PRODUCTION OF BIOGAS USING WATER HYACINTH(EICHHORNIA CRASSIPES) CO-DIGETION WITH COW DUNG

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Abstract- **Water hyacinth(Eichhornia crassipes) is considered as a noxious weed in many parts of the world as it grows very fast and depletes nutrient and oxygen rapidly from water bodies, adversely affecting flora and fauna. Water hyacinths are very rich in hydrocarbon which is essential for the production of methane. Production of biogas through anaerobic digestion of organic waste materials provides an alternative environmental friendly renewable energy. In this study, biogas production from co-digestion of water hyacinth with cow dung is carried out for four mix ratios. In all treatments, Total Solids(TS), Volatile Solids(VS), and pH were measured before and after digestion.The digestion of residues was undertaken by weight-type anaerobic process, it was operated at a temperature 32°C for a period of 28 days. The resultant mixture was mixed with water at a ratio of 1:2 (w/v) and fed into the Anaerobic digester. The digester was recharged with 6 kg with combination of water hyacinth and cow dung. Gas chromatography was used to quantify the different composition of biogas production for various combination of water hyacinth and cow dung. Overall results indicate that the increment of biogas yield and Volatile Solids, and Total Solids reduction can be significantly enhanced when Water Hyacinth and Cow Dung are co-digested.The study concludes that Water hyacinth is a potential feedstock for biogas production.**

Keywords- **Biogas, Water hyacinth (E. crassipes), Anaerobic digester. Gas chromatography, cow dung.**

I. INTRODUCTION

Energy is one of the most important limiting factors to global prosperity. Currently, the global mix of fuels comes from fossil (78%), renewable (18%) and nuclear (4%) energy sources[1]. As far as fuel is concerned, the rural population in developing countries heavily depends on traditional fuels, such as firewood, animal wastes and agricultural residues[2]. The dependence on fossil fuels as primary energy source has led to global climate change, environmental degradation, and human health problems. Moreover, the recent rise in oil and natural gas prices may drive the current economy towards alternative energy sources such as biogas[3,4].

Globally biogas fuel helps to reduce greenhouse gas emissions. Domestic biogas installations can reduce greenhouse gas (GHG) emissions in three ways: by changing the manure management modality; by substituting fossil fuels and non-renewable biomass for cooking (and to a smaller extent for lighting) with biogas, and; by substituting chemical fertilizer with bioslurry[5].Utilizing biogas as an alternative to fossil based fuels reduces the net amount of carbon dioxide emitted to the atmosphere. Moreover, the emissions of methane gas, which is more aggressive greenhouse gas than carbon dioxide, from otherwise naturally digested dung can be prevented[6].

The use of renewable energy sources can contribute to solve the present and future energy problems. Among the alternative energy sources, biogas production from green energy crops and organic wastes has world wide application as it yields a good quality fuel and fermented slurry, which may be used as a manure or soil conditioner[8]. In addition, it helps to a great extent in the abatement of pollution.Biogas is an alternative and renewable energy source produced through anaerobic digestion of organic matter by various specialized groups of bacteria and fungi (e.g. *Neocallimastix frontalis)* in several successive steps. The end product of this anaerobic digestion is production of mainly the combustible gas, methane (CH4) and a liquid effluent.

Problem Statement

water hyacinth is a one of the major source to reduce the fertility of the soil when harvested and dumped on soil as it contain more hydro corbon and also it reduces the

water table and block the beaching access and reduce the survival of fishes.On one hand, attempts have been made towards the use of biological, chemical and mechanical approaches for preventing the spread of, or eradication of water hyacinth.

On the other hand, much attention has been focused on the potentials and constraints of using water hyacinth as a biomass for biogas production.

Objective of the study

The main objective is to review the possibility of using water hyacinth for biogas production

II. MATERIALS AND COLLECTION

A. Sample Collection

Co*w* dung sample were collected from the animal farm house at Kumbakonam, Thanjavur. Cowdung is a waste material and its have methane content. So its used for thr production of Biogas. Water hyacinth (WH) was collected from a river located in Kumbakonam. Thanjavur district of Tamil Nadu. Fig**. 1** shows the water hyacinth. Every part of the water hyacinth have methane content such as root, leaf, and stem. So its used for the production of Biogas .

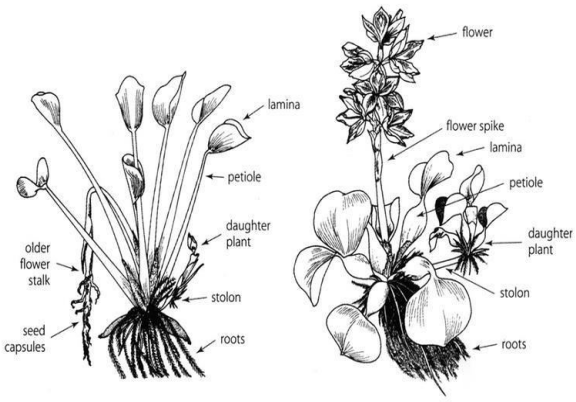


Fig. 1 Parts of Water Hyacinth

The water hyacinth were cleaned to remove soil and dead plant materials and it was chopped separately to about small pieces later it was dried in front of sunlight and grined in powde form. The cow dung was diluted with water to 1:2 ratio (w/v) [7] [8] . The temperature was measured through the temperature measuring devices and pH was checked using pH meter.

B. Anaerobic Digestion Process

Anaerobic digestion is a collection of processes by which microorganisms break down biodegradable material in the absence of oxygen. The process is used for industrial or domestic purposes to `manage waste or to produce fuels. Fig**. 2** shows the anaerobic digester.The mixture s fed into the digestion tank and the gas are collected in the tube.

Fig**. 2** Anaerobic digester

The digestion process begins with bacterial hydrolysis of the input materials. Insoluble organic polymers, such as carbohydrates, are broken down to soluble derivatives that become available for other bacteria. Acidogenic bacteria then convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia, and organic acids. These bacteria convert these resulting organic acids into acetic acid, along with additional ammonia, hydrogen, and carbon dioxide. Finally, methanogens convert these products to methane and carbon dioxide. The methanogenic archaea populations play an indispensable role in anaerobic wastewater treatments.

Much of the fermentation used industrially to produce food and drink products, as well as home fermentation, uses anaerobic digestion [9]. This process is called “anaerobic digestion”. The digestion process consists of three main process.

Hydrolysis

Hydrolysis usually means the cleavage of chemical bonds by the addition of water. When a carbohydrate is broken into its component sugar molecules by hydrolysis. Generally, hydrolysis is a step in the degradation of a substance or in the language of chemistry "The reaction of cation and anion or both with water molecule due to which pH is altered, cleavage of H-O bond in hydrolysis takes place."

Acetogenesis

Acetogenesis is a process through which acetate is produced by anaerobic bacteria from a variety of energy and carbon sources. The different bacterial species that are capable of acetogenesis are collectively termed acetogens.

Methanogenesis

Methanogenesis or biomethanation is the formation of methane by microbes known as methanogens. Organisms capable of producing methane have been identified only from the domain Archaea, a group phylogenetically distinct from both eukaryotes and

bacteria, although many live in close association with anaerobic bacteria.

E. Formation of Slurry-

Water hyacinth and Cow dung consist of organic solids, inorganic solids and water. Biogas is formed by digestion of the organic substances. The inorganic materials are unused and are unaffected by the digestion process. Adding water in the combination of water hyacinth and cow dung gives fluid properties. This is important for the operation of a biogas plant [10]. The cow dung was diluted with water to 1:2 ratio (w/v) [7] [8] .

F. Biogas

Biogas can be produced by anaerobic digestion with anaerobic organisms, which digest material inside a closed system, or fermentation of biodegradable materials. Biogas is primarily methane (CH_4) and carbon dioxide (CO_2) and may have small amounts of hydrogen sulphide (H.2S), moisture and siloxanes. The first gas from a newly filled biogas plant contains too little amount of methane. The gas formed in the first five to seven days must therefore be discharged unused. The methane content depends on the digestion temperature so keep the temperature ranged between 27˚C - 32˚C at the digestion give high methane content, but less gas is then produced [7].

III. METHODS AND DATA SOURCES

A. Experimental Setup

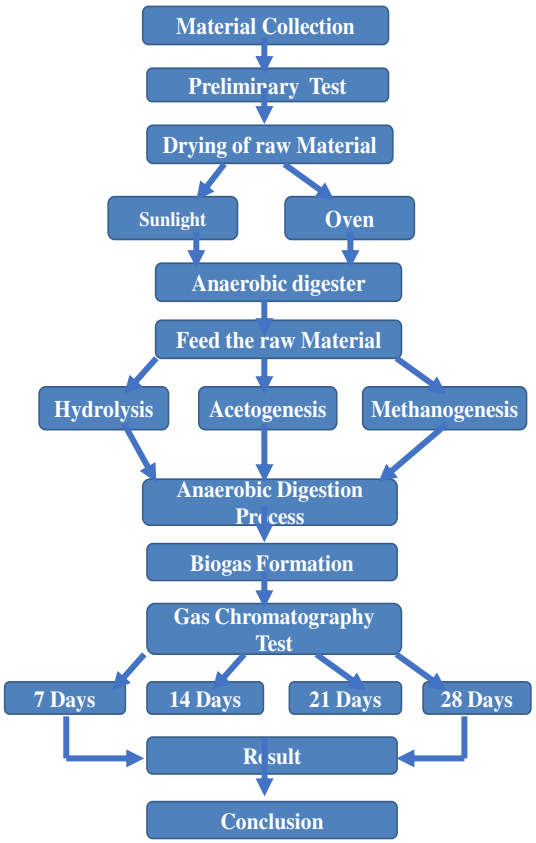
The capacity of digestion tank is 0 .02m^3 shown in fig 2. This digestion tank is placed in dark room at maintained temperature ranged between 27˚C - 32˚C at the digestion. Because temperature also important characteristics producing a biogas. This study is carried out for four different composition as listed in table 1. The combination of (25%)WH + (75%) CD, (50%)WH + (50%) CD, (75%)WH + (25%) CD, and (100%)WH + (0%) CD. The raw materials was blended with water in composition of (1:2) ratio (w/v)

Table 1: The composition of raw material

WH- Water Hyacinth CD- Cow dung

Composition	WH in kg	CD in kg	Water in lts
75%CD+25%WH	2	4	12
50%CD+50%WH	3	3	12
25%CD+75%WH	4	2	12
0%CD+100%WH	6	0	12

B. Methodology



IV. RESULTS AND DISCUSSION

In the anaerobic digestion plant the methanogenic evaluation for the production of methane gas using naturally available waste material such as water hyacinth along with cow dung were considered. The composition of raw material are shown in Table 1.

In the first trial of 25% WH & 75% CD the amount of water added was 12 liters and the mixure was in semi solid state having a pH of 6.8 and the methane production was started at tehe early period of 7days.

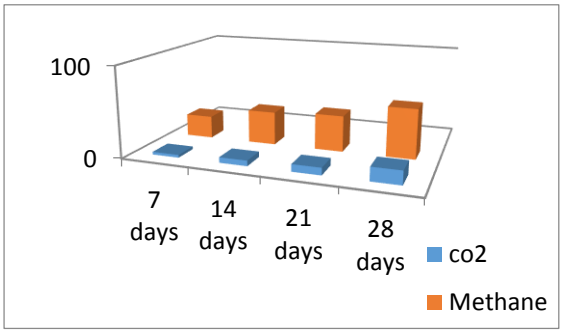


Fig. 2- 75% CD + 25% WH in composition

In the second trial as the percentage of water hyacinth was increased to 50% for the same amount of water (12 liters) the mixture was semi solid, since water hyacinth obsorbes water from the mix the yield of biogas became less.

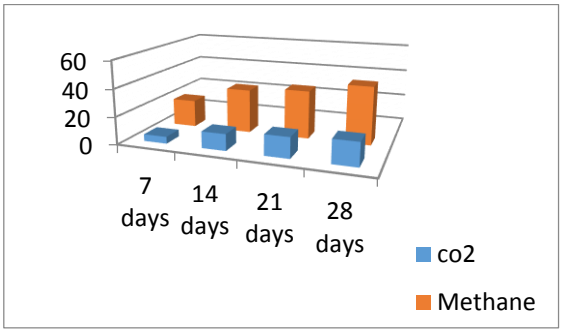


Fig. 3- 50% CD + 50% WH in composition

In the third & fourth trial as the percentage of water hyacinth was increased with out increasing the water content the mixure became solid yielding to less production of biogas. There was minimum gas production observed from 100% water hyacinth (control) containing plants.

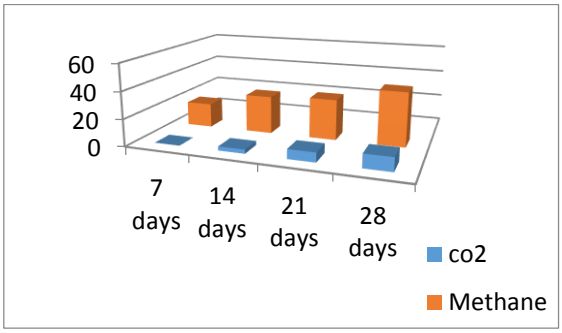


Fig. 4- 25% CD + 50% WH in composition

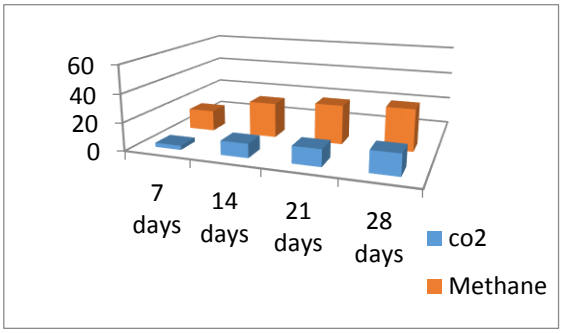


Fig. 5- 0% CD + 100% WH in composition

The production of biogas is also depends on pH of feed slurry material. If the pH of feed slurry material was decreased then the production will be affected. In all treatments, Total Dissolve Solids, Volatile Solids and pH were measured before and after digestion. The total solids and pH value was found in each combination of material shown in table 2.

Table 2. Analysis of anaerobic digested sample

Substract	Totalsolid mg/l	Total Dissolve Solids (ppm)	Total Volatile Solids (mg/l)	pH
75%CD+ 25%WH	98.2	2600	16	6.8
50%CD+ 50%WH	98.5	2540	12	7.2
25%CD+ 75%WH	98.8	2270	7	7.5
0%CD+ 100%WH	99.5	2120	5	7.8

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It is necessary to understand the role of the total solids content on the behavior of the microbial communities involved in anaerobic digestion of organic matter. Better performances mainly including volatile solids reduction and methane yield were obtained in the digestion tank with higher total solids content in the first trial (75%CD+25%WH)indicates the bio gas yield with water hyacinth co digestion with cow dung.

The gas evolved through the process is tested using flame photometer.

Fig. 6- Digestion tank & Flame Photo meter

Fig. 7- Flame

V. FUTURE WORK

This study concludes that Water hyacinth is a potential feedstock for biogas production.Future work can be carried out by increasing the water content to determine the max yield of biogas. Water hyacinth can be used as adsorbent for the removal of contaminants present in the textile wastewater.wate rhyacinth can also be used as an filter to reduce the air pollution and water pollution.

VI. CONCLUSION

The study of result is possible to produce biogas from a different mixture of water hyacinth and cow dung. This study of investigation of different composition is an attempt to use the naturally available waste material such as water hyacinth and cow dung for production of biogas and also methane production. The different combination using cow dung and water hyacinth were tried and maximum yield of biogas results were obtained when 25% Water hyacinth and 75% cow dung combination.

VII. REFERENCES

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