International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.11 No.03, pp 219-226, 2018

Natural Gas Production from Batch Feeding of Sheep Droppings and Food Waste as a Partial Mixture in a Confined Batch Digester

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Abstract : Solid waste is a one of the major issues created by the society due to the improper disposal of solid waste environmental issues are created. That is Air pollution, ground water contamination, soil pollution, water quality depletion & human health related problems etc. The biogas production is one of the solutions to reduce solid waste related environmental problems. In this project study was conducted to analyze the biogas production with co-digestion of sheep droppings and food wastes. The biogas production was carried out under a mesophilic temperature of 27°C to 33°C for duration of 55 days. The objectives of this project is to analyze the different ratio co-digestion of sheep droppings and food waste and also optimize the high biogas producing ratio. There are five laboratory scale samples composed of a different ratio of a sheep droppings to food wastes to make a sample D1 (100:0, D2 (80:20), D3 (70:30), D4 (60:40) and D3 (50:50). The co-digestion occurred in a 20 litre capacity of cylindrical container. The sample will be a semi solid liquid which is poured 16 litre in the container. The pH is noted over the fermentation period of 55 days. All the parameter influencing the anaerobic digestion like pH, temperature, alkalinity, total solids, volatile solids and volatile fatty acid are tested every day to find the digestion process takes place inside the digester. Sample D1 (100 % sheep droppings) showed the maximum gas production 85.45 l/kg at the end of the digestion. Sample D-2 (80: 20 for 80 % sheep droppings and 20 % food waste) of the gas production is 62.71 l/kg. Sample D-3 (60: 40 for 60 % sheep droppings and 40 % food waste) of the gas production is 36.46 l/kg. Sample D-5 (50: 50 for 50 % sheep droppings and 50 % food waste) of the gas production is 4.25 l/kg.The Paper completely deals with the digestor set up of 2, In which it comprises of 80 % sheep droppings and 20 % food waste.
Keywords: Natural Gas Production, Sheep Dropping, Food Waste, Digester.

International Journal of ChemTech Research, 2018,11(03): 219-226

DOI : http://dx.doi.org/10.20902/IJCTR.2018.110324

Introduction

1.1 General

Sheep dropping is a valuable source of nutrients and renewable energy. Mostly the waste is collected in sheep cattle or nearer to degradation in the open point sources.which cause a significant environmental hazard. The air pollutants spread from waste include methane, carbon dioxide, nitrous oxide, ammonia, hydrogen sulfide, volatile organic compounds and particulate matter which can cause severe environmental issues and health problems. Previously, cattle waste was reused and simply spread onto agricultural land. The establishment of solid environmental management leads to unpleasant smell and water pollution. This creates that some form of waste management is necessary, which provides more reason for biomass-to-energy conversion.**S.S. Kanwar et al. (1992) -** To study about Production of biogas in batch digesters at WC from sheep droppings produced 93 1 gas/kg dry matters whereas cattle dung yielded 234 l/kg dry matter. Food waste is an organic material having large calorific value and nutritive value to microbes and hence ability of methane production is higher. Food waste is disposed in landfill or discarded which causes the public health hazards. It can affect by polluting environment and ground water contamination. It emits unpleasant smell and methane, while carbon dioxide is a major green house gas to emitting global warming. Co-digestion is the simultaneous digestion process of more than one types of waste in same unit. Benefits include better digestibility, highly biogas production and methane yield come into existence from possibility of additional nutrients. Sheep dropping is high in anaerobic bacteria and is easily accessible nearby and also there is very limited literature available on using sheep dropping in co-digestion with food waste. Hence this research was undertaken to explore the possibility of co-digestion with sheep droppings and food waste. Sheep droppings and food waste were taken in different ratios observations were carried out for the mixture. **M.R. Al-Masri et al. (2000) -** Reported the biogas production and some biochemical parameters of anaerobic fermentation at 30°C for 40 days were studied for eight experimental groups of fermentation media as affected by two factors

1.2 Batch feeding

A full charge of raw material is placed into the digester which is then sealed off and left to ferment as long as gas is produced. When gas production has ceased, the digester is emptied and refilled with a new batch of raw materials. Batch digesters have advantages where the availability of raw materials is limited to coarse plant wastes which contain undigestible materials that can be conveniently removed when batch digesters are reloaded. Also, batch digesters require little daily attention. Batch digesters have disadvantages, however, in that a great deal of energy is required to empty and load them; also gas and sludge production tend to be quite sporadic. **Sadek et al. (2012) -** reported the study about the anaerobic digestion offers an advantageous alternative to land filling, incineration and composting since it is considered as the most appropriate treatment solution. Indeed, the biogas naturally produced by the fermentation of organic waste into anaerobic digesters, **Paul et al. (2014) -**The biogas production is influenced by many factors, of which the temperature of the anaerobic digester process and of the sub layer is the most important. Depending on the reaction medium temperature, certain groups of microorganisms are stimulated, while others are inhibited (mesophilic bacteria require an optimal temperature around 35°C

1.3 Continuous load digester

A small quantity of raw material is added to the digester every day. In this way the rate of production of both gas and sludge is more or less continuous and reliable. Continuous-load digesters are especially efficient when raw materials consist of a regular supply of easily digestible wastes from nearby sources such as livestock manures. **Wante H. P. (2014) -** this study was carried out to assess and determine the biogas yield from cow and goat dung. Biogas yield assessment was carried out at room temperatures (26.0– 30.0 °C) for a period of 20 days from a solid dung mixture of 1000 g in each sample (fermentation slurry) left to ferment over 35 days. **Leta et al. (2015)** reported the present work explores the production of biogas from fruit and vegetable wastes mixed with cow manure in an anaerobic digester. The total solid, volatile solids, moisture content and ash content of the wastes were examined.

II. Methodology

2.1 General

This chapter consists of the collection of material and making digester with a different ratio of sheep dropping and food waste. The lab scale experiments to factors consider anaerobic process and conforming methane.

2.2 Planning

In this project planned to produce biogas under anaerobic digestion from sheep droppings and food waste and then co digestion of sheep droppings and food waste with different set of ratio.

2.3 Survey

In this study, survey taken about the material to available nears the surroundings of National Engineering College, Kovilpatti located at Southern TamilnaduState,India.9°10′0″ N and 77°52′0″ E. The waste is dumped more created environmental hazards. Environmental issues are created due to non renewable energy consumption. Biogas productions reduces the consumption of non renewable energy being depleted at faster rates. Sheep droppings are mostly used as a fertilizer and food waste is disposed in land fill or discarded which causes public health hazards. Biogas production from organic wastes its one of the solution for solid waste management.

2.4 Collection of Waste

Sheep droppings are collected from nalatinputhur 3km from the college. Food wastes are collected from gents hostel 2. A food wastes contains banana peels, stale cooked food, rotten eggs and vegetables refuse like rotten tomatoes, brinjaletc,. These will be crushed separately by mixer grinders. This occurs due to thick organic waste that not reaches to the microorganisms to digest, So the easy way to this problem is to convert solid wastes into liquid slurry. Mixer can be used to convert solid into semisolid.

2.5 Digester Set Up

Fresh sheep droppings and crushed food waste mixed with water thoroughly by hand and poured into a 20 litre cylindrical container .The waste can be filled 16 litre in each digester. 20 % empty space inside the digester to collecting the gas. They planned to co digestion with sheep droppings and food waste can poured into a digester with a different mix ratio. The digester can be filled with 16 litre of waste. The waste can be poured into the digester will can be sealed tightly with the cape. 5000 grams of waste taken to make a digester.There are 5 different sets of ratio with different composition are installed as below as in the ratio of D1(100:00),D2(80:20),D3(70:30),D4(60:40),D5(50:50) as in the aspect ratio of mere equivalent sheep droppings and food wastes.only sheep droppings with water to make 10 liter which is poured in 20 litre cylindrical container digestor tank. The digester is made up by using the following proportions.

1) 100:0, only sheep droppings with water to make 10 litre which is poured in 20 litre cylindrical container D1.
2) 80:20, 80 % sheep droppings and 20 % food waste with added water to make 8 litre which is poured into 20 litre cylindrical container D2.

2.6 Lab Scale Experiment

In lab scale this experiment was done in 20 litre cylindrical container. Here different concentration & combination of wastes are used. Different parameters of input and effluent like total solid, volatile solid, volatile fatty acid, pH, temperature and alkalinity will be measured. Here also different parameter will be checked below.

- Total solid
- Volatile solid
- Volatile fatty acid
- pH

- Temperature
- Alkalinity

III. Result and Discussion

3.1 General

This chapter consists of the graphical view of the taken experimental results like Ph, temperature, volatile fatty acid, total solids, volatile solids and alkalinity. The interpretation as well as comparison chart was provided.

3.2 Digester

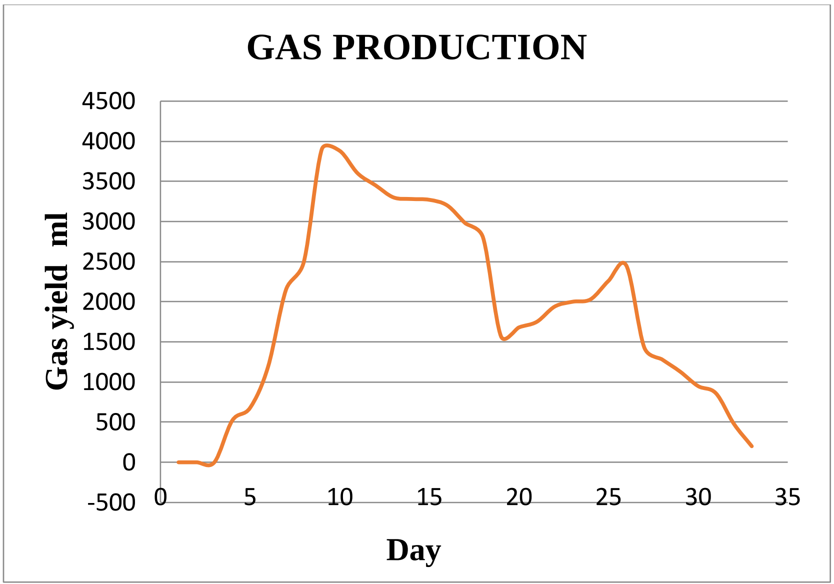

Fig 3.1 Gas production for digester-2

Table 3.1 Digester – 2 readings

SL. NO	TEMP °C	pH	VOLATILE FATTY ACID mg/l	ALKALINITY mg/l	TOTAL SOLIDS mg/l	VOLATILE SOLIDS mg/l	DAILY GAS PRODUCTION l/kg	CUMULATIVE GAS PRODUCTION l/kg
1	28	6.94	5740	2600	40500	19500	0	0
2	30	6.85	5830	2800	46600	23900	0	0
3	28	6.81	5930	3450	49800	26800	0	0
4	29	6.77	6020	3560	60600	27000	520	520
5	33	5.91	6120	3680	60200	29500	680	1200
6	28	5.75	11880	14500	59600	30000	1190	2390
7	32	5.71	12240	15500	57400	60990	2150	4540
8	33	5.64	14640	17900	53600	60100	2500	7040
9	29	5.69	16320	20500	62400	59800	3900	10940

10	28	5.84	19020	21000	62800	59000	3880	14820
11	32	6.3	19440	21300	69400	58700	3600	18420
12	33	6.18	24780	22500	69300	57000	3450	21870
13	33	6.3	24960	23000	68000	52000	3300	25170
14	30	6.41	25140	35350	67600	50600	3280	28450
15	32	6.1	15420	39500	67300	49600	3270	31720
16	33	5.78	16650	37500	66200	48000	3200	34920
17	33	5.95	17600	66000	64400	67400	2980	37900
18	31	6.08	17760	63600	63800	65820	2800	40700
26	30	5.9	18960	56800	63000	65600	1570	42270
25	32	5.95	20640	57800	73100	65200	1680	43950
24	32	6.12	21360	52000	72300	63000	1750	45700
23	33	6	21720	51000	71800	47400	1940	47640
22	31	5.92	22140	43400	71000	47000	2000	49640
21	33	5.98	12840	36900	70400	45800	2030	51670
20	30	6.06	21000	49800	69650	43800	2260	53930
19	32	6.2	22560	44700	69400	40800	2450	56380
27	32	5.79	23640	28500	73400	40800	1430	57810
28	33	5.65	26560	22300	74200	38760	1280	59090
29	31	5.7	28120	18500	78200	38000	1130	60220
30	28	5.74	28140	17550	76800	32000	950	61170
31	30	5.62	29240	16700	75500	37100	860	62030
32	32	5.41	31850	16000	75200	36800	480	62510
33	33	5.86	35550	15000	74600	35800	200	62710

The graphs represents in the digester – 2, the temperature is maintain at under a mesophilic condition at 28°C to 33°C. The temperature should be maintained 33 days for the complete production of methane. The growth of methanogenic bacteria under the pH ranges above 5.5 to 8.The pH maintain in the digester, so the methane production is high. The volatile fatty acid is an important factor consider to biogas production. In the digester VFA is not stable, the methanogenic reaction and hydrolyses process in the digester. Alkalinity is maintained a buffering capacity to maintain the pH ranges maintained in the digester. The bicarbonate ion (HCO_3-) is the main source of buffering capacity to maintain the system's pH in the range of 5.5 – 7.6.

The concentration of HCO_3- in solution is related to the percent of carbon dioxide in the gas phase. Alkalinity usually provides enough buffering capacity to withstand moderate shock loads of volatile fatty acids. Initially the total solids are low in the ranges 10 %. And they increase constant heavy solids in the range of 32%. Volatile solids, the waste characterized by a high solids and low non bio degradable material is suited for the anaerobic digestion factors. In this graph both are maintained frequently same. Gas production has a constant and produce 62.71 l/kg for 33 days.

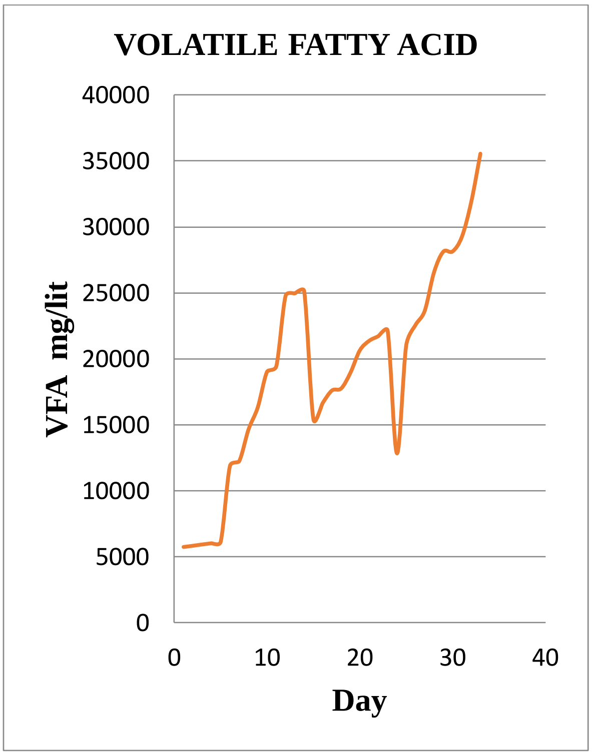

Fig 3.3 VFA for digester-2

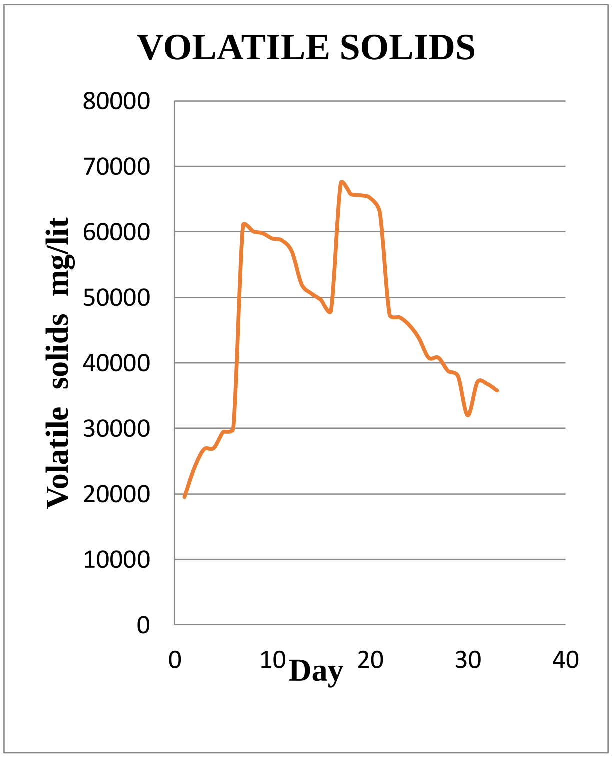

Fig 3.4 Volatile solids for digester-2

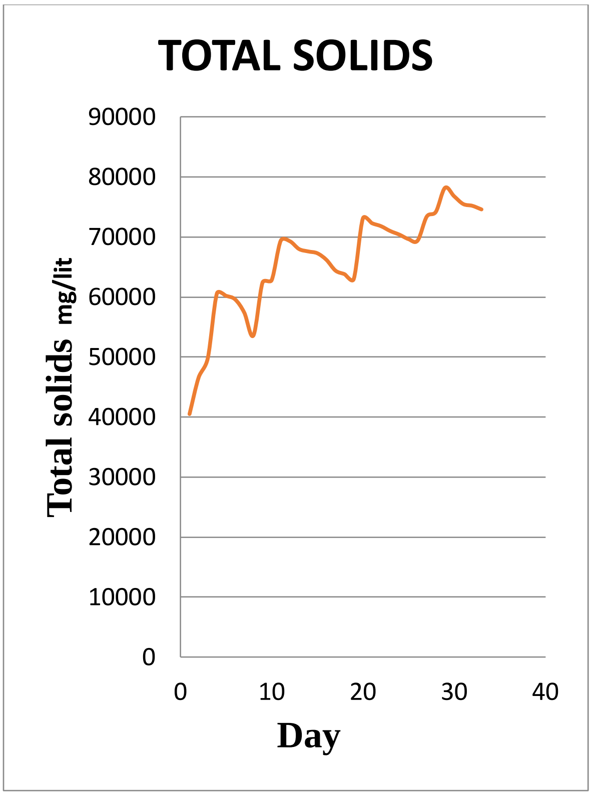

Fig 3.5 Total solids for digester-2

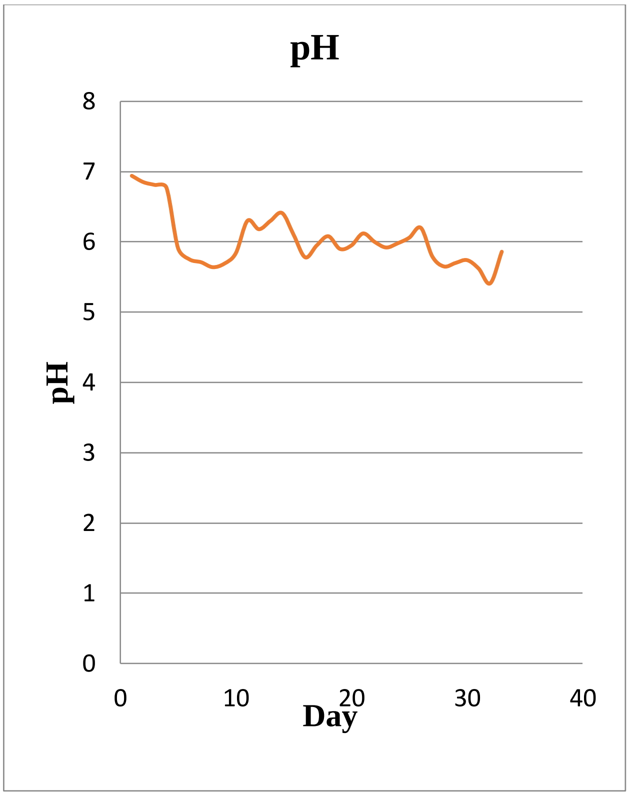

Fig 3.6 pH for digester-2

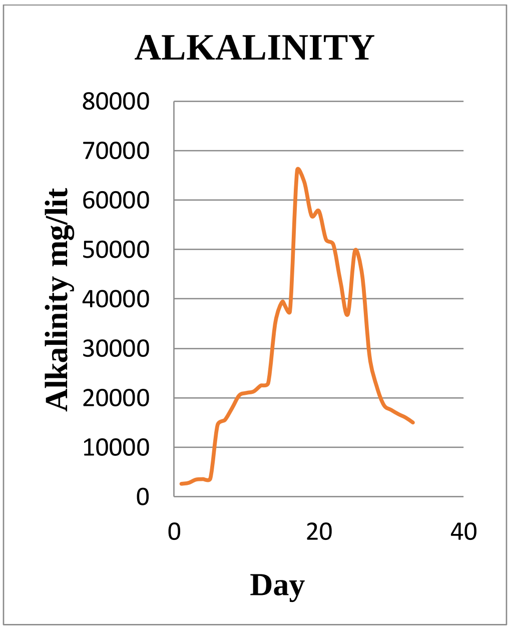

Fig 3.7 Alkalinity for digester-2

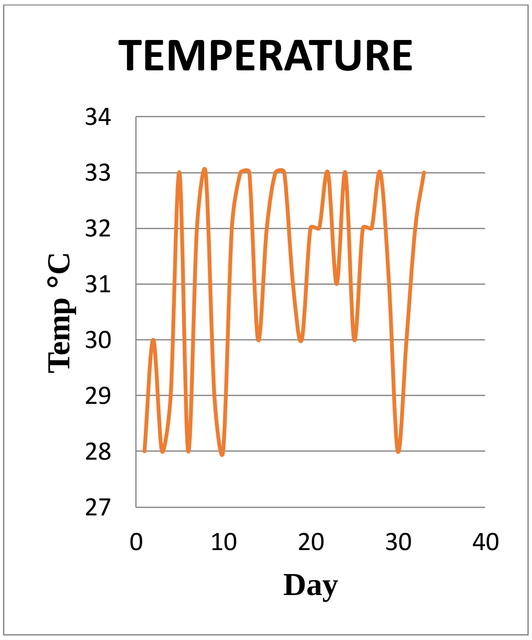

Fig 3.8 Temperature for digester-2

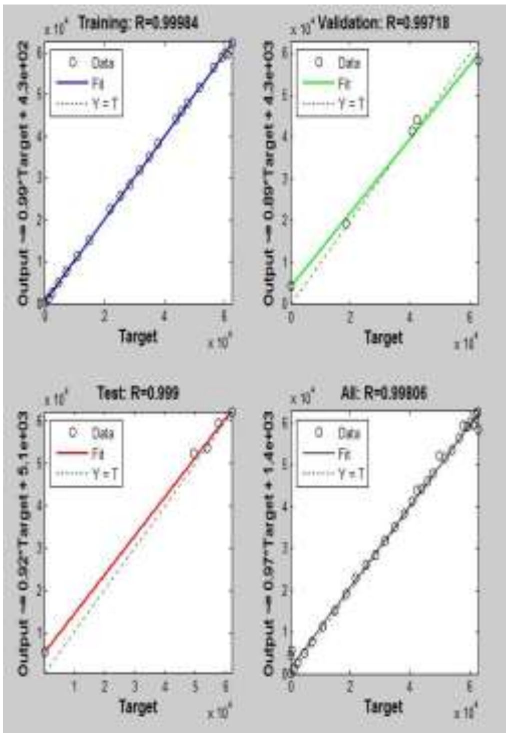

Fig 3.9 :Regression analysis Using ANN

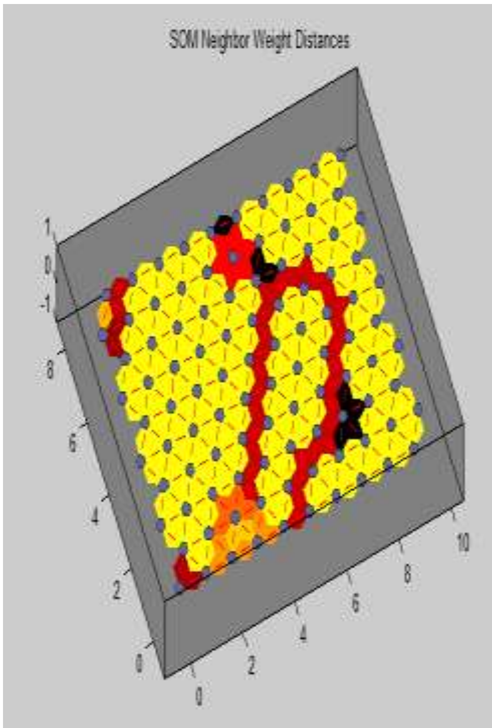

Fig3.10:SOM Possible weight distances

Conclusion

The Results of this study has been shown clearly that sheep droppings and food wastes, when used in combination are good substrates for biogas generation. The D-2 (80:20) co digestion of sheep droppings and food waste produce 62.71 l/kg in 33 days. The D-1 (100:0) sheep droppings produces around 85.450 l/kg in a 16 lit of slurry under a mesophilic temperature 27°c to 33°c. The application of biogas using sheep droppings can provide various benefits both in term of environment and providing alternative energy resources. This technology should be developed and ensured its sustainability. We got a considerable rise of gas production in the digester 1, digester 2.

List of Symbols and Abbreviations

(C:N- Carbon Nitrogen; AD- Anaerobic Digestion; HDPE- High Density Poly Ethylene; LPG- Liquefied Petroleum Gas; MO- Micro Organism; VFA- Volatile Fatty Acid; WTE- Waste To Energy; TS- Total Solids; VS- Volatile Solids; WH- Water Hyacinth)

References

1. Amelounnar, Lamia Benhabyles and SadekIgoud., "Energetic valorization of biomethane produced from cow dung," procedia engineering 33 (2012) 330 – 334.
2. F. Almomani, F.Shawaqfah, R.R. Bhosale, a. Kumar, and M.A.M. Khraisheh., "Intermediate ozonation to enhance biogas production in batch and continuous systems using animal dung and agricultural waste," 3rd November 2016 in Elsevier
3. IS Code 9478 – 1989 family size biogas plant.
4. K.Karthick, K.S.Prabhakaran, K.Visagavel, "Effective use of bio waste in institutions," (2014).
5. Karthik Rajendran, Solmaz Aslanzadeh and Mohammad J. Taherzadeh, "Household Biogas Digesters,"(2012),—A Review.
6. LetaDeressa, Solomon Libsu , R . B.Chavan , Daniel Manaye and Anbessa Dabassa., " Production of biogas from fruit and vegetables wastes mixed with different wastes," Environment and ecology research 3(3): 65-71, 2015.
7. m.r. Al-masri., "Changes in biogas production due to different ratios of some animal and agricultural wastes," 10 august 2000 in Elsevier.
8. Mohammad roman miah, Abdul kalammd.Lutfor Rahman, Muhammad Rajibulakanda, Abdullah Pulakand AbdurRouf., "Production of biogas from poultry litter mixed with co substrate with cow dung," journal of taiga university for science 10 (2016) 497–504.
9. Molla Asmare., "Design of cylindrical fixed dome bio digester in the condominium houses for cooking purpose at Dibiza Site," East Gojjam, Ethiopia. American Journal of Energy Engineering. Vol. 2, No. 1, 2014, pp. 16-22. doi: 10.11648/j.ajee.2014.02.01.12.
10. Nathan Curry, Pragasen Pillay, "Biogas prediction and design of a food waste to energy system for the urban environment," (2011).
11. S.Mohan and K.Jagadeesan., "Production of biogas by using food waste," vol. 3, issue 4, jul-agu 2013, pp. 390-394.
12. S.S.Kanwar and A.K.Kalia., "Anaerobic fermentation of sheep droppings for biogas production," 1984.
13. Sanaullah Ahmad, Khalid Mahmood, Muhammad Anas, "Designing and Strategic Cost Estimation of Biogas Plant: An Alternative for Current Energy Crisis in Pakistan," (2015).
14. Sathish R, Desai.Vijaykumar and Rajeshwar Mathad, "Performance evaluation of fixed dome type biogas plant for solid state digestion of cattle dung," (2013).
15. Stefan Junne, Kozani, "Basics of the Biogas Production Process," (2014).
16. SuyogVij, "Biogas Production From Kitchen Waste," (2011).
17. Wante H. P., And Galadima .A.I., "Determination of biogas yield from co- digestion of cow and goat dung," annals of biological research, 2014, 5 (9):59-65.

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