogas production

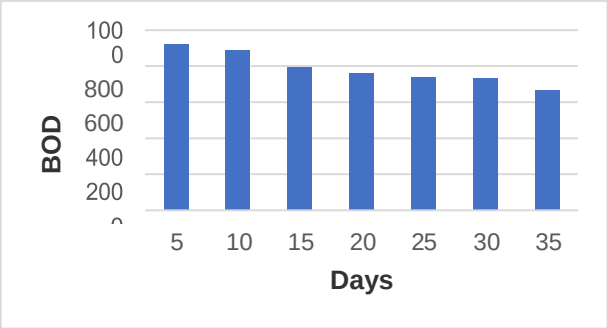


Chart -2: BOD Rating

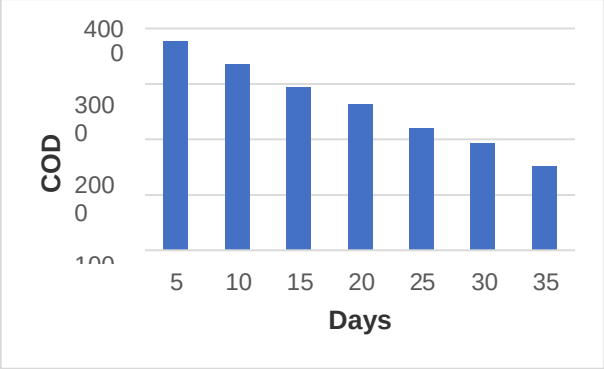


Chart -3: COD Rating

Table - 2: Characteristics of sugar mill waste water in UASB Reactor after producing biogas – using natural coagulants.

S.NO	parameters	Stage
1	pH	7.12
2	COD	1512 mg/l
3	BOD	727.82 mg/l
4	TS	1956 mg/l
5	TDS	1256 mg/l
6	DSS	563 mg/l
7	Color	Dark brown
8	Sulphate	427 mg/l
9	chloride	172 mg/l
10	DO	936 mg/l

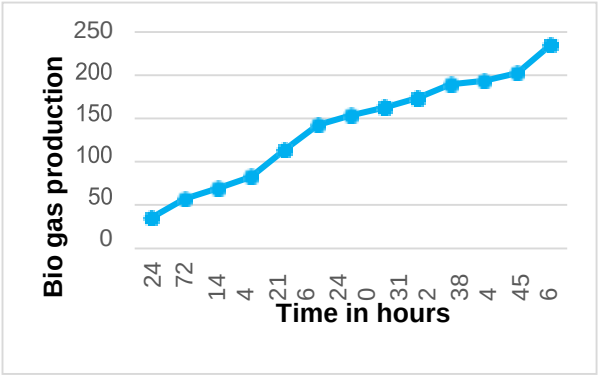


Chart -4 : Biogas production

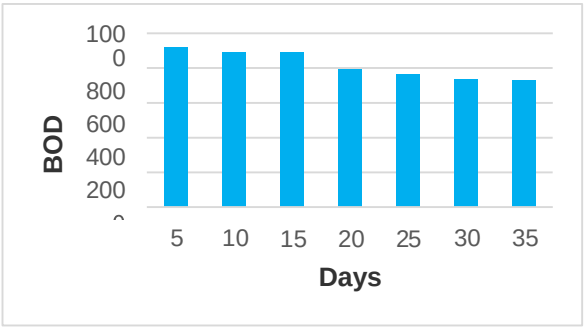


Chart-5: BOD Rating

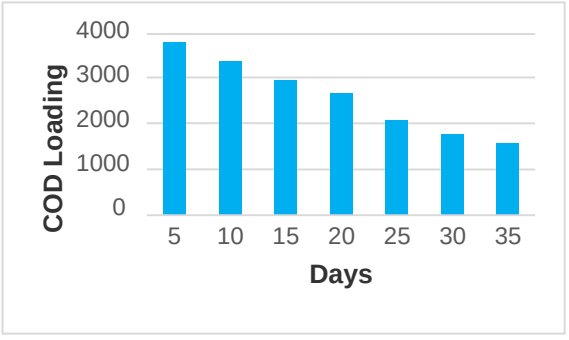


Chart-6: COD Rating

8. CONCLUSION

Where UASB Reactor's function and principle was studied. The characters of natural and chemical coagulants are investigated, and the physical and chemical characters was analyzed. The biogas production was monitor for day by day. The biogas was computed by water displacement method. When compared to chemical coagulants the natural coagulants produce more biogas.

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