

Electricity Generated by Vegetable Waste

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1. INTRODUCTION

Abstract –The rapid increase in organic waste generation, particularly vegetable waste from households, markets, and food processing industries, presents both an environmental challenge and an opportunity for sustainable energy recovery. This paper explores the potential of converting vegetable waste into electricity using bio-electrochemical systems, specifically Microbial Fuel Cells (MFCs). Vegetable waste, rich in biodegradable organic matter such as carbohydrates, proteins, and lipids, serves as an effective substrate for microbial metabolism. In this study, vegetable waste samples including potato peels, tomato residues, and leafy discards were processed and introduced into a dual-chamber microbial fuel cell. Electro genic bacteria facilitated the breakdown of organic compounds under anaerobic conditions, releasing electrons and protons. The electrons were transferred through an external circuit, generating measurable electrical current, while protons migrated through a proton exchange membrane to complete the circuit. Key parameters such as pH, temperature, substrate concentration, and electrode material were optimized to enhance power output. The experimental setup demonstrated a maximum power density of X mW/m² and a stable voltage output over a continuous operation period of Y days. Additionally, the system achieved partial waste degradation, indicating its dual benefit of waste management and energy production. The findings highlight the feasibility of using vegetable waste as a low-cost, renewable feedstock for electricity generation. Although current power outputs are relatively low for large-scale applications, advancements in electrode materials, microbial efficiency, and reactor design could significantly improve performance. This technology offers a promising pathway toward decentralized energy systems and sustainable waste-to-energy solutions, particularly in urban and semi-urban settings.

Key Words: Juicer mixer grinder, Zinc Plate, Copper Plate, Battery.

Energy demand is increasing rapidly due to population growth and industrial development. At the same time. Large amount of vegetable waste is generated daily from homes, markets, and hotels. Improper disposal of this waste causes environmental pollution and health problems. Electricity generation from vegetable waste is

an innovative and eco-friendly approach that converts waste into useful energy. This project uses the chemical properties of vegetable waste to generate electrical energy using simple electrodes like zinc and copper. The generated electricity can be used for small applications such as lighting LEDs. This project helps in waste management, reduces dependence in waste management, reduces dependence on fossil fuels, and promotes renewable energy sources. It also creates awareness about sustainable and clean energy solutions. This project demonstrates a practical and sustainable method of converting waste into energy, encouraging innovation in renewable power generation.

2. OBJECTIVES

- Generate a certain amount of electricity using vegetable waste.
- To design and demonstrate an electrochemical cell using vegetable waste and zinc-copper plates to generate electricity.
- To reduce environmental pollution by converting waste into energy.
- To develop a low cost and eco-friendly power generation method.
- To generate electricity using vegetable waste.
- To utilize organic waste efficiently.
- To promote sustainable solutions.
- To explore waste-to-energy conversion techniques

3. LITERATURE REVIEW

[1].Wajeeha Anum Qazi and Mahound F M Abushammala (2020) has studied multicriteria call analysis of waste to energy technologies. This article shows that the fast increase within the generation of solid

waste and rising demand for energy and preservation of fossil fuels worldwide caused a rise within the quality of waste to energy technologies because the answer for waste management issues and energy demands. WTE technologies convert the waste to energy and minimize the number of waste sent to landfills, that additionally reduces negative impact on close surroundings.

[2]. Suraiya Yasmin and Md Imranur Rahman (2017), This study review of Solid Waste Management follow in capital of Bangladesh town. Waste management could be a stimulating task because of population is increasing and kind of waste is dynamical. Waste management follow desires concern for its generation increasing and inadequate follow. The waste generation rate is increasing because of increasing rate of population in capital of Bangladesh town wherever a reparable waste follow is needed to develop. This criticism can summaries the recent year’s state of waste generation and management practices. The review reveals that the uncollected wastes area unit drop in open areas and streets that clog the system making serious hazards, environmental degradation and health risks within the town. Awareness on varied aspects of waste management will facilitate reduce waste generation and improve waste management method.

4. BLOCK DIAGRAM

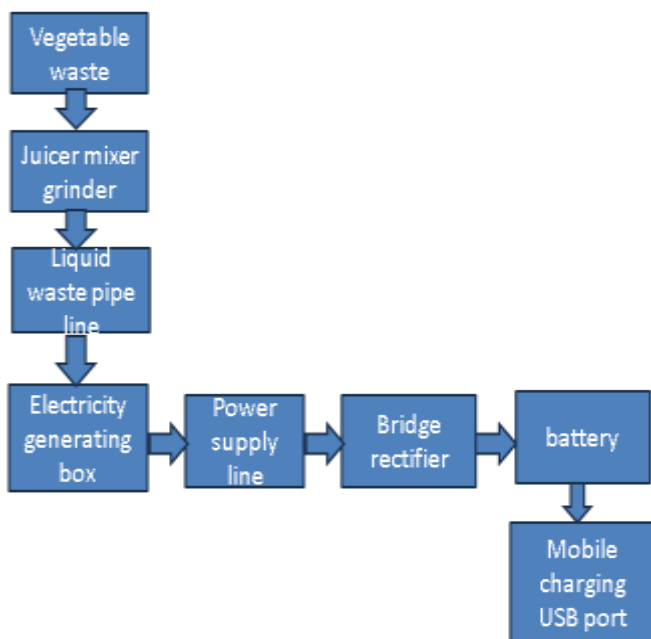
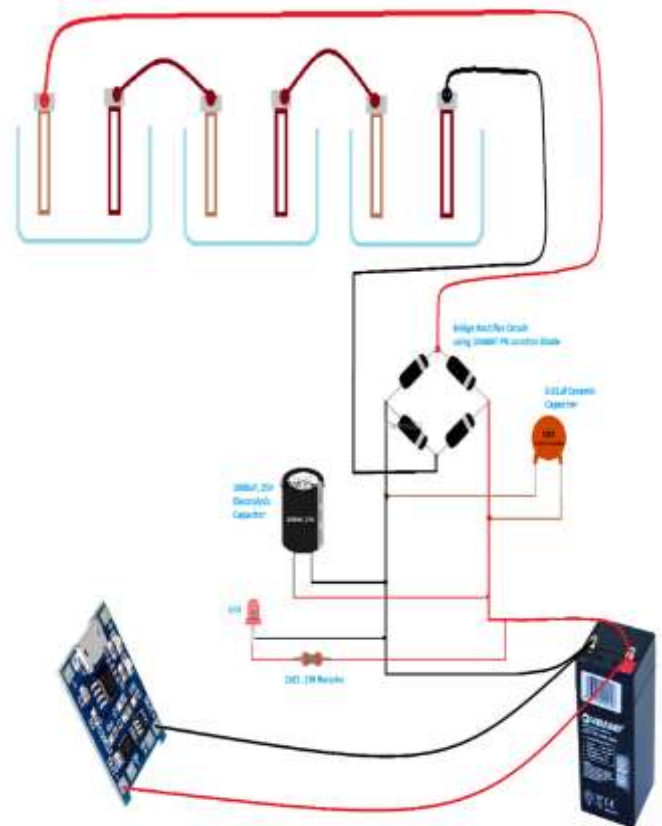


FIGURE 1 BLOCK DIAGRAM

Electricity Generation Process: collecting vegetable waste Vegetable waste such as peels and leftover vegetables is used as the raw materials in this project. These wastes contain organic substances and electrolyte. They help in producing electrical energy through a chemical reaction process. The vegetable waste is crushed using a juicer mixer grinder Grinding converts solid waste into liquid form This liquid contains ions needed for electricity generation The extracted vegetable liquid flows through a pipeline This ensure smooth transfer of electrolyte solution. This box contains copper and zinc plates. The vegetable liquid acts as an electrolyte between the plates. This helps in proper distribution of power The bridge rectifier converts AC into DC Batteries and electronic devices require DC power It helps in providing stable DC output. The battery stores the electrical energy produced A sealed lead acid battery is commonly used Stored energy can be used later for devices

5. CIRCUIT DIAGRAM



The Vegetable waste such as peels and leftover vegetables is used as the raw materials in this project. These wastes contain organic substances and electrolyte. They help in producing electrical energy through a chemical reaction process. The zinc plate work as the anode electrode in the electrochemical cell It loses electrons during the oxidation reaction These released electrons move through the external circuit and produce electric current The copper plate acts as the cathode electrode of the system. It receives electrons coming from the external circuit This electron transfer completes the circuit and allows current to flow a bridge rectifier is an electronic circuit made of four diodes arranged in bridge form Its main function is to convert alternating current (AC) into direct current (DC) It allows current to flow in only one direction producing a pulsating DC output A capacitor is an electronic component used to store electrical energy temporarily in an electric field It is commonly used in circuits for filtering and smoothing voltage The capacitor charges when voltage increases and smoothing voltage The capacitor charges when voltage LED (light Emitting Diode) is a semiconductor device that emits light when current passes through it It works on the principle of electroluminescence

6. COMPONENTS



FIGURE 2 ZINC PLATE

Zinc plate acts as the anode electrode in the electrochemical system. It reacts with the vegetable electrolyte and releases electrons These electrons start the flow of electric current in the circuit The zinc plate is an active metal used as the anode in the system . When it is placed in the vegetable electrons solution, a chemical reaction occurs and zinc atoms release electrons. These electrons move through the external circuit towards the copper plate, producing electrical energy, thus the zinc plate plays an important role in initiating the electricity generation process.



FIGURE 3 COPPER PLATE

copper plate works as the cathode electrode of the circuit It receives electrons coming from the zinc plate This completes the electrical circuit The copper plate acts as the cathode in the electrochemical reaction. It attracts and collects the electrons released by the zinc plate through the external circuit. This movement of electrons from zinc to copper forms electric current. Copper is used because it is a good conductor and supports stable current flow.



FIGURE 4 DIODE IN4007

A diode is a semiconductor device that allows current to flow in only one direction. It blocks the current when it flows in the opposite direction. Diodes are commonly used in rectifier circuits to convert AC into DC.A diode is an electronic component made from semiconductor materials such as silicon. It has two terminals called anode and cathode. When the diode is forward biased, current flows through it easily. When it is reverse biased, it blocks the current. In this project, diodes are used in the bridge rectifier circuit to convert alternating current into direct current, which is suitable for charging the battery and powering electronic devices.



FIGURE 4 SERVO MOTOR

Battery is used to store electrical energy. It supplies power when required. It provides a stable voltage output battery is an energy storage device that stores electrical energy in chemical form and converts it back into electrical energy when needed. In this system, the battery stores the electricity generated from vegetable waste. The stored energy can later be used to power small devices or for charging purposes.



FIGURE 5 CAPACITOR

A Capacitor is used for voltage filtering and smoothing. It stores electrical energy temporarily. It reduces voltage fluctuations in the output capacitor is an electronic component that stores electric charge between two conductive plates separated by a dielectric material. In power circuits, capacitors are used to smooth the DC output by reducing ripples and voltage variations. This helps in maintaining a stable voltage supply for electronic devices and improves overall circuit performance

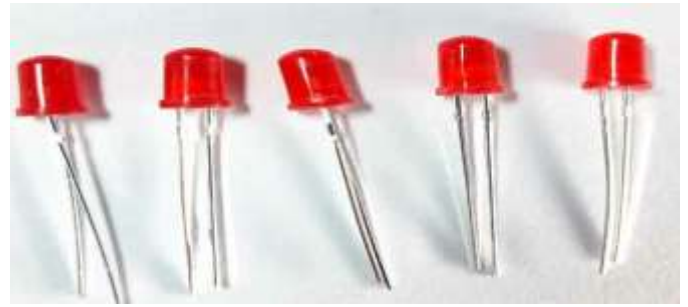


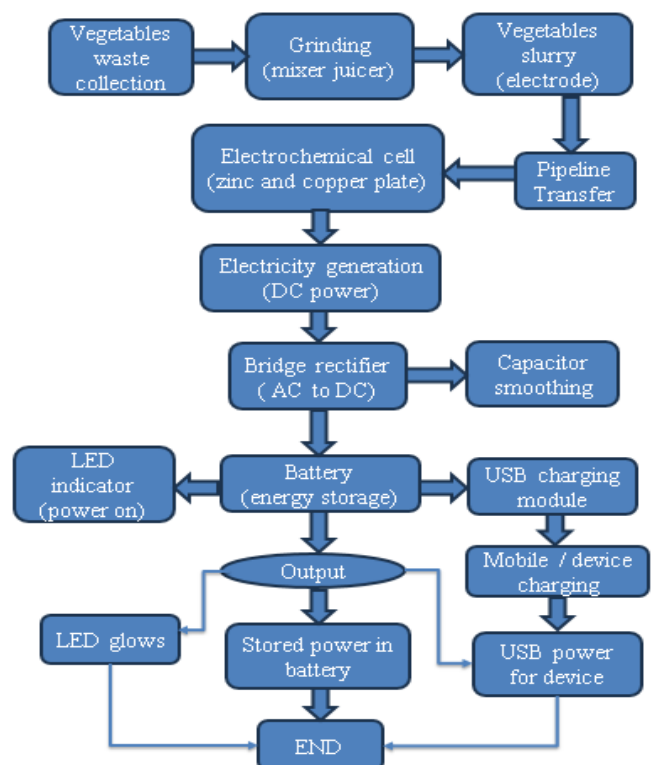
FIGURE 6 LED INDICATOR

LED is used as a visual indicator. It glows when electric current flows through the circuit. This shows that electricity is being generated. A Light Emitting Diode (LED) is a semiconductor device that emits light when current passes through it. In this project, the LED acts as an indicator to show that electrical energy is being produced by the system. When current flows through the circuit, the LED lights up, confirming the working condition of the setup.

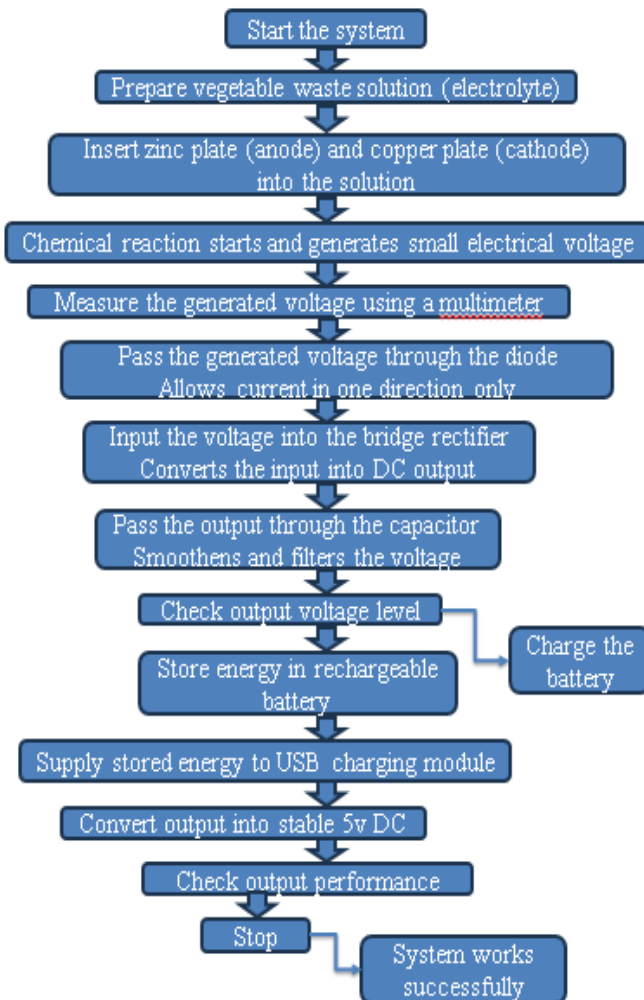


FIGURE 7 RESISTOR

7. FLOW CHART



8. ALGORITHM



The system operates based on the electrochemical reaction between different metal electrodes and vegetable waste acting as an electrolyte. When zinc and copper electrodes are inserted into the vegetable waste solution, a chemical reaction takes place which produces a small amount of electrical energy. This generated voltage is very low and not stable initially. Therefore, it is passed through a rectifier circuit to convert it into a proper DC output. A capacitor is used to smooth the fluctuations in voltage and provide a more stable output. The stored energy is then transferred to a rechargeable battery, which acts as a storage unit. This ensures that energy can be used later when required instead of being wasted. Finally, the stored energy is supplied to output devices such as LEDs or a USB charging module. The USB module regulates the voltage and provides a constant 5V output suitable for charging small electronic devices. The entire system works continuously as long as the electrochemical reaction is active, making it a

simple and eco-friendly method of generating electricity from waste materials.

9. ADVANTAGES

- **Low Cost:** -Uses easily available vegetable waste materials. No need for expensive components or fuel.
- **Eco-friendly:**-Does not produce harmful gases or pollution. Safe for environment and human health.
- **Waste Utilization:** -Converts kitchen waste into useful energy. Helps in reducing garbage and pollution.
- **Renewable energy source:-** Vegetable waste is continuously available. Can be reused again and again for power generation.

10. CONCLUSION

This The project “Electricity Generation using Vegetable Waste” has been successfully designed and implemented using simple and easily available components. It demonstrates the conversion of chemical energy present in vegetable waste into electrical energy through an electrochemical process. The system effectively generates small amounts of electricity using zinc and copper electrodes placed in a vegetable electrolyte solution. The generated energy is then converted, filtered, and stored using a rectifier, capacitor, and battery. The project proves that organic waste materials can be utilized as a renewable source of energy instead of being discarded. This helps in reducing environmental pollution and promotes proper waste management. The generated power can be used for small applications such as LED lighting and mobile charging, making the system practical and useful. The overall design is simple, cost-effective, and easy to understand, making it suitable for educational purposes and small-scale applications. Although the output power is limited, the system can be improved by increasing the number of cells and enhancing the efficiency of components.

11. REFERENCES

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