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Kitchen Waste to Biogas -A Smart Energy

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ABSTRACT

Inadequate management of solid waste like uncontrolled dumping leads to several adverse effects like polluting the surface and ground water through leachate. It further promotes the breeding of flies, mosquitoes and other vector born diseases. Also, it leads to release of unpleasant odour and methane a major green house gas contributing to global warming. An attempt was made to manage the kitchen waste which is highly nutritive to microbes to synthesize methane by creating an eco-friendly and cost effective biogas plant especially in residential hostel's backyards.

Graphical Abstract

Experimental Setup

Keywords: Solid waste, Sold waste management, Biogas, Methane.

INTRODUCTION

Growing energy needs are threatening the non-renewable energy resources throughout the world. These needs made each and every corner of the world to search for green substitutes, of all the green renewable energy sources like Solar, Wind, Tidal, Hydel, Geothermal, Biomass sources are discrete. The reason is of their easy collection, utilization, zero waste process, not having any geographical limitations and not requiring any advanced technology for production.

In most of the developing countries like India, China, Bangladesh- Kitchen waste is disposed in landfill or discarded in open which promotes the breeding of flies, mosquitoes and vector born diseases. It also pollutes ground and surface waters through leachate. It further leads to release of unpleasant odour and methane a major green house gas contributing to global warming. In this regard an attempt is made to manage the kitchen waste which is highly nutritive to microbes to synthesize methane by creating an eco-friendly and cost-effective biogas plant especially in residential hostel's backyards where plenty of food wastes are released. In this project biogas is produced using varieties of kitchen waste i.e raw and cooked food in Aluminium digester which helps to maintain sufficient temperature. The gas produced is burnt in blue flame. It is observed that the produced gas compensate nearly 50% of the LPG consumption. The sludge retained in the bed can be used as manure.

From the long period of time world wide a wide research efforts have targeted to develop and implement more effective technologies for effective solid waste management. Our interest in solid waste management made us to focus on Biogas production from kitchen waste.

R.P. Agrahari and G.N. Tiwari [1] explained that Kitchen waste is the best alternate for Biogas production in community level. S. P. Kale and Mehel [2] compared the conventional and non-conventional biogas units. A.D. Karve [3] designed the low cost compacted biogas plant and explained the production of biogas with some seasonal variations. Shalini sing *et al* [4] used the microbial activating substances with anaerobic fermentation of cattle dung and kitchen waste and examined the biogas production. Peter Wieland [5] explained that anaerobic digestion of waste minimizes the growth of pathogens and was an effective technique for energy production. Considering the different aspects specified in these literature reviews we designed our own biogas digester and used different waste materials from kitchen for production.

MATERIALS AND METHODS

Materials Used: These are-vegetable peels, rotten fruits and vegetables, cooked rice, raw and cooked meat, tea waste, milk products waste, aluminium digester, inoculum, pressure gauge, gas node. The percentage of materials used is coded in figure1.

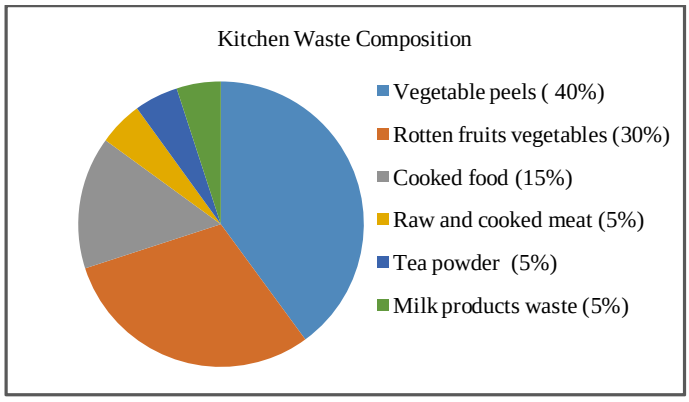

Figure 1. Kitchen Waste Composition

Experimental Setup: An aluminium digester of capacity 50 kg was fixed with pressure gauge and gas node.10 kg of waste was grinded to fine paste. It is mixed with 20 L of water and 5 L of inoculum. Slurry collected from the biogas plant from a nearby village was used as inoculums to enhance the methanogenesis. After proper mixing of contents, the digester was kept in sunlight which is slightly shaded to maintain temperature essential for bacterial growth. The gas obtained was weighed to measure the production intensity.

Experimental Setup

RESULTS AND DISCUSSION

In the present study it was observed that from the first day on wards i.e. after 24 h of the experimental setup, the gas was collected in the tank. The amount of fuel collected was measured as 0.320 kg on the first day. The day wise production of the biogas is tabulated in table.1 and figure 2. In the initial two days the splinter was blown off indicating the CO_2 accumulation in the tank. From the third day onwards we observed the flame burning with blue flame indicating the presence of methane.

Table 1. Biogas Production

Number of Days	Production in kg	Number of Days	Production in kg
Day 1	0.32	Day 9	8.37
Day 2	0.99	Day 10	9.99
Day 3	1.69	Day 11	11.20
Day 4	3.92	Day 12	12.78
Day 5	4.32	Day 13	8.13
Day 6	5.98	Day 14	6.27
Day 7	6.84	Day 15	3.92
Day 8	7.98	--	--

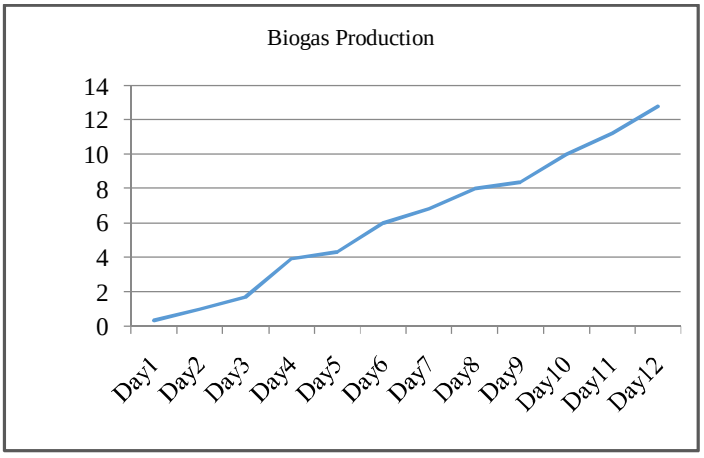

Figure 2. Biogas Production

APPLICATION

This study gains importance in the use of kitchen waste in production of biogas is an effective tool for waste management and helps as a solution for resource development and removes economic crisis in long run.The solid residues retained in the tank can be used as organic compost, which would highly compensate the synthetic fertilizers usage and helps in developing sustainable environment.

CONCLUSION

From our experiment it is evident that 10 kg of kitchen waste produces nearly 11.20 to 12.78 kg of biogas. According to literature review the hostel population with capacity of 200 people releases nearly 60 kg's of waste per day. Then the biogas production will be 650 to 750 kg day^{-1}. Not all the kitchen waste generates the same amount of biogas, in an average this reduces the LPG consumption in a grand way i.e nearly 20 kg LPG day^{-1}. Our study gains importance in the use of kitchen waste in production of biogas is an effective tool for waste management and helps as a solution for resource development and removes economic crisis in long run. The solid residues retained in the tank can be used as organic compost, which would highly compensate the synthetic fertilizers usage and helps in developing sustainable environment.

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