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EFFECT OF CO-DIGESTION USING MUNICIPAL SOLID WASTE WITH FOOD WASTE UNDER MECHANICAL LAB SCALE ANAEROBIC REACTOR

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Abstract

This present study consider extraordinary to assess the potential of co-digestion for utilizing Municipal Solid Waste (MSW) and Food Waste (FW) for improved biogas production. The lab scale batch type anaerobic digester is worked at room temperature changing from 25 to 36°C with a settled hydraulic retention time (HRT) of 30 days. The anaerobic digester at different organic loading rates (OLR) of 0.5, 1.5, 2.5, 3.0 and 3.5, 4.5 kg of volatile solids (VS)/m^3 of digester slurry/day, similarly the biogas and methane yield is improved by the inclusion of food waste to MSW. The most extreme biogas yield and methane is 0.42 m^3/kg and 34 % of VS included per day happened at the ideal natural nourishing rate of 3.0 kg of VS/ m^3/day accomplished on 16th day of digestion. In addition, the methane generation from MSW with food waste can offer assistance to overcome the worldwide energy gas inside the following next few decades.

Keywords: solid waste, food waste, energy, hydraulic retention time, volatile solids

Introduction

The anaerobic absorption of MSW mixed with food waste is a one of the efficient anaerobic digestion process could be a handle that has become a major center of intrigued in waste management all over the world [1]. The untreated household sewage and food waste causes serious ecological harm to the range by contaminating ground water and surface water, and it must be arranged securely. In India the sums of MSW produced in urban zones ranges from 350 to 600 g per capita/day. The [2] sums of MSW created within the Chennai Metropolitan city is nearly 3500 t/day, and contains around 75 % of the organic solid waste. The natural solid waste incorporates rubbish, a vegetable and food waste contains 52%, straw and wood contains 14%, dress 3.1% and paper 3.5%. [3] Presently, the rising prices of the traditional energy sources and the global warming problem have led to a large trouble to promote renewable energy. The [4] International Energy Agency (IEA 2016) reported that the global energy demand is growing fleetly, and about 88 of this demand are met at present time by reactionary energies. Biogas yield [5] mainly categorized as one of the solution for renewable energy promotion scheme also as an alternate for minimization of greenhouse gas emissions, mainly it is helpful to possess a smoke and ash free kitchen, in order that women and their children are not any longer prone to respiratory infections. In [6] most of the industrialized countries, the conversion of external MSW and FW to biogas has come decreasingly popular in recent times as a sustainable technology producing bio energy, and colorful with high tech designs of different scales have been evolved but significant eventuality for biogas utilization still exists. The [7] type of solid waste and lignin content in the feedstock influence the natural exertion and degradability of the substrate. Biogas [8] yield rates are also induced by the balance of carbon and nitrogen in the waste material. The C/ N (carbon/nitrogen) rate should be in the range between 25: 5 and 30:5. [9] The environmental factors similar as high or low temperature and pH are also some of the important determinants of biogas product. The N_2 and phosphorus carried in the MSW and food waste are sufficient to develop the cell enhancement conditions during biogas product. The [10] others rudiments, similar as sodium, potassium, calcium, magnesium and iron are present in low concentrations. However, they may parade inhibitory goods at advanced attention with maximum concentrations.

The choice of [11] MSW as a substrate for product of biogas similar as its miscellaneous nature that calls for redundant sorting of the substrate as well as big particle sizes all of which enhanced its pre-treatment value. [12] Hence special care must be taken in the design of a biogas digester to handle MSW mixed with FW. In this experimental investigation co-digestion of Municipal Solid Waste mixed with Food Waste to generate biogas and methane yield to create the effect of positive synergism using lab scale batch type anaerobic digester. The effluents of MSW and FW from the anaerobic digester are rich in N_2 and pphosphorus, remaining digested slurry is used as a fertilizer for soils.

Experiments and Methods

The FM and MSW are collected from the near koyambedu market at the Chennai metropolitan city. Exchanges transport the MSW and FW collected from the point sources. The hand sorting system is applied. The Organic wastes used in digestion trials are collected independently, dried by natural styles, shredded to a maximum particle size of 2 – 4 m and stored in a plastic vessel at room temperature previous to characterization. Table .1 shows the chemical characteristics of MSW and FW.

Table 2: The chemical characteristic of MSW and FW

S.No	Parameters	MSW	FW
1	Moisture content	**56.7**	**71.3**
2	Total solids (TS)	**46**	**55.2**
3	Volatile solids (VS) (% of TS)	**51**	**88.4**
4	Ash	**15**	**-**
5	pH	**6.9**	**6.8**

The Food waste is mixed to MSW convert into degradation in the form of semi-solid with dray sate then reduced particle size of the waste. After that both the feedstocks are added in the form of slurry. The MSW contains methanogen and pathogenic bacteria's, it's also one of the easy option for feed into the digester, similarly which enhances the concentration of the organic loading rate. This inclusion culture is improved outside of the anaerobic digester. Once the mixed slurry enters the digester through directly the degradation process begins and the biogas yield gradually enhance.

Fig: 1 photograph view of Lab Scale Anaerobic Digester

The experiments are conducted using 25 L Lab scale batch type anaerobic digester working at a batch mode feeding range with various room temperatures changing from 25 to 36° C with fixed with HRT of 30 days with various organic loading rate of 0.5, 1.5, 2.5, 3.0 and 3.5, 4.5 kg of volatile solids (VS)/m^3 of digester slurry per day and MSW mixed with FW ratio of 50:50. Figure. 1. Illustrates the photographic view of lab scale anaerobic digester. The anaerobic digester is divided in two portions on the top, one is the slurry inlet and other one is digester slurry discharge pipe, similarly top left hand side of the digester provide hole for collecting the biogas from inside the anaerobic digester tank. The amount of biogas stored in the air bag and CH_4, CO_2, percentage is measured with the ADI gas analyzer, which is obtain from TPL (Tamilnadu petrochemical limited). Acid production pH level of the inner slurry is measured using pen type pH meter. Temperature of inside slurry monitored with the help of thermocouple probe type digital indicator.

Result and Discussions

The experimental results represent that the HRT and OLR is one of the major role as well as design parameters influence the economics of the anaerobic digester. Generally the lab scale anaerobic digester will influence in a lower HRT.

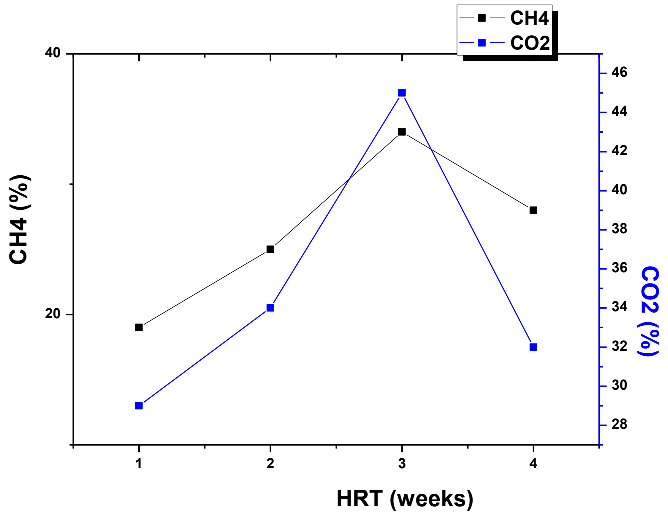

Figure 2. Biogas yield due to the various OLR at Different HRT

Hence, the initial cost will be smaller, the period might not be long sufficient to obtain result for biogas yield. Figure 2. Shows the biogas yield due to the various OLR at different HRT. Since biogas production begins quickly at first day of the digestion and it's increased gradually at 10th day of digestion at OLR range of 2.5 kg of VS/m^3/day. Similarly the 16th day of digestion obtained the maximum biogas yield at rate of 0.42 m^3/kg of VS with OLR of 3.0 kg of VS/m^3/day is achieved and after 30th day of digestion period began to decline because of less number of methanogen bacteria is generated in the slurry due to the effect of pathogenic bacteria production end of the digestion obtain very low biogas yield. The MSW and FW is carrying the maximum energy density compare to other textile, fruit wastes and also higher number of OLR to generate the maximum percentage of microorganism in digester slurry, it's one of the major role in the biogas production for 16th day of digestion period.

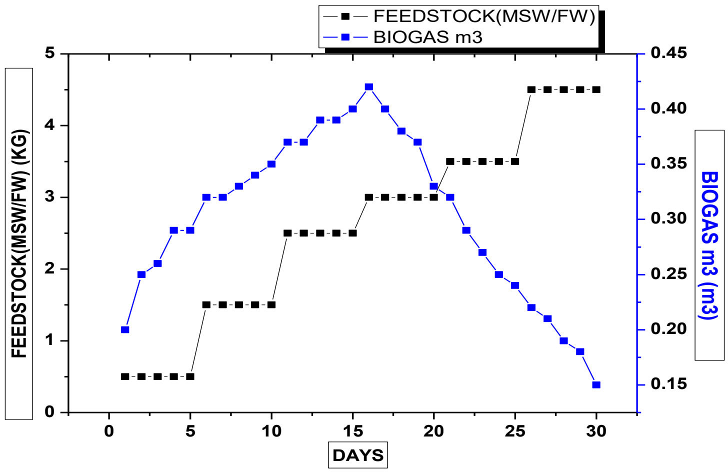

Figure 3. Various compositions of carbon dioxide and methane at different HRT

The concentration of CH_4 and CO_2 is measured in weekly bases. Figure 2. Shows the various compositions of carbon dioxide and methane at different HRT. The maximum level of CH_4 and CO_2 obtained at 3 week 0.34 and 0.48 m^3 respectively. The more number of microorganisms initiate the methane concentration in the 16th day of digestion. It is the main cause of the CH_4 and CO_2 concentration higher in those days. In other hand carbon/nitrogen ratio of MSW is very high 25:1, these also one of the causes of higher percentage in both days of digestion. Final 30th day of digestion period obtain lower level of microorganisms in the digester slurry. Since those periods both the concentration is very less.

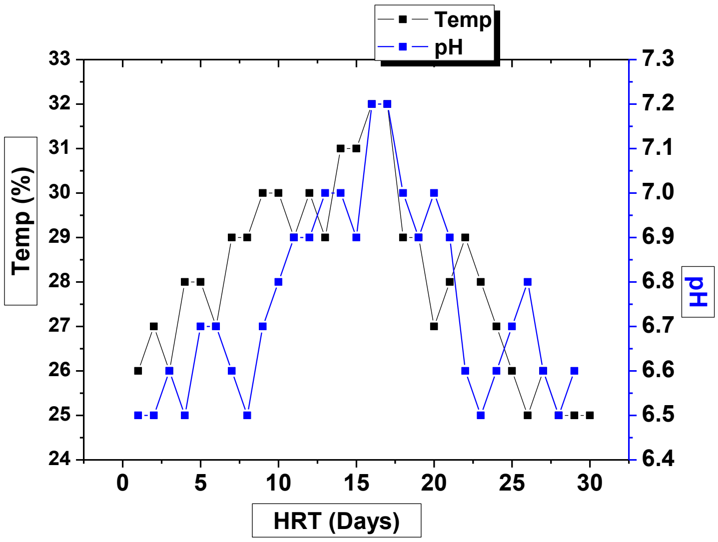

Figure 3. pH range in the slurry various temperature with HRT

The pH and temperature is one of the main factor for biogas generation and higher amount of ammonia concentration present in the digester slurry besides the digester temperature is increased. Figure 3. Shows the pH range in slurry various temperature with HRT. In this study results indicated that temperature and pH increases biogas yield also enhanced. The maximum biogas and methane yield achieved at the temperature range of 38°C and 6.9 respectively. MSW loading rates are characterized by minimum pH level lower the optimum level 7.5 due to higher level of concentration in meaty food wastes.

The research carried out an anaerobic digestion of MSW by (ref) reported that the anaerobic process is very sensitive and the anaerobic bio reactors is very easily be feeder and generated larger amount of volatile acids concentration.

CONCLUSION

The biogas generation from MSW mixed with FW is one of the potential solutions to environmental conservation, and very easy to disposed the wastes. This studies proved that the pH and temperature, OLR is prime factor for produce efficient biogas and methane. Therefore co-digestion of FW and MS Wastes one of the best way of improve the biogas and methane yield.

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