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A review – To treat the solid waste or organic waste by using anaerobic digestion process

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ABSTRACT

Generation of solid waste from community can segregate in two major categories, first category is organic waste and second is inorganic waste but treatment of organic waste is tedious process. It need sequential process to convert complex organic matter into simpler one, bacteria's plays very important role to decompose organic matter present in simpler one. During the process of decomposition gasses get release, some of the evolved gasses are useful and can use as a fuel called as biofuel. Biogas or methane is one of the important biofuels generated during anaerobic decomposition process. Biogas is to be produce from the raw material like vegetable waste, fruits waste by break down of organic waste in the absence of oxygen for generate methane and carbon dioxide. Biogas is the mixture of methane, carbon dioxide (CO_2), H_2S and other gases. For generation of biogas active digestion process is to be used. Energy or biofuel generation from organic waste is economical any easy. Generally, in rural areas biogas is to be generated. The generation of vegetable waste is increasing day by day from every households. The Vegetable waste can be used for biomethanation process which is anaerobic digestion using biogas plant. The biogas plant is simple technique to produce methane. The biogas is non-conventional source called as gobar gas. In rural India, the daily wastes obtained from animals can use as raw material for biogas plants called "Gobar gas". Anaerobic treatment systems are **divided into 'high-rate' systems with biomass retention and 'low-rate' systems without biomass retention.**

Keywords— *Anaerobic Digestion, Biogas, Energy, Vegetable*

1. INTRODUCTION

Biogas is the mixture of gases. This biogas is to be produce by break down of organic matter in the absence of oxygen in which methane is generated. This gas is to be produce from raw organic material like vegetable waste and other organic matter so as to get anaerobic digestion and also for methane generation. This is to be carried out in the anaerobic digester. The biogas is Nothing but the methane and carbon dioxide is combusted with oxygen. This method is easy to adopt and economical. The methane production is totally depending upon quantity of raw organic material). Biogas is the renewable energy source and it can be used in various ways Like power engine, mechanical power, heat and electricity, fuel boilers and furnaces, heating digester, run alternative fuel vehicles, supply home and business through the natural gas pipeline. The process in which micro-organisms breakdown the degradable materials in the absence of oxygen are called as anaerobic digestion. Methane can be generated from the organic waste by the method of anaerobic digestion. The micro-organisms like acetic acid-forming bacteria (acetogens) and methane-forming archaea (methanogens) helps in various chemical processes for converting biomass into biogas. Oxygen containing products are totally removed from container before reactions. When the oxygen is obtained from the organic material (waste) in anaerobic condition, the intermediate product is forms like alcohol, aldehydes, organic acids. Now in the presence of microorganisms like methane forming archaea (methanogens), These intermediate products are converted into final end products of methane and carbon dioxide. The increase in the number of micro-organisms takes the sufficient time developed themselves to be fully effectives. The main objective of this research is to employ anaerobic digestion process as a sustainable technology for digesting the vegetable wastes and solid waste produced in large amounts during harvesting, handling, transportation, storage, marketing and processing, and to provide the non-conventional source of energy as well as to reduce the potential greenhouse gas emission.

1.1 Bio Chemical Process

The anaerobic digestion process is to be carried out in airproof reactor tank called as digester for production of biogas. In

anaerobic digestion process various group of microorganisms involved which generate energy rich biogas and nutrients. The breakdown of organic matter begins which involves four stage of chemical process which converts the matter into usable biogas.

Fig. 1: Biogas plant for manure digestion Praktijkcentrum Sterksel, The Netherlands

1.2 Hydrolysis

Biomass is made up of large organic polymers. To access the potential energy of the material. These large chains constitute is to be broken down into small constitutes like polymer into monomer. This process of breakdown of large chain into single chain and also dissolution of smaller molecules into the solution is called as hydrolysis through hydrolysis the organic molecules is to be break down into smaller molecules like amino acid, sugar and fatty acid. In the very First stage acetate and hydrogen is produced. This molecule can be used directly as methanogens.

1.3 Acid genesis

Acid genesis is the biological process. In which the remaining compounds is to be break down by fermentative bacteria i.e. Acid genesis. The process Acid genesis is very similar to process milk sour. The microorganisms of facultative and anaerobic groups are called as acid formers, hydrolyze and ferment. This is production of first face i.e. water-soluble substances is volatile acid. Acetic acid is the major component in volatile acids. Prop ionic acid and butyric acid is to be form from the addition of acetate or hydrogen and carbon dioxide.

1.4 Cytogenesis

In the third stage of Cytogenesis, breakdown of carbohydrates take place to convert them into acetate, carbon dioxide and hydrogen. This reaction takes in low concentration of hydrogen. This reaction is critical due to presence of hydrogen consuming bacteria. This reaction converts ethanol, glucose and propionate to acetate.

2. METHANOGENESIS

2.1 Parameters of anaerobic digestion

2.1.1 Feedstock of anaerobic digestion: Feedstock is also called as raw material or input material. We can distinguish between solid content and water content. Solid content (dry content) also called as total solid. Now some of this total solid are biodegradable and some total solid are non-biodegradable. Biodegradable solid are relevant that is called volatile solid. level of total solid and volatile solid in waste differs depending on the type of waste. Following are the example of different waste feedstock based on solid waste.

Table 1

Substrate	TS (% of raw waste)	VS (% of TS)
Spent fruits	25-45	90-95
Vegetable wastes	5-20	76-90
Market wastes	8-20	75-90
Leftovers(Canteen)	9-37	75-98
Overstored food	14-18	81-97
Fruit wastes	15-20	75-85
Bio wastes	25-40	50-70
Kitchen wastes	9-37	50-70
Market wastes	28-45	50-80

Following are the example of different amount of methane based on solid waste.

Table 2

Substrate	Methane Yield (L/KgVS)
Palm oil mill waste	610
Municipal solid waste	360-530
Fruit and vegetable wastes	420
Food waste	396
Rise straw	350
Household waste	350
Swine manure	337
Maize silage and straw	312
Food waste leachate	294
Lignin-rich organic waste	200

2.1.2 Organic loading rate (OLR): Organic Loading Rate (OLR) An important parameter of AD is the Organic Loading Rate (OLR). This parameter quantifies the substrate quantity per reactor volume and time. An unstirred daily loading rate of reactor is 2 or below 2 and with stirred loading rate is higher up to 8. This daily loading rate having unit is kilograms volatile solids per cubic meter and day.

2.1.3 pH: The pH for anaerobic waste is in between 6.5 to 7.5. However, in the acidic phases, the pH is rather lower, whereas in methenogenic phase it is somewhat higher. When the loading rate is high acidogenic bacteria will cause acidification of the reactor. Methanogenic are rather more sensitive to these conditions and will thus be inhibited. pH level should be increase by reducing the loading rate or also it should be increase by adding lime and sodium hydroxide.

2.1.4 Temperature: Temperature is another factor influencing the AD process. A temperature below 15^0C is not ideal. If temperature goes down from 15°C organism slow down their reaction. There is a variation in temperature due to underground construction of biogas plant Anaerobic digestion is comfortably carried in two temperature zone.

(a) The mesophilic temperature zone between 30 to 40°C
(b) The thermopile temperature zone in between 45 to 60°C.

Operation on the mesophilic range is more stable and can tolerate greater changes in parameters and consume less energy. However mesophilic organisms are slower in degrading so you need to give them thermophilic organism, it is a faster but the system is more sensitive to changes.

2.1.5 Hydraulic Retention Time (HRT): It is the 5th parameter of AD that influence the process is hydraulic retention time. That is amount of time that the material stays in the reactor. Ideal is a time between 10 and 40 days. In thermophillic range, the lower value for higher temperature, because the process is quicker. If there is a small volume of reactor then the retention time is also slow, that means we get little biogas, because of little time for the process. If volume of reactor is large then the large retention time is required so that we get more biogas. Large volume required large space and higher investment cost.

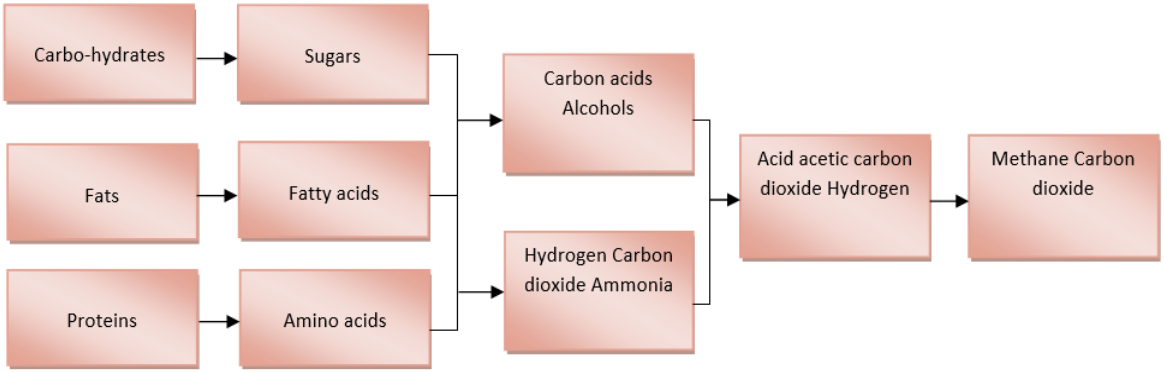

Fig. 2: Methanogenesis process

2.1.6 C/N Ratio: We have heard about this in the composting module. Ideal is a value between 16 and 25. There is a less biogas production because of limited supply of nitrogen that means less food available for bacteria. So that they are not capable for produce that much amount of gas. A lower C/N ratio cause ammonia accumulation which then inhibits the anaerobic process.

2.1.7 Particle size: Particle size below 5cm is ideal. What that does ,it increase the surface area of the material and allowes the micro-organisms to faster degrade the material. For operation that means , that usually we chop up through shredder our input material to make small particle..

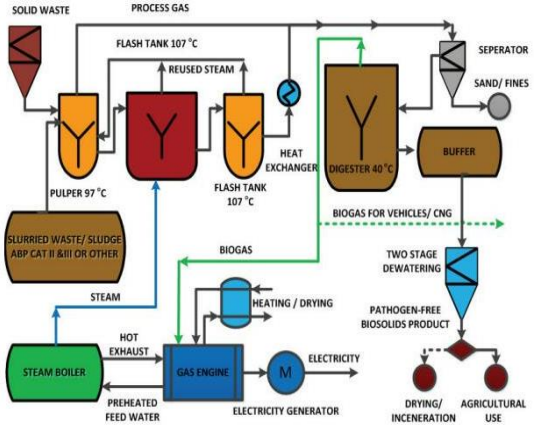

Fig. 3: Schematic View of the waste treatment process

3. WORK OF ANAEROBIC DIGESTION PROCESS

Some of organic matter break down more easily than others. Generally, the more digestible organic matter is the more biogas can be produced. Co-digestion occurs when. anaerobic digestion is used to break down more types of organic waste in one anaerobic digester. Biogas production is best suitable for farms that collect waste material from animals

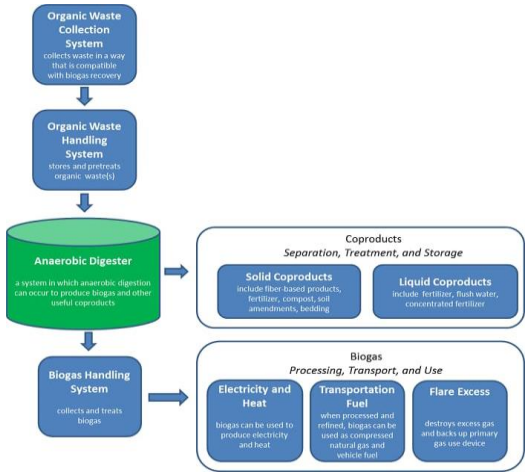

Fig. 4: Anaerobic Digestion Process

(a) Organic Waste Collection System: As a liquid, semi-solid. Most of the large amounts of bedding or other materials (e.g. rocks, stones, straw or sand), which cannot block the pipes of the digester and hinder operation.

(b) Organic Waste Handling System: waste may be pre-treated before entering a digester to adjust the total solids content. This may include addition of water, separating solids, mixing.

(c) Anaerobic Digester Designs: In a covered anaerobic lagoon design, methane is recovered and piped to the combustive device from a lagoon with a flexible cover. Some systems use only single cell for combined digestion and storage.

(d) Coproduces: Solid and Liquid Components: Digested solids can be removed from the digester effluent with a solid's separator. Solids are commonly used as livestock bedding, but can also be sold for use in landscape products, such as soil modification s or biodegradable planting pots. The liquid effluent from a digester can be used as a fertilizer which can be reduced the purchase of commercial fertilizers.

(e) Biogas Handling Process: Captured biogas is transported through a pipe from the digester, directly to a gas use device or to a gas treatment system. In most of the cases, the only treatment needed is to remove excess moisture prior to combustion.

(f) Biogas: Processing, Transport and Use:

(i) Electricity and Heat: While a variety of biogas use options are available, the collected biogas is most often used to generate electricity.

(ii) Transportation Fuel: Biogas can be processed to pipeline quality and sold to the local gas utility. Biogas can be converted to compressed natural gas (CNG) which can be used as vehicle fuel or burning fuel.

(iii) Flares Excess: Flares are used to are used to burnt excess biogas or to combust biogas during periods when the primary gas use device is undergoing maintenance or repair.

Fig. 5: Vagron Plant (Groningen) for seperation and digestion of the organic fraction of MSW

4. LITREATURE PAPER

1) Ms Await Jamil Maskhoot Al Saadi, Dr. Lakkimsetty NageswaraRao On July 2016, **1**In this literature paper there is the treat the organic solid waste in the organic waste the three types of waste are use which is grain waste, vegetables waste and fruit waste for treating the organic waste and the more production of the methane use the anaerobic digestion process this process run in a close container and run for 30 days. The result after 30 day is the methane production in high amount from the grain waste at 40°C - 36°C in variations with respect to days the production is 2500ml of methane. And the second-high amount of methane production from fruit waste is 2000 ml at 40°C -37°C temperature. And the lowest amount of production of methane from the vegetables waste is 1000ml at 26°C-22°C. The production of methane in most of the cases is depend on the carbohydrates and sugar present in the organic waste.

2) W. N. Schirmer, J. F. T. Juca, A. R. P. Schuler, S. Holanda and L. L. Jesus On July 28 , 2013 **,** In this literature paper the various parameters are use like Total Kjeldahl Nitrogen (TKN) , moisture content, Volatile Solids (VS) , Chemical Oxygen Demand (COD), phand alkalinity of fresh refuse, old refuse in this method the phone value for methane formation is neutral and slightly alkaline and the volatile matter is good parameter for the biodegradable organic matter degradation . Anaerobic digestion method are use for the generation of methane from fresh and old refuse there is the comparison between the production of methane from old refuse and fresh refuse. The production of biogas for the fresh refuse is 1816 NmL and for 1-year old refuse is 1846 NmL.

3)Yebo Li*, Stephen Y. Park, Jiying Zhu on 16 July 2010 In this literature paper the solid state anaerobic digestion operated at the solid concentration of 15- 40% has widely apply for the processing of municipal solid waste (MSW), agricultural waste, food waste for the production of energy. The end product of solid-state anaerobic digestion include biogas (60-70%methane) and an organic residue reach in nitrogen

4) Dhanalakshmishridevi V1, and Ramanujam R. A2, 16th February 2012, In this literature review, the vegetable waste and fruit waste containing the high carbohydrate are amenable to the anaerobic digestion process and then it is generated the maximum gas production was observed during 5-1 days of digestion.

5) Pradeep Kumar, Vijay V2, Arunkumarthalla, Hiya Char, Sunil Kumar, 13 March 2015, in this literature review, the effect of anaerobic sludge in any kind of bio-waste in production of CH_4 (methane) is significant, higher the quantity of anaerobic sludge higher will be the methane production. Studied demonstrated production of 30L CH_4/kg VS added and 54 L CH_4/kg VS added from Run 2 and Run 3 respectively in term of TVS added. There is a prevalence and inverse relationship between TVS degradation and methane production.

6) Jeff Kuoa and Jason Dow on March 28, 2017 In this literature paper organic solid waste are treat in A waste water treatment plant and the organic waste is food waste and FOG are used for the generation of the energy and the remaining waste material is use as a fertilizer this fertilizer is less chemical fertilizer. The biogas Production rate is 1.15 m3 VS destroyed with 33% more VS loading from FOG and food waste the daily biogas production is 60% more. The various gases and compound are from during the process.

5. CONCLUSION

The various papers in the review described that the methane production is the alternate source of fuel. Day by day natural natural source will be decreases with increasing population and from this waste also goes on increasing significantly so that there is best solution ‘make something best from waste'. Methane generation is totally depending upon the type of biomass used. Catalyst is also used to increase the speed of chemical reaction. After extraction of methane, large amount of de-oiled is also produce and other unused. This waste is to be again recycle and convert it into the biogas.

Above observation we conclude, anaerobic digestion process is work efficiently to generate methane from organic and solid waste. The pH value for methane formation is in between 6.5 to 7.5 or neutral and slightly alkaline. The process of anaerobic digestion is easy to understand compare to aerobic digestion and the volatile parameter is very important parameter for anaerobic digestion process Oxygen source in an anaerobic system

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