PROSPECTS IN THE USE OF THERMOELECTRIC GENERATORS FOR VEHICLES

Xojimatov Umidbek Turg'unboy o'g'li
Xojimatov Islombek Turg'unboy o'g'li
Mamirov Abduvoxid Muxammadamin o'g'li
Andijan machine-building institute

Abstrakt: *In this article offers a comprehensive analysis of thermoelectric generators (TEGs), with a particular emphasis on their many designs, construction methods, and operational processes, all aimed at achieving optimal conversion of thermal energy into electrical energy. This chapter extensively examines the fundamental principles that control thermoelectric generators (TEGs), providing a complete examination of their respective merits and drawbacks in comparison with conventional energy conversion techniques. This study thoroughly investigates the key elements that have a significant impact on the performance of thermoelectric generators (TEGs), including the temperature gradient, heat source temperature, and load resistance.*

Key words: *thermoelectric generators, Seebeck effect, semiconductors, temperature.*

Introduction.

We know, the world had now focused more on how to reduce pollution, global warming and greenhouse effect. In order to find a solution for these, there is a lot of research and development had been going on in the field of renewable energy or alternative source of energy apart from conventional energy production from coal and natural gas. The main reason is to keep our natural resources safe and to reduce pollution by combustion of them. Here, the automotive industry also had a significant part in reducing pollution as most automotive vehicles run by combustion of fuel [1-2]. Now, there is a great revolution in the automotive industry with the introduction of electric vehicles, which are now becoming more popular as they do not harm the environment. We also had a part of the world where a lot of research is going in the field of thermoelectric generator, which produces electricity from the waste heat generated by a machine.

Method. A thermoelectric generator produces electricity when a temperature gradient occurred between two dissimilar materials causing a hot and cold junction. There is a voltage developed called Seebeck voltage. The thermoelectric generator works on a principle called Seebeck effect, which discovered by Thomas Seebeck in 1821[3-5]. These thermoelectric generators are solid-state devices integrated circuits, which had made in keeping the number of thermoelectric modules in series to develop more voltage and connected parallel in order to increase the thermal conductivity. When a temperature gradient happened between the hot and cold sides of two materials, then there will be a flow of charge carriers which results in the production of electricity [6]. These thermoelectric generators mainly affected by the Peltier effect, Thomson effect, and Seebeck effect. In 1834, Jean Charles Athanase Peltier discovered a reverse theory of the Seebeck effect that if a current passes from an external source through a circuit of two metals, it cools one junction and heats the other, known as the Peltier effect. These thermoelectric modules are thermocouples that made up of p-type and n-type semiconductors. These all connected in series by a metal conductor or strip. In thermoelectric generators, when the hot side of the n-type and p-type semiconductor increases enough heat for the movement of the electrons in the n-type and holes in the p-type semiconductor will move to the other side of it where a metal strip exists [7-9, 10-16]. Now, there will be a creation of charge carriers, which leads to the development of voltage, which varies along with the variation in temperature. In the next diagram, you can see how the semiconductors, metal strips, and where the movement of charge carriers occurs. In general, the materials used for semiconductors in thermoelectric generators are bismuth (Bi_2Te_3) telluride, lead telluride (PbTe), and Silicon germanium (SiGe) and together silicon oxide (SiO_2). The main application of TEG will be space, automobile, medical, electronic industries, etc.

Conclusion.

Analyzing the facts related to this topic, we can conclude. type of semiconductor material used for the thermoelectric generator and each material is suitable for only a certain limit of temperature like Bi_2Te_3 for low-temperature range <250 °C, PbTe for a medium temperature range of 250 °C – 500 °C and skutterudite materials high temperatures range of 500 °C – 700 °C. Sufficient space under the vehicle to mount the some vehicle. Power density is also a concern for some vehicle, where it has to achieve 10kW heat energy from the exhaust; given that most of the current system efficiency is less than 10%. Also, another concern where the car can produce heat at more than 1000 °C during very high speeds, which is a very high temperature for the TE materials and finally leads to their damage.

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