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Research Paper

STUDY AND DEVELOPMENT OF NEW PORTABLE REFRIGERATOR KIT FOR MEDICAL APPLICATION

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Numerous peoples are affected by diabetic disease. In the diabetes medical survey says that "In 2020 eight crore peoples will be a diabetic patient in the world". It is specially designed for persevering insulin and other medical instruments. It may be implementing in medical field. The paper reports on an effort to develop a portable refrigerator kit using peltier effect is the solution for maintain medicine for the particular temperature level at any time with low cost. This is most effective for poor people (by the cost) and travelling people (because of size).

Keywords: Peltier effect, Thermo electric effect, Thermo electric cooler, Portable refrigerator

INTRODUCTION

Insulin injection is used to control blood sugar in people who have type 1 diabetes (condition in which the body does not make insulin and therefore cannot control the amount of sugar in the blood) or in people who have type 2 diabetes (condition in which the blood sugar is too high because the body does not produce or use insulin normally) that cannot be controlled with oral medications alone. Insulin injection is in a class of medications called hormones. Insulin injection is used to take the place of insulin that is normally produced by the body. It works by helping move sugar from the blood into other body tissues where it is used for energy. It also stops the liver from producing more sugar. All of the types of insulin that are available work in this way. The types of insulin differ only in how quickly they begin to work and how long they continue to control blood sugar. Many doctors recommended that, store unopened vials of insulin, unopened disposable dosing devices and unopened insulin pens in the refrigerator. Do not freeze insulin and do not use insulin that has been frozen. Opened vials of insulin should be stored in the refrigerator but may also be stored at room temperature, in a cool place that is away from heat and direct sunlight. Store opened insulin pens and opened dosing devices at

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room temperature. Otherwise it is not properly mixed with blood and also it makes pain. For that reasons we maintain temperature the medicine by use of refrigerator. But poor people fails for the costly operation and many of the diabetes must inject the medicine 4 to 5 times. During travelling times maintain the medicine temperature is not a practical one. For the above reason the portable refrigerator is the solution for maintain medicine for the particular temperature level.

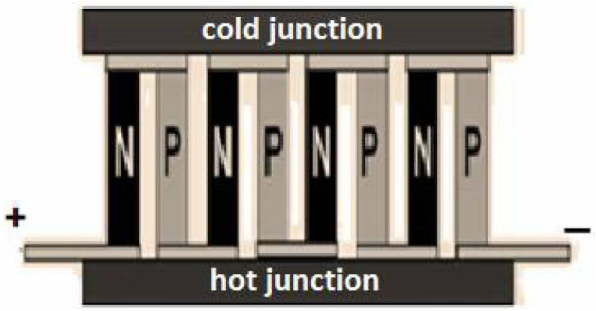
LITERATURE SURVEY

There are several methods of cooling electronic depending on the application. The cooling techniques can be classified broadly into two classes: (i) Passive, and (ii) Active techniques. Passive techniques can be defined as those where no external power is required for cooling where active techniques require external power to cool. There are three scales of cooling for products: (i) Module level cooling, (ii) System Cooling, and (iii) Data centre cooling. Module level cooling refers to cooling the object, system level cooling refers to the entire area and data centre cooling refers to cooling the rooms where objects and equipment are stored. The research in this project will focus on the system level cooling using peltier cooling system which involves peltier cooler modules; heat pipes and an air cooled heat sink. The components of the hybrid system along with other cooling techniques, both active and passive, adopted in object cooling are reviewed in the following sections. This technology has existed for about 40 years. Many researchers are concerned about the physical properties of the peltier material and its applications.

PELTIER EFFECT

Heat could be either removed from a junction to freeze water into ice, or by reversing the current; heat can be generated to melt ice. The heat absorbed or created at the junction is proportional to the electrical current. The proportionality constant is known as the Peltier coefficient. Peltier thermo-elements are mainly made up of semi conductive material. This means that they have P-N contacts within. Actually, they have a lot of P-N contacts connected in series. They are also heavily doped, meaning that they have special additives that will increase the excess or lack of electrons.The following Figure 1 shows that how the P-N contacts are connected internally within a Peltier TEC.

Figure 1: Peltier Device



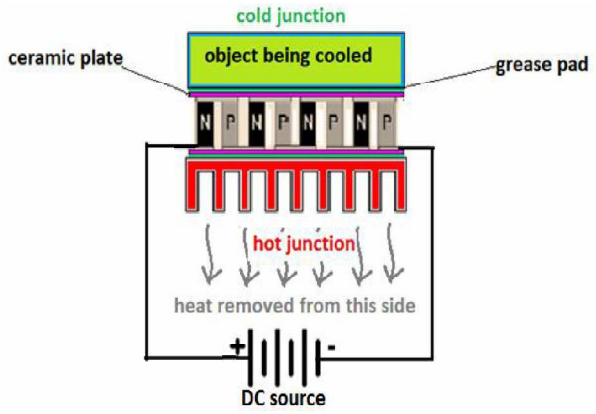
METHODOLOGY

A refrigerator is a device which is used to removal of heat from a substance or space in order to maintain it to a particular temperature level (lower than the natural surroundings). A portable refrigerator aims at providing cooling effect by using peltier effect. In the peltier effect current is passed through a thermocouple, and then the heat is absorbed at cold junction of the thermocouple and liberated at the hot junction. So by using the cold junction of the thermocouple as the evaporator, a hot junction

as the condenser and a DC power source as the compressor of the refrigerator, cooling effect can be provided.

A peltier effect refrigerator has analogous parts. At the cold junction, energy is absorbed by electrons as they pass from a low energy level in the p-type semiconductor element, to a higher energy level in the n-type semiconductor element. The power supply provides the energy to move the electrons through the system. At the hot junction, energy is expelled to a heat sink as electrons move from a high energy level element (n-type) to a lower energy level element (p-type). As the electrons move from the p-type material to the n-type material through an electrical connector, the electrons jump to a higher energy state absorbing thermal energy (cold side). Continuing through the lattice of material, the electrons flow from the n-type material to the p-type material through an electrical connector, dropping to a lower energy state and releasing energy as heat to the heat sink (hot side). A peltier module thus uses a pair of fixed junctions into which electrical energy is applied causing one junction to become cold while the other becomes hot. Figure 2 shows, an object being cooled is placed on a cold junction. A grease pad and ceramic plate are in place between the object and the semi conductor. A grease pad is a thermal insulator and the ceramic plate act as a heat conductor and electric insulator. The semiconductor materials are N and P type, and are so named because either they have more electrons than necessary to complete a perfect molecular lattice structure (N-type) or not enough electrons to complete a lattice structure (P-type). The extra electrons in the N-type material and the holes left in the P-type material are called “carriers” and they are the agents that move the heat energy from the cold to the hot junction. Heat absorbed at the cold junction is pumped to the hot junction at a rate proportional to carrier current passing through the circuit and the number of couples. Good thermoelectric semiconductor materials such as bismuth telluride greatly impede conventional heat conduction from hot to cold areas, yet provide an easy flow for the carriers. In addition, these materials have carriers with a capacity for transferring more heat. Thermoelectric cooling couples are made from two elements of semiconductor, primarily Bismuth Telluride, heavily doped to create either an excess (n-type) or deficiency (p-type) of electrons. Heat absorbed at the cold junction is pumped to the hot junction at a rate proportional to current passing through the circuit and the number of couples. The material used for the assembly components deserves careful thought. The hot junction and cold junction mounting surface should be made out of materials that have a high thermal conductivity (i.e., copper or aluminum) to promote heat transfer. However, insulation and assembly hardware should be made of materials that have low thermal

Figure 2: Peltier Effect – Refrigerator



conductivity to reduce heat loss. The fins attached to the hot face of the cooling unit are larger than those entering the cooled chamber. This is because the latter fins merely have to abstract heat from the chamber whereas the former have to pass this heat, as well as that developed in the thermocouples, on to the surroundings. Ideally the fins should be of sufficient area for the temperature of their bases to be insignificantly different from their respective ambient temperatures. However such fin areas are generally as large as to be economically impracticable and a balance must be drawn between the reduction of the fin sizes and the lowering of the temperature differences between the metal slabs and their surroundings. These temperature differences must be taken into account while calculating the coefficient of performance of the units. They must be added to the temperature difference between the cooled chamber and ambient air in order to obtain the difference of temperature between the thermocouple junctions. It is also necessary to add any temperature differences across the electrical insulation between the metal slabs and the connectors.

ANALYSIS

Figure 3 shows that the temperature of the cold junction was decreased when increase the time. The desired temperature will be set in the device, the temperature of the object (being cooled) was decreased and achieve the desired temperature and maintain the level of temperature.

Figure 4 shows that the temperature of the cold junction decreases when the voltage increases. In the peltier cooler the input current voltage is increases the cold junction temperature was decreased.

Figure 3: Variation of Temperature of Cold Junction (Tc) with Time

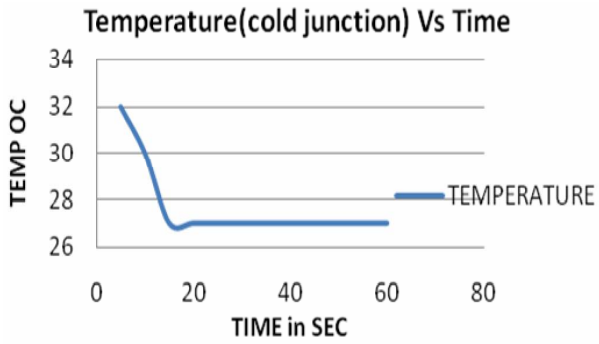


Figure 4: Variation of Cold Junction Temperature with Input Current (Voltage)

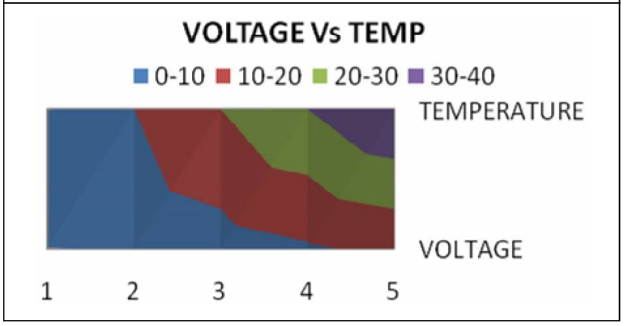
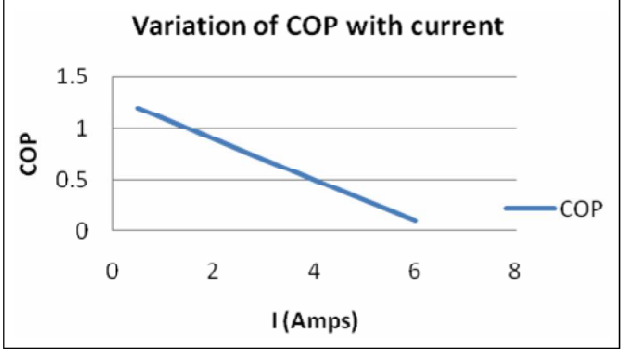


Figure 5 shows that the variation of COP with current. The COP of the peltier cooler monotonically increases with decreasing current.

Figure 5: Variation of COP with Current (I)



CONCLUSION

The portable refrigerator has no moving parts, fluid, or refrigerants. In particular, its size is very

small so it is convenient for travelers to store the medicine. Temperature was controllable via changing the input voltage/current so we can maintain the medicine as desired level of temperature and the cost of the device is very low. This system achieves 40% to 60% of cooling effect compare to conventional refrigerator. For the above reasons this is most effective for poor people (by the cost) and travelling people (because of size).

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