

RENEWABLE ENERGY GENERATION FROM FOOD WASTE

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Abstract - Food wastes are messy, moist and can smell when left out in the open. Additionally, the gas that is created from these wastes has unpleasant smell and has a highly combustible composition. Here, we proposed a system that enables the collection of food wastes for anaerobic decomposition incorporating anaerobic digestion that is in absence of air. The produced biogas in a small scale can generate small amount of electricity. So, biogas at low levels can produce little quantities of electricity. The level of biogas production could be low without cow dung. In order to manufacture sufficient amount of biogas and turn it into power without the use of any extra complicated chemicals or components, a system has been created. The main purpose of the submitted paper is the production of electricity from Food Wastes. The proposed system will result in the production of biogas, which is then used to generate electric energy.

Keywords- Biogas, Organic Waste, Electricity, Renewable, Arduino

1. Introduction

Globally, one –third of food material is lost and exhausted on behalf of human and animal causes. One of the main issues affecting agriculture, as well as the people who depend on agriculture, is food waste. High levels of waste can lead to a rise in greenhouse gases, which have a significant impact on climate change. Energy and time used for growth and preparation are also squandered when processed food, vegetables, or fruits are thrown away. If not managed appropriately, food waste and organic waste can lead to sanitary and health issues. All of the materials, labour, and energy used to produce the food are wasted when it is not used properly. Finally, the organic waste is dumped in a landfill where it decomposes and may release methane, a dangerous greenhouse gas that can catch fire.[1,10]

Global warming results as a result of the ability of methane gas to trap solar heat. The problem described above has a solution provided by this project. The collected organic waste is decomposed by microbes without oxygen environment and converted to biogas, which is consisting of methane, carbon and minute quantities of other gases.. [2]. Electricity is generated using the aforementioned gas.

By utilizing microorganisms, recyclable organic matter is degraded by anaerobic digestion and is not contaminated by the ambience. In view of the fact that it offers a lofty quantity of food that is condensed by up to 50% while attaining the result, the above said method was employed in farming wastes, organic production and domestic wastes, and in water slush.[3]

From biodegradable wastes, such as cow dung, plants and animal wastes were commonly employed for the production of renewable energy using non-contaminating procedure. Cow faeces is a particularly extreme composition that produces more biogas. It is now commonly used in communities, and local residents use the generated biogas. [4]

In an integrated waste management system, Anaerobic Digestion (AD) is utilized as a procedure for the reduction of methane, greenhouse gas keeps rising in the environment when organic waste put in landfills were kept left to decompose [5]. The organic waste is handled with specified temperature and humidity. The detritivores are included

as shown on the Liquid Crystal Display (LCD) after food garbage is collected in a container. This decomposer supported in the anaerobic decomposition of organic waste. Microorganisms assist in the decomposition process when the food waste tank was closed at least for 10 days. The arrangement was left intact, and the biogas is generated [11].

After that, other elements need to be taken into AD system that is put up in an urban area. The biogas produced from AD process is utilized to generate heat. The heat energy can then be converted into electric power using a steam turbine. If any excess electricity is generated, it can be connected to a grid and used for a variety of applications including local consumption [6,7].

As a result, anaerobic digestion may transform food waste into power and a green energy source. The biogas produced after a few days have been used as fuel for the purpose of heating and cooking. The water in a boiler is now heated using biogas. In the boiler, water is transformed into steam. Through a tiny nozzle, the steam is released. As a result, the steam is released with high pressure [8]. The fan-blade begins to whirl as soon as the steam contacts it, creating mechanical energy which has been converted into electrical energy with the help of a generator. Direct use of the generated biogas for cooking is possible, and it can also be utilized to generate electricity. [9]

In fact, urbanized and emergent nations have Food Waste (FW) percentage in between 15% and 63% of their municipal waste streams [12]. This made FW a reflective substrate for energy generation and a sure way to address the ever-increasing challenges of food waste management especially in urban areas [13]. Besides, Anaerobic Digestion (AD) is one of the most potential technologies for the efficient recovery of energy from food waste by utilizing functional microbes for the conversion of the organic portion of FW into biogas with about 50 to 70% methane content [14]. Another method observed here was the composition of FW which will be different based on the types of food materials entering into the stream. This also necessitated that the components in the FW used in this study be treated individually in a fuel cell. All these were carried exclusive of prior optimistic management before actual fuel cell reactions. Glucose, starch, and protein were used as fuel in the fuel cells irrespective of the degradation and generation of electricity was computed [15].

2. Methodology and Materials Used

The proposed project consists of Load cell, a transducer which converts force into a measurable electrical output. It is located beneath a garbage bin, which collects organic waste. The weight of the food waste collected is measured using Load cell placed above the bin. The food waste load measured by the load cell is given as input signal to the ARDUINO UNO 328. This will check the weight of food waste level collected in the garbage bin. After the collection of food wastes, decomposer has been added for the anaerobic digestion of the food process. The required capacity of decomposer solution is displayed using LCD. When organic waste bin is full, text message will be sent to a connected cell phone number shows the details of biogas production. The trash in the boiler is heated using this biogas. Biogas is utilized to produce steam. This steam will be given as input to steam turbine which is converted as mechanical energy. By using generator the converted mechanical energy is generated as electrical energy. The electricity generated has been operated to turn on an LED.

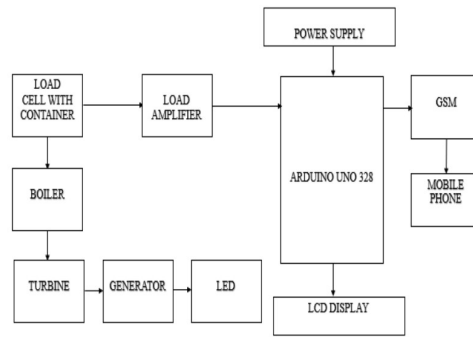


Fig.1 Block diagram of the Proposed Food to Electric Energy Generation System

Fig. 1 shows the Block diagram of the Proposed Food to Electric Energy Generation System. The proposed method of energy generation calculates quantity of food wastes collected in the garbage bin. After the collection of food waste, the anaerobic process has been gone through by adding the necessary chemicals. The decomposer solution has been added at the suitable stage equivalent to the amount of waste collected. The quantity of solution required for the composed wastes is automatically determined by the ARDUINO UNO 328. Total quantity of waste gathered in the bin and the projected production of biogas are communicated to a specific cell phone number with the help of GSM application whenever specified weight of food waste is reached.

3. Results and Discussion

The submitted paper proposes renewable electric generation from Food waste. The value for the decomposer solution varies depending on how much waste is gathered in the bin. The display indicates the status of message transmission, when the message is initiated. As an outcome of the proposed work, LED lamp glows after the electricity generation from the organic wastes.

The formula to determine the amount of biogas produced and required amount of decomposer is also coded in Arduino UNO 328's C language which is linked to the mobile number that receives message of same.

The proposed research has been done in our college by collecting food wastes from our college hostel. Then the Food wastes are converted into biogas. This biogas has been utilized for producing steam energy. After that, steam energy is converted into electric energy.

Total quantity of food waste collected:

$$1\text{kg of waste} = 0.3\text{m}^3 \text{ of biogas}$$

$$\text{Therefore, } 2\text{kg of waste} = 0.6\text{m}^3 \text{ of biogas}$$

The maximum amount of energy that can be obtained is calculated and sent as a message to a mobile number once the weight reaches 2kg or above. The estimated amount of biogas is yielded once the process is completed.

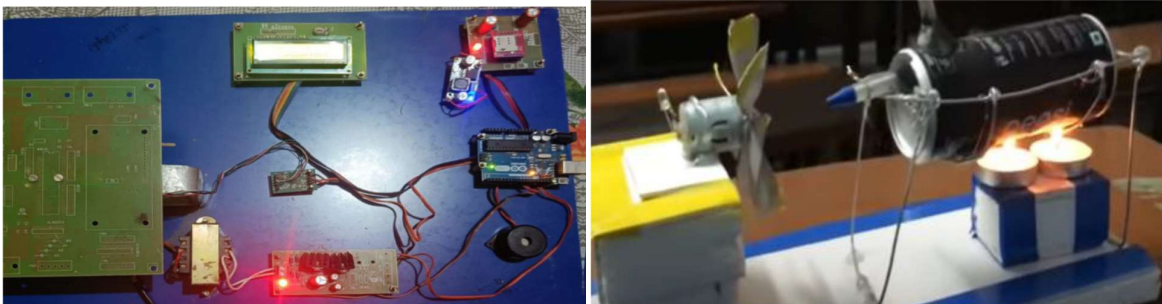


Fig. 2 Working model of proposed electricity generation

The submitted paper has contributed the provision of renewable energy derived from food wastes. Additionally, it offers a user-friendly setup which is portable and doesn't require ongoing repair. By using the wastes more effectively, pollution to the atmosphere and land are decreased.

4. Conclusion

This paper intends to enable the easy shift from fossil fuels to renewable energy sources. Because of the lack of information about biogas and other renewable energy sources, as well as the widespread use of fossil fuels like gasoline and diesel, the transition from fossil fuels to renewable energy sources is challenging. This prototype is simple to use and anyone can use it without additional knowledge or expertise. The system is fairly affordable and can be utilized in a variety of locations, inclusive of restaurants, malls, messes, health centre, and many other locations where food wastes are collected. It is incredibly user-friendly and convenient to use. The efficiency is same to that generated by a traditional biogas power plant. Thermal power plants can potentially utilize the biogas as an additional fuel source.

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