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Manure and Distributed Energy From An Institutional Generated Food Waste Through IOT Control

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ABSTRACT

In our nation we have several places where all having their own individual mess. Taking example of our college, where daily a large amount of kitchen waste is obtained which can be utilized for better purposes. Biogas production requires anaerobic digestion. Project was to create 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. Overall by creating biogas reactors on campus in the backyard of our hostels will be beneficial. Kitchen (food waste) can be collected from hostels and canteen as feedstock for our reactor which works as anaerobic digester system to produce biogas energy. The anaerobic digestion of kitchen waste produces biogas, a valuable energy resource.
Keywords: Digester tank, Methane storage tank, Conveyer belt, Bluetooth module.

I. INTRODUCTION

Anaerobic Digestion (AD) is a process in which micro organisms break down biodegradable material in the absence of oxygen. The process is widely used to treat wastewater sludge's and industrial and farm wastes because it provides volume and mass reduction of the input material (up to 50% reduction). Anaerobic digestion is considered a renewable energy source because the methane rich biogas produced is suitable for energy production and can replace fossil fuels. As part of an integrated waste management system, AD reduces the amount of methane that would be sent into the atmosphere if the waste was just sent to the landfill .Additionally, the nutrient rich solids and liquids left after Digestion can be used as fertilizer.The anaerobic process itself is a very complicated Biochemical process, Based on temperature and input Substrate, different strains of bacteria digest complex chains of carbohydrates, fats and proteins into their component parts. In food waste applications, the first phase of Hydrolysis can be separated from the rest as little methane is produced in this phase and the input substrate can be pasteurized to adhere to waste handling regulations. The last stage of the process, Methanogenesis, is where the biogas is produced and it can contain 65-70% methane which can be used for heat and power application, above all these process can be controlled and maintained by using IOT.

II. METHODOLOGY

Biogas can be obtained from anaerobic digestion this have three main Phases.

1. First Stage.
2. Second Stage.
3. Third Stage.

1. **First stage**

Complex organic compounds are attacked by hydrolytic and fermentative bacteria, which secrete enzymes and ferment hydrolyzed compounds into acetate and hydrogen .A small amount of the carbon converted will end up as volatile fatty acids, primarily propoinic acids and butyric acids.

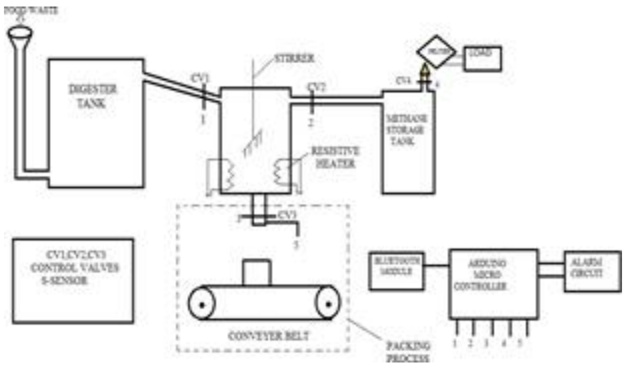


Figure 1. Fermentative Bacteria

1. **Second *Stage***

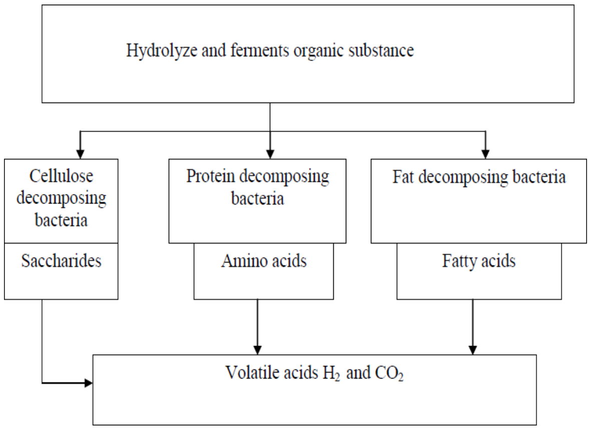


Figure 2. Block Diagram

The process involved in the above diagram is explained below:

The hydrogen- producing acetogenic bacteria continue decomposing by converting the volatile fatty acids into acetate and hydrogen producing acetogenic bacteria.

2. **Third Stage**

Methane –producing bacteria convert the hydrogen and acetate into methane .There is a certain amount of specialization in that different bacteria act on different substrates.

In order for these bacteria to work properly and achieve the desired end products, the following conditions have to be well balanced :

1. The dilution of the substrate i.e. amount of water to dilute the animal waste.
2. The optimum temperature which should be 350C.
3 .Type of substrate (due to their suitable carbon to Nitrogen (C: N) ratio and total solid content cattle, pig and poultry manures are recommended).
4 Rate of feeding the digester (overfeeding can lead to accumulation of volatile fatty acids).

- ✓ The food waste is first hydrolyzed and then dumped to the digester tank through the funnel
- ✓ The food waste is in semi liquid form and is allowed to decay for about 40 days. The decay period may vary depending upon the rigidity of the food waste.
- ✓ The slurry produced is heated using resistive heater. The heating produces the required methane gas.
- ✓ The produced methane gas is stored in the methane storage tank and is heated and used when required.
- ✓ The methane gas is burnt to produce electricity by peltiers.
- ✓ After heating, the retained waste is packed by automation.

III. PROCEDURE

As the project was on small scale, we employed all regularly available materials to create the working proto type of the model.

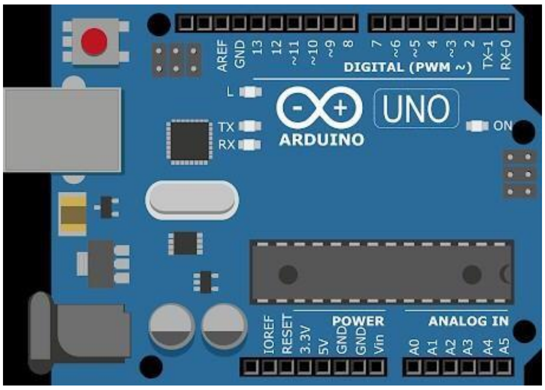
1. Substrate inlet: This consists of a receptacle for the raw fresh organic waste and pipe leading to digester. The digester must be air tight.

2. Digester: This is the reservoir of organic wastes in which the substrate is acted on by anaerobic microorganisms to produce biogas.
3. Gas storage: This is simple empty chamber but enclosed space above the slurry in the digester, which has an inlet and outlet outfit.
4. Gas burner and Peltier coupler: This may be a modified burner for heating water and this is passed over peltier coupler to produce electricity.
5. Resistive heater: it is to heat the food waste to produce more biogas.
6. Exhaust outlet: This consists of a pipe of large size to facilitate outflow of exhausted slurry
7. Microcontroller (Atmel series): This is used to control the whole process. By connecting to Wi-Fi hotspot of the system we can control and operate the system.

IV. IOT-INTERNET OF THINGS

The Internet of Things (IOT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these objects to connect and exchange data. Each thing is uniquely identifiable through its embedded computing system but is able to inter-operate within the existing internet infrastructure. The figure of online capable devices increased 31% from 2016 to 8.4 billion in 2017. Experts estimate that the IOT will consist of about 30 billion objects by 2020. It is also estimated that the global market value of IOT will reach $7.1 trillion by 2020.

The IOT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.



3. BIOGAS

BIOGAS is produced by bacteria through the bio-degradation of organic material under anaerobic conditions. Natural generation of biogas is an important part of bio- geochemical carbon cycle. It can be used both in rural and urban areas.

components	Concentration(by volume)
Methane ($CH4$)	55-60%
Carbon-dioxide ($CO2$)	35-40%
Hydrogen sulphide ($H2S$)	20-20,000ppm (2%)
Ammonia($NH3$)	0-0.05 %
Nitrogen (N)	0-2 %
Oxygen ($O2$)	0-2%
Hydrogen (H)	0-1 %
water($H2O$)	2-7%

Figure 3. Composition of Biogas

PROPERTIES OF BIOGAS

1. Change in volume as a function of temperature and pressure.
2. Change in calorific value as function of temperature, pressure and water vapour content.
3. Change in water vapour as a function of temperature and pressure.

Energy content	6-6.5 kWh/m3
Fuel equivalent	0.6-0.65 1 oil/m3 biogas
Explosion limits	6-12% biogas in air
Ignition temperature	650-750 *C
Critical pressure	75-89 bar
Critical temperature	-82.5*C
Normal density	1.2 kg/m3
Smell	Bad eggs

Figure 4. General Features of Biogas

BENEFITS OF BIOGAS TECHNOLOGY

- ✓ Transformation of organic wastes to very high quality fertilizer
- ✓ Improvement of hygienic conditions through reduction of pathogens
- ✓ Environmental advantages through protection of soil, water, air etc.
- ✓ Micro-economical benefits by energy and fertilizer substitutes
- ✓ Macro-economical benefits through decentralizes energy generation and environmental protection

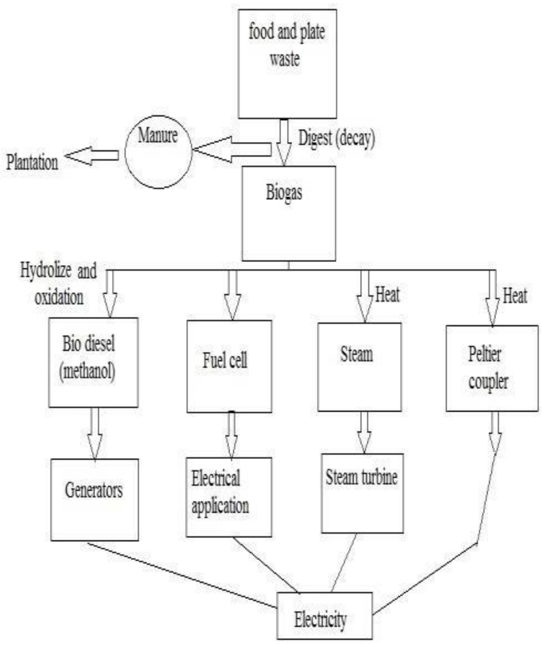


Figure 5. Web Diagram

V. OBJECTIVE

- The purpose of this is to find how the Institutional food waste can be managed by converting it into biogas and to design an anaerobic digester which uses food waste to generate the biogas.
- The waste generated in canteen/hostel in the form of vegetable refuse, stale cooked and uncooked food, milk products can all be processed in this plant.
- By this method we can achieve hygienic environment for an extent.
- Electricity generation from Institutional food waste.
- Manure from food waste sludge (scalable to entrepreneurial activity).
- Implementing advance technology for the process (IOT- Internet of things- Arduino).

VI. POSSIBLE OUTCOMES

- Generating up to 10w /kg of waste.
- Packaged organic manure for plantation in the college.
- Hygiene of the institution can be achieved.
- The food waste can be reduced by AD and we get biogas.
- The electrical energy can be generated using biogas.
- The slurry can be used as manure since it has nutritious values.

VII. ADVANTAGES

- Due to anaerobic digestion is implemented all milk and oil products also degraded by microorganisms.
- Due to automation through I O T methods it's easy to control the system.
- Low maintenance required and Eco friendly.

VIII. APPLICATIONS

- The food waste produced in the institution/hostel can be converted into electrical energy.
- Produced electricity can be used to institution or if produced in large scale it can be selling to power grids.
- Slurry which is very nutritious it can be used as manure for plantation.
- Biogas will be produced this can be stored in cylinders.

IX. REFERENCES

[1] Preparation study on food waste across EU 27, European Commission, 2010, pp. 210

[2] Waste to Energy: A case study from Thailand, Alice Sharp, 2010

[3] R.C.M. Michael von Massow, Preliminary Findings Residential Food Waste Numbers University of Guelph, 2011, pp. 4.

[4] Xian Fang Lou, Jaya Nair, G. Ho., Potential for energy generation from anaerobic digestion of food waste in Australia, Waste Management & Research, 31 (2016) 283-294.

[5] C.S.K. Lin, L. A.P faltzgraff, L. Food waste as a valuable resource for the production of chemicals, materials and fuels. Current situation and global perspective, Energy & Environmental Science,6 (2014) 426-464.

[6] Kale, S.P and Mehele, S.T. kitchen waste based biogas plant.pdf. Nuclear agriculture and Biotechnology/ Division.

[7] Karve .A.D. (2007), Compact biogas plant, a low cost digester for biogas from waste starch. http://www.arti-india.org.

[8] Karve of Pune A.D (2006). Compact biogas plant compact low-cost digester from waste starch. www.bioenergylists.org.

[9] Shalini sing, sushil kumar, M.C. Jain, Dinesh kumar (2000), the increased biogas production using microbial stimulants.

[10] Hilkiah Igoni, M. F. N. Abowei, M. J. Ayotamuno and C. L. Eze (2008), Effect of Total Solids Concentration of Municipal Solid Waste on the Biogas Produced in an Anaerobic Continuous Digester