

# PERFORMANCE AND EVALUATION OF THERMOELECTRIC POWER GENERATOR

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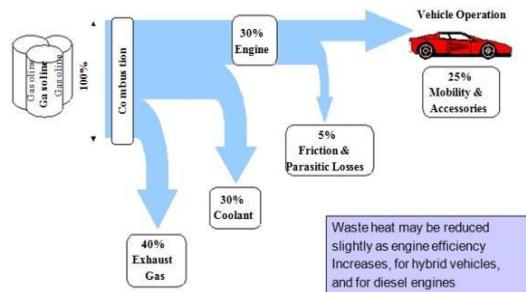
**Abstract**— In recent years, on increasing concern of environmental issues of emission, in particular global warming and the limitation of energy resources has resulted in extensive research into novel technologies of generation electric power thermoelectric power generation offers a potential application in the direct conversion of waste heat energy into electrical power by seebeck effect in which waste heat energy is directly converted into electrical energy. The Thermo Electric Generator can be used to produce power using the exhaust waste heat from IC engines. This power can be used for various applications In automobile like charge the battery of automobiles. The system can be used as an alternative of the solar energy. It finds its application in industrial instruments, military, medical and aerospace.

**Index Terms**— Seebeck effect, TEG, Peltier, Hot Heat Exchanger.

## I. INTRODUCTION

The "Energy Crisis" has become a major challenge in front of engineers across the world due to highly increasing demands and consumption of energy. Over the years, the cost of electricity has risen to unprecedented levels due to the limited supply of oil and economic and political factors. For almost two to three hundred years, the main energy resource has been fossil fuel and will continue to supply much of the energy for the next twenty to thirty years. Through world oil consumption is rise from 80 million barrels per day in 2003 to 98 million barrels per day in 2015 approximately. and then it will be rise to 118 million barrels per day in 2030. In world most of the oil demand will be from automobile sector. The automobile and transport sector will share 54% of global primary oil consumption in 2030 as compared to 47% today and 33% in 1971. internal combustion engines, around 30% of the heat energy

is wasted in the form of exhaust gases, and 30% in coolant as shown in figure.[1]



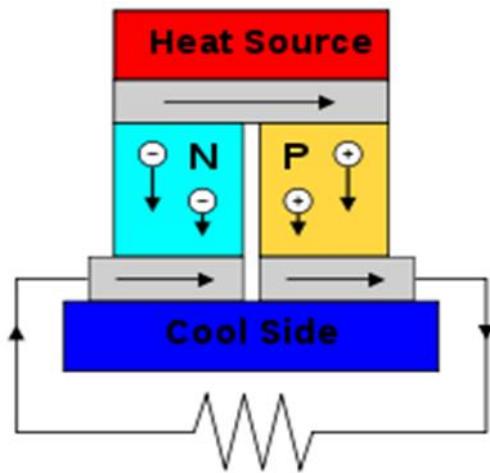
**Figure 1: losses of waste heat in combustion[1]**

One possible solution is the usage of the exhaust gases waste heat of internal combustion engines. This is possible by the waste heat recovery using thermoelectric power generator. A thermoelectric generator converts the temperature difference into useful voltage that can be used for providing electrical power for additional systems.[1]

The thermo electric power generator is used to generate power from low temperatures. Thermo electric power generator generate the power from temperature which is less than 1000K as heat input. It is best method to recovery of exhaust gases heat. The working of TEG is based on the principle of seebeck effect, and its efficiency ranges between 5 to 15 percents. Its applications can be seen in many fields such as automobiles, boilers, thermal plant etc. The extraordinary fact of thermo electric power generator is the direction of energy flow can be reversible. means it can also use to produce refrigeration effect. If the direction of energy flow can be reverse by substitutes DC power the thermo electric power generator is used to remove heat from heat source and decreases its temperature. In this process electric power is supply to pump heat from hot side and produce refrigeration effect.[2]

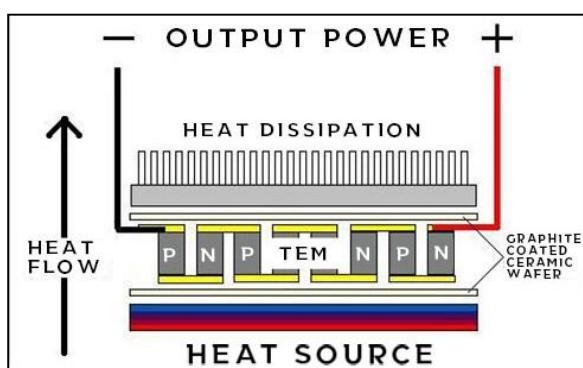
## II.WORKING OF THERMO ELECTRIC POWER GENERATOR

The working of thermo electric power generator is based on principle of seebeck effect.



**Figure 2: seebeck effect**

The seebeck effect is the conversion of heat directly into electricity at the junction of different types of wire. The seebeck effect is phenomenon in which a temperature difference between two dissimilar electrical conductors or semi-conductors produces a voltage difference between the two substance. When heat is applied to one of the two conductors or semi-conductors, heated electrons flow towards the cooler one, if the pair is connected through an electrical circuit direct current (DC) flows through that circuit.

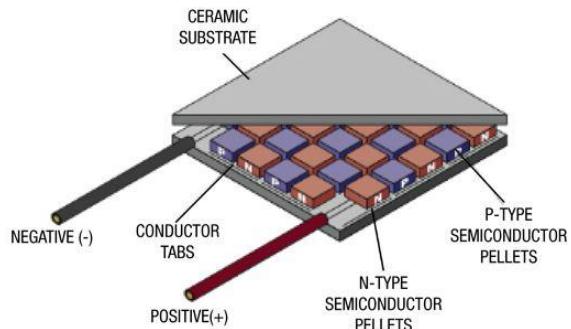


**Figure 3: working of TEG module [3]**

Thermoelectric power generator consist hot side heat exchanger and cold side heat exchanger. A thermoelectric module is mount in between hot side heat exchanger which is at a temperature  $T_1$  and cold side heat exchanger which is at temperature  $T_2$ . As shown in figure heat is transfer from hot side heat

exchanger at a rate of  $Q_2$  to the cold side which is at a low temperature at a rate of  $Q_1$ . According to the first law of thermodynamics that is energy conservation principle energy can neither be create nor be destroy, it can only be converted from one form of energy to other form of energy. the difference between  $Q_2$  and  $Q_1$  is the electrical power we get.

A thermoelectric module is a circuit containing thermoelectric materials that generate electricity from heat directly. A thermoelectric module consists of two dissimilar thermoelectric materials joining in their ends: an n-type (negatively charged) and p-type (positively charged) semiconductors. A direct electric current will flow in the circuit when there is a temperature difference between the two materials according to seebeck and peltier effect. Generally, the current magnitude has a proportional relationship with the temperature difference. The more the temperature difference, the higher will be the current. Maximum power generated by one module largely depends upon type of material use, Density of semiconductor per module, area of module.



**Figure 4: TEG module. [2]**

## III. APPLICATION OF TEG

The output of TEG is in the form of electrical energy. Hence it finds numerous applications, but its property of requirement of temperature difference across which restrict its field of application. It can fulfill the basic electricity need of industry by using waste heat from industrial plants.TEG also find application in thermal plant. . The system can be used as an alternative of the solar energy. It finds its application in industrial instruments, military, medical automobile and aerospace.

#### IV. CONCLUSION

We can use TEG module to recover waste heat energy and convert it to electrical energy. Despite the large amount of heat energy which is wasted can be brought to use by this device directly.

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