Hardware Model for Electricity Generation from Solid Waste

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Abstract:
Good solid waste management needs to be different in each location and fit in with the culture in which it is implemented. Although there is no global correlation between energy and trash policy, in a world where resources are limited, there is a growing recognition that waste contains a substantial quantity of energy. Rapid Urbanization and community expansion are the prime factors responsible for the increase in solid waste quantum. Solid waste management, a major environmental problem in developing countries, may lead to serious health hazards for mankind. A model is prepared to show the production of waste to energy. The electricity passes through the circuit to charge the battery andwaste materials starts burning in the burning container. When the sensor senses the maximum heat, LED will start glowing automatically and the energy generation process is seen from waste materials.

Keywords: Waste to energy, Hardware model, Municipal Solid Waste

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1.0 Introduction:

Solid waste is only expanding at a significant rate due to urbanisation and population increase, and both urban and rural areas struggle with efficient trash management. Waste creation might not have been very significant in places with low population densities. Even biodegradable garbage has to be handled in regions with higher human densities. Effective solid waste management requires a different strategy for each location that fits the needs of the local community. The amounts and composition of wastes vary depending on the characteristics of a place, according to various studies on solid waste management, particularly Municipal Solid Waste Management in emerging nations. As a result, the management policy must be adopted with proper consideration and focus on the local factors. Reducing the quantity of waste that ends up in landfills can significantly lower greenhouse gas emissions. The amount of waste that may be used is further reduced by recycling any metal that is left over after burning, such as steel and aluminium, thanks to technology that turns waste into energy. Though there is no global correlation between energy and trash policy, in a world where resources are limited, there is growing recognition that waste contains a substantial quantity of energy. It might be necessary for us to acknowledge that the garbage and energy sectors cannot and ought not to be handled as independent businesses.

2.0 Literature survey:

A feasibility study titled "Municipal solid waste management in India: From waste disposal to recovery of resources" was completed by Narayana in 2009. This study compares the three approaches—incineration, landfilling, and composting—while taking costs into account. This study makes it abundantly evident that

good regulation execution and active public participation are essential for the successful operation of a recovery-centric strategy to MSW management. The paper's findings make it abundantly evident that, in industrialised nations, composting is the most effective way to manage solid waste, following segregation.

The study "Electricity Production from Municipal Solid Waste in Brazil" was conducted by Nordi et al. in 2017. The purpose of this work is to evaluate the impact of the content of municipal solid waste on the incineration of garbage and the production of power through steam cycles. The investigation revealed that despite the separation of plastics had deteriorated the cycle's primary energy characteristics, the removal of metal, glasses, and organic debris was favourable to the Rankine cycle's ability to generate electricity.

Research on "Waste to Energy Trends and Prospects" was conducted in 2016 by Eslam et al. Over the past few years, there has been a significant growth in both energy usage and demands. Thus, the purpose of this study was to present and analyze Egypt's waste management initiatives in order to produce energy, as well as to draw comparisons between these initiatives and those of other nations, including China, India, and the United States. This study suggests that while making plans for municipal solid waste management (MSWM), decision-makers need to consider alternative sources of energy from garbage. According to this research, WTE can produce MSWM solutions that are superior than national norms when compared to global trends.

3.0 Waste recovery process:

3.1 Thermal Technologies:

An approach to trash management called incineration entails burning the organic elements present in waste products. There is a reduction of around 80–85% in the solid mass and 95–96% in volume of the initial trash. Although it doesn't completely replace landfilling, incineration significantly lowers the quantity of waste that needs to be disposed of.
The thermal breakdown of waste materials in an oxygen-poor atmosphere while they are inert is known as pyrolysis. Pyrolysis's goal is to produce high-value energy products that can eventually replace non-renewable fossil fuels.

The process of gasification involves heating carbonaceous materials derived from organic or fossil sources to a high temperature. Waste is partially burned during the gasification process to produce electricity. To do this, a high temperature ($>700^0$ C) and a small volume of air are combined (partial combustion). Char, tar, and syngas are the byproducts of the gasification process. Syngas is a clean, high-energy fuel that may be converted into heat and electricity using a gas turbine or engine.

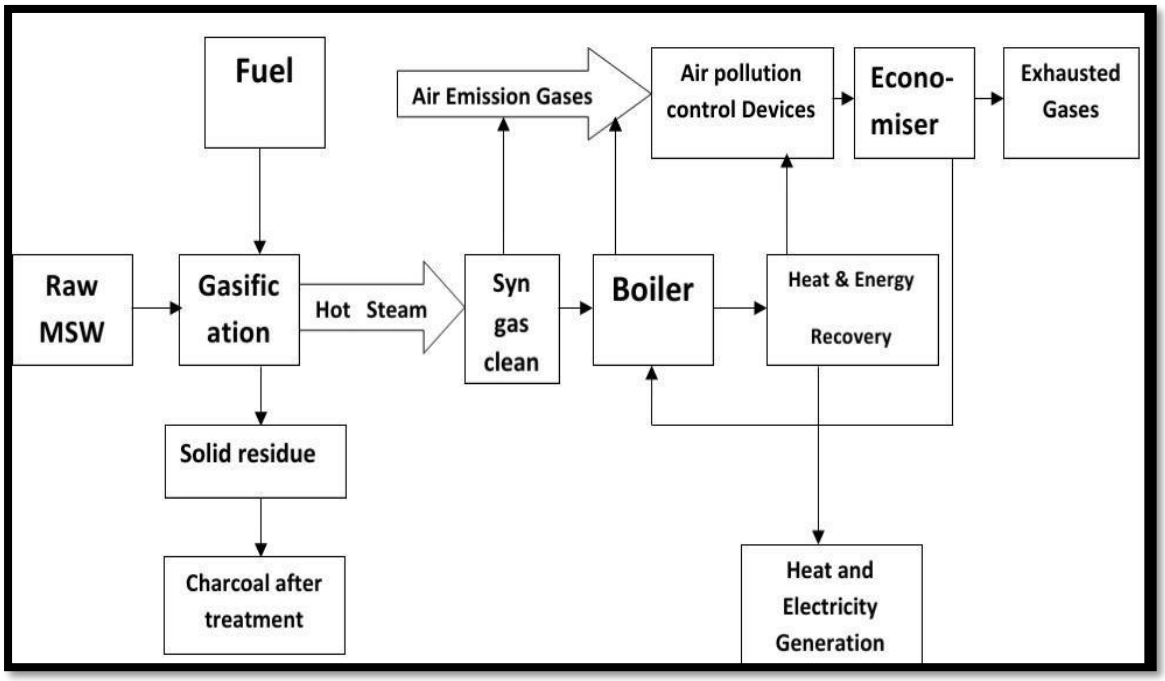

Figure: 1 Flow Chart for electricity generation from solid waste

3.2 Biological technologies:

The process of biologically breaking down diverse solid organic materials under carefully regulated, aerobic, self-heating, and moist conditions to produce a stable product that may be utilised as organic fertiliser is known as composting.

In the absence of oxygen, microorganisms break down organic materials including animal dung, waste water biosolids, and food waste through a process known as anaerobic digestion.

4.0 Model of waste to energy technology:

Components used:

- CAPACITORS: Two different values of capacitors of4700µF/10v and 4700µF/10v.
- RESISTOR: Two 100-ohm 5-watt resistors.
- BATTERY: Two batteries of 9 v and 4 v rechargeable battery.
- Light Emitting Diode (LED): 3 LED of 4 volt.
- HEATING SENSOR: Tube light sensor as a heat sensor.
- DC MOTOR: Two numbers of 9-volt dc motor.
- HEATING PANEL: Two 5volt solar panel as a heating panel.
- SMALL DC WATER PUMP: 5V dc water pump in cooling process area
- Some other components like wire, card board, empty container etc.

5.0 Methodology:

5.1 Making charging circuit:

- First, 4 capacitors of 4700μF/25V are connected in parallel.
- Then 2 diodes (UF 1007) will be connected in parallel and 2 resistors of (100 ohm/5W) are to be connected in parallel.
- From the connection of capacitors 2 wires will be connected tothe battery to store the energy.

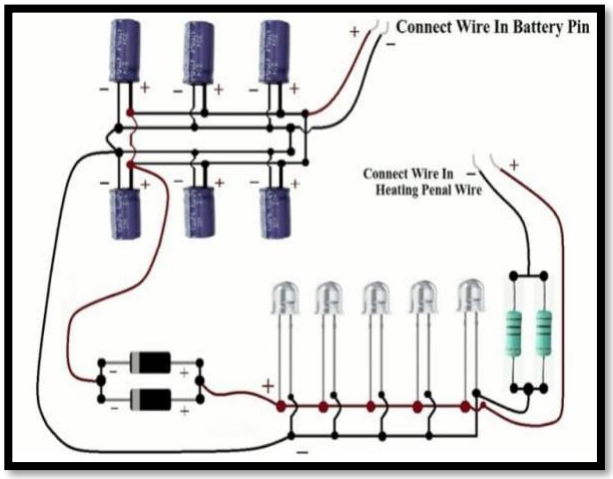

Figure: 2 Making Charging circuit

- Now, from the positive point of the capacitor, a wire is connected to the cathode point of diode and another point is connected form the negative point of the capacitor to the anode points of diode.
- A wire will be connected. One from diode's anode point of the capacitor to LED's positive terminal and another is from diode's cathode point to negative terminal of the LED.
- Lastly, one wire is connected from one point of resistor to the LED positivepoint and 2 wires will come from the other point of the resistor and LED'snegative point. And these wires will connect to the heating panel.

5.2 Making of waste combustion furnace and connection of solar plate:

- A box is taken and cut it into two pieces to make a furnace.
- Then the solar panel is connected to the furnace for getting energy while waste is burned.
- After that solar panell is connected parallel with each other.
- After connecting them two wires come as an output wire from the solar panel.

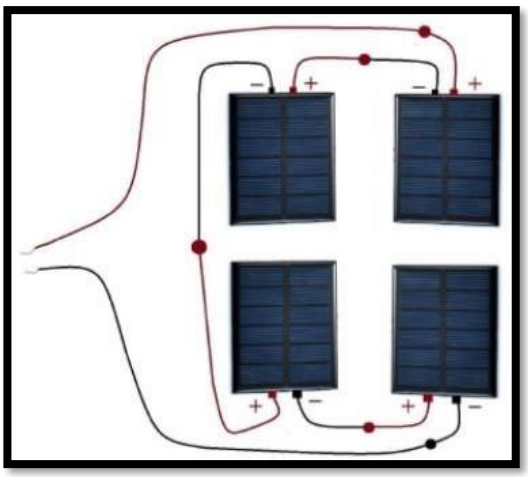

Figure: 3 Making of waste combustion furnace and connection of solar plate.

5.3 Making of led bulb, battery and heating sensor connection with charging circuit:

- Two wires which come from charging circuit (asdiscussed above) are connected to the battery terminal and other two wires are connected to the solar panel.
- For LED connection two capacitors (4700μF/25V) are taken and connected in parallel.

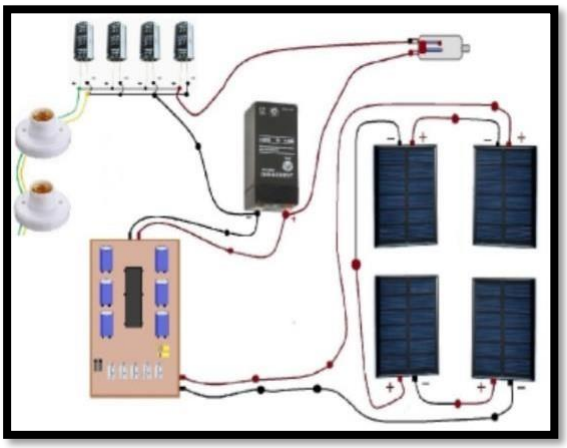

Figure: 4 Making of led bulb, battery and heating sensor connection with charging circuit

- Then, the terminals of LED are connected to the terminals of capacitors. (Positive to positive and negative to negative).
- Now the heating sensor is connected with battery and LED. So, we connected one wire of the sensor directly to the positive terminal of capacitor and other wire will connect to the positive terminal of battery tomake it a switching device.
- At last, a wire is connected between negative terminals of capacitor and battery.

So, when we burn the waste the energy will be stored in battery through the solar panel. Also, when the sensor sense the maximum heat LED will start glowing automatically.

5.4 Making of pollution control area:

In this project the wastes will burn so there will be an occurrence of pollution. Toovercome this pollution, a water-cooling system is made.

- In this system a watercontainer in which a roller is installed using DC motor and awater pump.
- A pipe is connected to another cooling tower and in that cooling tower a fan is installed to cool water.
- After cooling, the waste will come into the water container.

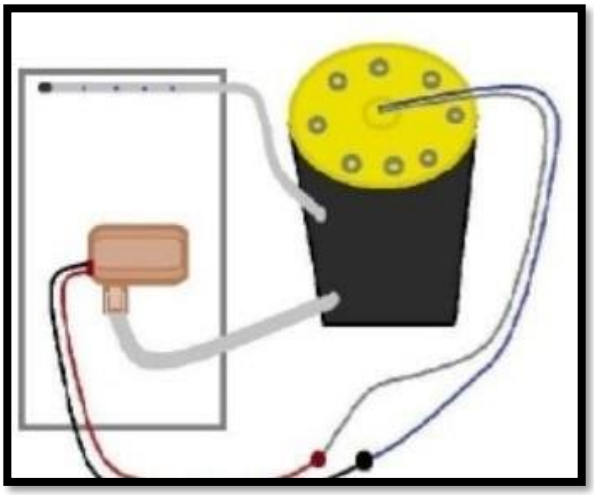

Figure: 5 Making of pollution control area

6.0 Discussion:

When the waste materials is burnt, heating panels convert heat intoelectricity and Red LED bulb starts glowing to show the electric power. After that the electricity passes through the circuit to charge the battery andwaste materials starts burning in the burning container. There is a heating sensor which is working as a ON/OFF switch. When thesensor is heated then it turns on the LED bulb. When the sensor senses the maximum heat, LED will start glowing automatically and the energy generation process is seen from waste materials. When the waste is burnt, the energy will be stored in battery.

7.0 Conclusion:

Solid waste is any undesired solid material produced by commercial, industrial, and residential facilities. Rapid Urbanization and community expansion are the prime factors responsible for increase in solid waste quantum .Solid waste management, a major environment problem in developing countries may lead to serious health hazards for the mankind. The main drawback linked with the effective waste management is the non-involvement of lion share of stake holders i.e. general public in planning process. A model is prepared to show the production of waste to energy. The electricity passes through the circuit to charge the battery andwaste materials starts burning in the burning container. When the waste is burnt, the energy will be stored in battery.

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