

ELECTRICITY GENERATION FROM SOLID WASTE MANAGEMENT USING INCINERATION AND SEE BECK EFFECT

K.Sumalatha , G. Shubham

Assistant Professor, Department of Electrical & Electronics Engineering, Kakatiya University Campus, Warangal, India.

sumalathakalat@kakatiya.ac.in

Student, Department of Electrical & Electronics Engineering, Kakatiya University Campus, Warangal, India

Abstract - India generates a significant quantity of garbage every day, and this initiative seeks to reduce pollution by halting the production of nearly all hazardous gases, including CO₂, CO, SO₂, NO₂, and heavy metals like mercury in significant quantities. It is past due for India to embrace the concept of waste to energy. A map plan was implemented for study to gather data on the total amount of garbage produced in India, which inspired academics to move further with this project.

Power is created by burning waste materials in waste-to-energy plants. Energy is produced from the turbine by the steam from water due to combustion of fuel. When all potential losses are taken into account, the net power generated by trash incineration is around 12 MW. The electricity demand and supply differences in the university can be minimised using this method of Power generation.

Keywords: Waste to Energy, Municipal Solid Waste, Incineration, Electricity Generation, Pollution Control.

INTRODUCTION

One of the biggest environmental issues that developing countries like India face is solid waste management. Municipal solid waste (MSW) management issues put locals at risk. Waste to Energy (WtE) offers a way to meet legal requirements and implement integrated solid waste management. [1-3] The best solution, which offers greater benefits than incineration, is anaerobic digestion using gas turbine technology. The use of garbage as a source of energy and the production of power from waste using renewable energies will likely advance the goals of sustainable technology. [4-5] The combination of domestic, commercial and industrial wastes produced and released out by public is known as Municipal Solid Waste (MSW). This incineration process produces waste heat energy, acid rain, and infectious illnesses when it is discharged into the atmosphere. Poor waste management

infrastructure leads to incorrect garbage disposal, which can cause disease outbreaks and ozone layer depletion.

[6-9] Since garbage contains a variety of nutrients, processing it to create several byproducts and finished goods is helpful. This WtE strategy will also guarantee a steady supply of less expensive, greener energy. It can create green jobs and will probably lessen the issue of the energy crisis. [11-13]

AIM AND OBJECTIVE

1. To generate electricity using municipal solid waste with less cost.
2. The study of the use of the incineration process to produce electricity from municipal solid waste
3. Decrease the quantity of solid trash generated in cities.

WHY WASTE TO ENERGY IS IMPORTANT?

The majority of generated wastes end up in land and water bodies without being properly treated, which severely pollutes the water. They contribute to air pollution and release gases like carbon dioxide (CO₂) and methane (CH₄). Due to its capacity to get recycled, any organic waste from cities, towns, and industries can be used as a resource.

Urban regions in India create over 55 million tonnes of municipal solid waste (MSW) and 38 billion gallons of sewage per year. In addition, companies create a lot of solid and liquid waste. India's production of trash is expected to increase substantially in the future.[3]

WASTE TO ENERGY

In waste-to-energy plants, municipal solid waste (MSW), sometimes referred to as rubbish or trash, is burnt to create steam that is used to turn an electric generator turbine. Materials having a high energy content, such as paper, plastic, yard waste, and wood-based goods, are combined to form MSW.[4]

MAJOR TYPES OF WASTE

There are two types of solid waste produced.

1. Municipal waste
2. Medical waste

Municipal waste.

Municipal waste is the waste which was collected by the municipalities. It contains bulky waste as well as household waste.

A form of waste known as "municipal solid waste" is made up of everyday items that the general public dumps.. In a garbage disposal, the term "garbage" can also apply particularly to food waste; the two are sometimes collected separately.



Fig 1. Municipal Waste

This waste consists of different components such as Plastic, Paper, Glass, Wood, Metal, Organic [food] waste and other type of wastes. Our university produces about 400-500 kgs of municipal waste.

Medical Waste:

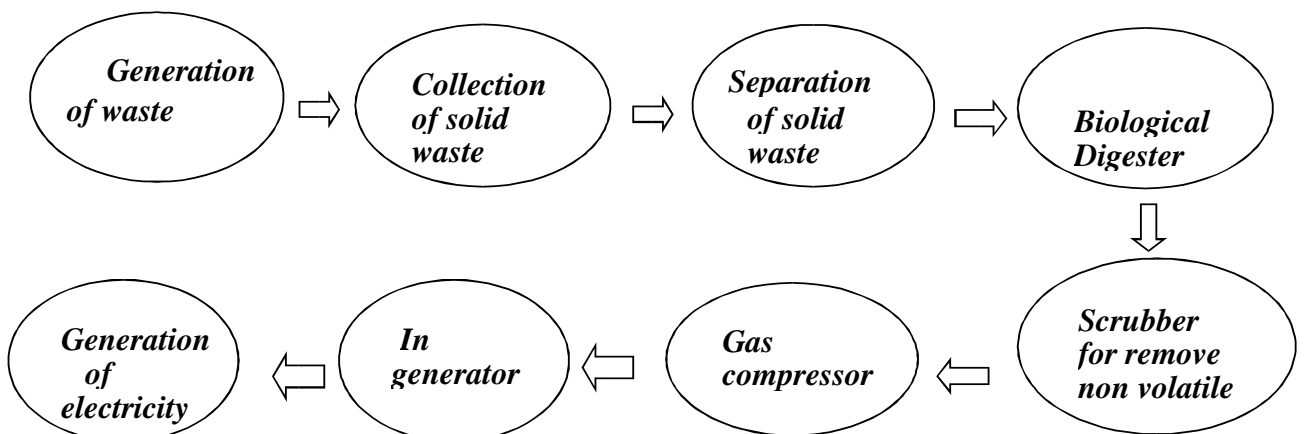
The World Health Organisation defines medical waste as waste produced during the course of medical treatment. This waste can range from spent needles and syringes to soiled dressings, body parts, diagnostic tests, blood, chemicals, medications, medical equipment, and radioactive materials.

Health care includes the management of waste. Poor waste management puts community members, trash handlers, and health care personnel at risk for injuries, illnesses, harmful consequences, and the environment.[22]



Fig 2. Medical Waste

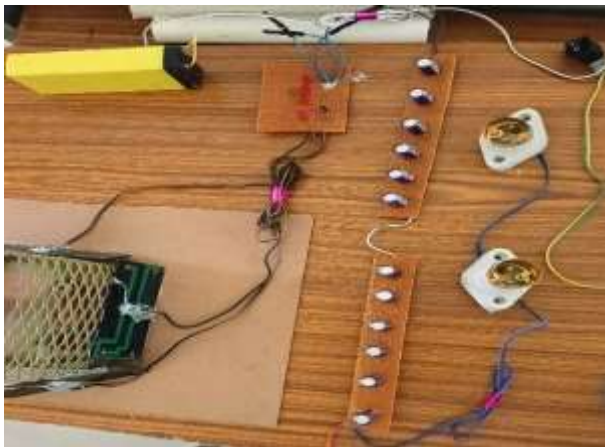
WORKING MECHANISM



METHODOLOGY

The setup's methodology is straightforward and small, requiring a relatively small number of devices to operate the system in accordance. In order to build a small demonstration power plant, we needed devices that are A few of the items required to set up this system are the Boosting Coil/Tesla Coil, Conveyor Belt, DC Motor, Heating Panel, Mode Switch, Step Switch, and Heating Sensor.

This project demonstrates how to develop heating power without expanding the size or voltage of the heating power plat. Heating comes from solar in a very small Heating Power Plat 2V because the solar panel's upper side is glass. Heating Power Plat then turns the heating into electricity, which goes to a Tesla coil, which boosts and conserves



electricity.

Fig 3. Circuit of the experimental setup

ELECTRICITY GENERATION

Electricity generation from renewable energy sources is different from other methods of generation. In the electric power industry, it is the period prior to distribution to final customers or storage for utilities. Electricity must be "generated" because it does not exist naturally.

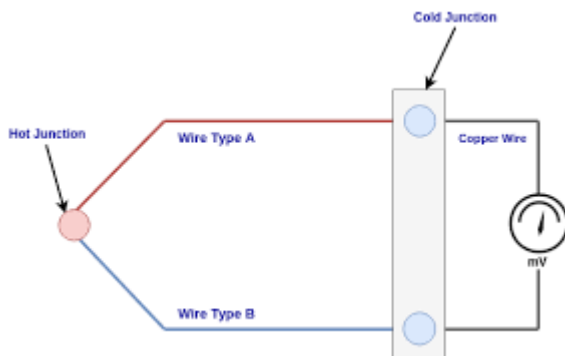


Fig 4. functioning of thermocouple

A thermocouple is a transducer that creates a junction by connecting wires composed of different metals and converts

heat energy into electrical energy. Voltage is produced when the junction's temperature changes.

Electrons in a thermoelectric material begin to flow from the hot end to the cold end when subjected to a temperature gradient, such as when one end is heated and the other is chilled. This results in the creation of electric current.

INCINERATION

Incineration, the burning of combustible material like trash with a energy recovery, is the most popular WtE application. In OECD countries, new WtE plants are required to follow strict emission regulations, including for heavy metals, dioxins, Sulphur dioxide (SO₂), and nitrogen oxides (NO_x). Facilities that burn waste including all residual MSW, commercial and industrial wastes are subject to these criteria. Because of this, incineration plants are different from other plants, some of which didn't recover materials or energy. Modern incinerators decrease the amount of actual waste quantity by 90–95%, depending on the type of material recovered and the degree of the material for recycling from the ash.



Fig 5. Process of incineration

WORKING OF INCINERATION PLANT

Waste to Energy (WtE) is a type of power plant that generates energy from waste, just like other power plants that do the same with oil, natural gas or coal. Burning these fuels produces steam, which runs the turbine to generate electricity. This process may decrease the size of a community's landfill by up to 85% for every tonne of garbage burnt while simultaneously preventing the emission of one tonne of carbon dioxide.

INCINERATOR IN LOW-COST

A incinerator is built with steel, fire bricks, and building bricks in a straightforward manner. It is primarily made up of two chambers: the primary chamber, which is used to load waste into the incinerator, and the secondary chamber, which is used to exhaust flue gases.[6]

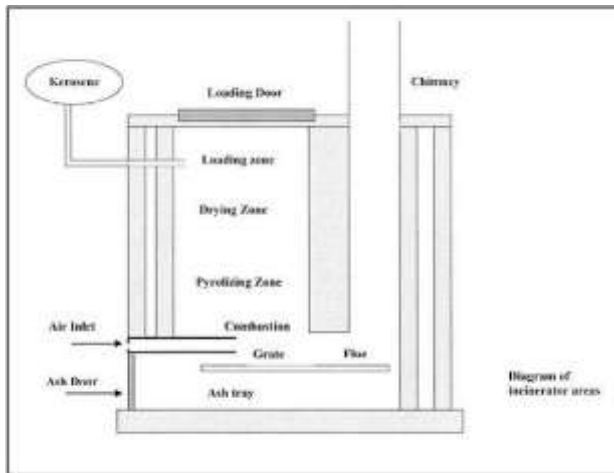


Fig 6. Layout of low-cost Incinerator

Building bricks are used to build the exterior walls, and fire bricks are used to build the interior wall. The top plate is made up of steel sheets, and it has apertures where the door and chimney fittings are present. Stack is held in place once it is positioned over the top of the incinerator an angle iron frame and strips are put on the outer wall. The door frame that is welded to the top plate accommodates the angled loading door made of iron. A front hinge allows the door to open towards the operator.

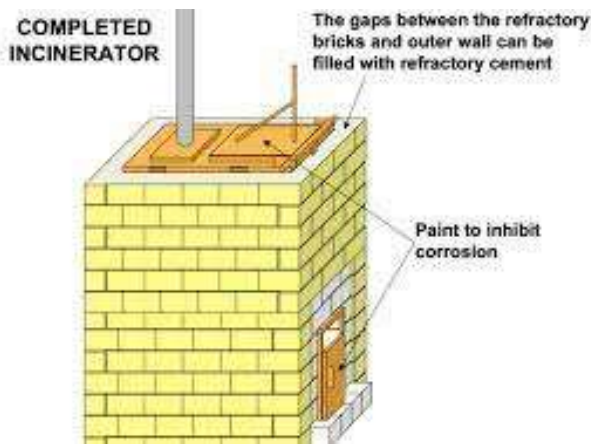


Fig 7. Common type low-cost incinerator

Fig 6 and 7 shows a incinerator that can be built in key urban locations and use the heat produced to generate electricity. The resultant flue gases can be created for various uses after being extracted individually.[6]

EFFECTIVE UTILIZATION OF BYPRODUCTS DURING INCINERATION

The waste is gathered collectively, and the organic components are burned during the incineration process. This incineration process produces waste heat energy, acid rain, and infectious diseases when it is released into the atmosphere. In order to protect humans and other creatures

from the negative effects of breathing toxic air, this study emphasises the appropriate utilisation of Ash content, flue gases, and Heat energy.

I. Ash

After it has been burnt, ash is removed from ash doors. The garbage is fed in from the top. The ash is available as solid lumps that may be used for both residential and commercial construction. Another use for it is in laying of roads.

II. Flue gases

As a by-product of incineration, flue gas, a mixture of several gases, is produced. Asthma, lung cancer, and heart attacks are only a few of the illnesses caused by these gases, which are released into atmosphere and which indirectly cause early mortality in living things. In Japan, people currently live an average of 82 years, compared to only 65 years in India. The hazardous substances that are present in our environment are to blame for this gap.

III. Heat

Utilizing waste heat by turning it into energy is possible. Thermoelectric generators use the see-beck effect to convert heat into energy. Utilising a phenomenon where the temperature difference is converted into electric potential by See Beck Effect. Bismuth telluride is a thermoelectric material that is frequently utilised. These days, there are frequent power cuts in every Indian city. This power generation method will use waste materials to generate electricity, thereby lowering India's electricity crisis.[6]

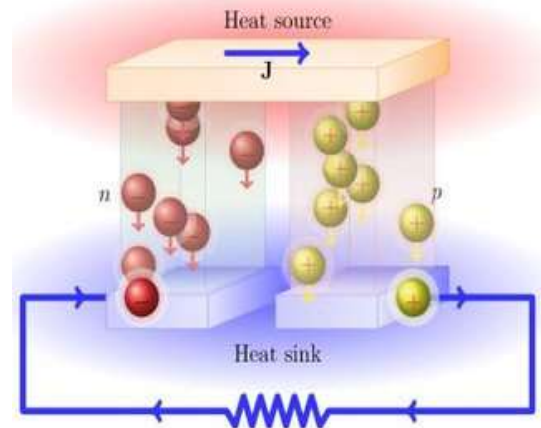


Fig 8. See-Beck Effect

REDUCTION OF GREENHOUSE GASSES

A greenhouse gas is a gaseous chemical system that absorbs infrared radiation and holds heat in the atmosphere, causing it to warm up. India's CO₂ emissions increased by 6.8% to around 2.0 billion tonnes in 2012, placing it as the fourth-largest emitter of CO₂. This is mostly because India's coal production has increased to suit the needs of the world's third-largest

economy and second-largest population. The CO₂ emissions controlled by the generation of coal-based electricity, which account for the majority of India's coal-related CO₂ emissions, increased by roughly 13% in 2012, the largest annual growth ever. Decreased reliance on coal-based power generation is consequently important to lessen the global warming effect. The suggested model is an innovative strategy for lowering the usage of coal-based energy.[10]

SCOPE OF THE PROJECT

1. 1. Problematic solid waste management in public spaces contributes to major environmental and health problems
2. 2. Open and unregulated dumping also results in the closure of the urban drainage system, a cessation of water flow, and pollution of the water supply.
3. Electricity is more in demand for consumption in homes, industries, industrial locations, and institutional settings. [17]

CONCLUSION

Converting waste to energy can help us solve our power outage issue and reduce unwanted waste. India generates a lot of biodegradable waste that can be used to generate a lot of electricity. Organic garbage makes up the majority of waste. Waste generally undergoes fewer recycling processes and doesn't emit any toxic gases. The waste we collect in our nation is sufficient to generate electricity for essential tasks in a smaller quantity. The cost of establishing a plant may be expensive in some locations, but over time, this cost may be justified and ultimately be advantageous for both the government and the general public.

REFERENCES

- [1] Chen Tao, Li Xiang, "Municipal Solid Waste Recycle Management Information Platform Based on Internet of Things Technology", 2010 IEEE.
- [2] Laura Michelle Goris, Mohan T Harish, Rao R Bhavani, "System Design for Solid Waste Management: A Case study of an implementation in Kerala", 2017 IEEE.
- [3] Leena Singh, R. Sunderesan, Renu Sarin, "Waste to Energy Generation from Municipal Solid Waste in India", 2014 IJCRGG.
- [4] Md. Rashidul Islam, Jobair Al Rafi, Md. Sajjad Hossain, "Operation Planning of Renewable Energy Based Hybrid System Incorporating Waste-to-Energy (WtE) Technologies", 2019 (STI) IEEE.
- [5] Desti Octavianthy, Widodo Wahyu Purwanto, "Municipal Solid Waste to Electricity Using Anaerobic Digestion and Incineration Conversion Technologies: A Comparative Study", 2019 IEEE (ICIRD).
- [6] Shyam Swaroop Nigam, Adil Usman*, Divakar B'P, "Effective Utilization of Low-Cost Incineration and Its By-Products in India", 2014 IEEE.
- [7] Pingli Wu, Guoguang Gao, "An Optimization Control Method of Waste Incinerator for Power Generation", 2011 IEEE.
- [8] T. D. Sechoala, O.M. Popoola, T.R. Ayodele, "A Review of Waste-to-Energy Recovery Pathway for Feasible Electricity Generation in Lowland Cities of Lesotho", 2019 IEEE.
- [9] Rajkamal R, Anitha V, Gomathi Nayaki P, Ramya K, Kayalvizhi E, "A Novel Approach for Waste Segregation at Source Level for Effective Generation of Electricity -GREENBIN", (ICSEMR 2014) IEEE.
- [10] Sahil, P.K. Sharma, N. Hari, N. Kumar and D. Shahi, "An Innovative Technique of Electricity Generation and Washing Machine Application using Treadmill", (ICPEICES-2016) IEEE.
- [11] R.A. Ibikunle*, I.F. Titiladunayo, B.O. Akinnuli, S.O. Dahunsi, T.M.A. Olayanju, "Estimation of power generation from municipal solid wastes: A case Study of Ilorin metropolis, Nigeria", <http://www.elsevier.com/locate/egyr>, 2019.
- [12] T. Subramani, R. Murugan, "Generation of Electricity Using Solid Waste Management in Krishnagiri Municipality", <http://www.ijera.com>, 2014.
- [13] K. M. Nazmul Islam, "Municipal Solid Waste to Energy Generation in Bangladesh: Possible Scenarios to Generate Renewable Electricity in Dhaka and Chittagong City", <http://dx.doi.org/10.1155/2016/1712370>, 2016.
- [14] Santiago Alzate, Bonie Restrepo-Cuevas* and Álvaro Jaramillo-Duque, "Municipal Solid Waste as a Source of Electric Power Generation in Colombia: A Techno-Economic Evaluation under Different Scenarios", <http://www.mdpi.com/journal/resources>, 2019.
- [15] V. Tsyplenkov, "Electricity production and waste management: Comparing the options", IAEA BULLETIN, 1993.
- [16] Dr. Nalini E Rebello, Anvith V Badikana, Akshay Kumar M, Muhammad Shunaif, Sahana J, "Generation of Electricity Using Solid Waste", 2021.
- [17] P. Praveen, K. Srilatha, M. Sathvika, E. Nishitha and M. Nikhil, "Prediction of Alzheimer's Disease using Deep Learning Algorithms," 2023 2nd International Conference on Applied Artificial Intelligence and Computing (ICAAIC), Salem, India, 2023, pp. 587-594, doi: 10.1109/ICAAIC56838.2023.10140746.
- [18] P. Praveen, S. Shrivani, R. Srija and M. Tajuddin, "A Model to Stock Price Prediction using Deep Learning," 2023 International Conference on Sustainable Computing and Smart Systems (ICSCSS), Coimbatore, India, 2023, pp. 242-252, doi: 10.1109/ICSCSS57650.2023.10169558.
- [19] P. Praveen, P. Akshitha, S. Samreen, R. Kumar and Y. Shashank, "Evaluation of Digital Banking Implementation Using Programming Paradigm," 2023 International Conference on Self Sustainable Artificial Intelligence Systems (ICSSAS), Erode, India, 2023, pp. 1019-1024, doi: 10.1109/ICSSAS57918.2023.10331646.
- [20] P. Praveen and S. Madihabanu, "A Real Time Multiple Object Tracking in Videos using CNN Algorithm," 2023 International Conference on Self Sustainable Artificial Intelligence Systems (ICSSAS), Erode, India, 2023, pp. 1-6, doi: 10.1109/ICSSAS57918.2023.10331876.
- [21] Mohammed Ali Shaik, Praveen Pappula, T. Sampath Kumar, Battu Chiranjeevi, "Ensemble model based prediction of hypothyroid disease using through ML approaches", AIP Conference Proceedings, 2971, 020038 (2024), <https://doi.org/10.1063/5.0196055>
- [22] Mohammed Ali, P. Praveen, Sampath Kumar, Sallauddin Mohammad, M. Sruthi, "A survey report on cloud based cryptography and steganography procedures", International Conference on Research in Sciences, Engineering, and Technology, AIP Conf. Proc. 2971, 020040-1-020040-8; <https://doi.org/10.1063/5.0196050>
- [23] Mohammed Ali Shaik, P. Praveen, T. Sampath Kumar, Masrath Parveen, Swetha Mucha, "Machine learning based approach for predicting house price in real estate", International Conference on Research in Sciences, Engineering, and Technology, AIP Conf. Proc. 2971, 020041-1-020041-5; <https://doi.org/10.1063/5.0196051>
- [24] Praveen Pappula, Mohammed Ali Shaik, Sampath Kumar Tallapally, Vadlakonda Anitha, Nagavelli Yogendernath, "A new method to detect brain tumor using with convolution neural networks", AIP Conference Proceedings, 2971, 020048 (2024), <https://doi.org/10.1063/5.0196060>