Materials Today: Proceedings xxx (xxxx) xxx

Contents lists available at ScienceDirect

Materials Today: Proceedings

journal homepage: www.elsevier.com/locate/matpr

sAnaerobic co - digestion of canteen waste with cattle manure for methane production

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ARTICLE INFO

Article history:
Received 21 August 2020
Accepted 10 September 2020
Available online xxxx

Keywords:
Canteen waste
Biogas
Methane
Codigestion
Slurry
Cattle Manure

ABSTRACT

The growth of world population and increasing of living standards have enhancing apparel utilization, and the production of canteen wastes. Canteen waste (CW), Cattle manure (CM) and the combination of CW and CM is anaerobically digested. The performance of codigestion with CW and CM were investigate the generation of methane from laboratory scale mini digester with a volume of 25 L is developed and experiments is conducted for a retention time of 40 days. The cattle manure is biomass slurry used as a co-substrate with CW. Maximum biogas and methane generation in 32nd day 0.33 m3, 36% respectively. While adding NaOH solution the alkalinity levels are reduced and enhance the biogas, methane percentage during the digestion. The codigestion of CW and CM is best method of produce methane and biogas.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Newer Trends and Innovation in Mechanical Engineering: Materials Science.

1. Introduction

The world energy challenge is enhancing at a great rate at regularly, particularly around 90% of this challenges created from fossil fuel [1]. The need will maintain to develop during this century. Although, greenhouse gas emissions have create one of the dangers most environmental issues. Generally usage of fossil fuel is one the important causes [2]. Most different energy resources are there but biomass one of the very useful and promising and assured one of the renewable energy, Also it will play main role in the future. The production of biomass has enhanced significantly in present years [3]. Now a days most of the countries make use of such sustainable eco-friendly environmental renewable energy sources mainly as biogas energy, solar energy, also wind energy sources [4].

The accumulation of these wastes and lack of safe waste handling practices have also contributed to environmental and health problems. [5] In this context, the production of biogas by using these organic wastes can potentially reduce the volume of these generated wastes in rural vicinities. On the other hand, both rural and urban areas have abundant waste by-products, such as crop residues, animal wastes, and other organic wastes.

Generally biogas is generated from anaerobic process by biomass energy. The world fourth largest sources of energy in this case global scale providing closely about 15% of preliminary energy [6]. Previous researcher developed the new trend for the biological changes of such containing of sugar and vegetable wastes co-digest with cattle manure digested to convert to generate methane [7]. Particularly in chennai most of industries and colleges dispose the waste from canteens, several benefits to minimize the waste from canteen other hand, it is one of the causes for pollution creates in environment [8]. The cattle dung contain cellulose, lignin, hemicellulose with complex structure, by the way pre-treatment is conduct in cattle dung, in this process used to totally degrade the cellulose to enhance the digestion property of cattle manure [9]. Among the many factors affects the biogas production but temperature is one of the main parameter for increase the percentage of microorganism's growth in biogas generation [10]. The most of significance reasons for anaerobic process for treatment of meth-

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https://doi.org/10.1016/j.matpr.2020.09.290
2214-7853/
Selection and peer-review under responsibility of the scientific committee of the International Conference on Newer Trends and Innovation in Mechanical Engineering: Materials Science.

ods using co-digestion with high waste water [11]. Mainly co-fermentation of manure and vegetable, canteen waste can increase the percentage of digestion, there are possibly economical and blending with different feedstock waste [12].

2. Experiments and methods

This work is conducted from department chemical engineering laboratory (Hindustan). The inoculum used as a cowdung for initial feedstock of the digester. In this case anaerobic type 25 L is used to transfer the biogas generation from bio reactor to collected biogas from air bag is measured the CH4, CO2 content with the help of gas chromatography. pH level of the digester is calibrates to using the pH meter of the inlet and outlet slurry from the digester. The digital thermometer used to measure the temperature inner and outer of the digested slurry. Canteen waste collected from college mess mixed cattle dung with ratio of 2:2, waste by volume of 30:70, then methane and biogas content is measured daily in 40 days.

Daily gas is measured with the help of Aalborg gas flow meter, Fig. 1 shows the photographic view of the experiment. carbon/nitrogen ratio is very high 3:5 in cattle dung, In this case adding NaOH solution 2% per day in the case of enhance acidity level from the digested slurry. Digester inside and outside slurry pressure is calculated by using pressure measuring device. The bio reactor is coolered with black painted fully, so as to constrict the progress of sunlight. The digester is worked at normal sunlight temperatures no adding any external sources. The digested outlet slurry is collected finally and used as an organic fertilizer. The causes of different acid production, sizes of starter and temperatures of digester slurry are tested. Sodium hydroxide (5 ML) is mixed to regulate the pH intermittently every 3 h for 5 days of fermentation. The decreased pH value dropped during this meantime is pH 3 [13].

Fig. 1. Photographic view of experiment.

3. Results and discussion

Biogas generation begins quickly at sixth day of fermentation is shown in Fig. 2. Then 34th day attained the highest biogas generation range of 0.35 m^3 and then final week of the process start to decline. The biogas generation begins after then feeding the feedstock enhancing until obtain the initial peak and then start to reduce several high values generated as the fermentation process is proceed. The major change is occurring the maximum value of daily biogas production.

In basically the biogas begin to produced starting stage at minimum time for the lowest feeding concentration due to high substrate make an entreaty, this get a maximum time for the anaerobic fermentation maximum micro-organism to digest the co-fermentation with cow dung and cattle dung at 1:3 and 1:4 ratio of the feeding value of 60 g/l should depends the acidification of phenomena at the starting stage but get better to the position later [14]. Also, carbon/Nitrogen ratio of the cattle dung is very high so, in this case adding the NaOH solution is enhance the biogas yield as well as improve acidity level in the digested slurry [15]. The bio energy have that find by both volume of the gas and CH4 content the total CH4 is measured by sum of daily methane generation by timing.

The temperature is one of the important for gas generation, in this case when the digester slurry temperature obtained at this stage gas generation is very high; comparatively below 27 °C tem-

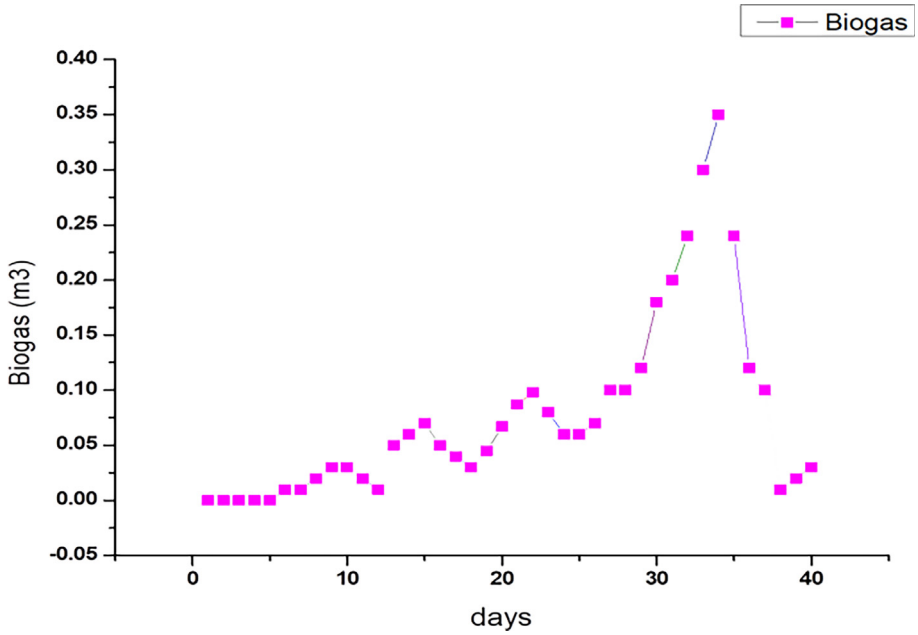

Fig. 2. Biogas with respect to digestion period.

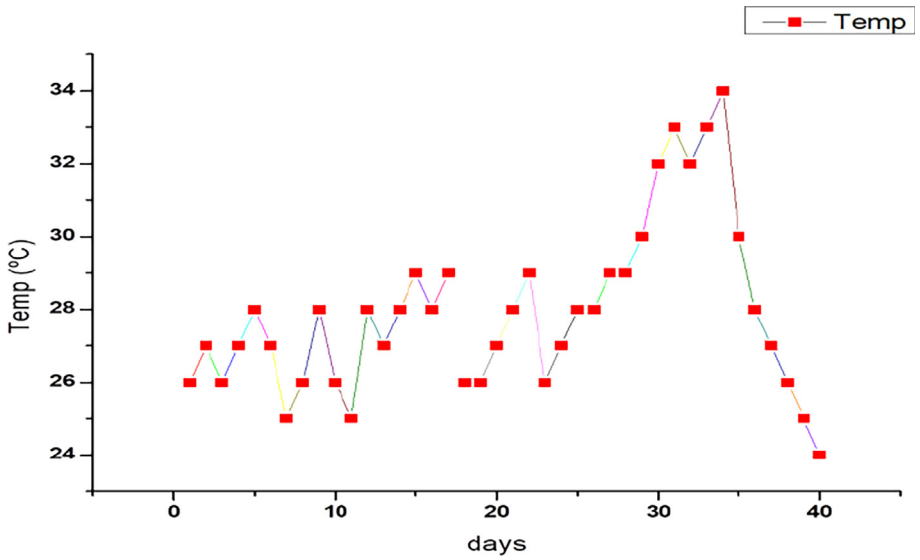

Fig. 3. Temperature with respect to digestion period.

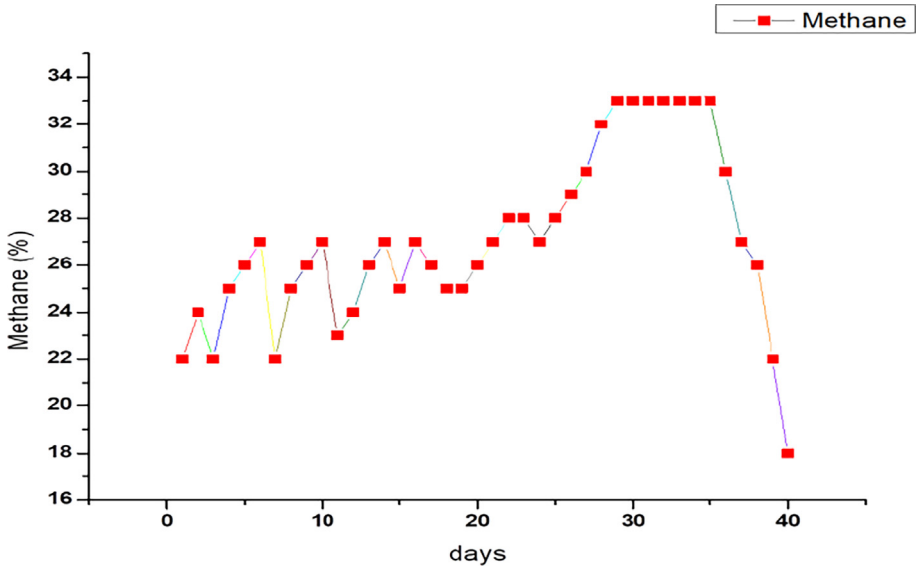

Fig. 4. Methane with respect to digestion period.

perature achieved very lower gas volume [16]. Fig. 3 shows the temperature with respect to digestion period.

The amount of methane content measured every day of digestion at 40 days. Fig. 4 effect methane with digestion periods. The higher methane, content is high at the 33rd day of digestion 34%. The microorganisms present in the digester so, methane production is high. The amount of methane content is high in last week of digestion, since microorganism's presents in the digested slurry at end of digestion its generated high amount, one of the causes of higher methane generation.

The loading rate is an important parameter which affects the methane yield [17]. It is an amount of feed stocks per unit volume of digester. Co-digestion is a recent developed technique is used for different treatment of dry and wet organic wastes.

The acid production pH is an important prime factor for biogas generation. In this work optimum biogas and methane generation in 7 to 7.2 at the time peak gas production since [18]. In this work maximum is pH is obtained in 30th week of digestion at 7.2 is the highest range Fig. 5 show the pH value of the digested slurry.

4. Conclusions

The experimental output showed that the biogas is efficiently produced from co-fermentation of cattle dung with canteen waste using anaerobic digestion process. After NaOH pretreated slurry contributes to promoting the degradability of digested slurry as well as enhanced the methane generation. Mainly the co-fermentation of canteen and animal waste (cattle dung) one of the great development to generate the efficient biogas due to the synergistic effect. The cumulative gas obtained from the co-fermentation is more compared to the single digestion. This technique could be an assuring feedstock for biomass as co-ferment

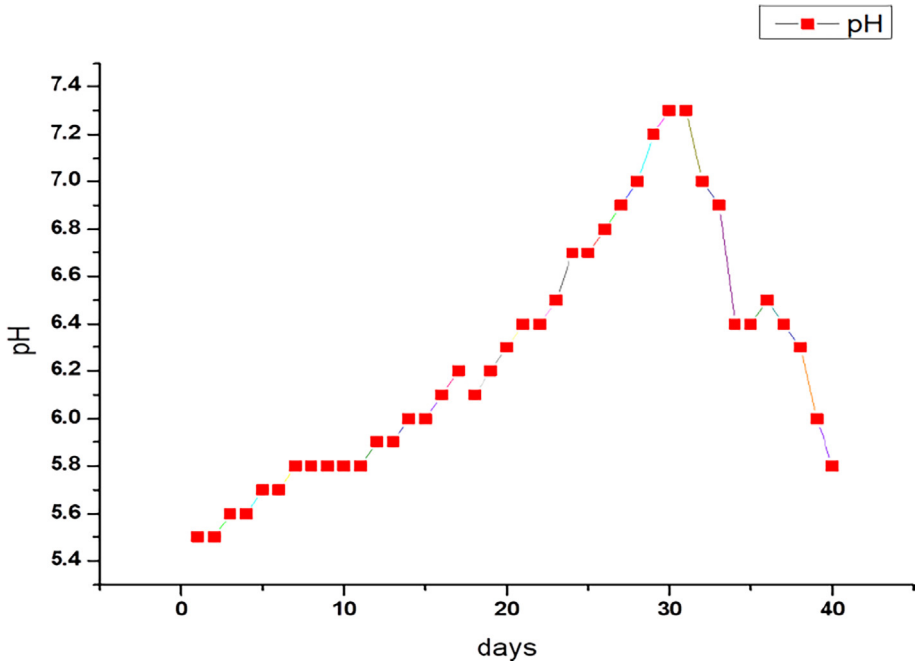

Fig. 5. pH with respect to digestion periods.

with cattle dung using ananerobic digestion, obtained easily due to very low monetary value of biomass.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] H. YEN, D. BRUNE, Anaerobic co-digestion of algal sludge and waste paper to produce methane, Bioresour. Technol. 98 (1) (2007) 130–134.
[2] S. Mehariya, A.K. Patel, P.K. Obulisamy, E. Punniyakotti, J.W.C. Wong, Co-digestion of food waste and sewage sludge for methane production: Current status and perspective, Bioresour. Technol. 265 (2018) 519–531.
[3] I. Syaichurrozi, Biogas production from co-digestion Salvinia molesta and rice straw and kinetics, Renew. Energy 115 (2018) 76–86.
[4] K. Hagos, J. Zong, D. Li, C. Liu, X. Lu, Anaerobic co-digestion process for biogas production: Progress, challenges and perspectives, Renew. Sustain. Energy Rev. 76 (2017) 1485–1496.
[5] S.A. Neshat, M. Mohammadi, G.D. Najafpour, P. Lahijani, Anaerobic co-digestion of animal manures and lignocellulosic residues as a potent approach for sustainable biogas production, Renew. Sustain. Energy Rev. 79 (2017) 308–322.
[6] S. Pavi, L.E. Kramer, L.P. Gomes, L.A.S. Miranda, Biogas production from co-digestion of organic fraction of municipal solid waste and fruit and vegetable waste, Bioresour. Technol. 228 (2017) 362–367.
[7] J. Mata-Alvarez, J. Dosta, M.S. Romero-Güiza, X. Fonoll, M. Peces, S. Astals, A critical review on anaerobic co-digestion achievements between 2010 and 2013, Renew. Sustain. Energy Rev. 36 (2014) 412–427.
[8] A.R. Brandt, G.A. Heath, E.A. Kort, F. O'Sullivan, G. Petron, S.M. Jordaan, P. Tans, J. Wilcox, A.M. Gopstein, D. Arent, S. Wofsy, N.J. Brown, R. Bradley, G.D. Stucky, D. Eardley, R. Harriss, Methane leaks from North American natural gas systems, Science 343 (6172) (2014) 733–735.
[9] S. Sathish, S. Vivekanandan, Optimization of different parameters affecting biogas production from rice straw: An analytical approach, J. Simulat. Sci. Tech 78 (2011) 112–116.
[10] D. Sivaramakrishna, D. Sreekanth, M. Sivaramakrishnan, B. Sathish Kumar, V. Himabindu, M.L. Narasu, Effect of system optimizing conditions on biohydrogen production from herbal wastewater by slaughterhouse sludge, Int. J. Hydrogen Energy 39 (14) (2014) 7526–7533.
[11] Yadvika, Santosh, T.R. Sreekrishnan, S. Kohli, V. Rana, Enhancement of biogas production from solid substrates using different techniques––a review, Bioresour. Technol. 95 (1) (2004) 1–10.
[12] E. Marañón, L. Castrillón, G. Quiroga, Y. Fernández-Nava, L. Gómez, M.M. García, Co-digestion of cattle manure with food waste and sludge to increase biogas production, Waste Manage. 32 (10) (2012) 1821–1825.
[13] R. Li, S. Chen, X. Li, J. Saifullah Lar, Y. He, B. Zhu, Anaerobic codigestion of kitchen waste with cattle manure for biogas production, Energy Fuels 23 (4) (2009) 2225–2228.
[14] A. Lallai, G. Mura, N. Onnis, The effects of certain antibiotics on biogas production in the anaerobic digestion of pig waste slurry, Bioresour. Technol. 82 (2) (2002) 205–208.
[15] Sambusiti, Cecilia, Elena Ficara, M. Rollini, M. Manzoni, and Francesca Malpei. "Sodium hydroxide pretreatment of ensiled sorghum forage and wheat straw to increase methane production." Water Sci. Technol. 66, no. 11 (2012): 2447-2452.
[16] C.A. Gibson, M.A. Meybodi, M. Behnia, A methodology to compare combined heat and power systems operating under emissions reduction policies considering biomass co-fired, coal- and natural gas-fuelled steam turbines, Energy Efficiency 9 (6) (2016) 1271–1297.
[17] CIBER, Nataša, Mateja DOLENC, Benjamin DRAKSLAR, Andreja GAZVODA, Nika KLINEC, Bojan PAPIĆ, Anja PUGELJ et al. "Student performance study: the outcomes of metabolic, molecular and physical-chemical characterization of intestinal tract microbiome on a four mammalian species model." Acta agriculturae Slovenica 104, no. 2 (2015): 91-98.
[18] E. Muñoz, R. Navia, Life cycle assessment of solid waste management strategies in a chlor-alkali production facility, Waste Manag. Res. 29 (6) (2011) 634–643.