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Production of Biogas by Using Food Waste

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ABSTRACT

The current work focuses on the generating bio-gas from food waste produced by Mahendra Engineering College Canteen using anaerobic digestion process. Attempts have been made to optimize various parameters in order to determine the most favorable recipe for maximum biogas production from the digested food waste. The biogas yields have been determined using batch anaerobic thermophilic digestion tests for a period of 90 days. Characteristic oscillation was observed in the rate of methane production, which may be due to the presence of methylotroph population in the activated sludge, which uses methane as a carbon source for their growth. The total biogas generated in the system over the experimental period was the sum of methane and carbon dioxide. Biogas produced from the decomposition of food waste was a mixture of 76% methane and 24% carbon dioxide.

Keywords- Anaerobic Digestion, BOD, Biogas, Food Waste,

I. INTRODUCTION

Biogas refers to a gas made from anaerobic digestion of kitchen waste. Methane is a clean energy one of the constituent of biogas which has a great potential to be an alternative fuel. Abundant biomass from various institutions could be a source for Methane production where combination of waste treatment and energy production would be an advantage. In state of Tamil Nadu around of 2944 educational institutions are there, from those institutions a large amount of waste is produced but those waste are not utilized. Objective of this study is to utilize the kitchen waste in a bio digester to produce biogas which will be the alternative fuel for their kitchen energy need. This work was carried out to produce biogas in a Compact Water Plastic Tank with a fixed type, using different kitchen waste from the kitchen, hostel, and canteen in Mahendra Engineering College.

1.1 PURPOSE OF WASTE WATER TREATMENT

Manufacturing of food items, chemicals ingredients and fat produces numerous by-products, solid wastes, high amounts of wastewater containing different loads of pollutants and emissions into the air. The uncontrolled release of effluents to natural water bodies increases health risks for human beings and environmental pollution. Effluents from raw hide processing food items, which produce rotten smell, crust or finished items, contain compounds of trivalent chemical compounds in most cases. Organic and other ingredients are responsible for high BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand) values and represent an immense pollution load, causing technical problems, sophisticated technologies and high costs in concern with effluent treatment.

1.2. OBJECTIVES OF THE PRESENT STUDY

Anaerobic treatment is clearly suitable for India's tropical climate. The reduced cost brought about by lower power consumption are generally enough among all the waste treatment methods even if any returns of gas utilization are neglected.

1.3. SCOPE OF PRESENT STUDY

- Solid and liquid waste of food is collected from kitchen and their characteristic has been studied.
- Before discharging waste water to water bodies it has to be treated to reduce the Chemical Oxygen Demand, Sulphate content.
- As a result of this treatment Biogas liberated can be used for domestic purpose.
- The amount of land fill has also been considerable reduced.

1.4. UPFLOW ANAEROBIC SLUDGE BLANKET (UASB) REACTORS.

The UASB is a high rate suspended growth in which a pre-treated raw influent is introduced into the reactor from the bottom and distributed evenly. "Flocs" of anaerobic bacteria will tend to settle against moderate flow velocities. The effluent passes upward through, and helps to suspend, a blanket of anaerobic sludge. A particular matter is trapped as it passes upward through the sludge blanket, where it is retained and digested.

Digestion of the particular matter retained in the sludge blanket and breakdown of soluble organic materials generate gas and relatively small amounts of new sludge. The rising gas bubbles help to mix the substrate with the anaerobic biomass.

The biogas, the liquid fraction and the sludge are separated in the gas/solid/liquids phase separator, consisting of the gas collector dome and a separate quiescent settling zone. The settling zone is relatively free of mixing effect of the gas, allowing the solid particles to fall back into the reactor; the

clarified effluent is collected in gutters at the top of the reactor and removed. The biogas has methane content typically around 75% and may be collected and used as a fuel or flared.

II. MATERIALS AND METHODS

2.1. SOURCES AND GENERATION OF FOOD WASTE

Food waste which is collected from Mahendra Engineering College canteen situated in Namakkal includes vegetables, fruits and other items. The treatment process of food waste products gives hazardous waste. The usage of chemicals are one of the main reason for this.The manufacturing of food items is a process that must be accomplished by adhering to strict controls of both the local and Federal food regulatory agencies. The items of food that are manufactured are as varied as the people they serve. Common staples, exotic delicacies, snack foods and ethnic specialties are all food items that go through a controlled and precise manufacturing process with safety always at the forefront.

2.2. SAMPLE COLLECTION.

Samples for treatment of food waste, both solid and liquid were collected from Mahendra Engineering College canteen.

About 15 kg of waste items collected are categorized as vegetables, fruits, rice, other food items and waste water which mixing together, forms semi solid state.

Fig-1 Food Waste Produced From College Canteen

2.3. MATERIALS

The semi solid waste used in this study is collected from college canteen. The fresh Cow Dung Slurry was added to the above food waste to supplement the reaction process. It is used as a seeding material for the reaction process in the UASB (Up flow Anaerobic Sludge Blanket Reactor). Effective micro organism collected from private company was used to accelerate the reaction process. Also yeast is added for fermentation process to take place.

2.4 EXPERIMENTAL PROCEDURE

Experimental studies were carried out in batch reactors of 1000ml capacity and made up compact water plastic material. The effective volume of the reactors was maintained at 500ml .the reactor was provide with suitable arrangements for feeding, gas collection, draining residues. Experiments were carried out in the ambient temperature. Each reactor was added with 100ml sludge and diluted to 500ml of working volume. The characters of samples are show in Table -1

2.3. EXPERIMENTAL METHODS

pH was measure using digital pH meter ,alkalinity, acidity were estimated according to the procedure recommended, standard methods of examination water and (APHA-AWWA1992) appropriate.

III. RESULT AND DISCUSSION

Fig-1 Shows setup of anaerobic reactor (UASB reactor)

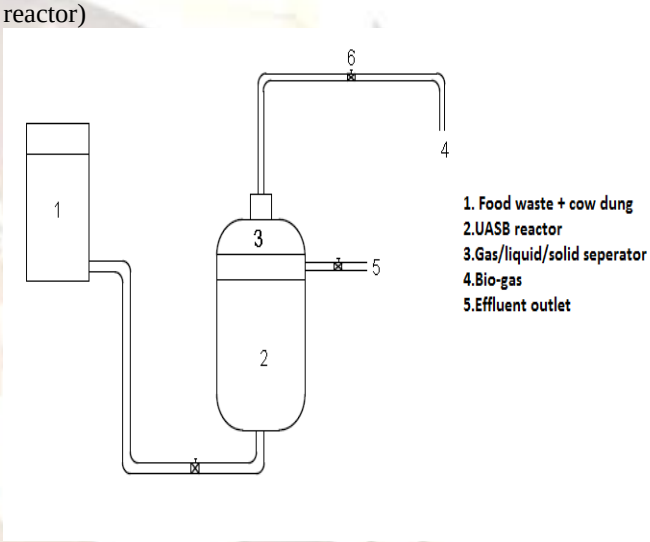

Fig-2 Diagram of UASB Reactor

Fig-3 UASB Reactor before Production of Biogas

Fig-4 UASB Reactor after Production of Biogas

S.No	Parameters	Results
1	P^H	8.2
2	T. Alkalinity mg/l	510.00
3	T. Acidity mg/l	628.00
4	COD mg/l	24000.00
5	BOD_5 mg/l	8120.00
6	Chloride mg/l	849.00
7	Sulphate mg/l	3209.00

Table-1 chemical characteristics of sample

Days	pH	Total alkalinity	Total acidity	COD	BOD	Chloride	Sulphate
0-10	8.2	510	628	24000	8120	849	3209
10-20	8.2	506	620	23907	7909	848	3119
20-30	7.9	489	607	22605	7011	789	3013
30-40	7.9	406	583	20671	6772	711	2994
40-50	7.8	368	501	17289	6126	683	2789
50-60	7.5	343	452	14777	5424	633	2538
60-70	7.5	321	395	10509	4920	597	2219
70-80	7.3	297	359	7113	4225	560	1910
80-90	7.1	235	315	4210	3401	425	1604

Table-2 chemical characteristics of food waste water sample after 90days

S.No	Parameters	Results
1	P^H	7.1
2	T. Alkalinity mg/l	235.00
3	T. Acidity mg/l	315.00
4	COD mg/l	4210.00
5	BOD_5 mg/l	3401.00
6	Chloride mg/l	425.00
7	Sulphate mg/l	1604.00

Table-3 Indicates efficiency of the USAB Reactor for the digestion of food waste

Table-3 Operational parameter and treatment efficiency of USAB Reactors.

However Fig-5 demonstrates the pH of the waste is gradually reduced with increasing days. The similar trends as shown Fig-6-7 for the alkalinity and acidity. The COD, BOD, Chloride and Sulphate are decreased with Fig 8-11 increasing time

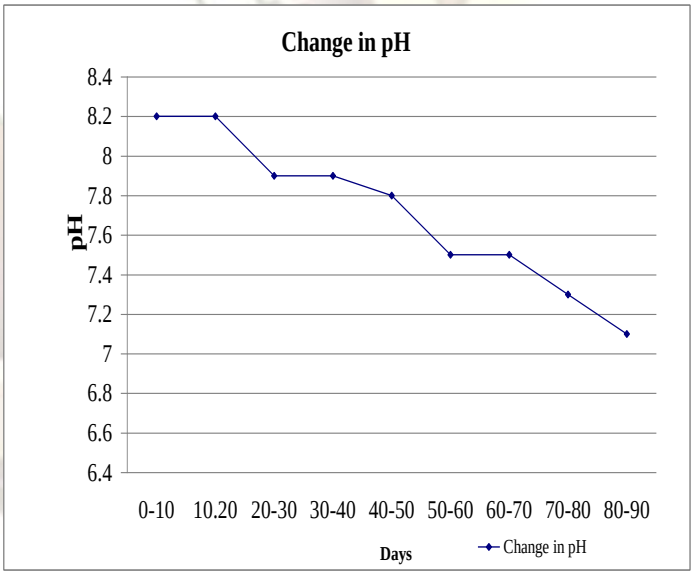

Fig- 5 pH of effluent changes with time

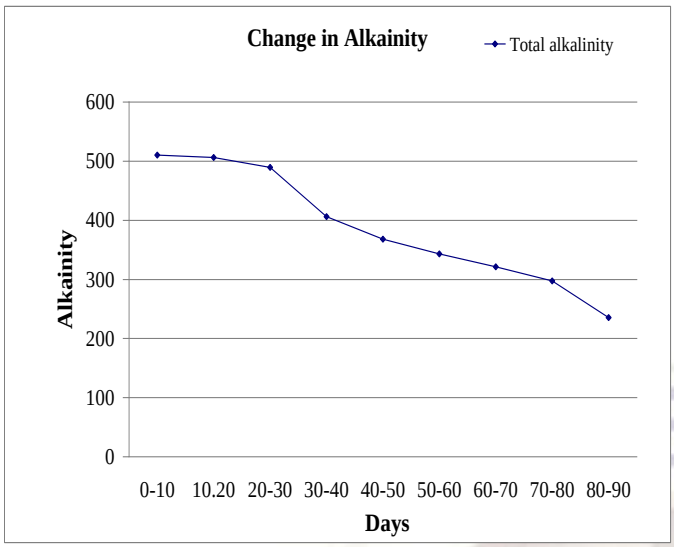

Fig-6 Total alkainity of effluent changes with time

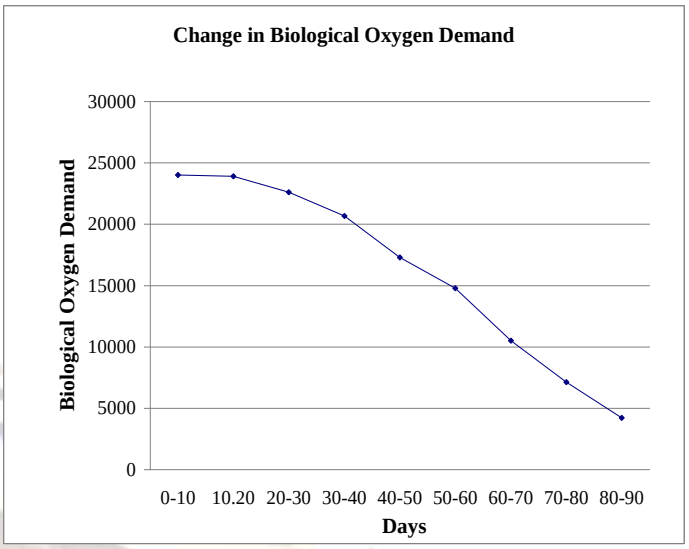

Fig- 9 Biological Oxygen Demand of effluent changes with time

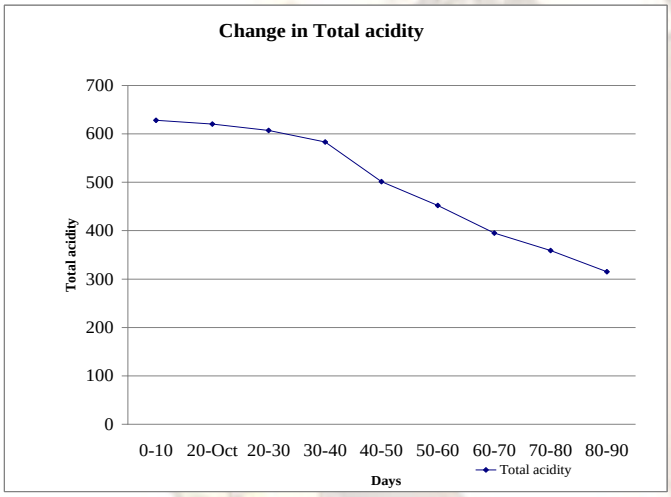

Fig- 7 Acidity of effluent changes with time

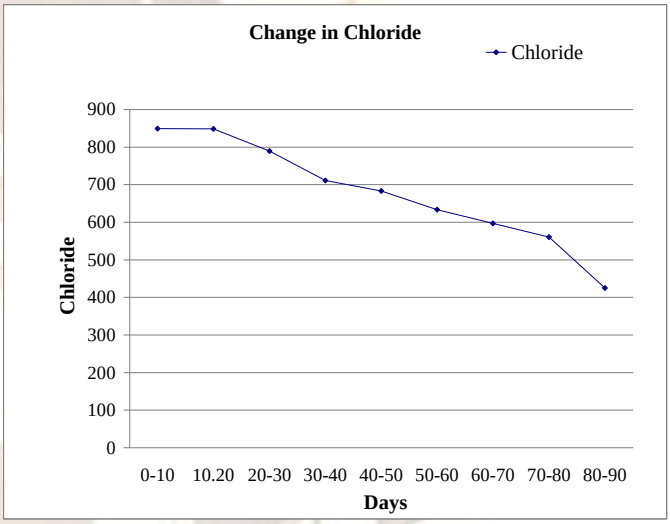

Fig- 10 Chloride of effluent changes with time

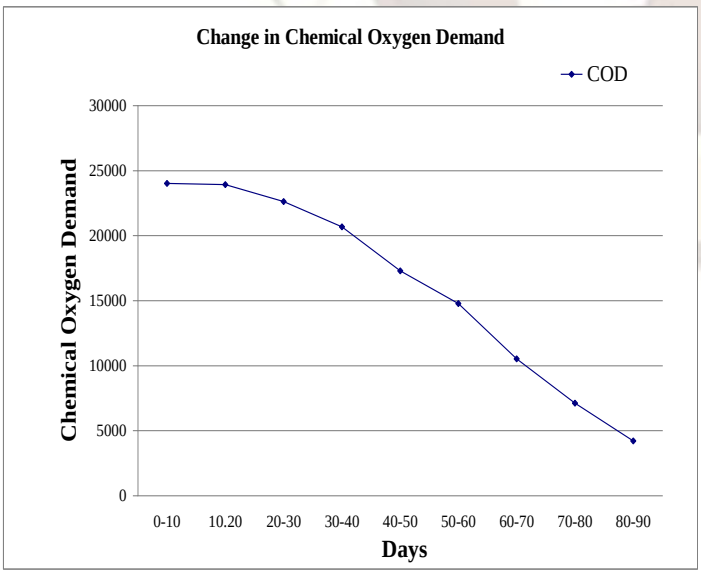

Fig-8 Chemical Oxygen Demand of effluent changes with time

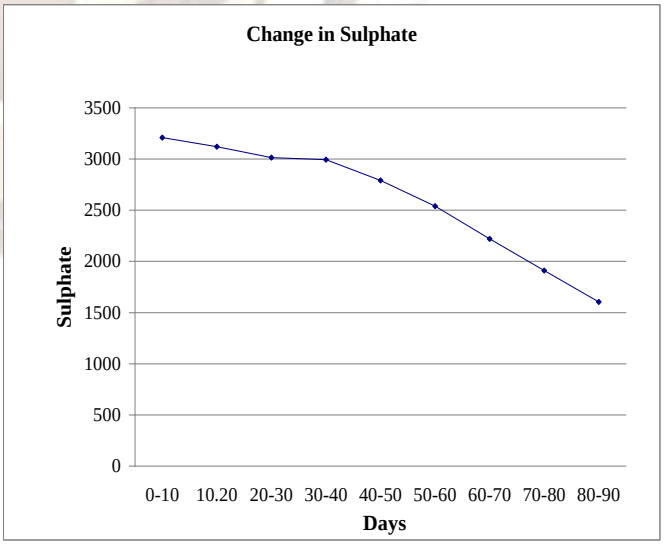

Fig- 11 Sulphate of effluent changes with time

IV. CONCLUSION

After the thorough study on the performance of UASB reactor and evolution of acidogenic reactor, the following collusion have been reached,

As a result of the treatment of food effluent using UASB reactor, the useful bi product, bio-gas has been produced with a considerable rate of decrease in the values of COD, BOD, pH, acidity and alkalinity.

Through the successful anaerobic processing inside the UASB reactor in 90days food waste treatment, methanogen gradually converts the organic acids into the methane gas and carbon dioxide, which indicates that the waste has better anaerobic biodegradability. Thus achieves a waste of resource utilization.

The results show that UASB reactor can treat food waste with high contaminated load.

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