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ELECTRICITY GENERATION FROM WASTE MATERIALS

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ABSTRACT: Electricity generation by burning waste materials, also known as thermal waste-to-energy, is a process that involves converting waste materials into electricity by burning them in a combustion chamber. This process is a sustainable solution for waste management as it reduces the volume of waste sent to landfills while producing renewable energy. The methodology for electricity generation by burning waste materials typically involves waste collection, handling, and preparation, incineration, energy recovery, and ash management. The generated electricity can be used to power local communities or industries or fed back into the national grid. The process of electricity generation by burning waste materials provides a reliable source of electricity while reducing greenhouse gas emissions by avoiding the release of methane gas from landfills.

1.INTRODUCTION

Electricity generation from waste material is a rapidly growing field that involves the conversion of various types of waste into usable energy. This process is often referred to as waste-to-energy, and it offers a number of benefits including reducing waste in landfills, reducing greenhouse gas emissions, and providing a source of renewable energy. The process of generating electricity from waste materials typically involves the use of thermal or biological processes. Thermal processes involve the incineration of waste, which is then used to generate steam to power turbines and produce electricity. One of the main advantages of electricity generation by burning waste materials is that it reduces the volume of waste sent to landfills, which in turn reduces the amount of space required for landfill sites. This can help to mitigate the negative impacts of landfill sites on the environment, such as groundwater contamination and greenhouse gas emissions. Another advantage of electricity generation by burning waste materials is that it produces a reliable source of electricity. This is particularly important in areas where there may be limited access to other sources of electricity, such as remote communities or developing countries. The technology used to generate electricity from these waste materials is constantly evolving, and new innovations are being developed to make the process more efficient and cost-effective. Overall, the generation of electricity from waste material represents an exciting opportunity to reduce waste, lower greenhouse gas emissions, and provide a source of renewable energy for communities around the world.

II.LITERATURE REVIEW

The growing global concern over waste management and the need for sustainable energy solutions have spurred the development of technologies that generate electricity from waste materials.

This process, often referred to as Waste-to-Energy (WTE), offers an environmentally friendly alternative to traditional methods of waste disposal and energy production.

This literature review summarizes the main technologies, feedstocks, environmental impacts, and challenges associated with electricity generation from waste. International Journal of Research Publication and Reviews, Vol 5, no 11, pp 7720-7724 November 2024 7721 2.1 Overview of Waste-to-Energy (WTE) Technologies Waste-to-Energy (WTE) refers to the conversion of non-recyclable waste materials into usable energy (such as electricity, heat, or fuel) through various processes.

The primary WTE technologies are:

a.) Incineration Incineration involves the combustion of waste materials at high

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temperatures to produce heat, which is then converted into electricity via steam turbines. This is one of the oldest and most widely used methods for generating electricity from waste. According to Arena (2012), incineration of municipal solid waste (MSW) is an effective way to reduce waste volume by up to 90%, while producing electricity [1].

b) Anaerobic Digestion Anaerobic digestion (AD) is a biological process where microorganisms break down organic matter in the absence of oxygen to produce biogas, which primarily consists of methane. The biogas can then be used to generate electricity in gas engines or turbines. Al Seadi et al. (2008) emphasize the role of AD in converting organic waste, such as food waste, agricultural residues, and sewage sludge, into renewable energy. AD offers significant advantages in terms of reducing greenhouse gas emissions, especially methane emissions from landfills. [2]

c) Gasification Gasification involves converting organic material into a synthetic gas (syngas) through high-temperature partial oxidation in a low-oxygen environment. The syngas, a mixture of carbon monoxide, hydrogen, and methane, can then be used in internal combustion engines or gas turbines for electricity generation. Zhao et al. (2015) demonstrated that gasification is a promising method for producing energy from a wide variety of feedstocks, including biomass and waste plastics.[3]

2.2 Waste Materials Used in Electricity Generation The efficiency of WTE technologies largely depends on the type of waste material used. Different waste streams are suitable for different technologies, and understanding the material properties is key to optimizing the energy recovery process. Common feedstocks include:

a.Municipal Solid Waste (MSW) MSW consists of a mix of household, industrial, and commercial waste, including paper, plastics, metals, and organic materials. Papageorgiou et al. (2020) emphasize that MSW is the most widely used waste type for WTE systems, particularly for incineration and gasification. The calorific value of MSW varies significantly, which can impact energy recovery. Sorting and preprocessing of waste may be necessary to enhance efficiency [4]

b) Plastics Plastics are increasingly recognized as a valuable waste resource due to their high energy content. Basu (2010) highlights the potential for using waste plastics in pyrolysis and gasification, where plastics can be converted into valuable fuels or syngas. However, the disposal of plastics has environmental implications, particularly regarding plastic waste's persistence in the environment.[5]

c) Food and Agricultural Waste Organic materials like food scraps, crop residues, and animal manure are widely used in anaerobic digestion systems. Sangkham (2017) discusses how these waste materials, rich in biodegradable organic matter, are efficiently converted to biogas, a versatile energy carrier that can be used for electricity [6]

BLOCK DIAGRAM

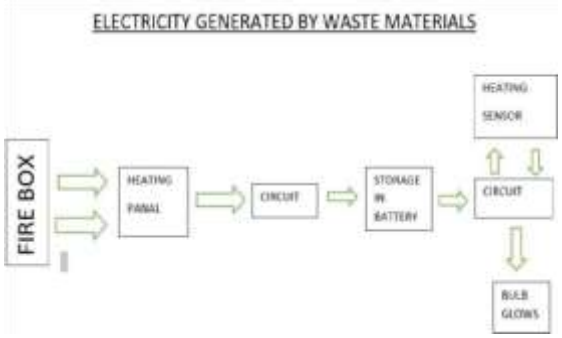

Figure -1 Block Diagram

In this Block Diagram you can see when we burn waste materials and fire box then heat generating and heating panel starts to heat convert electricity and after that that electricity we can see by LED Bulb glowing and that electricity go to circuit and after that in battery and start storing power and when electricity store in battery then heating sensor turn on the output power supply and LED Bulb start

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glowing and smoke go to water tank and filter system start controlling pollution.

III. METHODOLOGY

Electricity generation by burning waste materials, also known as thermal waste-to-energy, typically involves the following methodology:

Waste collection and transportation: Waste materials are collected from various sources, such as households, businesses, and industries, and transported to a waste-to-energy plant.

Waste handling and preparation: Waste materials are unloaded and handled to remove any non-combustible materials such as metals, stones, and glass. The waste is then shredded to reduce its size and improve its burn ability.

Incineration: The prepared waste is burned in a combustion chamber at high temperatures, typically between 850°C and 1200°C, producing heat and gases.

Energy recovery: The heat generated by the incineration process is used to create steam that drives a turbine, which generates electricity. The exhaust gases produced during the combustion process are treated to reduce harmful pollutants before being released into the atmosphere.

Ash management: The remaining ash produced by the incineration process is collected and transported to a landfill for disposal.

The generated electricity can be used to power local communities, industries or be fed back into the national grid. This method of electricity generation by burning waste materials is a sustainable solution for waste management, reducing the volume of waste sent to landfills, and producing renewable energy. It also help to reduce greenhouse gas emissions by avoiding the landfills.

IV. MATERIAL SELECTION

When doing a project, it is important to pay attention to the selection of materials. To prevent waste, the items selection process must be carefully welcomed. A precise selection of items is necessary to ensure that they are long-lasting and safe for usage.

1.1. HEATING PANEL

Heating panels can be used in the process of electricity generation from waste material in several ways, depending on the specific technology used.

For example, in thermal waste-to-energy plants, waste material is burnedin a combustion chamber to produce high-temperature gases. These gases are then used to heat water and produce steam, which drives a turbine to generate electricity. In this process, heating panels may be used to line the combustion chamber, as well as other areas of the plant where heat is generated or transferred. The heating panels can help to maintain the high temperatures required for efficient combustion and steam production, while also protecting the plant's infrastructure from heat damage.

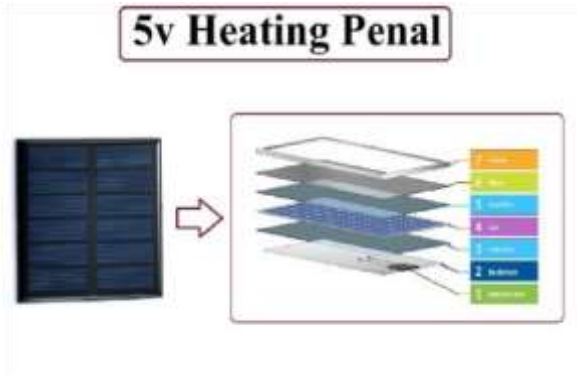

Figure no 2: Heating panel

1.2. HEATING SENSOR

Heating sensors are an important component of many waste-to-energy technologies that involve thermal processes, such as incineration and gasification. These sensors are used to measure temperature in various parts of the process, providing valuable information that can be used to optimize the efficiency of the system and prevent damage.

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Figure No. 3: Heating Sensor

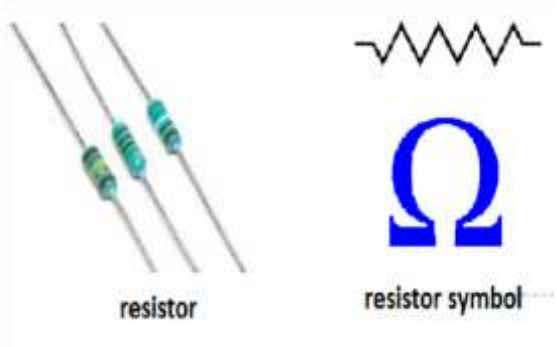

Figure No. 4:- Resistor

1.3. CAPACITOR

Capacitors can be used in various ways in the process of electricity generation from waste material. Capacitors are electrical components that store and release electrical energy, and they are commonly used in electrical systems to provide power factor correction, voltage regulation, and energy storage**.**

In waste-to-energy plants that use thermal processes such as incineration, capacitors may be used in the electrical systems that control the turbines and generators that produce electricity.

1.4. RESISTOR

Resistors can be used in various ways in the process of electricity generation from waste material. Resistors are electrical components that resist the flow of current in a circuit, and they are commonly used in electrical systems to control current, voltage, and power.

In waste-to-energy plants that use thermal processes such as incineration, resistors may be used in the electrical control systems that regulate the temperature and flow of gases in the combustion chamber. These resistors can help to control the flow of current to heating elements or other devices that generate heat, ensuring that the temperature is maintained within the desired range for efficient combustion.

1.5. BATTERY

Batteries can be used in various ways in the process of electricity generation from waste material. Batteries are devices that store electrical energy chemically and can release it as needed to power electrical devices.

One common use of batteries in waste-to-energy plants is to store excess energy generated by the plant during periods of low demand or low generation. This excess energy can be stored in batteries and used to supplement the plant's output during periods of high demand or low generation, providing a more stable and reliable source of electricity.

Figure No. 5:- Battery

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1.6. LED BULBS

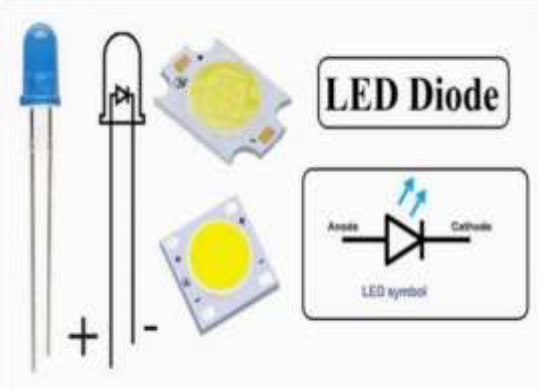

Figure No. 6:- LED Bulbs

WORKING:

When we start burning the waste material in the burning box the heating panels will start collecting the generated heat energy by waste material in the burning box.

The heat energy collected by heating panel will be converted into the electrical energy. The generated electrical energy will be seen in circuit box with led glowing.

The generated electrical energy will transfer to the batteries through the power boosters. The batteries will not dissipate the energy back because a diode is connected to it.

The batteries relate to the heat sensor and LED bulbs. Whenever the heat sensor will start conducting the batteries allow energy to flow will start conducting and LED bulbs will glow.

A heating panel works by allowing photons, or particles of light or heat, to knock electrons free from atoms, generating a flow of electricity.

Heating panels actually comprises of many smaller units called photovoltaic cells.(Photovoltaic simply means they convert heating or light into electricity The p-type, one with less electron, attracts the surplus electron from the n-type to stabilize itself.

Thus the electricity is displaced and generates a flow of electrons, otherwise known as electricity. When heat hits the semiconductor, an electron springs up and is attracted toward the n-type semiconductor. This causes more negatives in the n-type semiconductors and more positives in the p-type, thus generating a higher flow of electricity. This is the photovoltaic effect.

The generated electricity can be used to power local communities, industries or be fed back into the national grid. This method of electricity generation by burning waste materials is a sustainable solution for waste management, reducing the volume of waste sent to landfills, and producing renewable energy. It also helps to reduce greenhouse gas emissions by avoiding the release of methane gas, which is produced when waste decomposes in landfills.

The batteries relate to the heat sensor and LED bulbs. Whenever the heat sensor will start conducting the batteries allow energy to flow will start conducting and LED bulbs will glow.

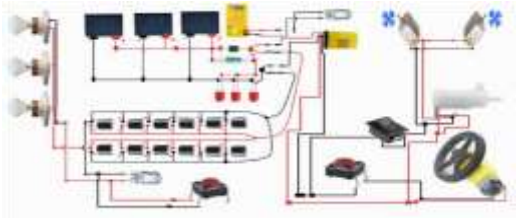

Figure no -7 Working Model

V. RESULT

In this prototype when we are start heating waste material inside zaar box the heat generated will be collected by heating panels. The heating panels will collect the converted energy (heat energy into the electrical energy) which will be transferred to circuit board. Which is constructed with IN4007

Diode and capacitor connected in series and parallel because in to increase the generated energy and push to store in the battery. Then the heating sensor is will be sensing the heat and connect circuit to output of LED Bulbs and the bulbs will glow until the energy getting stored and until the heating sensor sensing the energy generation. The bulb will glow uninterruptedly while the energy generation and battery storage. This stored energy can be used for anything.

In the present situation waste material at any place, we can see with some procedure collect

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everything and we can use the prototype to generate the more energy for utilization.

With this we came know that the energy generation by this method is very easy with some precaution. This prototype helps us to know about waste utilization.

With this project we can increase our own energy at industrial purpose and use them for some needs.

PROTOTYPE

Figure No. 8:- Prototype

VI.CONCLUSION

Incineration technology is complete combustion of waste (Municipal Solid Waste or Refuse derived fuel) with the recovery of heat to produce energy that in turn produces power through heating panels. Now from this we can conclude that electricity plays an important role in our life we are made aware of how the generate electricity waste is done. For technical service provider plant Objectives & Maintenance activities are very important as its service mostly depends on the availability of its equipment. From this we see that how electricity generated successfully. From this we can see how to store the energy in batteries.

FUTURE SCOPE

1. We can make high quality heating penal for generate high electricity 2. We can make large level burning box with easily heating penal connecting system 3. We can make best storage system by generate electricity by waste materials 4. Reduction of pollution: Recycling helps to reduce energy usage, consumption of virgin raw materials, air and water pollution.

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