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Co-Digestion of MSW, With Cow Manure & Poultry Waste: An innovative approach for Biogas Production

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Abstract-- **Current object manages the estimation of the biodegradability of Municipal Solid Waste (MSW) and energy through anaerobic assimilation. The maintenance time of the procedure increments in anaerobic processing when contrasted with other waste, for example, leafy foods waste, cow fertilizer, Poultry waste, rural buildups and so forth. Two targets are (a) waste diminishment and (b) lessening in the natural issues which can be accomplished with the utilization of suitable bio-motorization innovation.**

The four different batch experiments were carried out: 1) organic waste of MSW with poultry waste, 2) organic waste of MSW with cow dung and 3) organic waste of MSW with cow dung and poultry waste 4) only OFMSW. The present study aims at choosing the best ratio between organic waste of MSW and animal manure and comparing the results in either case. The process of Co-digestion is carried out in mesophilic temperature which ranges from 30 to 35°C with a total solid attentiveness of 8% in each sample (dig slurry). The biogas is composed by the downward displacement of water, and was then measured. The results obtained claimed that blending organic matter of MSW with cow manure and poultry waste had major improvement on the biogas yield.

I. INTRODUCTION

The main cause for global reduction of power is its Over-utilization which is a major problem of the present and future world Community. The estimates show that entire fossil fuel will deplete out by the next few decades **[1]**. Therefore exploring and exploiting new sources of energy is a must which are renewable as well as eco-friendly **[2]**.The temperature condition of India being the tropical country is very suitable for the fermentation of organic materials throughout the year. This motivates the use of biogas to be used as an alternative source of energy in India.

The technique of Biogas offers a very attractive route to utilize certain categories of biomass for meeting partial energy needs. The technique of anaerobic digestion (AD) is widely used for treatment of organic waste for biogas production. AD that utilizes manure for biogas production is one of the most promising uses of biomass wastes because it provides a source of energy while simultaneously resolving ecological and agrochemical issues **[3]**.

The anaerobic fermentation of manure for biogas production does not reduce its value as a fertilizer supplement, as available nitrogen and other substances remain in the treated sludge **[4]**.

The process of simultaneous digestion of more than one type of waste in the same unit is called Co-digestion. Advantages include better digestibility, enhanced biogas production methane yield arising from availability of additional nutrients, as well as a more efficient utilization of equipment and cost sharing **[5]**. It is revealed from studies that co-digestion of several substrates, for example, cow manure, poultry waste, pig waste and plantain peels, spent grains and rice husk, and cassava peels, sewage and brewery sludge, among many others , have resulted in improved methane yield by as much as 60% compared to that obtained from single substrates **[6]**.

The co-digestion of organic waste of MSW (OFMSW) with cow manure and poultry waste in anaerobic digestion system conducted at laboratory scale showed that the gas production rate (GPR) of co-digestion was enhanced by 0.8 - 5.5 times as compared to the digestion with OFMSW alone. A wide variety of substrates, animal and plant wastes have been used for biogas production **[7]**. In these studies, the rate of biogas production was found to depend on several factors such as pH, temperature, C: N ratio, retention time, etc. Methane production can be improved by the Co-digestion of OFMSW with cow manure and poultry waste of anaerobic digestion processes **[8]** and has been recently reviewed **[9]**. The co-digestion of cattle manure with MSW **[10]** has also been shown to enhance methane production. The present study was undertaken to evaluate co-digestion of organic waste of MSW and animal manure.

1.1 Biomass

Biomass is biological material derived from living, or recently living organisms. In the context of biomass as a resource for making energy, it most often refers to plants or plant-based materials which is not used for food or feed, and are specifically called lignocellulosic biomass.[1] As an energy source, biomass can either be used directly via combustion to produce heat, or indirectly after converting it to various forms of biofuel.

Conversion of biomass to biofuel can be achieved by different methods which are broadly classified into: thermal, chemical, and biochemical methods.

1.2 Anaerobic digestion

Anaerobic digestion is a collection of processes by which microorganisms break down biodegradable material in the absence of oxygen [1]. The process is used for industrial or domestic purposes to manage waste and/or to produce fuels. Much of the fermentation used industrially to produce food and drink products, as well as home fermentation, uses anaerobic digestion.

1.3 Anaerobic Co-digestion

Co-digestion is a process whereby energy-rich organic waste materials (e.g. Fats, Oils, and Grease (FOG) and/or food scraps) are added to dairy or wastewater digesters with excess capacity. In addition to diverting food waste and FOG from landfills and the public sewer lines, these high-energy materials have at least three times the methane production potential (e.g. biogas) of biosolids and manure.

1.3.1 Advantages and disadvantages of anaerobic Co-digestion

1.3.1.1 Advantages

1) Improved nutrient balance and digestion.
2) Additional biogas collection.
3) Possible gate fees for waste treatment.
4) Additional fertilizer i.e. soil conditioner
5) Renewable biomass disposable for digestion in agriculture.

1.3.1.2 Disadvantages

1) Increased digester effluent COD.
2) Additional pre-treatment requirements.
3) Increased mixing requirements.
4) Wastewater treatment requirement
5) Hygienization requirements.
6) Restrictions of land use for digestate.
7) Economically critical dependent on crop.

1.4 Research area

1. To analyze energy value through MSW with co-digestion with cow manure and poultry waste.
2. To reduce environment impact.

1.5 Scope of Work

1. The population of Jabalpur city is over 24 lacks produces 1, 59,825 tonnes per annum and 450 tonnes per day of MSW .Waste generation per capita per day for year 2011 was found 500 gm/c/day. Waste generation for year 2030 is predicted to an increase of 5% per annum: 1326 gm/c/day. In present time Jabalpur city divided in t*o 8 zones.*
2. As we know that solid waste generated from the house hold and various places pollutes our environment therefore there is a need for its safe disposal and utilization and this has inspired me to work for the generation of electricity using these wastes.
3. Utilization of MSW of Jabalpur city for useful, efficient and renewable energy generation.

II. METHODOLOGY

2.1 Anaerobic digestion of municipal solid waste and co-digestion with manure

Anaerobic digestion of the organic fraction of municipal solid waste (OFMSW) co digestion with cow manure and poultry waste. This was carried out in two mesophilic (35^{o}C) wet digestion treatment systems. Initially only OFMSW digested S_1 setup and OFMSW co-digested with cow manure in S_2 setup then we take OFMSW co-digested with poultry waste in S_3 setup and then OFMSW co-digested with cow manure and poultry waste, at a hydraulic retention time (HRT) of approximate 4-5 days. Over a period of 6 weeks adaptation of the co-digestion process was established to an OFMSW: manure. The pH raised to a value of above 7 and the reactor showed stable performance with high biogas yield and low VFA levels. We analyzed the biogas production in 4 setup after digestion.

2.2 Materials for designing and development of digester

i) Digester: 4 batch type airtight plastic bottles, Capacity – 20 litres

ii) Gas Container: one liter High-density glass container for contains the biogas.

iii) Substrates: The substrates used as feed stock materials for the generation of biogas in the Takshshila Institute campus were OFMSW which contains market and household wastes including vegetables, fruits and kitchen wastes. MSW are collected from different areas in the city. OFMSW were chopped in appropriate size to prepare it for the experiments.

iv) Inoculums: The inoculums for mesophilic incubations were collected from the pilot scale mesophilic anaerobic treatment plant based on cow dung and MSW. This system exhibited ~40-60% VS removal, in which the gas composition, CH_4 was detected as being 50- 60%.

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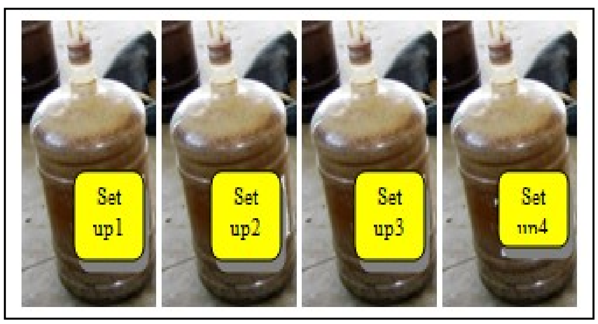
v) Plastic tubes: 0.5 inch

vi) Measuring jar: 1000 ml

2.3 Experimental Setup

Experiments were carried out in 500 ml airtight cylindrical anaerobic digester at ambient temp. and 100 ml airtight container to keep the temperature at ambient state to determine biogas production from different mixing factor of OFMSW, cow manure(CM) and poultry waste (PW). In all Experimental setup of feeding ratio is of OFMSW, CM and PW in digester are follows.

Reactor	OFMSW	CM	PW
Experimental setup 1	100%	0%	0%
Experimental setup 2	50%	50%	0%
Experimental setup 3	50%	0%	50%
Experimental setup 4	33.3%	33.3%	33.3%



III. Results And Discussion

This chapter deals by means of the results obtained on the investigational scale of anaerobic digestion of cow dung and poultry waste. The characteristics of the wastes are presented. The result shows the anaerobic digestion process as an efficient technology for the OFMSW with CM (Cow dung) and PW (Poultry waste) co-substrate. The some problems bring in in the world due to high quantity of OFMSW, cow dung and poultry waste.

3.1 Results and discussion on the experimental work

The experiments were conducted in AD i.e. the hydrolysis of OFMSW by using different acid concentration for several days and gas production and organic solid reduction from AD system using substrate mixing factor OFMSW, CM and PW.

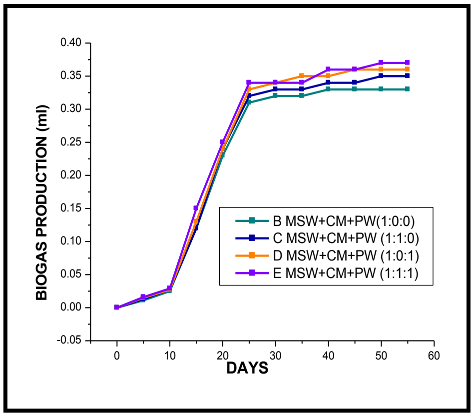
3.1.1 Only Organic waste of MSW as Fermentable Material: The Maximum gas production from only organic waste after digestion is 0.33 ml. The average digester temperature was about 35ºC. It shows that the hydraulic retention time for organic waste is about 55 days and gas production starts at the 4th day.

3.1.2 OFMSW with Cow manure as Fermentable Material: The maximum gas production from co digestion of OFMSW and cow manure is 0.35 ml. The average digester temperature was about 35ºC. It shows that the hydraulic retention time for cow manure is about 55 days.

3.1.3 OFMSW with Poultry Waste as Fermentable Material: The maximum gas production from OFMSW and poultry waste is 0.36 ml. The average digester temperature was about 35ºC. It shows that the hydraulic retention time for poultry waste is about 55 days.

3.1.4 OFMSW, with Poultry Waste and cow manure as Fermentable Material: The maximum gas production from OFMSW, cow manure and poultry waste is 0.37 ml. The average digester temperature was about 35ºC. It shows that the hydraulic retention time for poultry waste is about 55 days and gas production starts at the 1st day.

Fig. illustrates the variation of biogas of with respect to Retention Time, the assessment of biogas production between two Substrate MSW: CM: PW and MSW: CM and MSW: PW at mesophilic temperature. The biogas yield is fewer up to 10th days but after 10th days biogas yield continuously grow. After 15th days the biogas production is rapidly grow at higher rating on mesophilic temperature, C/N ratio 33:1, and pH value 7.3. Beyond 20th days the biogas production constant rate because growth of methanogens slow. Initially co-substrate MSW: CM: PW give higher value compared to MSW: CM and MSW: PW it may be because of CO_2 generation and later at around 7th day of RT the biogas production are comparatively same and in the later stage it has been seen that substrate gives constant growth where as other substrate shows variation it may be because of varied rate of suitable bacteria. The biogas produces and recorded duration 55 days.



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