

Electricity Generation by Using Waste Heat

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Abstract- This paper presents the investigation of power generation using the thermo-electric generators. A majority of thermal energy in the industry is dissipated as waste heat to the environment. This waste heat can be utilized further for power generation. The related problems of global warming and dwindling fossil fuel supplies has led to improving the efficiency of any industrial process being a priority. One method to improve the efficiency is to develop methods to utilize waste heat that is usually wasted. Two promising technologies that were found to be useful for this purpose were thermoelectric generators. Therefore, this project involved making a bench type, proof of concept model of power production by thermoelectric generators using simulated hot air. A higher mass flow rate ratio results in a higher amount of heat transfer and higher power output. The proposed system can be used for waste heat recovery from the industry where thermal energy is used in their daily process.

Keywords- Thermoelectric Generator, Thermal Energy.

I. INTRODUCTION

As the dawn breaks, every day we come across some new technology or development in the field of science. The scope of this wide spectrum in which humans are encouraged to find a better substitute for the older technologies has made so many advancements to make day-to-day life easy. One such major point of focus today is to replace the electricity with the non-conventional energy resource-harvesting methods. In the same way, heat can be a good source to produce power from it.

The principle of Seebeck effect can be used for such applications. A German physicist - Thomas Seebeck, first described it as long ago in 1820. Two metals with a common contact point, where the potential developed due to the temperature differences in the other two ends of metals, is all about Seebeck effect. Peltier module also follows the same principle. We have used TEC- 12706 in our experimentations to know ways to optimize the use of a peltier module.

This paper shows that heat harvested from different heat sources generate different amount of voltages and overall power. Experimentations also showed that using different ways to extract heat from the other side of the module made output voltage to vary accordingly.

These days the demand of electricity is rising tremendously with the growing industries and household electrical appliances. To fulfill these daily requirements different energy sources like coal, water,

wind and solar energy are employed at a very high cost. From all these sources, energy is extracted and utilized but the demand for power is still at large. Even though the world is fast changing and developing there are still many villages and far flung areas where electricity is not reached and still a demand.

From some the power generation method after harvesting energy, heat is simply wasted as by product into the environment. If such heat can be converted even in a small mill watt range, it can be reuse in domestic low power lighting and in running low power consumption electronic products.

According to thermodynamics law of energy also known as law of conservation of energy, energy cannot be created nor destroy but can be transformed from one form to another. Thermoelectric device which work with the principle of Seebeck effect converts temperature gradient between the two junctions into voltage and vice versa can be utilize to harness electricity from heat.

The basic generation of electric power from thermocouple is as both the junction is maintained at different temperature gradient i.e one side is heated with a heat source and the other side is attached with heat sink. The output voltage is directly proportional to the temperature difference between the two sides of the module.

As the direct output of the device is normally low, it is further amplified with a Darlington pair transistors circuit.

II. LITERATURE REVIEW

This invention relates to the industrial combustion liberated heat and Internal Combustion of Engine. Among all research direction, waste heat recovery system (WHRs) is most concerned, due to the all over the place existence and high accessibility of suitable resources. According to India Bureau of Energy Efficiency, the benefits of WHR includes reduction in the process consumption and cost, reduction in pollution and equipment sizes, and also reduction in auxiliary energy consumption. While there are a number of devices to fulfill WHR, thermoelectric generator (TEG) has been utilized in most industrial and automotive applications.

Jihad G. Haidar, Jamil I. Ghojel, “waste heat recovery from the exhaust of low- power Diesel engine using thermoelectric generators, 20TH international conference on thermoelectric (2001), p413-417 From literature survey 1 we studied how to recover waste heat and how to utilize waste heat from different industries.

III. MATERIALS & MEDHOD

1. Thermo Electric Generator:

The TEG is a device that generates electricity by difference in temperature of both sides.

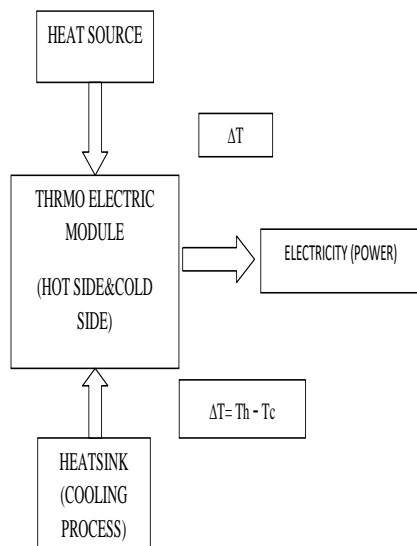


Fig 1. Working Principle of Thermoelectric Generator.

2. Inverter:

In this inverter is used for conversion of DC to AC because the generation is in DC and the utilization is in AC as well as DC.

3. Temperature Sensor or Thermometer:

It is used to take or observe the temperature of one side of thermo electric generator as well as other side of generator.

4. Battery:

We are using this battery to store the generated power for future use or for whenever when we required to use the stored power.

5. Ammeter-Voltmeter:

Voltmeter-ammeter is used for to observe the exact value of voltage & current after the generation and storage.

6. Heat Source (Hot Air Blower):

The hot air blower is using in this as a heat source (Its like the waste heat liberation from the industries) for generation of electricity or the conversion of heat into electricity.

7. DC Motor with Fan:

The Direct current motor are using in this as the indication that the direct current is generated from the thermoelectric generator.

8. Heat Sink:

It is a device that absorbs the heat generated by the electronic devices or any system.

9. TEG Efficiency Calculation:

Four basic physical phenomena are associated with the operation of thermoelectric generators (TEG), namely, the Seebeck effect, the Peltier effect, the Thomson effect and Joule effect. Under steady state conditions, the contribution of the four phenomena to energy flow, through a unit volume is expressed as follows:

10. Working:

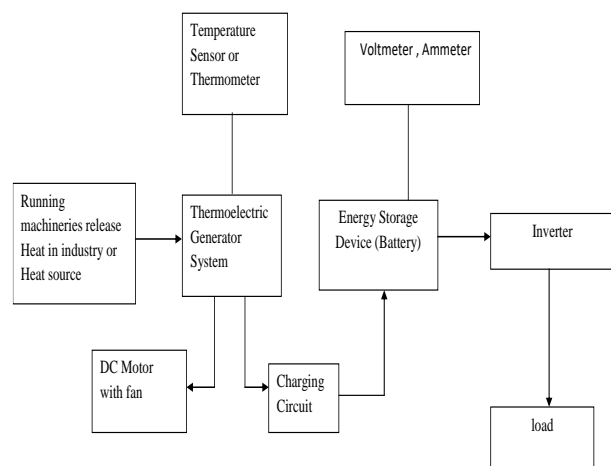


Fig 2. Block Diagram of Power Generation Using Waste Heat.

The heat source (hot air blower) is made using heating element (nichrome wire 1000watt) 2.5mm2 wires and silicon wire sleeve (5no.and 8no.), DC fan for blow of air. Then it is placed near to the TEG (thermoelectric generator). The first side of the generator is regularly

going hotter and other side of TEG is maintaining temperature difference using heat sink with fan along with TEG. The temperature meter is placed to obtain the temperature of one side and another of TEG. The TEG is connected with DC motor with fan for the indication of generation (DC generation).

The TEG is now connect with battery (12V, 6A) for the storage and between TEG and battery the voltmeter-ammeter is placed for obtaining the current and voltage generated. After battery the inverter is connected to convert DC to AC. The 12V DC is now convert into AC and then connect with the load.

IV. WORKING MODEL

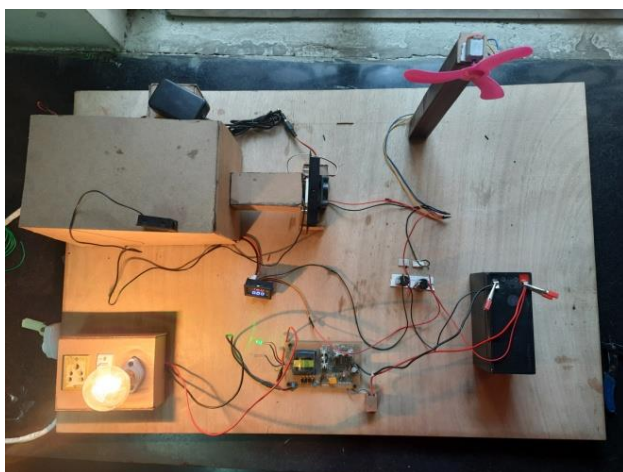


Fig 3. Working Model.

1. Advantages:

- It recycles the wasted heat.
- It requires less maintainance.
- It does not produce any vibration and noice.
- It has low manufacturing cost.
- Absence of refrigerants.

2. Applications:

- It recovers the waste heat of vehicle engine.
- It recovers the waste heat of Industries.
- Recharge the battery where ever waste heat is obtained.

V. CONCLUSION

Using thermoelectric generator we generate electricity by heat source, stored in a battery and inverted into AC and then utilized as per requirement of load. Waste heat recovery entails capturing and reusing the waste heat from machineries in industries and using it for generating electrical work. It would also help to recognize the improvement in performance and emissions of the machineries if these technologies were adopted by the production industries.

If this concept of thermoelectric system is taken to the practical level then there will be large amount of electricity can be generated, which will be used to run industrial load itself. Also large amount of wastage heat for pollution is also uses in this system in continue manner. And such industries also somehow help to protect the environmental pollution.

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