

# A Review on Design and Thermal Analysis of Thermoelectric Generator for Direct Power Generation from Municipal Waste Garbage

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**Abstract** - In recent years, an increasing concern of environmental issues of emissions, in particular global warming and the limitations of energy resources has resulted in extensive research into novel technologies of generating electrical power. Thermoelectric power generators have emerged as a promising alternative green technology due to their distinct advantages. Thermoelectric power generation offer a potential application in the direct conversion of thermal energy by combusting municipal inorganic waste garbage into direct electrical power generation, where it is unnecessary to consider the cost of the thermal energy input. Generating electricity in present there is a shortage of fossil fuel, oil, gas, etc. burning of these fuels causes environmental problem like radio activity pollution, global warming etc. So that these (coal, oil, gas) are the limiting resources hence resulting new technology is needed for electricity generation, by using thermoelectric generators to generate power as a most promising technology and environmental free and several advantages in production. Thermoelectric generator can convert directly thermal (heat) energy into electrical power. In this TEG there are no moving parts and it cannot be produce any waste during power production hence it is consider as a green technology.

**Key Words:** Thermoelectric power generation, alternative green technology, direct energy conversion, heat, electrical power, thermoelectric materials.

## 1. INTRODUCTION

Recently we are depending upon fossil fuels for maximum electricity generation. However, the reserves of fossil fuels will be goes on depleting, since oil & gas are the least sources. Recent years cost of unit electricity has increasing to unpredictable levels due the less supply of (oil, gas, coal). Thus the, green energies are more attractive artificial to electricity generation, as it will also provide a pollution free and cost less. In this innovative project, we are using one device which is used to be created and introduced by human as a renewable energy that is thermo electric generator equipment to generate electricity. As we know Renewable energies are, solar energy, wind energy, hydro energy, tidal energy, etc. above energies can produce electricity in different forms and way of generating method. There are some disadvantages. Solar cells are the most

commonly used in applications such as household industrial and spacecraft electrical systems. However, if there is no sun light there will no production of electricity alternative sources are necessary for generating electricity. Or a method of storing energy for future use. Wind and hydro electric energy have their own drawback making them less power production and insufficient for wider usage. Many steam power plants there is large number of losses and bursting of pipes and low opt out low efficiency. But reviewing to model power generation from municipal inorganic waste garbage using thermoelectric generator has instant power output, noise free, no vibration and very high efficiency.

Utilizing municipal inorganic waste material into electricity using principle of seeback effect. Model use two seeback module with test ring .It contain heating zone, aluminum plate, and copper plate, water cooling jacket, radiator and coolant for generating maximum temperature difference for TEG power generation.

TEG of SP1848-27145, 10W module of material bismuth telluride ( $\text{Bi}_2\text{Te}_3$ ), and Approx. Size: 40MM \* 40MM\* 3.4M. It produce power at 100 degree, produce 4.8V and 0.67 Amp current approx. 3.2W. Such type of two module used in this project and  $3.2 \times 2 = 6.4$ Watt power will be produce by this model.

For such power generation municipal waste garbage specially inorganic i.e. Plastic bags, Plastic, Cans, Food packaging, plastic soda bottles, Medicine bottles, Fertilizer and pesticide containers, Tea and coffee cups, Tyres, Rubber items are collected and burned in heating zone and heat produced from these are transferred to TEG and then converted to power.

In this model closed compartment of heating zone is used and emission of carbon content and any gaseous pollutant gets totally control and produce environmental friendly, zero pollution model.

### 1.1 TEG Construction and Working

The EMF cause by temperature gradient across the junctions of two dissimilar conductors, which form a close loop is seebeck effect shown in figure 1.

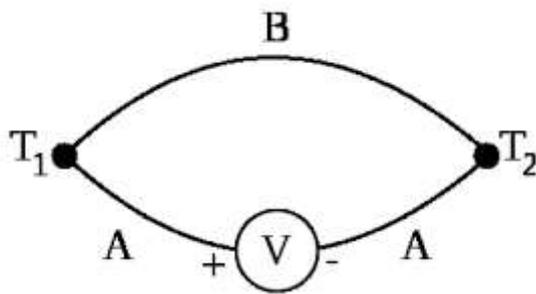


Figure 1: Seebeck effect [11]

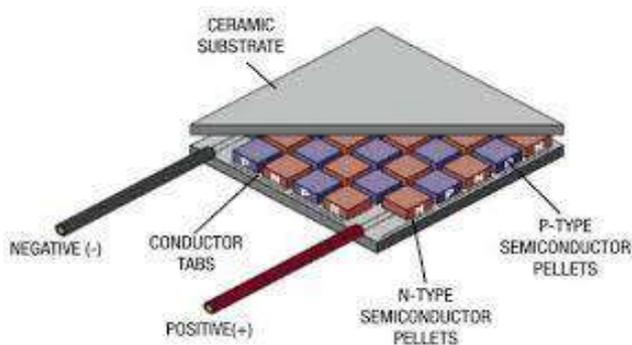


Figure 2: Thermoelectric generator [4]

A single thermoelectric couple is constructed from two ‘pellets’ of semiconductor material usually made from Bismuth Telluride (Bi<sub>2</sub>Te<sub>3</sub>). One of these pellets is doped with acceptor impurity to create a P-type pellet; the other is doped with donor impurity to produce an N-type pellet. The two pellets are physically linked together on one side, usually with a small strip of copper, and mounted between two ceramic outer plates that provide electrical isolation and structural integrity. For thermoelectric power generation semiconductor material A and B joint together show in figure.1, if a temperature difference is maintained between two sides of the thermoelectric couple (T<sub>1</sub> and T<sub>2</sub>), thermal energy will move through the device with this heat and an electrical voltage, called the Seebeck voltage, will be created. If a resistive load is connected across the thermoelectric couple’s output terminals, electrical current will flow in the load and a voltage (V) will be generated at the load. Practical thermoelectric modules are constructed with several of these thermoelectric couples connected electrically in series and thermally in parallel

The figure of merit Z describes material performance. It depends on the thermoelectric material properties material properties.

$$Z = \frac{\alpha^2 \sigma}{\kappa}$$

Where,  $\alpha$  =Seebeck coefficient,  $\sigma$  = electrical conductivity,  $\kappa$  = thermal conductivity.

## 2. LITERATURE SURVEY

Basel I. Ismail, Wael H. Ahmed [1] he has worked on Thermoelectric Power Generation Using Waste-Heat Energy as an Alternative Green Technology and such a model is developed for generating power from waste. He fined that thermoelectric power generation is presented through the applications implemented in the recent patents of thermoelectric power generation relevant to waste-heat energy.

Prashantha K, Sonam Wango [2] they have found that Smart Power Generation from Waste Heat by Thermo Electric Generator. They model such TEG for generating smart power from different waste heat.

Parth Shah [3] he worked on Analysis on Power Generation through Thermoelectric Generator. Find that detail analysis of power generation from waste heat using Thermoelectric Generator.

Aravind Karuppaiah, Ganesh’s, Dileepan. T, Jayabharathi.S [4] they have created Fabrication and Analysis of Thermo Electric Generator for Power Generator. They have fabricated TEG for suitable power generation and detail analysis of these are taken.

M. G. Jadhav and J. S. Sidhu [5] have Design and Fabricate Silencer Waste Heat Power Generation System Using Thermo-Electric Generator. They fabricate and use TEG for power generation from silencer waste heat.

Tzer-Ming Jeng, Sheg Chung Tzeng, Bo-Jun Yang and Yi-Chun Li [6] they have Design, Manufacture and takes different Performance Test on Thermoelectric Generator System for Waste Heat Recovery of Engine Exhaust

Z.B.Tang, Y.D.Deng, C.Q.Su, W.W.Shuai, C.J.Xi. [7] has worked on a research on thermoelectric generator’s electrical performance under temperature mismatch conditions for automotive waste heat recovery system and takes different performance riding under temperature mismatch condition.

Dipak Patil, Dr. R. R. Arakerimath, [8] have discuss A Review of Thermoelectric Generator for Waste Heat Recovery from Engine Exhaust and used TEG in this model for recovery from engine exhaust.

Shrutika Carped. [9] has worked on Thermoelectric Power Generation using Waste Heat of Automobile. Use waste heat of automobile for power generation.

Govind mishra, Shushil kumar Sharma [10] has discussed on Review of automotive thermoelectric generator and use waste heat of automobile for power generation.

Saniya LeBlanc [11] in their worked entitled thermoelectric generators linking material properties and systems engineering for waste heat recovery applications and suggest different material properties for TEG application.

P.Mohamed Shameer, D. Christopher [12] has worked on Design of Exhaust Heat Recovery Power Generation System Using Thermo-Electric Generator.

Rasit Ahiska, Hayati Mamur [13] they have discussed a review on thermoelectric generator in renewable energy. Use TEG in renewable energy as source.

Sham Patidar [14] he has discuss different Application of Thermoelectric Energy. Such as waste heat recovery as energy for power generation.

### 3. MODEL SP1848-27145 DESCRIPTION

Thermoelectric Power Generators also are known as TEG create and detects temperature differential on each side. You can take the advantage of this temperature differential detection to generate electricity.

After applying the heat on one side and cold on other side the device will start generating the voltage which depends upon the value of applied heat. The SP1848-27145 40x40mm Thermoelectric Power Generator TEG 150°C will generate the moderate amount of voltage with mA of current.

A Thermoelectric Generator (TEG) module is a semiconductor-based electronic component that functions as a small generator.

Temperature (°C)	20	40	60	80	100
Open circuit voltage (V)	0.97	1.8	2.4	3.6	4.8
Current (mA)	225	368	469	558	669

Model number side is exposed to "heat-sink or ice" and opposite side to "heat". Placing 2-3 drops of grease compound on both sides of TEG Module

#### 3.1 Features

1. Small and lightweight, convenient for use.
2. Designed specifically for power generation.
3. Sealed for moisture protection and contain
4. Thermal elements formulated for optimum Seebeck power generation.
5. High-temperature 150°C, with NM static Protection.
6. Quality tested cooling cells.

7. Simple to install and operate.
8. With 5v Booster board you can charge the cell phone

### 3.2 Inorganic Municipal Waste for Power Generation

About 1.43 lakh metric tons of solid waste is generated every day in the country. 23% of this waste is treated and disposed. Note that, under the Swachh Bharat Mission (SBM), 100% scientific processing and disposal of municipal solid waste is envisaged by 2019. The Committee recommended that all urban local bodies should prepare action plans to establish waste treatment facilities. Further, segregation of waste should be made mandatory in all government offices, households, and commercial establishments. It also suggested that scientific treatment and disposal of municipal solid waste should be made compulsory under SBM.

Organic wastes contain materials which originated from living organisms. Organic wastes are often disposed of with other wastes in landfills or incinerators, but since they are biodegradable, some organic wastes are suitable for composting and land application. They not create any harmful effect on environment that's not's required large management technic.

But inorganic waste garbage material are non-biodegradable and synthetic and semi-synthetic material create large harmful effect on leaving being and environment, required huge amount of management .this inorganic waste garbage are collected and we directly using in this model with zero pollution and produce direct power using TEG.

Different inorganic materials used are Plastic bags, Plastic, Polystyrene, Cans, Food packaging, plastic soda bottles, Medicine bottles, Fertilizer and pesticide containers, Tea and coffee cups, Tyres, Rubber items.

### 4. CONCLUSIONS

1. This project aims to Design and Thermal Analysis of thermoelectric generator for direct power generation from municipal inorganic waste garbage material.
2. Experimentally it is found that when two thermoelectric generators are connected in series. This generated power either directly used to run some auxiliary devices or may be stored in the battery and used later.
3. Study how to use the municipal inorganic waste as renewable energy sources
4. Reviewing to create zero pollution environmental friendly models.

5. To control hazardous effect of inorganic municipal waste garbage.

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