ENERGY FROM WASTE USING BIOGAS PLANT AND PROVIDING ECONOMIC BENEFIT TO HOSTEL KITCHEN MESS

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Abstract

Increase in energy demand and the issues about current non-renewable energy resources led researchers to investigate alternative energy sources during the last two decades. Renewable energy resources draw attention all over the world because they are sustainable, improve the environmental quality and provide new job opportunities in rural areas. Biogas is a clean renewable energy produced from organic wastes using anaerobic digestion as a method. The products of the digestion are biogas and residue. Biogas is a mixture of methane (CH4) with percentage over than 65% and carbon dioxide (CO2). CH4 is the highest component of natural gas. Methane is the main combustible gas in biogas. The biogas is useful as a fuel substitute for firewood, dung, agricultural residues, petrol, diesel, and electricity, depending on the nature of the task, and local supply conditions and constraints, thus supplying energy for cooking and lighting. Biogas systems also provide a residue organic waste, after anaerobic digestion that has superior nutrient qualities over the usual organic fertilizer, cattle dung, as it is in the form of Ammonia.The present review aims to provide an overview of current debate on food waste definitions, generation and reduction strategies, and conversion technologies emerging from the bio refinery concept.

Keywords: Aerobic degradation, Waste Treatment, Biomass as bio fertilizers & CO2

Introduction

India is rich agricultural resources, accounts for 50 million tons of vegetable waste, which is about 30 % of its total production (Verma et al., 2011). Food waste is an unwanted raw or cooked food throw away during or after food preparation that is no longer fit for consumption or desirable (Jean et al, 2009). As food waste has high moisture content and can be decomposed rapidly, many unpleasant environmental consequences can arise during its storage, collection and transportation (Choi and Park, 1998). Microbial population of activated sludge is capable of degrading simple chemical structures from municipal wastewater, e.g. carbohydrates, short-chain fatty acids, simple alcohols, proteins and amino acids (Pike, 1975).

Kitchen Waste Sources: In Municipal Solid Waste, food and organic waste mostly consist of uneaten food and food waste generated to especially from residences (School, hospitals, universities, offices), and commercial (from restaurants, cafeteria, hotels, markets and industry) sources known as kitchen waste.

Kitchen waste is organic material having the high calorific value and nutritive value to microbes, that's why efficiency of methane production can be increased by several order of magnitude, using higher efficiency and size of reactor. The bio gas used can be used for cooking and lighting purposes. And also on large scale generation the cost of biogas production is reduced. Also in most of cities and places, residential communities, hostels of university campuses, agricultural market yards, fruits and vegetable market huge amounts of bio degradable wastes are generated and are being disposed on to the landfill or discarded in open dumping yards. (N et al., 2017)

Advantages of Biogas

Biogas systems make clean energy for household use. After an initial investment in the system, there is no need to spend money on fuel and no more smoke from wood or charcoal.

- Cooking on biogas is quicker and easier than cooking with firewood
- Biogas systems kill the bacteria in livestock manure. A farm with a biogas system is a cleaner and safer place.
- Biogas systems produce excellent safe fertilizers for use on the farm.
- Biogas systems can help in the fight against global warming by allowing us to burn methane from organic waste, instead of letting it escape into the atmosphere where it adds to the greenhouse effect. It also helps by letting us leave more trees standing.

Biodegradation of Kitchen Waste

Composting is considered one of the most suitable approaches for disposing of solid waste and for increasing the amount of organic matter that can be used to restore and preserve the environment (Stentiford, 1987). Aerobic composting involves a process of biological decomposition and stabilization of organic substrates under conditions that allow multiplication and activity of thermophilic microorganisms as a result of biologically produced heat, to produce a final product that is stable, free of pathogens, pests and plant seeds, useful in agriculture and forestry as manure (Balasundaran et al., 1999; Saravannan et al., 2003).

Literature Review

(Dinesh Kumar & Rajakumar, 2016) explained that with increasing energy demand in the World and to keep Environment Friendly, biogas technology has attained a notable position for the future scope. This paper tells about a comprehension review on anaerobic digestion of cow dung and food waste with Water hyacinths to enhance biogas productions. Water hyacinths are treated as waste in rivers, ponds, but they have high potential in biogas production.

(Dumitru, 2014) stated that food wastes have a high biomethane production potential because of their high organic matter contents. In his review paper also presented an overview on the fundamentals of anaerobic digestion (AD) of food wastes. The most important influential parameters on the biomethane production, including feedstock characteristics (nutrient contents, particle size, and inhibitory compounds) and process parameters (process configuration, pH, temperature, retention time, organic loading rate, agitation, hydrogen concentration, moisture content, and inoculum), are discussed in full.

(Tenzin et al., 2019) presented an overview of the biogas plant and optimization of gas production installed near students' dining room at College of Science and Technology (CST) located in the Southern foothills of Bhutan. The mixed kitchen waste produced is collected and directly feed to the biogas plant. This research is installed in collaboration with Department of Energy and College of Science and Technology as a pilot project with the aim "Waste-To-Energy Initiatives."

(Vikrant & Shekhar, 2013) explained that for biogas production anaerobic digestion is required. He also stated that for creating an Organic Processing we should have the facility to create biogas which will be more cost effective, eco-friendly, cut down on landfill waste, generate a high-quality renewable fuel, and reduce carbon dioxide & methane emissions. The anaerobic digestion of kitchen waste produces biogas, a valuable energy resource. Anaerobic digestion is a microbial process for production of biogas, which consists of primarily methane (CH4) & carbon dioxide (CO2).

(Ogur & Mbatia, 2013) stated that facing energy crisis and climate change, the world is in need of a green, efficient, carbon neutral energy source to replace fossil fuels. The search for energy alternatives involving locally available and renewable resource is one of the main concern of governments, scientists, and businesspeople worldwide. Biogas, formed by anaerobic digestion of organic materials, makes sustainable, reliable and renewable energy possible. There is potential for biogas production from kitchen waste, and at the same time the waste themselves can be treated to minimize the environmental impact and provide nutrient rich organic fertilizer.

(Lama et al., 2016) explained that due to the increasing demand for fossil fuels and environmental threat, a number of renewable sources of energy have been studied. Considering the present scenario there is a peak demand for energy in our country. An attempt is

made to assess the suitability alternate fuel like Biogas production from kitchen waste by anaerobic digestion was investigated. The kitchen waste had slightly higher solids and volatile solids (9.3% and 94.9%) content compared to cow dung (8.5% and 93.1%).

(Singh, 2018) explained that biogas production requires anaerobic digestion. We should go for creating an Organic Processing Facility to create biogas which will be more cost effective, eco-friendly, cut down on landfill waste, generate a high-quality renewable fuel, and reduce carbon dioxide & methane emissions. The anaerobic digestion of kitchen waste produces biogas, a valuable energy resource.

(Aisha Aliyu, 2017) worked on a comparative study of biogas potential of some selected kitchen wastes within Kaduna metropolis was carried out. The Volatile Solid, Total Solid, Moisture Content and Ash Content were examined. The materials used as feedstock were Food waste (yam peels, plantain peels, and potatoes peels) and fruit waste (orange and pineapple peels). Varying volumes of digesters were employed for biogas generation. The digestion process was carried out under ambient temperature for a retention period of 30 days. Anaerobic digestion is very sensitive to change in pH therefore pH was maintained at 6.7 - 6.9 for a healthy system.

CONCLUSIONS

Based on the literature survey, it can be concluded that kitchen waste is very useful and very harmful to our day life in different conditions. It can be used for biogas, an organic acids, biofertilizers, and biomass production as humus which contain biological activity and associated with many major roles for fixation of environmental parts. Due to its degradation is becoming a great challenge because kitchen waste made up of biological polymer substances which provide nutritional substances for growing pathogenic microorganisms. Various treatment methods are available in the literature but the cheapest, eco-friendly and acceptable method is aerobic degradation (composting) by aerobic microbes. The anaerobic microbes release the extracellular enzymes such as hydrolytic enzymes involve in degradation of kitchen waste in anaerobic conditions and produces methane gas act as a global warming factor. So composting methods is a suitable for controlling of methane and global warming effect in environment.

REFRENCE

1. Verma, N., Bansal, N.C., Kumar, V. 2011. Pea peel waste: a lignocellulosic waste and its utility in cellulose production by Trichodermareesei under solid state cultivation. Bioresources, 6, 1505–1519.
2. Jean, Nathalie -Baptiste, 2009. People & Food waste-The practice of everyday life;
3. Choi, M.H., Park, Y.H. 1998. The influence of yeast on thermophilic composting of food waste. Letters in Applied Microbiology, 26, 175-178.
4. Pike, E.B. 1975. Aerobic Bacteria, in: Ecological Aspects of Used Water Treatment, Curds, C. R. and Hawkes, H. A. (Ed.), Vol. 1, Academic Press, London, pp 1–63.
5. N, S. R., V., S. S., & G., S. (2017). Bio Gas Generation from Biodegradable Kitchen Waste. *International Journal of Environment, Agriculture and Biotechnology*, *2*(2), 689–694. https://doi.org/10.22161/ijeab/2.2.15
6. Stentiford, E.J. 1987. Resent developments in composting. In: STROM, P.F. 1985. Applied and Environmental Microbiology, 50, 899
7. Balasundaran, M. 1999. Chemistry and Process of Composting. In: Balasundaran, M., Sharma, J.K., and Chacko, K.C., (eds.), Compost for Container Seedling Production in Forest Nurseries. Kerala Forest Research Institute, Peechi, Thrissur. pp 31-36.
8. Dinesh Kumar, K. K., &Rajakumar, S. (2016). International Journal of Research in Science and Technology Review on Biogas Production From Co-Digestion of Cow Dung and Foodwaste With Water Hyacinth. *International Journal of Research in Science and Technology (IJRST)*, *6*, 2249–2604.
9. Dumitru, M. (2014). Considerations over a biogas plant components. *Scientific Papers Series - Management, Economic Engineering in Agriculture and Rural Development*, *14*(1), 121–126.

10. Tenzin, T., Wangdi, S., Dorji, G., Nepal, P. K., Tamang, S. W., Tshering, L., Pradhan, P., &Pradhan, B. (2019). Optimization of biogas production from kitchen waste installed at college of science and technology. *2018 International Conference on Computing, Power and Communication Technologies, GUCON 2018*, *November*, 956–960. https://doi.org/10.1109/GUCON.2018.8674963
11. Vikrant, D., &Shekhar, P. (2013). Generation of Biogas from Kitchen Waste -Experimental Analysis. *International Journal of Engineering Science Invention ISSN (Online*, *2*(10), 2319–6734.
12. Ogur, E., &Mbatia, S. (2013). Conversion of Kitchen Waste into Biogas. *The International Journal of Engineering and Science (IJES)*, *2*(11), 70–76.
13. Lama, L., Prasad, S., Lama, R., &Adhikari, J. R. (2016). Production of biogas from kitchen waste. *L Rentech Symposium Compendium*, *2*(7), 218–221.
14. Singh, A. K. (2018). Relative Analysis of Biogas from Kitchen Waste. *IOSR Journal of Engineering (IOSRJEN) Www.Iosrjen.Org ISSN*, *08*(9), 1–12.
15. Aisha Aliyu, A. (2017). Biogas Potential of Some Selected Kitchen Wastes Within Kaduna Metropolis. *American Journal of Engineering Research (AJER)*, *l*(6), 53–63.