VOLUME-8, ISSUE-12, DECEMBER-2019 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper | Mechanical Engineering

THERMOELECTRIC BASED ALL WEATHER COOLER

Saswat Kumar Das	Department of Mechanical Engineering,IIMT College of Engineering, Greater Noida
Atul Kr Yadav*	Department of Mechanical Engineering,IIMT College of Engineering, Greater Noida *Corresponding Author
Bablu	Department of Mechanical Engineering,IIMT College of Engineering, Greater Noida
Deepak	Department of Mechanical Engineering,IIMT College of Engineering, Greater Noida
Deepak Kumar	Department of Mechanical Engineering,IIMT College of Engineering, Greater Noida

ABSTRACT

In this automation scenario when everyone is serious about glaciers melting & ozone layer depletion so it's important to do which helps in overcoming this problem. Many type of refrigerator are made using refrigerant which to extent affect our environment. Then it strikes to make a cooling & heating system in which there is no use of refrigerant so there is an option of vapour absorption system. Now the problem occurs about its shape (heating & cooling system) is heavy & bulky. But our system is not very heavier shape and weight. The idea generation for the project had come in order to face and tackle the harmful for the environment. That's where the principle of internal heat generation and manipulation comes to save the day. If the room is heated or cooled just before the required time, it will subsequently decrease the energy losses and produce the required temperature at the right time. But despite using high energy consuming resistance coils to produce heat and refrigeration system to produce cooling. We use Peltier effect to produce either heating/cooling as per the user's requirement. The JIT (just in time) philosophy of our product increases accountability to meet the user's needs efficiently while reducing the heat loss/gain incurred during the process of pre-heating/pre-cooling of room. There have been a lot of advancements made to all weather coller over the years, but no one's made anything for the "modern man,". Without any harm to our environment.

KEYWORDS : Peltier, Thermoelectric Heating/Cooling, Environment

1.LITERATURE REVIEW

Thermoelectric coolers (TEC), also known as Peltier Coolers are solid state heat pumps that utilize the Peltier effect to move heat. The principle of thermoelectric cooling dates back to the discovery of the Peltier effect by Jean Peltier in 1834. Peltier observed that when electric current passes across the two junctions of two dissimilar conductors (a thermocouple) there was a heating effect that could not be explained by Joule heating alone. Infect, the direction of current decides the cooling effect or heating effect. This effect can be harnessed to transfer heat, creating a heater or cooler. Peltier could not realize the importance of this phenomenon and the other scientists also could not utilize this phenomenon till late 20th century. Thermoelectric technology, as one entirely solid state energy conversion way, can directly transform thermal energy in to electricity and vice-versa by using thermoelectric transformation materials. A thermoelectric TEC has no moving parts, and is compact, quiet, highly reliable and environment friendly. Due to these merits, this technology is presently becoming a noticeable research direction. Bell (2008); Heremans et al. (2008); Poudel et al. (2008); Hochbaum et al. (2008); Boukai et al. (2008); Lyeo et al. (2004); Hsu et al. (2004)

2.WORKING OF TEC

When the two ends of two dissimilar conductors are connected to a battery, electrons flow out of one in which the electrons are loosely bound to the one in which the electrons are tightly bound. This occurs due to the deference in the Fermi level between the conductors. The Fermi level represents the demarcation in energy with in the conduction band of a metal, between the energy level occupied and unoccupied energy levels. When the two different conductors are joined which have different Fermi levels, electron start flowing from the conductor with higher level to the other one. This flow continues till the electrostatic potential bridges this gap and the two Fermi levels come at the same value. Current passing across the junction results in either a forward or a reverse bias, resulting in temperature gradient. If the temperature of the hotter junction is kept low by removing the heat, the temperature of the cold plate can be cooled by tens of degrees.

2.1TEC Construction

TEC are constructed using two dissimilar semi-conductors, n-type and p-type (in order to have different electron densities needed for better effect) Fig 2.1. The two semi-conductors are positioned thermally in parallel and joined at one end by a conducting cooling plate (typically of copper or aluminum). A voltage is applied to the free ends of the two different conducting materials, resulting in a flow of electricity through the two semi conductors in series. The flow of DC across the junction of the two semiconductors creates a temperature difference. Giving rise to Peltier cooling and hence absorption of heat from the vicinity of the cooling plate. If the direction of current is changed by changing the polarity of the battery, the cold side becomes hot side and the hot side becomes cold side in TEC.

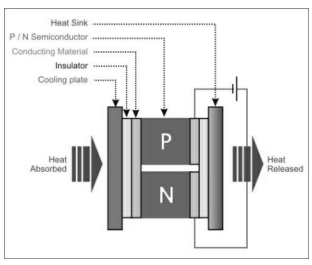


Fig 2.1: TEC construction

2.2 Benefits of TEC

While refrigerators and air-conditioners utilize compressors, condensers and refrigerants to lower temperature; solid state cooling utilizes DC power, heat sinks and semiconductors. Venkatasubramanain et al. (2001); Chen et al. (2010); Yamashita (2009); Yamashita (2008). This fundamental difference gives solid state thermoelectric coolers the following advantages over conventional devices.

Environment friendly (as no refrigerants are used). Therefore leaking problem of refrigerants can also be avoided. As CFC's have high ozone depletion potential and HCFC's have comparatively low ozone depletion level, they are being phased out. It this situation TEC's can be the best alternate as it has zero harmful effect. It Can be manufactured in compact sizes using less space. Light weight, which can be advantageous where light weight is more imporatant feature than COP.(e.g. in aircrafts). Rate of refrigeration and COP can be easily controlled by varying voltage and current.

3.THERMOECONOMICS

Thermoeconomics, as an exergy-aided cost reduction method, provides important information for the design of cost effective energy conversion systems. The exergy costing principle is used to assign monitory values to all material and energy streams within a system as well as tho the exergy destruction within the system. The design evaluation and optimization is based upon the trade-off between exergy destruction (exegetic efficiency) and investment cost. It is observed that in most of the studies (Adnan, 2001; Aprea et al, 2002; Adnan et al., 2003; Aprea et al., 2004; Adnan et al., 2007; Kabul et al;, 2008; Ozkaymak et al., 2008; bayrakci et al., 2009; Kizilkan et al., 2010; Variyelni et al., 2011), performance comparison and performance analysis of refrigeration system is performed using energy approach based on first law and exergy analysis based on second law. Energy and exergy approaches are generally well known approaches, used to analyze thermal processes.

There are various terminologies and names given to various exergoeconomic approaches presented in the past by researchers in previous years.

These names include the following:

3.1 Economic Approach (EEA)
3.2 First Exergoeconomic Approach (FEA)
3.3 Thermoeconomic Functional Analysis (TEA)
3.4 Exergetic Cost Theory (ECT)
3.5 Engineering Functional analysis (EFA)
3.6 Last-in-First Out Approach (LIFOA)
3.7 Structural Analysis Approach (SAA)
3.8 SPECO Method (SPECOM)

4.RECENT DEVELOPMENTS IN THERMOELECTRICS

A multi-objective and multi-parameter optimization was implemented by Meng et al. (2014) to design the optimal structure of bismuth-telluride-based TEG (thermoelectric generator) module. A multi-physics TEG model combining the SCG (simplified conjugate-gradient) algorithm was used as the optimization tool. A thermoelectric generator must be designed keeping all geometric features in to account to enhance the performance such as efficiency and power output. A study has been done in which three the-state-of-the-art multi-objective evolutionary algorithms, namely, NSGA-II (Non-dominated Sorting Genetic Algorithm-II), GDE3 (Generalized Differential Evolution generation 3), and SMPSO (Speed- constrained Multi-objective Particle Swarm Optimization) are used to optimize the geometric features of a thermoelectric generator to improve its efficiency and power output when it is operating in different conditions. Geometric parameters may be defined shape factor and size of pin length and the operating parameters may be defined as temperature ratio and load on thermoelectric cooler.

5.GAPS AND OPPORTUNITIES

5.1Second Law Analysis of thermoelectric devices is required to understand their potential to serve the desired purposes.

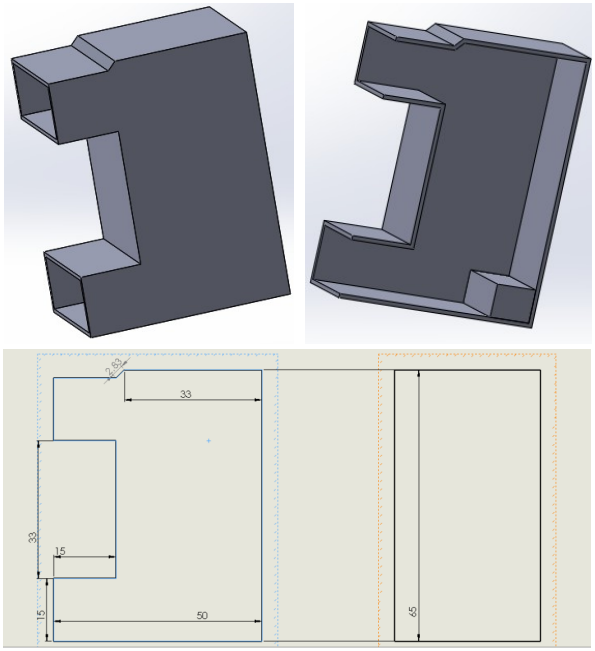
5.2Optimized operating condition should be evaluated to improve the performance.

Optimized design should be developed to enhance the application of thermoelectric devices where size, weight and shape are more important than efficiency or COP.

6.CONCLUSION

- As per the calculation and heat transfer rate required, Peltier module TEC-12706 is selected for cooling and heat generation.

Design :



7. ADVANTAGES

1. Environmentally friendly
2. Recycles wasted heat energy
3. Reliable source of energy
4. Lowers production cost
5. Scability, meaning that the device can be applied to any size heat source from a water heater to a manufactures equipment.

8. DISADVANTAGES

1.TE material is expensive
2. Structural failure of TE at high temperatures
3.Electrical resistivity increases.

9.APPLICATIONS

1. Stir coolers
2. Electrophoresis cell coolers
3. Environmental analyzers

REFERENCES