

DESIGN AND FABRICATION OF A PORTABLE MINI REFRIGERATOR

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Abstract: This paper deals with the working of mini refrigerator. Thermoelectric Cooler Design is a Microsoft Windows program to be used as an aid in the design of thermoelectric cooler devices. This program was written to be used to quickly model and compare alternative designs. A couple's optimum coefficient of performance and maximum heat pumping can be quickly determined. Other major features of the program include the ability to change material properties and dimensions of couples, analyze cascaded couples, and graph performance parameters

Keywords: TEC, Peltier effect, coefficient of performance.

1.1 Introduction

Refrigeration means removal of heat from a substance or space in order to bring it to a temperature lower than those of the natural surroundings. In this context, my topic, **Thermoelectric Refrigeration** aims at providing cooling effect by using thermoelectric effects rather than the more prevalent conventional methods like those using the 'vapour compression cycle' or the 'gas compression cycle'.

There are 5 thermoelectric effects and these are observed when a current is

passed through a thermocouple whose junctions are at different temperatures. These phenomenon are the Seebeck effect, the Peltier effect, the Joulean effect, the conduction effect, and the Thomson effect. Thermoelectric cooling, also called "Peltier Effect", is a solid-state method of heat transfer through dissimilar semiconductor materials. It is based on the thermoelectric effect known as 'Peltier Effect' according to which if current is passed through a thermocouple, then the heat is absorbed at one junction of the thermocouple and liberated at the other junction. So by using the cold junction of the thermocouple as the evaporator, a heat sink as the condenser and a DC power source as the compressor of the refrigerator, cooling effect can be provided.

The coefficient of performance of compression refrigerators decrease with the decrease of it's capacity. Therefore, when it is necessary to design a refrigerator for cooling a chamber of only a few litres capacity, thermoelectric cooling is always preferable. Also for controlling the temperature of small units, thermoelectric cooling has no competition from existing refrigerators of the conventional types.

2.1 Literature Survey :

Maamar Ouali [1] studies the importance of temperature control in household refrigerator on the environmental and economic plan. Refrigerator energy consumption is greatly affected by room temperature, door opening and thermostat regulation. A household refrigerator powered by photovoltaic energy was tested in laboratory to determine the effect of thermal regulation on energy consumption. R.Best [2] studied the performance and development of thermal-powered cooling systems is presented. The review covers the current state of theoretical and experimental studies of absorption, adsorption, desiccants (liquid and solid), ejector-compression and hybrid systems. Riccardo Brignoli [3] concluded two shortcomings. First, it neglects transport properties, whose influence on system performance is particularly strong through their impact on the performance of the heat exchangers. Second, the refrigerant temperatures in the evaporator and condenser are specified as input, while real-life equipment operates at imposed heat sink and heat source temperatures; the temperatures in the evaporator and condensers are established based on overall heat transfer resistances of these heat exchangers and the balance of the system. Tomohiko Imamura [4] Even in the absence of mechanical ventilation, neither ignition nor flame propagation occurred if the amount of "LFL equivalent", that the calculated interior concentration corresponded to the lower flammable limit, was leaked and mixed sufficiently. Even when the leak amount was "UFL equivalent", that the calculated interior

concentration corresponded to the upper flammable limit, ignition and flame propagation could be prevented by means of a suitable ventilation system. Diana Enescu [5] addresses the electrical characteristics of a thermoelectric refrigerator connected to the power grid in a microgrid-like installation. A sustainable solution, in which the thermoelectric refrigerator is connected to a microgrid powered by a photovoltaic plant and equipped with an electric storage system, is designed and simulated. L. Pizzo [6] concluded that availability of a 3 He refrigerator working at 300 mK for one day starting from 4.2 K, without pumping on the main 4 He bath, offers several advantages. J.H.Choi [7] classified the structures of insulation according to cooling methods, and studied the insulation characteristics of each insulation factor. Niccolò Aste [8] concluded thermoelectric technology is instead particularly suitable to preserve tropical fruits or vegetables suffering chilling injury, in temperate climatic conditions, and represents a good solution for portable applications. Murat Gökçek[9] concludes that the performance of minichannel heat sink used in this study has as good as other liquid water cooled systems used to absorb heat from thermoelectric modules hot side. Anna Roccato [10] studied that provided probability density distributions of domestic refrigerator temperatures for northern and southern European countries and of storage times of chilled food with long or short use-by-date. Shikalgar Niyaj [11] concludes that coefficient of performance of refrigeration systems with R290 as refrigerant is comparable with R134a as a refrigerant and starting torque of compressor reduces which leads to improvement in the life of a

compressor. T. Brown [12] concludes that particular equipped with dual compressors and more sophisticated controls, would be beneficial in checking that the measurements and the assumptions applied are appropriate when considering national (and wider) fridge stocks. R.Z. Wang [13] studied electric batteries developed for electric vehicles could in future be considered for residential uses. Low power density, high cost and efficient charge time are the bottlenecks for their application. Thermal storage development activity should aim to supply thermal batteries in the kWh range with high heat charge and release rate, and high power density. Mohan M. Tayde [14] investigated that, the main energy losses occurring in the condenser, evaporator and compressor were highlighted. The experimental results also indicate that the compression ratio of the compressor and COP. B.L.Thakor [15] concludes that without evacuation, perlite can be used in Refrigeration industry. Its unique biodegradable nature will definitely help to preserve nature and will keep earth green. L Cremaschi [16] clarifies that failure was caused by a systematic oil trap in the system, by issues with POE oil transport with the various refrigerants during drop-in tests, or by the fact that the compressor had unusual high oil concentration ratio during some of the experiments. H.Alan fine [17] concluded that adding insulation or incorporating vacuum panel insulation into a RIF can achieve significant energy reductions. Naser R. M. AL-Ajmi [18] said that small refrigerator is used as the testing and the coefficient of performance (COP) is studied by using different condenser designs and under varying evaporator loads. D. Astrain[19] studied that development of

thermoelectric refrigerators able to compete with vapour-compression ones in the domestic sector. Christian J.[20] concludes thermoelectric device is not at the same level as the other coolers. Serious improvement is needed to reduce both internal and external irreversibilities. J.G. Via'n [21] clarifies the control of temperatures, since it does not need to carry out start-stop cycles, making it possible to vary the supply voltage in a progressive way. Satheeshkumar Palaniappan, [22] concludes lower performance compared to Bi-Te, when it is operated at ambient temperature conditions. Hence, Bi-Te is considered as the better choice for ambient applications, while Pb-Te better for high temperature applications. Richard Lawton [23] describes the basic components in a modern-day vapor compression refrigeration system and typical design constraints of such a system. Amir Faraji [24] studied that a PID controller has several advantages compared with a conventional on-and-off controller for controlling the input power of the module. Xingyang Yang [25] concludes effect of condensing temperature and generating temperature on the cycle performance is analyzed. It is found that the system has a better performance at lower condensing temperature.

Conclusion:

Thermoelectric refrigerators are greatly needed, particularly for developing countries, where long life, low maintenance and clean environment are needed. In this aspect thermoelectrics cannot be challenged in spite of the fact that it has some disadvantages like low coefficient of

performance and high cost. These contentious issues are the frontal factors hampering the large-scale commercialization of thermoelectric cooling devices.

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