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# Fabrication of Two Wheeler Engine Cooling System Using Peltier Plates

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**ABSTRACT:** The current worldwide trend of increasing transportation is responsible for increasing the use of two wheeler engines .The purpose of this project has been to investigate the possibility of heating and cooling air by connecting peltier plates to system fins. When system runs it will dissipate heat and various toxic gases into atmosphere which causes global warming. At the mean time over heating of system will also affect the performance of the system when it's too hot. In order to reduce toxicity level of exhaust gases and smooth running of system we implement and tested peltier elements to cool the system to certain temperature. If the peltier is implemented on the system it will absorb the flue gas from the system to dissipate the cooled air into the atmosphere. It will increase the performance of the system and also reduces the global warming. .

**Keywords:** Peltier plates, Thermoeletric cooler, Seeback effect.

## 1 Introduction

Thermoelectric cooling is method used for cooling purpose in various applications. It has good impact over conventional cooling system. Thermoelectric coolers are compact in size, no coolant is used in the system, no frictional element present in system and weight of system is very less. The changing state between cooling device and heating device is easily controlled. Depending upon the requirement Thermoelectric Coolers (TEC) are used in various applications such as cooling of electronic equipment, thermoelectric refrigeration, space cooling with use of Phase Change Material (PCM), Portable active solar still etc. TEC are heat pumps that operate on Peltier effect. Research suggests that heating or cooling effect occurs when electric current passes through two conductors. When a voltage is applied to two ends of dissimilar material it will create difference. The temperature difference causes heat to flow according to peltier effect. A basic thermoelectric cooler will consist of semiconductor elements (p-type & n-type) that work as two dissimilar conductors arranged in specific order. The layer of elements is soldered between two ceramic plates, they are placed electrically in series structure and thermally in parallel structure. When the Direct current passes through one pair or multiple pairs of elements from 'n' to 'p' the temperature will decrease at that junction, resulting the absorption of heat from the surrounding. The heat is carried out through the transportation of electron and it will move from high state to low state. The pumping capacity of a cooler is directly proportional to no. of pairs of 'n' and 'p' type (couples).The 'n' and 'p' type semiconductor usually Bismuth Telluride are the most used material to achieve the Peltier effect because they are used for carrying out the heat. They also control the charge carrier type in the system.

## 2. Literature Survey

[1]Gang tan et al (2015) made thermoelectric space cooling system with the use of phase change material. Integrated thermoelectric cooling system with PCM is used for space cooling purpose. The function of Phase change material is to store cold thermal energy in night as cold side and it is used to reduce temperature of thermoelectric module in day period.

[2]Michael Gasik et al (2015) presented the functionally graduated material used for thermoelectric cooling of solar space power system. This system is designed to use natural resources such as intensive solar radiation approaching earth. The mirror arrangement is placed in the system which is at space. Sun radiation will fall on mirror, then arrangement of mirror and laser amplifier.

[3]Andrew B.Kustas et al (2012) represent the application of thermoelectric cooling in fire fighter. Fire-fighter has suffered physiological strain due to working environment. Some strain is produced due to presence in high temperature environment doing physical activity. Many fire fighter die because of external environment leads to increase internal body temperature as heat flows from high to low. External thermoelectric cooler provided with each fire fighter, so in presence of high temperature environment the external temperature will affect in less quantity and internal body temperature will remain normal. The TEC will be in portable form.

[4] Nandy Putra et al (2013) represents the thermoelectric cooling of a electrical equipment with the help of nanofluids with heat pipe liquid block. As the technology is increasing the size of microprocessor is also increasing. It will give higher heat flux. In computer, central processing unit (CPU) is the heart of computer. CPU contains 1 billion transistors and each transistor dissipates heat[5] Javad Abolfazli Esfahani et al (2004) Some techniques have been used to improve the performance to solar still. It consists of solar collector, a black wool covering is provided to wall of solar still. Water sprinkling device along with thermoelectric cooler is added to improve performance of still.

## 3. Thermoeletric Cooler

### 3.1. Thermoelectric effect

The thermoelectric effect is the direct conversion of temperature differences to electric voltage and vice versa. A thermoelectric device creates voltage when there is a different temperature on each side. Conversely, when a voltage is applied to it, it creates a temperature difference. At the atomic scale, an applied temperature gradient causes charge carriers in the material to diffuse from the hot side to the cold side.

The term "thermoelectric effect" encompasses three separately identified effects: the Seebeck effect and Peltier effect.

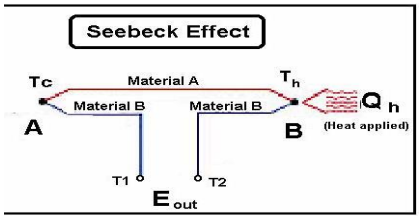
### 3.2. Seeback effect

The Seeback effect is the conversion of heat directly into electricity at the junction of dissimilar electrical conductors. It is named for the Baltic German physicist Thomas Johann Seeback.

From Fig.1, the conductors are two dissimilar metals denoted as material A and material B. The junction temperature at A is used as a reference and is maintained at a relatively cool temperature (TC). The junction temperature at B is used as temperature higher

Fig.1.Seeback Principle

than temperature TC. With heat applied to junction B, a voltage will appear across terminals T1 and T2 and hence an electric current would flow continuously in this closed circuit. This voltage is known as the Seeback EMF, can be expressed as




$$\alpha = dE / dT = \alpha A - \alpha B$$

Where:

α is the thermo electric power coefficient

### 3.3. Peltier effect

Peltier found there was an opposite phenomenon to the Seeback Effect, whereby thermal energy could be absorbed at one dissimilar metal junction and discharged at the other junction when an electric current flowed within the closed circuit.

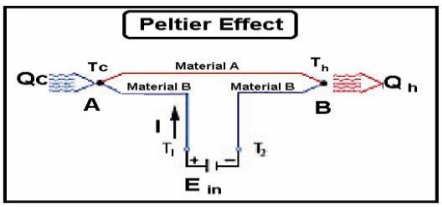



Fig.2.Peltier Principle

In Fig.2, the circuit is modified to obtain a different configuration that illustrates the peltier effect, a phenomenon opposite that of the Seeback effect. If a voltage ($E_{In}$) is applied to terminals T1 and T2, an electrical current (I) will flow in the circuit. As a result of the current flow, a slight cooling effect ($Q_C$) will occur at thermocouple junction A (where heat is absorbed), and a heating effect ($Q_H$) will occur at junction B (where heat is expelled). Note that this effect may be reversed whereby a change in the direction of electric current flow will reverse the direction of heat flow.

Joule heating, having a magnitude of $I^2$ x R (where R is the electrical resistance), also occurs in the conductors as a result of current flow. This Joule heating effect acts in opposition to the Peltier Effect and causes a net reduction of the available cooling. The Peltier effect can be expressed mathematically as $\beta = (Q_C - Q_H) / I$

## 4. Experimental Setup

The Peltier effect occurs whenever electrical current flows through two dissimilar conductors; depending on the direction of current flow, the junction of the two conductors will either absorb or release heat. In the world of thermoelectric technology, semiconductors (usually Bismuth Telluride) are the material of choice for producing the Peltier effect because they can be more easily optimized for pumping heat. Using this type of material, a Peltier device (i.e., thermoelectric module) can be constructed in its simplest form around a single semiconductor "pellet" which is soldered to electrically-conductive material on each end (usually plated copper). In this configuration, the second dissimilar material required for the Peltier effect is actually the copper connection paths to the power supply. It is important to note that the heat will be moved in the direction of charge carrier movement throughout the circuit (actually, it is the charge carriers that transfer the heat).

Fig.3(a).Experimental Setup

External electronics are responsible for controlling the temperature and protecting the package from overheating. T increases with increasing current (I) up to the point that the internal heating is greater than the heat pumping capacity. Increasing I beyond that point will heat the device, possibly to destruction. A thermistor should be used to provide feedback to controller.

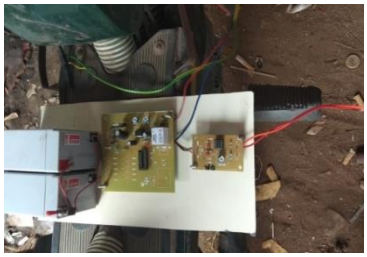
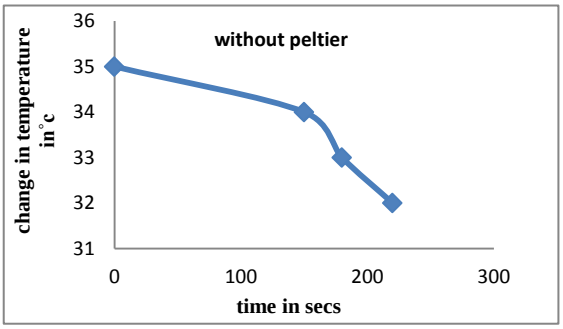
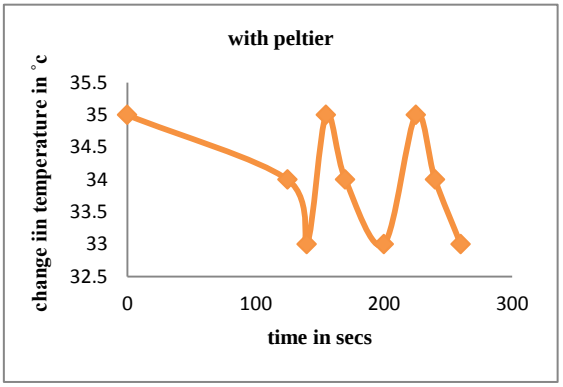


Fig.3(b).Experimental Setup

## 5. Result

Incase engine without peltier may damage the components due to over heating and significantly reduces its life. But if we implemented peltier plates to cool engine fins it may increase the efficiency of fuel consumptions and life of components from the problem of over heating.




From the above two graph we found that decrease in temperature/cooling of fins takes varying time with peltier and without peltier.

## 6. Conclusion:

A Thermoelectric cooling & heating system was designed and built which can be used for personal cooling & heating. Ten TECs were used for achieving the cooling with a DC power supply through external power supply. Accomplishing the set target establish the success of the project. All the components in the project had been tested individually and the results were found to be positive. The prototype can be made compact by selecting as single TEC of higher power. It can be done by choosing a better cold side heat sink that has twisted channels or pipes for circulating the air for a longer time. Even as shown in the appended figure we can mount no of TEC cooling in Well-known TEC brands (.i.e. Melcor, Ferro TEC etc) must be chosen if there is only one high power TEC selected for the cooling system. Bigger hot side heat sink (fins) has to be selected accurately based its calculated thermal resistances for best cooling efficiency. With a single TEC, one hot side and a cold side heat sink a smaller personal TEC cooler which gives comfort can be fabricated and can be installed on roof for individual cooling by changing the airflow and some mechanical or electronics section modification, the TEC air cooling for car can be used for heating applications too.

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