Fabrication and Analysis of Forest Furnace

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ABSTRACT

The aim of the paper is to design and develop an The forest furnace designed here is very useful for the people those who are living in forest/jungle. Tribal groups that are still dependant on forests do not cultivate land but hunt for living. People living in thick forest far away from the culture, doesn't know about the electricity and it is very difficult to get solar energy due to the thick forest. The furnace designed here is intended for them which can generate electric energy by burning waste wood produced by the forest. Often the thick forest generates plenty of waste wood and dry leaves. The electric energy produced by this furnace can be utilized to energize small fan, LED light, etc, and if required the same energy can be used to charge the cell phone also. In this regard here a unique furnace is designed for the jungle to generate electric energy when jungle waste like waste wood, dry levees, etc, is burning inside the furnace. While burning, the waste heat produced by the furnace will be converted in to electric energy and how much voltage is generated at what temperature is the data and it will be displayed through an embedded system interfaced with hot chamber.

Keywords: Construction of metal furnace, TEG modules, Temperature sensor, Arduino Uno processor, LCD, Lamp load designed with high glow LED's, mini fan, etc.

1. Introduction

The proposed project work is aimed to generate electric energy in deep forest where it is very difficult to acquire solar energy due to the thick forest. The furnace designed here is intended to generate electric energy by burning the forest produced debris such as leaves, branches, waste wood pieces, stems, etc. Here in forest, The primary problem of eliminating or removing the forest detritus will also be resolved, and excess heat generated by the smouldering burner will be transformed to electric energy. The method of producing electricity known as "Waste to Energy" or "Energy from

Waste" uses a recycling device, which is also used in refuse disposal yards, to transform thermal energy into electrical energy.

In general the people of forest department, lives in forest in a remote place where there is no electricity, and they don't have a chance to charge their cell phone, there is no light, and some times forest guards fed up due to nil air flow. Really this is horrible situation, to over come all these problems, here is a solution, carry this portable device designed with TEG (Thermo Electric Generator) modules, reaming is simple, collect waste forest wood, burn it by which the device generates electricity through TEG modules and energizes all above said devices. Cell-phone can be charged, Fan can be energized and lighting system designed with high glow LED's can be energized. This compact portable power generating device can be installed in the jungle permanently where required.

A refuse handling centre known as a waste-to-energy factory burns waste to create electricity. Trash-to-energy, municipal refuses burning, energy recovery, or resource recovery facility are other names for this kind of power plant. The garbage incinerators (an device for burning the debris) that were widely used until a few decades ago are very different from modern waste-to-energy facilities. In the past, steam engines were powered by burning waste in landfills, but this was a laborious process that needed daily upkeep. However, the one that was created here requires no upkeep.

1.1 Functional Description

The concept presented here is a heating appliance capable of burning wood fuel or any other type of dry garbage. The mechanical structure designed to burn the waste is constructed using special mechanical components like aluminum heat sink type of water cooling device, Thermo electric devices, etc, which is aimed to generate 6 to 8v DC through Thermo-Electric generators (TEG) attached to the hot body of the metal structure. The function of TEG module is to convert the heat energy in to electric energy. The electric energy produced by this portable power generator is used to energize multiple electric appliances like LED light, small DC fan, cell phone charger, etc, those consumes less energy.

In physics, heat is defined as energy that always passes from hot body to cold body. If hotter body doesn't find any colder body attached to it the heat energy will be radiated in to the atmosphere. When a suitable physical pathway exists, heat flows spontaneously from a hotter to a colder body. The transfer can be by contact between the source and the destination body, as in conduction or by radiation between remote bodies. For example, aluminum is the best conductor for the heat and it

absorbs the heat and transfers to the other metal which is attached to this hotplate. If this metal is used to build a hot chamber, heat from burning wood will be absorbed and successfully moved to a nearby colder body. If the chamber cannot locate the closest colder body, heat energy will be radiated in the air. When the food is cooked in aluminum vessel, heat will be transferred spontaneously to the food items present in the vessel, heat refers to a quantity of energy transferred between two bodies, this is the reason most of people choose aluminum vessels for cooking their food.

The tools to do so have been around for a while, and there are many various ways to convert thermal energy to electricity. In recent years, Thermo-Electric Generators are used for converting waste energy in to converting electricity, this is the modern trend adopted in the field of free energy sources. In few countries, a thermal power station utilizes this technology to produce additional electric energy from waste heat produced by the steam engines. A power facility that converts heat energy into electric electricity is called a thermal power station. The primary driver is typically powered by steam around the globe. Steam is created when water is heated, and the steam engine it rotates then powers an electrical generator. The method of creating energy from heat is known as thermal generation. An example of energy is heat. There are numerous methods to create heat energy that is converted into power. Burning fuels like coal, oil, gas, or timber can create it. The turbine is steam-driven in the majority of locations around the globe. Steam is created when water is heated, and the steam engine it rotates then powers an electrical generator.

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thermoelectric devices for cooling or heating purposes. The Seebeck effect is a phenomenon in which a temperature difference between two dissimilar electrical conductors or semiconductors produces a voltage difference between the two substances.

The magnitude of an induced thermoelectric voltage in reaction to a temperature differential across a substance is measured by the Seebeck coefficient, also referred to as thermo-power, thermoelectric power, or thermoelectric sensitivity. When a potential difference is applied across a thermocouple, a temperature difference between the junctions of the various elements in the thermocouple results. This occurrence is known as the Peltier effect. The Seebeck effect is opposed by this one. (named after the scientist who discovered it in 1821). In the part that follows, these TEG modules are described in depth.

II LITERATURE REVIEW

Natalia vukovic and Evgenia makogon 2022,14(21); a synopsis Waste-to-Energy generation has the ability to address the worldwide challenge of recycling municipal solid waste (MSW).Using data from operational facilities in several nations and the Balanced Scorecard (BSC) methodology, the efficacy of different thermal technologies was evaluated.The most promising, economical, and ecologically friendly technology was discovered to be gasification, while the least desirable and efficient technology was incineration moving grate.The study's findings can be applied to national and local agenda planning for refuse recycling and new energy initiatives.[1]

Sunita Barot; Work on solid refuse as an energy supply was completed on April 30, 2021.The main problem with trash-to-energy technology is that it frequently costs more to make energy from refuse than it does to simply dump it in a landfill. However, waste-to-energy facilities provide several ecological advantages that garbage dumping does not, such as the reduction of landfill methane pollution.[2]

R p Desh pande specialist in Indian capacitor sector; work has done on the Electricity from Garbage on nov 2015,Cities all over the world are facing the problem of garbage disposal. Large-scale production of it leaves it with nowhere to go but mostly dumps. Recently, this has caught the interest of municipal managers, and actions are being thought of to make the garbage disposal profitable. The use of waste as a source of energy is one of the main topics of concern.Burning garbage can produce electricity. This is a process called incineration. Incineration is the burning of

waste to produce heat or electricity. The heat produced by incineration can be used to generate electricity. The electricity can be used to power homes or businesses.[3]

MD Ariful Islam; a new approach to the utilization of solid waste to electric energy using TEG module in 2020,July.Thermal plasma gasification is a process that uses heat and a controlled flame to convert waste into a gas that can be burned to create energy. This process is more efficient than traditional incineration, and it also creates less pollution.[4]

Energy from Waste: A Guide to the Debate, Department for Environment, Food and Rural Affairs, Feb. 2014This manual's goal is to serve as a jumping off place for conversations about the potential contribution electricity from waste could make to waste management.[5]

This manual does not try to provide all the solutions because this position will always rely on particular circumstances. It does, however, emphasise pertinent inquiries, viable choices, and the procedure for making decisions and swaying them.[6]

III METHODOLOGY

3.1 Furnace: Furnace is a closed rectangular section is made up of the high thickness metal sheet of 0.5mm to 1mm,in the range of 18 inches length and 13 inches bredth of sheet metals are arrange in four sides close one together each as shown in figure 2. The Plates are joined together by using L-Type elbow strips with the help of nuts and bolts by making holes to the sheet and L strip.

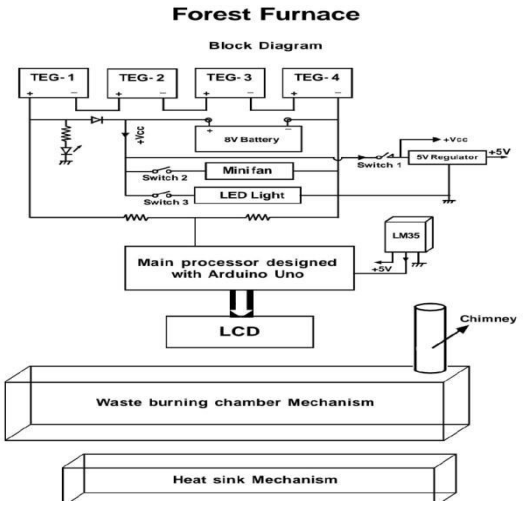

Figure.1 Basic line diagram of forest Furnace.

The main purpose of this furnace is, furnace is a device in which heat is generated and transferred to materials with the object of bringing about physical and chemical changes. The heat can be generated from burning wood fuel or any other type of dry garbage and dry leafs etc, which can burn in the furnace and produce the required heat. For this process, the furnace temperature needs to be maintained at 60 -1200 C. At the outer surface of the furnace, TEG modules are placed sequentially, where the required heat is observed by the module from the furnace.

Figure.2 Furnace fabrication

3.2 Heat Exchanger:A heat sink is a device that is used to dissipate heat from a component in a system. This is done in order to improve the performance and extend the life of the component. A heat sink usually incorporates a fan or other mechanism to reduce the temperature of the component.Heat sink is generally made in this project is aluminium material, it is posses good characteristics that are light in weight, easy heat transfer to the surrounding and less cost available so on. In our project the heat exchanger is in the range of about 10 inch length and 4 inch width,about 10 mm thickness as showen figure 3. On Al bar make a small sized holes by drilling machine to make it less area of contact to the atmosphere for easy heat decipation from the heat absorbed from the source.The prepared heat exchanger is fitted to the one side of the furnace by using bolts and nuts.in this heat sink we are provide some regular cooling water supply to maintain proper thermal difference between source and sink.

Figure.3 Heat Exchanger

Thermo ElectricGenerator Modules:Thermo electric generators are unique in that they convert heat into electricity. This is done by using the Seebeck effect, which is the creation of an electric current when two different types of materials are joined and a temperature difference is created between them.The TEG Modules are special components set up in this project, these are the modules play important role to conversion of heat energy into a a use full energy called electric energy. The TEG modules are placed in this set up between the furnace acting as a source and heat exchanger acting as sink. In simple way it is attached one side to the furnace and other side attached to the heat sink. Based on seebeck effect the heat energy released by burning waste in the furnace is converted into the electric energy, this energy stored into the battery set up in control board. In general there are four TEG modules are used to drive mini size loads like light and fan, It requires basic of voltage so that the single TEG module capacity is 2v it not enough to drive load , so that reason here we placed four modules in series connection. Now we get upto the voltage of 8v from all TEG modules.

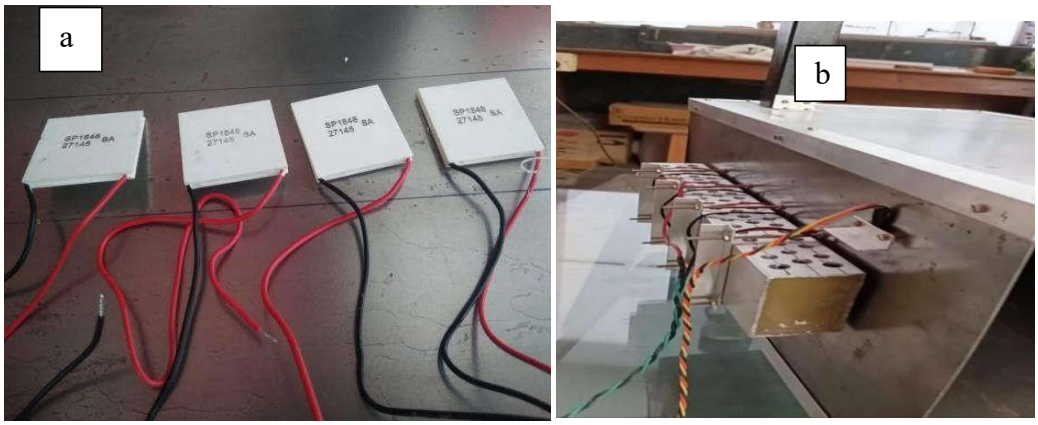

Figure.4 (a)TEG Modules (b) Connection arrangement of TEG module

Aurdino and Display unit: An Arduino board is a microcontroller board. It is unique in that it is open-source and can be used for a variety of purposes, from simple tasks like controlling a LED, FAN, to more complex tasks like controlling a robot. The all input connections are given to the aurdino board, where the signals of lights, finger sensors, some other way of signals it is controlled and processing the task and give out put actuation for the external device connected to it.Display is device is used to the showing working parameters what are done simultaneously with task.It provide all relevant data over display. the display is connected to the aurdino board, the controlling signalsconvert the anolouge to digital output. In this project the display work has to be showing the temperature maintain in furnace, amount of voltage generate from the burning of waste.

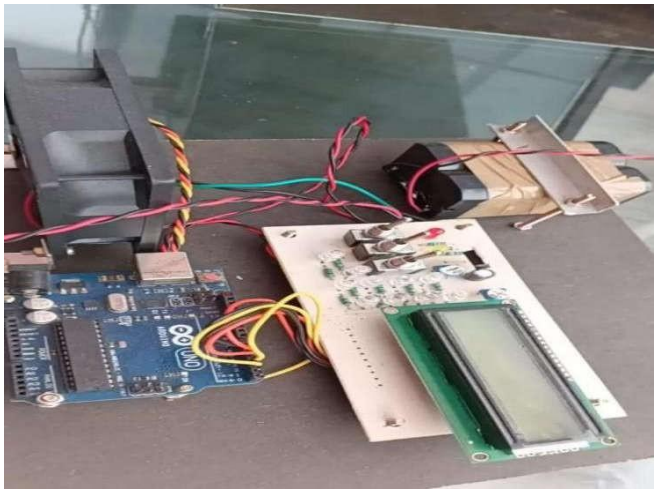

Figure.5 Aurdino and Display unit

Light and Fan:LED lights are a type of lightbulb that uses light-emitting diodes to produce light. LED lights are a more energy-efficient alternative to traditional lightbulbs, and can last up to 10 times longer. They are available in a variety of colors and sizes, and can be used for a variety of purposes.

Figure.6 Fan and Light arrangement

A mini fan is a small, portable fan. It is powered by either batteries or an AC adapter, and is perfect for cooling off in the summer months. Mini fans come in a variety of shapes and sizes, and some even have LED lights to create a soothing glow. These are the two load drive by using the power generated from the waste burning.

IV RESULTS& DISCUSSION

The "Forest Furnace" endeavour was effectively finished, and the outcomes were as expected. During our tests, we discovered that while the four TEG modules linked in series produce nearly 9V DC under load conditions when the mechanism is heated with a hot air blower, the voltage drops to less than 6V when a load of 200 milliamps is connected across the power supply. Each TEG module is supposed to produce 4.5V at 1500C according to the manufacturer's specifications, but in practice, they are not up to par and produce less voltage, so four TEG modules are used and connected in series to produce enough voltage to power small electrical appliances.

All modules attached to the hot body of the mechanism must be heated up equally with hot air blower. The current output of each module is also suppose to give 600 mA, but it is not giving, we found that each module is giving only 300 mA at 2v, when devices are connected in series, only voltage will be increased but whereas current remains same and therefore finally we are getting 300mA current at 6v DC.

Each TEG Module can produce 4.5V at 150℃, but in this project we are setup the equipment range upto 120℃. So that here now 2V to 3V can be generated. The temperature range maintain about minimum 50℃ to maximum of 120℃.

At 2V the electricity can produce the 250MA to 300Ma. ∴

The voltage generation is calculated by using a formula; V=α dT V/℃

Here; α is the seebeck effect coefficient =0.049

Dt is the temperature difference between source and sink. (t1-t2)=60-20=40℃

∴ 0.049*40=1.96 V/℃

Current produced at 1.96 V=V/R

I=1.96/9.41, I=0.2mA

Table1:voltage generation with respect to temperature difference;

S.NO	Temperature	voltage	current
1	60	2.5	0.26
2	80	3.9	0.41

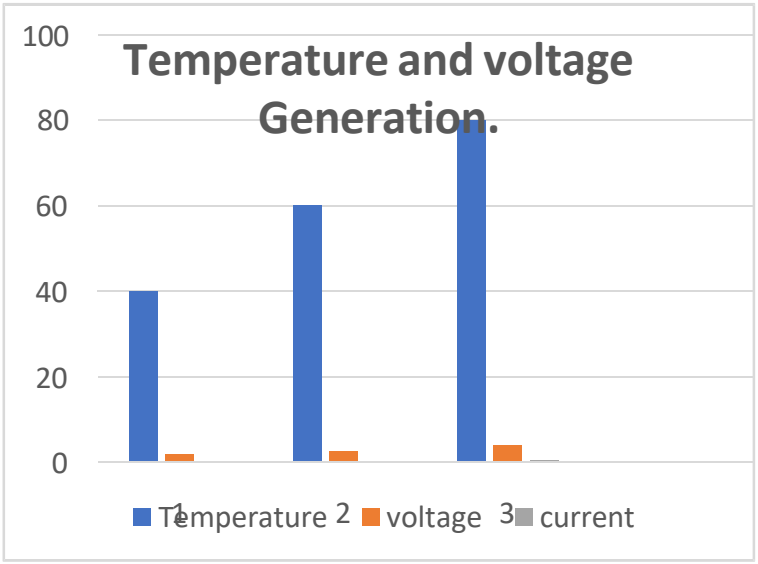

Fig.7 Graphical representation between TEMPERATURE and VOLTAGE

CONCLUSION

- The concept presented here is very useful for the people staying in rural areas where there is no electricity, especially in thick forest lands where it is difficult to get Sun rays also due to the thick and tall trees there this system can be used by converting the mechanism in to some useful application.
- Presently the mechanism is constructed as demo module, but when it is converted as cocking stove mechanism built with TEG modules attached with all sides of the stove, more power can be generated and it can be stored in to a rechargeable battery. The advantage of using battery is, the stored energy can be used to energize the important electrical devices like LED light when required**.**
- A prototype module is built for the goal of demonstration because functional orientation is given a lot of significance in order to make the project operate more realistically.
- This module mimics the actual functioning system, and based on this technology, the system can be modified for actual uses by making the necessary adjustments to the structure and device ratings. The device uses a technique to transform thermal energy into electric energy.

REFERENCE

[1]A.Thakuretal.LifecycleenergyandemissionanalysisofpowernerationfromForestbiomassAppl.Energy(2014)

[2].N.Puy*etal.*Environmentalassessmentofpost-consumerwoodandforestresidues gasification: thecase studyofBarcelonametropolitanareaBiomassBioenergy(2010)

[3].Abdoli,M.A.,Golzary,A.,Hosseini,A.,andSadeghi,P.(2018).“WoodPellet,”in WoodPellet as a Renewable Source Of Energy (Springer), 47–60. doi:10.1007/978-3-319-74482-7_3

[4].Aghbashlo,M.,Tabatabaei,M.,Nadian,M.H.,Davoodnia,V.,andSoltanian,S.(2019).Prognostication of Lignocellulosic Biomass Pyrolysis Behavior Using ANFIS Model Tuned by PSOAlgorithm.Fuel253,189–198.doi:10.1016/j.fuel.2019.04.169

[5].(TheGuardian,15Dec2022)LaborrevokesAbbottgovernmentmovewhichallowedenergy fromburningwoodwastetobecountedwithsolarandwind.

[6]. Brachi, P., Chirone, R., Miccio, F., Miccio, M., Picarelli, A., and Ruoppolo, G. (2014). FluidizedBed Co-gasification of Biomass and Polymeric Wastes for a Flexible

End-Use of the Syngas: FocusonBio-Methanol.Fuel128,88–98.doi:10.1016/j.fuel.2014.02.070

[7]SRMukhametzyanov,RRSafin,GFIlalova,RRKhasanshin,ARShaikhutdinova,"Improvingthequalityofpyrolysisproductsthroughpreliminarythermaltreatmentofwoodyrawmaterials",IOPConferenceSeries:MaterialsScienceandEngineering,vol.666,no.1,pp.012082,2019.

[8].I.B.Kubyshkin,Designanddevelopmentofaunifiedcombustiondeviceforutilizingofwood waste andhydroliticlignin,Sankt-Peterburg,1994.

[9] Morrison, B., Daystar, J., and Golden, J. S. (2018). Substituting wood Pellets for Coal in Large-ScalePowerStations:aDynamicLifeCycleAssessmentExamination. Ijgei 41,272–288.doi:10.1504/ijgei.2018.10018219

[10].M.I.Chudakov,PromyshlennoyeispolzovaniyeligninaM.,Lesnayapromyshlennost,1983.