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Anaerobic Co-Digestion of Water Hyacinth and Banana Peel with Cow Dung and Cow Urine With and Without using Chemical Pre-Treatment

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Abstract: ***This examination assesses the impact of blending proportion (1, 1.5, 2 and 2.5) and chemical pre-treatment on the anaerobic co-processing of banana strips and water hyacinth. Two plans of bio-engineered methane potential (BMP) tests were performed all the while. Banana strips was blended with untreated water hyacinth in set I, and water hyacinth be pre-treated before co-absorption in set II. Intent measure of bovine compost and dairy animals pee was added to every reactor as an inoculum. The anaerobic group test revealed that set II, where pre-treated banana strips and water hyacinth was co-handled, demonstrated high biogas creation and favoured nature of biogas over set I. Blending proportion 1.5 and 2 were outlined to be the ideal blending proportion for set I and II individually. Both the sets represented high biogas age than mono-processing of the substrates. In this way, anaerobic co-absorption of banana strips and water hyacinth depict a synergic activity via adjusting the general procedure. The purpose of this peculiar analysis was to scrutinize the repercussion of different mixing ratios and chemical pre-treatment on the anaerobic co-digestion process.***

Keywords: Banana peel, Water hyacinth, anaerobic digestion, Biogas, Co-digestion, Pre-treatment

I. INTRODUCTION

Decrease in petroleum product and natural contamination caused due to consuming of petroleum derivative is a noteworthy concern around the world. It is of most extreme need to diminish our reliance on petroleum product and locate a reasonable eco-accommodating choice. Anaerobic absorption is by all accounts a reasonable option as it can change natural squanders into biogas (bio energy) without oxygen with the help of vigorous of hearty microorganisms subsequently giving an answer for both natural waste administration and sustainable bio energy generation [1][13]. Be that as it may, anaerobic assimilation is a very delicate procedure in light of the fact that the microorganisms associated with changing natural squanders into biogas need inevitable viable ecological prerequisite so as to prosper.

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The possibility of substrate used is one of the essential parameter influencing the capacity of biogas age because of their made creation and biodegradability. Biogas is immaculate and naturally amicable fuel delivered by the anaerobic assimilation of organic waste. For example, dairy animals fertilizer, vegetable waste, civil strong waste and modern waste [2]. Banana strips which are essentially natural waste items may fill in as a conventional feedstock for the production of biogas as they are well off in common issue and expeditiously biodegradable [1]. Water hyacinth, then again, is viewed as the world's most hazardous amphibian weed; aggravating the oceanic biological system and the employment or entertainment exercises of individuals. Banana strips and water hyacinth have high dampness and effectively accessible in plenitude all through the world, along these lines anaerobic processing of both banana strips and water hyacinth is by all accounts an achievable alternative for the generation of eco-accommodating biogas[3, 4]. Valuable inoculums is important for triggering the co-assimilation process because creature squanders (compost of dairy animal) contain lofty nitrogen, ample range of supplements & better microbial movement[5]. The purpose of this research work was to fructify the execution of biological products, water hyacinth and Banana peel with Cow Dung and cow urine with and without using Chemical Retreatment digester for biogas production. Table 1 demonstrates the few feedstock absorption:

Feedstock	Digestion	Pretreatment	Methane content analyzer	Methane yield and energy efficiency	Software used	reference
Banana peel and Water hyacinth	Anaerobic Co-digestion	Thermal pretreatment	Gas chromatography (Thermo trace GC Ultra) ,Thermal Conductivity Detector	Specific methane yield= 253 ± 3 mL/g VS for Set I , Specific methane yield of 296 ± 9 mL/g VS for Set II	Titration method, Liquid displacement method, Gompertz Equation, Kinetic Model	[1]
Water hycinth with Cow manure and kitchen waste	Anaerobic co-digestion and mesophillic condition	Thermal pretreatment		Methane=65%,		[6]
Water hyacinth and sheep waste	Anaerobic Co-digestion mesophilic condition(30˚-37°C)	Alkali method	Gas chromatography (CHEMITO), Thermal Conductivity Detector	Highest biogas yield = 0.36 l/gVS	Standard Method, pH meter(Systronic),	[7]
Food waste , municipal waste and paper waste	Anaerobic Co-digestion Two stage thermophilic condition	-	Flame ionization detector, pH meter, Gas chromatograph	20% PW ratio boost the humiliation of matter	ANNOVA, IBM SPSS Statistics 19.0 software	[8]
Okra Waste and sheep waste	Mesophilic Condition	5% alkaline NaOH, Microwave,microwave +alkaline	Gas chromatography (Agilent 7890B, USA)	Cumulated biogas yield by pretreated with alkaline sample =45.87%	Artificial Neural Network, Modified Gompertz model, First order kinetic model, C-N elemental Analyser, pH meter, MATLAB version 2015b,Annova, STATISTICA 12 software	[9]
Water hyacinth and water chestnut	Anaerobic Co-digestion	Sulphuric acid	Nucon Make-5700 Gas chromatograph	For water chestnut=57.04%, For water hyacinth methane Content =63.82%	APHA, Microkjeldahl techniques	[10]
Sewage sludge with glycerine	Anaerobic (Mesophillic) Co-Digestion		Gas chromatograph with ionization reactor	Methane production yield= 0.8 l CH_4/l/d.	High precision gas flow meter, Standard method,	[11]
Cellulosic water hycinth	Anaerobic co-digestion			1-Ethyl-3-methylimidazolium acetate by alkali pretreatment	FTIR	[12]

2. Material and methods:

2.1. Test collection and arrangement:

Water hyacinth was acquired from the lake in village Dayalpur, near the premises of National Institute of Technology Kurukshetra (NITK) of India. Whereas, banana peels were gathered from Fruit Shop near NITK, India's campus. A bio-digester of 2000 litre capacity have been utilized to perform test.

In continuous operation mode,potaasium hydroxide has been utilized for pretreatment of water hyacinth and Banana peel waste in addition to boost pH value.For prepation of sample, 450 g potasium hydroxide, total of 1500 litre waste (combination of water hyacinth , banana peel, cow urine,fresh tap water[three different mixing ratio of 1, 1.5,2.5,2 have been used and working condition has been controlled at mesophillic condition using biogas analyzer. By Utilizing biogas analyzer,the entire biogas and its chief ingredient CH_4 and CO_2 formed in biodigester have been calculated In bio-digester, the digestion inoculums effect tests, the feedstock and inoculum were encumbered into the continuous system by feedstock/inoculum ratios of 1.0, 1.5, 2.0, 2.5.The Physicochemical properties of water hyacinth and banana peel shown in Table 2**[1]**

Parameter	Banana peel	Water Hyacinth
Cellulose	12.55 ± 2	32.84 ± 5
Hemicellulose (%)	9.24 ± 1	24.7 ± 2
sCOD (mg/L)	1600 ± 50	2150 ± 30
pH	5.2 ± 0.5	5.8 ± 0.5
Moisture Content	80 ± 2	90 ± 5

2.2. Experiment setup and detail:

For current study a test setup has been organized and prepared. The biogas arrangement have a bio-digester of $2m^3$ having height and diameter 1.4 meter, made up of Fibre reinforced-plastic. Bio digester has slurry holding capacity 2000 litre, gas holding capacity 800-900 gram. Daily waste feeding capacity of bio-digester is 20 kg. A PID controller has been utilized to keep up mesophilic condition of the digester. A flexible biogas analyzer has been utilized for biogas estimation. An engineered electronic weighing machine of accuracy 0.5 g has been used for weighing the slurry samples. A pH meter has been used for pH estimation. Hydrogen sulphide, oxygen and Methane, carbon dioxide have been assessed by the biogas analyzer. A schematic and a pictographic view of the biogas set-up have been outlined in Figure 1(a, b).

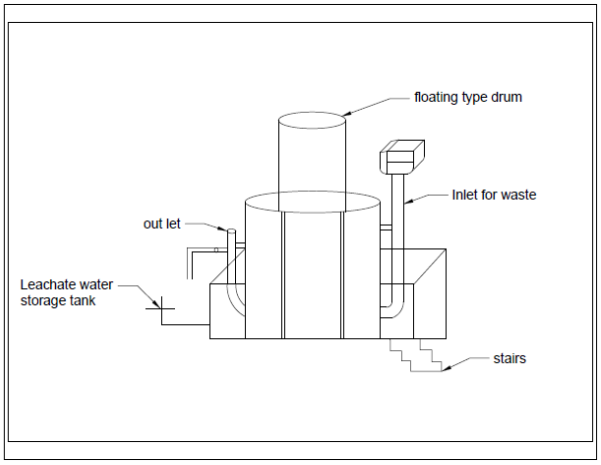

Fig 1: Illustrative outline of test setup

Fig 2: Pictorial outlook of the experimental unit (a) at initial stage (b) after formation of biogas

II. RESULTS AND DISCUSSION:

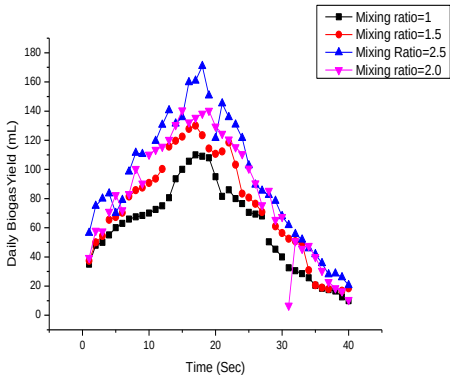

Fig 3: Daily biogas yield versus time for banana peel and pretreated water hyacinth

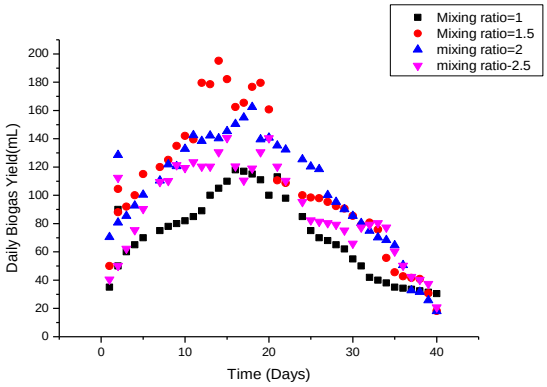

Fig4: Daily biogas yield versus time for banana peel and pretreated water hyacinth

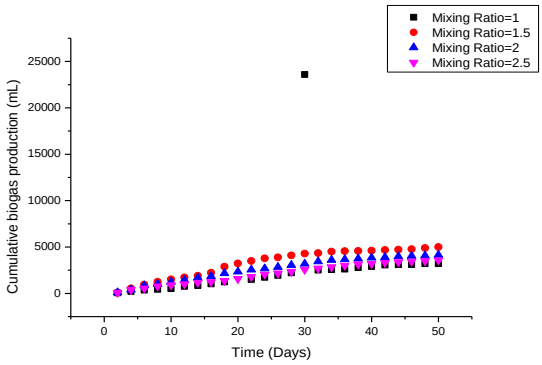

Fig 5: Cumulative biogas production for untreated water hyacinth &banana peel

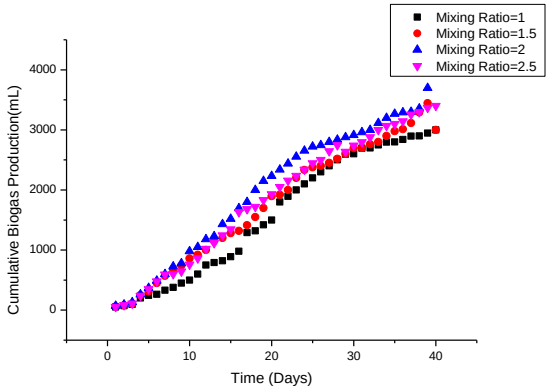

Fig6: Cumulative Biogas production for treated water hyacinth& banana peel

For the period of the methane potential measurement, the upshot of the anaerobic co-processing of banana strips and water hycinth were examined, in which two system of testing was considered, whereas all the blending ratios (1.5, 1.0, 2.5 and 2.0) were together. Water hyacinth was untreated in set I while it was chemically pretreated in set II. Illustrations for fig.3 and 4 are related to the daily biogas age of the individually blending ratio for both II and set I. Biogas creation started following setting up the test for all the blending proportions however in changing amount. The total biogas generation upgraded logically all through the anaerobic co-assimilation stage. Biogas generation apparently was fewer quantitatively in mono-assimilation of the substrate while diverged from co-absorption as co-processing and mixing extent acts in synergism towards change the enhancements and to increase the nearness of flexible & vital microbial system. In Figure 3, mixing proportion 2, on the sixteenth day demonstrated the most outrageous biogas production of 172 ± 15 mL in set I. Whereas mixing extent 1.5, on the eleventh day, in set II demonstrated the most extraordinary biogas production of 195.4 ± 20 mL itself in figure 4. In both set II and I, biogas generation enhanced because the mixing extent extended up to 2 in set I and up to 1.5 in set II. In set I, biogas generation decreased for the mixing extent 2.5 and in set II for the mixing extent 2. For the mixing ratio 2, the set of chemical pretreatment of water hyacinth in set II will increase the amount of simple soluble organisms easily available in the substrate. This improved amount of easy soluble organisms that are easily available in the substrate interrupts the methogenic bacteria due to accretion of noxious intermediate (VFA). Thus, the blending proportion 2 in set II displayed lower biogas generation when compared to the blending proportion 2 of set I.

In Fig.5 and 6 whole biogas generation graphs, generally long hydrolysis stage was not seen during anaerobic co-processing of banana strips and water hyacinth in both set II and I. There is consistent significant improvement in biogas creation was watched all through the start-up and the enduring stage for stage I and II. By the end of 51 days till the production of biogas was reduced and throughout the anaerobic co-digestion of banana peels and water hyacinth, stable phase was obtained for every mixture ratio. In Set II mixing ratio 1.5, the other mixing ratio of set II and the utmost cumulative production output of all sets of set I have been demonstrated. In set II blending proportion 1.5 exhibited the most extreme total biogas generation when contrasted with the other blending proportions of set II and every one of the proportions of set I separately.

In set II aggregate biogas production of 5000 ± 10 mL was achieved by the proportion 1.5 before 51 days' over. In set I though blending proportion 2 displayed most elevated combined methane creation of 3900±10 mL before 51 days' over.

III. IMMINENT OUTLOOK AND NEOTERIC CHALLENGES:

It has been seen by various individuals that biofuel is cleaner route for the vehicle part to meet all centrality needs. In the midst of turnover in the motor we accomplish natural positive conditions, for example, less carbon dioxide spreads relate to add up to that was isolated from air. This results being created of close carbon cycle. A couple of various gaps are showed up in Figure 7

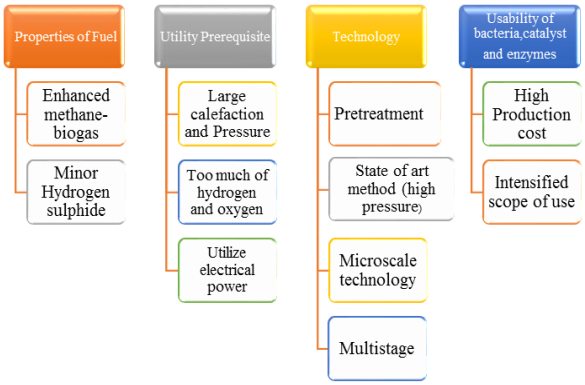

Fig 7: Various couple of gaps

IV. EPILOGUE:

To advance the biogas production & speed up the hydrolysis period than mono-digestion anaerobic co-digestion of banana peel & water hyacinth along with chemical pretreatment is an proficient method. All things considered co-absorption, pretreatment and a proper blending proportion inside and out particularly improved adjusted the supplements, the amount of dissolvable substrate,enlivened biodegradation ,cradled the harmful inhibitors, and expanded biogas creation in this manner improving digester conduct. In set I ,the optimal mixing ratio was perceived to be 2 while in set II ,the best mixing ratio was perceived to be 1.5. During anaerobic co-digestion process pretreatment of water hyacinth along with banana peels can be suggested in order to even more boost the bioavailability of soluble organic matter.

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