A PROJECT REPORT

ON

"DEVELOPMENT OF COLD & HOT WATER USING PELTIER EFFECT"

Submitted by

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In partial fulfillment for the award of the Degree

Of

BACHELOR OF ENGINEERING

IN

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UNDER THE GUIDANCE

Of

Prof. ASLAM HIRANI

DEPARTMENT OF MECHANICAL ENGINEERING

ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUS NEW PANVEL,

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CERTIFICATE

This is to certify that the project entitled

"**Development of cold & hot water using peltier effect**"

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To the Kalsekar Technical Campus, New Panvel is a record of bonafide work carried out by him under our supervision and guidance, for partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Mechanical Engineering as prescribed by **University Of Mumbai**, is approved.

Internal Examinar **External Examiner**

(Prof._____) (Prof.____)

Head of Department **Principal**

(Prof. _____) (Dr._____)

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APPROVAL OF DISSERTATION

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(Internal Examiner) **(External Examiner)**

_____ _____

Date: _____

ACKNOWLEDGEMENT

After the completion of this work, we would like to give our sincere thanks to all those who helped us to reach our goal. It's a great pleasure and moment of immense satisfaction for us to express my profound gratitude to our guide **Prof.____** whose constant encouragement enabled us to work enthusiastically. His perpetual motivation, patience and excellent expertise in discussion during progress of the project work have benefited us to an extent, which is beyond expression.

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Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

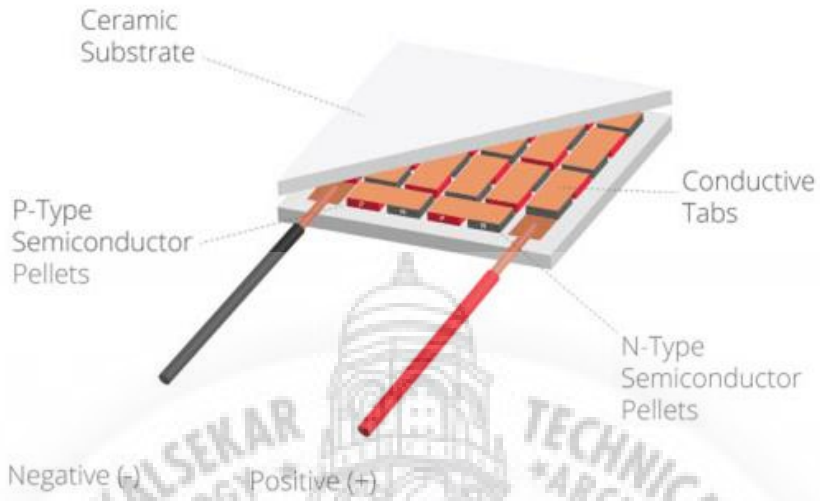
The selection of this topic gives us an opportunity to learn new method and technologies. In the present scenario, with the increase in awareness towards environmental degradation due to the production, use and disposal of Chloro Carbons(CFCs), Hydro Cholo-Fluoro-Carbon(HCFs), as refrigerant conventional cooling System.
Thermoelectric cooler are compact in size, robust in construction, no coolant requir no mechanical moving component are present and total weight of the system is less, noiseless. With the help of this system most of the people can be affort this cooling system in their day to day life.

Chapter 1 Introduction

1.1 INTRODUCTION TO PELTIER MODULE

The development of hot and cold water using peltier effect is based on thermoelectric modules (TEM). Thermoelectric modules (TEM) (also known as Peltier Module), are semiconductor based electronic devices, which are like solid state heat pumps. This system uses principle of peltier effect .When the thermoelectric module (TEM) and Peltier module is sandwiched between the Heat exchangers which is directly connected to water block and a DC current flows through Thermoelectric Module (TEM) or Peltier Module, it transfers heat and maintains a temperature difference across the module causing one side of the module to be cold and the other side to be hot. Due to this temperature difference across the both side of the module which is used for heating and cooling the water in the given system. The Thermoelectric Module (TEM) or Peltier Module consists of an array of semiconductor pallets that have been doped so that one of type of charge carrier either positive or negative carries majority of the current. The pairs of p and n type pallets are arranged so that they are connected electrically in series and thermally in parallel. The metalized ceramic substrates provides platform for pallets and the small conductive tabs connect them. They all found that TEM is best suited for small capacity cooling and heating purpose with effective temperature control, in situations where lower power and smaller space are required. TEM are having wide range of applications as domestic refrigerators, portable coolers and heaters, compact heat exchangers, constant temperature baths, dehumidifiers [5], electronic devices cooling etc. The TEM cooling and heating system has the capabilities to replace the conventional heating and cooling system.

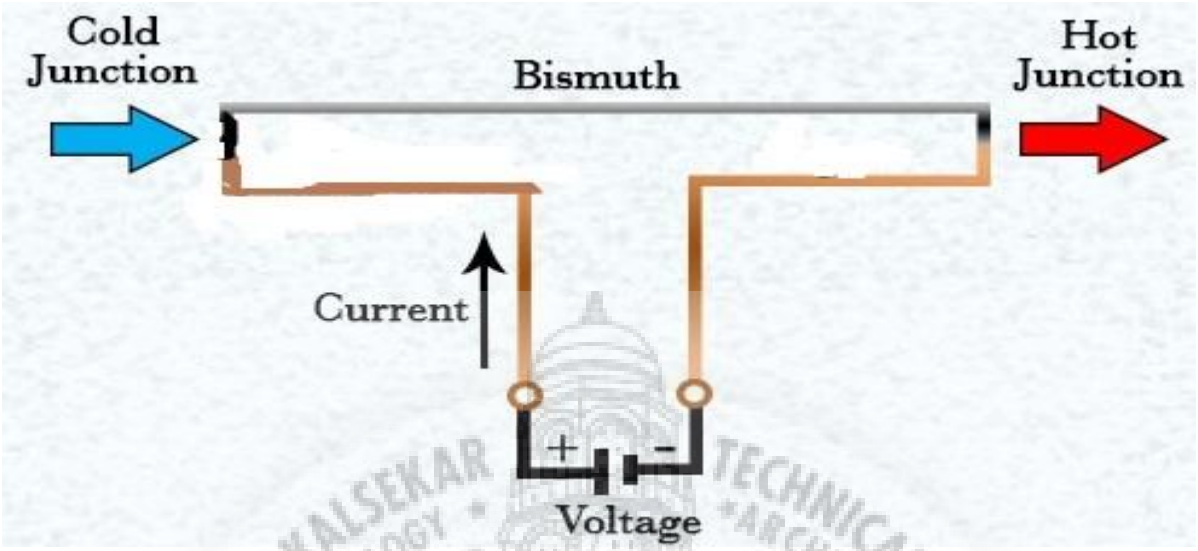
1.2 THE STUCTURE OF A PELTIER MODULE



A typical thermoelectric module consists of an array of Bismuth Telluride semiconductor pellets that have been "doped" so that one type of charge carrier– either positive or negative– carries the majority of current. The pairs of P/N pellets are configured so that they are connected electrically in series, but thermally in parallel. Metalized ceramic substrates provide the platform for the pellets and the small conductive tabs that connect them.

When dc voltage is applied to the module, the positive and negative charge carriers in the pellet array absorb heat energy from one substrate surface and release it to the substrate at the opposite side. The surface where heat energy is absorbed becomes cold; the opposite surface where heat energy is released, becomes hot. Reversing the polarity will result in reversed hot and cold.

1.3 PELTIER THEORY

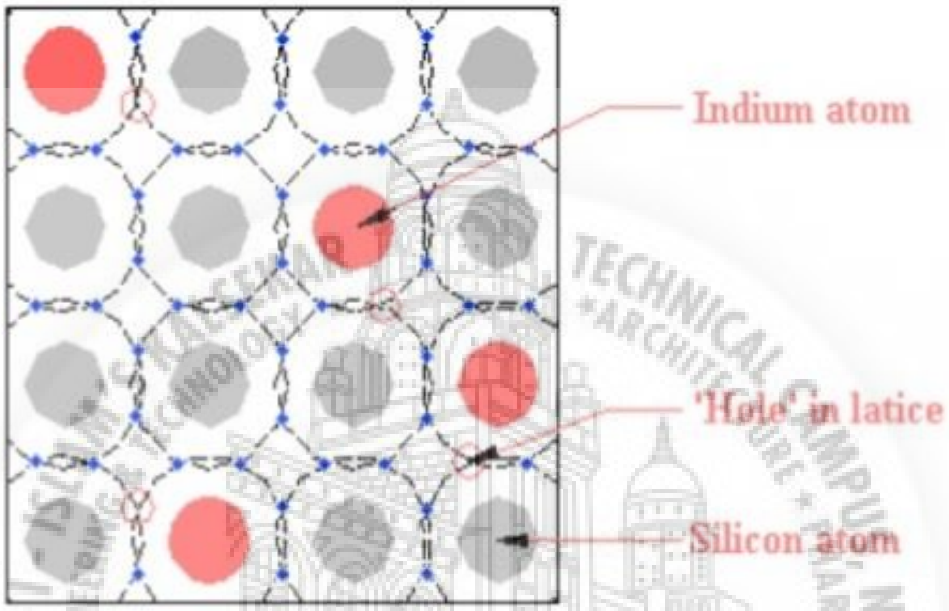


The Peltier effect states that, when an electric current flows through a circuit comprising dissimilar conductors, thermal energy is absorbed from one junction, and is discharged at the other, making the former cooler and the latter hotter. Thus, a thermal gradient develops from the flowing current, making the Peltier effect inverse of the Seeback effect. If QC is the rate of cooling in watts, and QH is the rate of heating in watts, I is the current flowing through the closed circuit. QC or QC = β x I.

Note: β is the differential Peltier coefficient between the two materials A and B in volts.The Peltier effect can be verified experimentally by using the following setup: Peltier Effect As shown, two pieces of copper wire are connected to the two terminals of a battery. These two pieces are then interconnected with the help of a bismuth wire, which completes the setup. It is observed that when the circuit is closed, as described above, temperature gradient as predicted by the Peltier effect develops. At the junction where current passes from copper to bismuth, the temperature rises, while at the junction where current passes from bismuth to copper, the temperature.

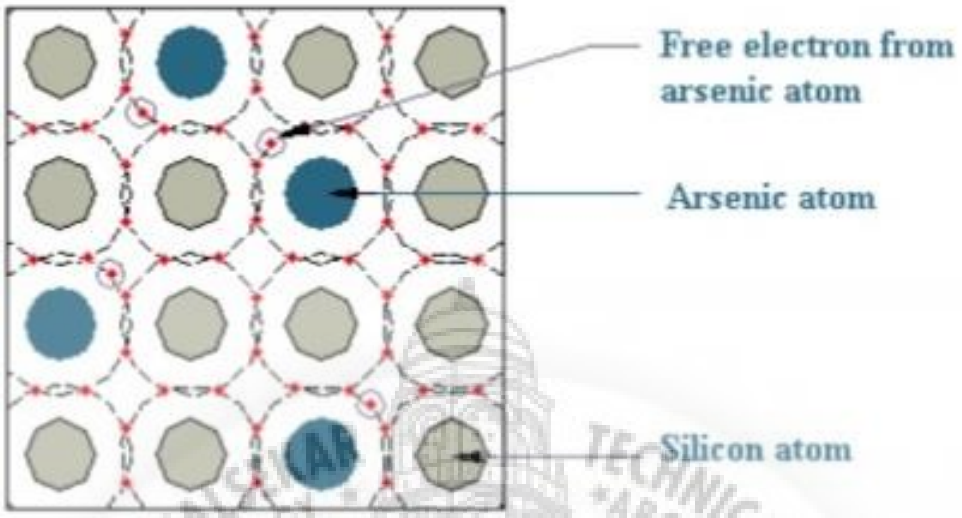
1.4 SEMICOUNDUCTOR P AND N TYPE DOPING

1.41 Semiconductor doping: P Type



For p type semiconductor the dopants are group 3 (In B) which have 3 valence electron these materials need an extra electron for bonding which create hole .P doped semiconductor are positive charge carriers . there an appearance that a hole is moving where there is current is apply because an electron moves to fill a hole creating a new hole where the electron was originally .holes and electron moves in opposite direction.

1.42 Semiconductor N Type



Arsenic dopant adds free electrons to the crystalline lattice, making it more electrically conductive, creating 'N' material.

N doped semiconductor has an abundant number of extra electrons to use as charge carriers. normally a group 4 material like silicon with 4 covalent bonds is bounded with other 4 silicon .to produce an N type semiconductor Si material is doped with group 5 metal actinium having 5 valence electron so that an additional electron on group5 metal is free to move and are the charge carrier.

1.5 THERMOELECTRIC MATERIALS

There are 3 main types of thermoelectric materials. Which are used in thermoelectric module.

1. Bismuth telluride (Bi2Te3) Alloy

It is a semiconductor, which has high electricity conductivity, but it's not good at transferring heat. It is used for the thermoelectric refrigeration; the best working temperature is lower than 450℃.

2. Lead Telluride (PbTe) Alloy

It has a melting point of 905℃. This kind of substance is extremely harmful to water. It can provoke the respiratory organs, skin and stomach of human. Then cause nausea, vomit or diarrhea.It is mainly used for thermoelectric generator. Best working temperature is around 1000℃.

3. Silicon-Germanium Alloy

A kind of semiconductor, often used for thermoelectric generator.Best working temperature is about 1300℃.

CHAPTER 2. LITERATURE SURVEY

2.1 PREVIOUS WORK

1.FRANZ LOUIE CHUA, BRANDON OHARA, RACHEL REID, AND BERNADETTE TONG DESIGNED A THERMOELECTRIC WATER CHILLER TO PROVIDE A MORE ENERGY EFFICIENT ALTERNATIVE. THE IMPLEMENTATION OF TEMS REDUCED CURRENT DISPENSER ENERGY CONSUMPTION BY 82.4%, FROM 91 W TO 16 W.

2.KRISHPERSAD MANOHAR1 , ADEMOLA ANTHONY ADEYANJUM PRESENTS AN EXPERIMENTAL COMPARISON BETWEEN A COMMERCIAL VAPOR COMPRESSION REFRIGERATOR AND A LABORATORY BUILT THERMOELECTRIC BEVERAGE COOLER TO DETERMINE WHICH ONE CAN REDUCE THE TEMPERATURE OF 325ML OF WATER FASTER.

3.PROF. N. B. TOTALA, PROF. V. P. DESAI, RAHUL K. N. SINGH, DEBARSHI GANGOPADHYAY, MOHD. SALMAN MOHD. YAQUB, NIKHIL SHARAD JANE, PRESENTS A STUDY ON FABRICATION OF THERMOELECTRIC AIR COOLING AND HEATING SYSTEM WHERE THEY HAVE SHOWN THE NEED OF FINDING AN ALTERNATIVE OF THE CONVENTIONAL HVAC SYSTEM, I.E. THERMO-ELECTRIC COOLING AND HEATING SYSTEM.

2.2 PROBLEM STATEMENT

The conventional water cooler and water heater which are available in the market are bulky and occupy large space and also its requires heavy static and moving components like compressors , induction coils, refrigerants like CFC's gases and etc. The systems which are available in market are much costly. Due to this maintenance is required for such type of heating and cooling system. By viewing this we had developed a new system which will provide cooling and heating effect simultaneously without any moving mechanical parts. Thermoelectric cooling and heating system does not require working fluids. This device can be used to cool water without use of refrigerants. And simultaneously heating can be achieved from the hot side of thermoelectric module to heat the water, this is due to heat absorption and rejection using peltier element. This compact design is very useful in elimination of CFC and it would replace conventional refrigeration system and also making single system which can simultaneously produce heating and cooling effect at low price as compared to conventional systems which are available in the market. So this report shall deal with development of hot and cold water system by using peltier effect.

2.3 MARKET SURVEY

1. Estimated earnings Rise of the Hot and Cold Water Dispensers marketplace throughout the forecast period

2. Factors expected to aid the Rise of the Hot and Cold Water Dispensers marketplace

3.The potential market growth of this Hot and Cold Water Dispensers market in a variety of regions

4. Consumption pricing arrangement and adoption routine of this Hot and Cold Water Dispensers

5.Company profiles of top players in the Hot and Cold Water Dispensers market.

2.4 OBJECTIVES

1. To eliminate the emission of CFC (Chlorofluorocarbon) from water dispensers, this could ultimately reduce global warming and also reduce power consumption.

2.To provide a system with less a long life time.

3.Minimization of cost of the system.

4.To reduce the size and weight of the system.

5.Increasing the cooling rate with maintaining temperature difference.

6. increase the effectiveness of the system

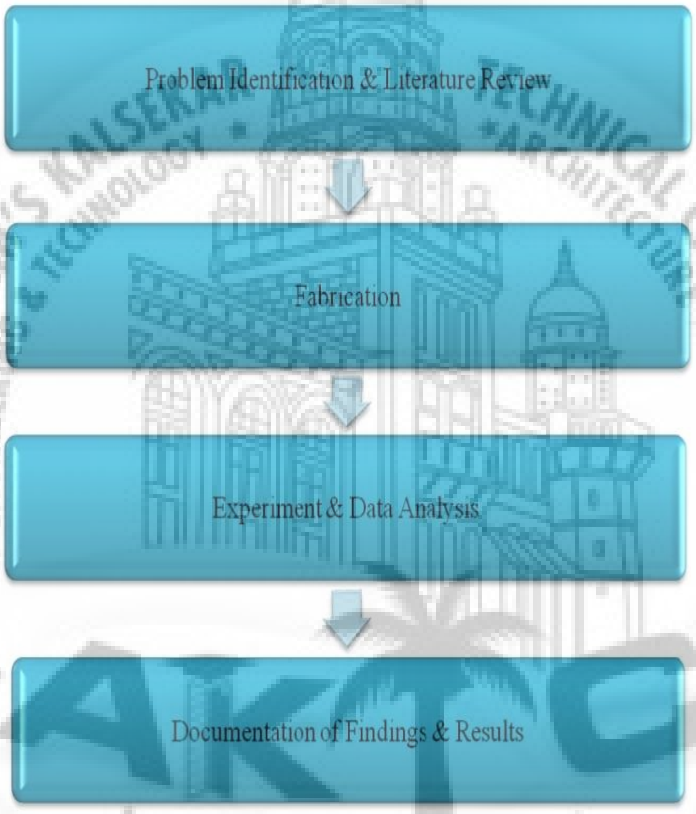
2.5 SCOPE OF PROJECT

The conventional heating and cooling system requires more maintenances because use of moving element in it. So we had designed a system in which less maintenances is there and it last for long time which are probably used in houses, offices and etc. This kind of thermoelectric heater and cooler are used in Industrial areas, Medical fields and etc. This kind of system also reduces emission of CFC's gases which are harmful and hence used in automobiles, small industries and etc.

CHAPTER 3. METHODOLOGY

This chapter is described briefly about the methodology used in experiment, 3D designing and actual constructionof the system

- **flow chart**



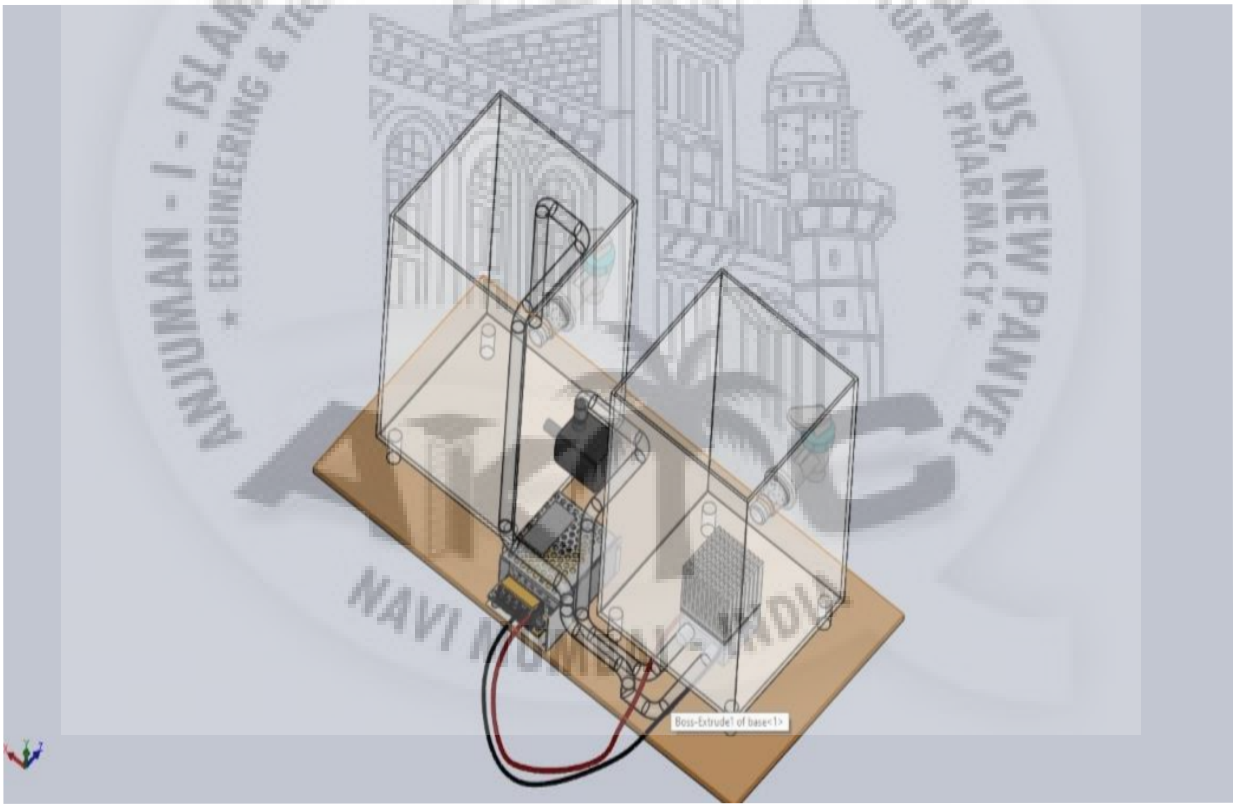
CAD MODEL

Procedure

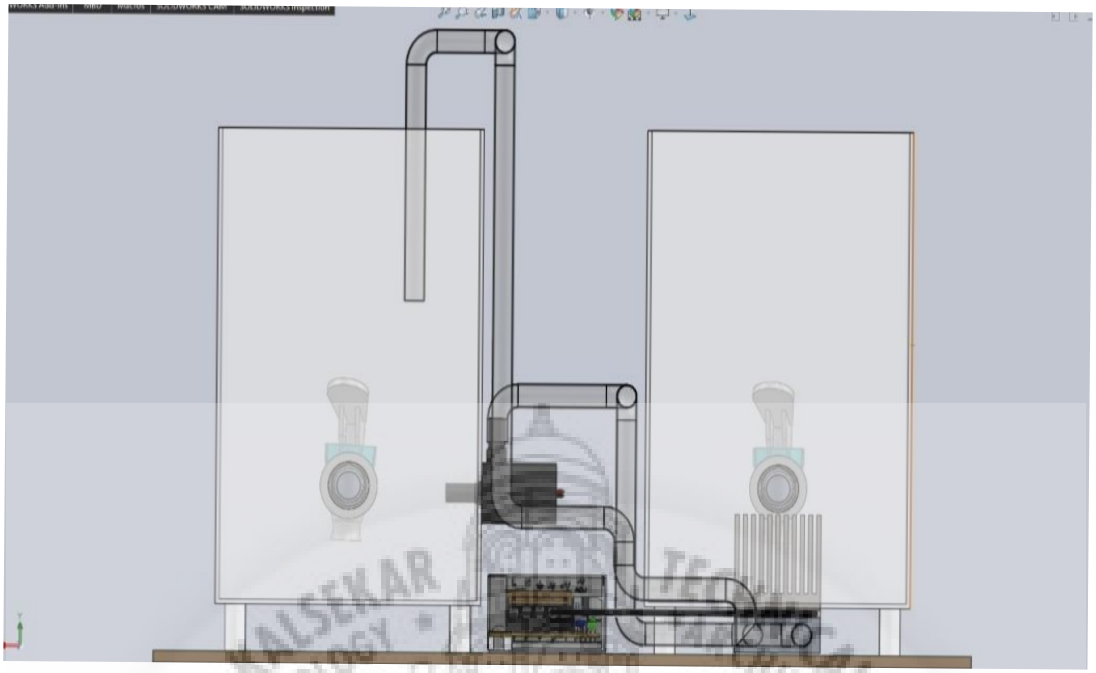
The entire model has been designed with the help of designing software solid works With the help of colour feature the colours are given to the entire model

SOLID MODELING

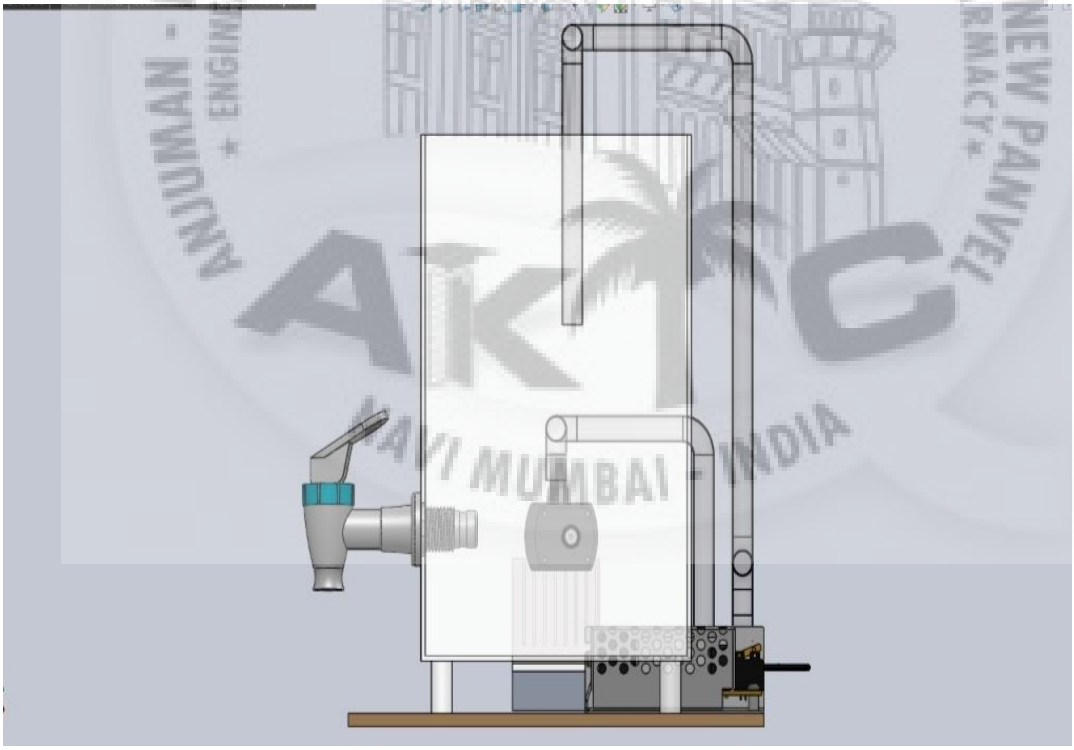
The entire model has boen designed with the help of designing software solid works.



ISOMETRIC VIEW-1



ISOMETRIC VIEW- 2



ISOMETRIC VIEW-3

Material and Methodology The goal was to supply power to the thermoelectric modules using an ac source by converting it into dc power. The modules in turn will cool a container wherein water will be filled and tests be done.

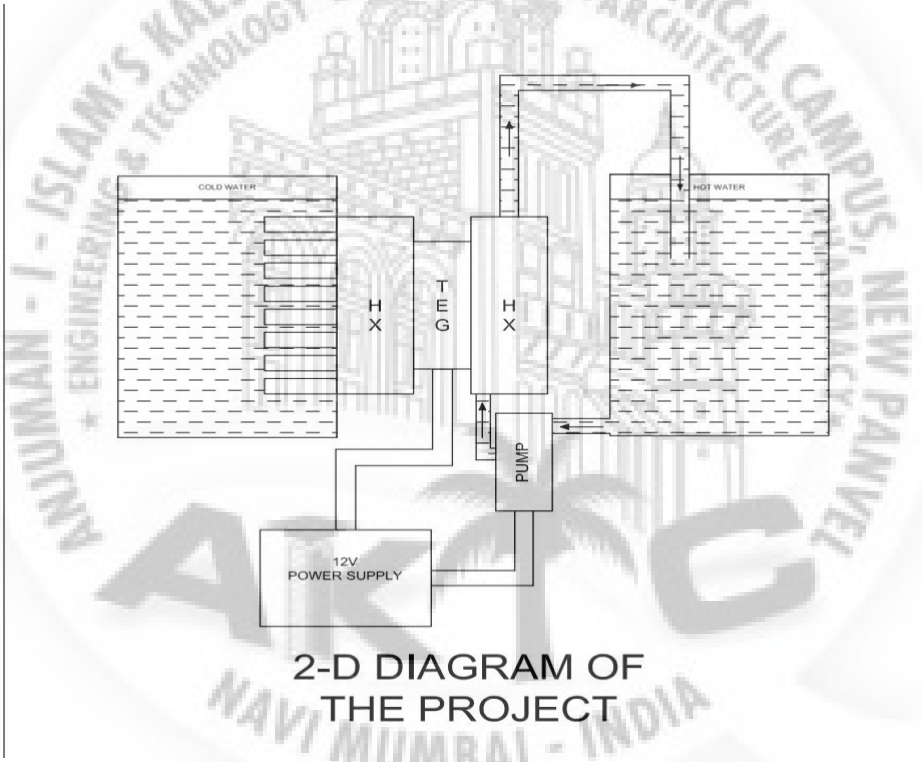
A container had to be fabricated of a material, which would easily conduct heat. Other requirements of the container include that it should be strong enough to bear the pressure of water that will be filled inside it, it should be easier to handle and, more importantly, it should have a flat surface for the modules to be mounted on. To achieve these objectives, we bought a thermocol box. At the bottom of the box, where the modules were to be attached, five slots were cut to place plates of such a material that can transfer the cold temperature of TE modules easily to the water inside the box. We chose copper as the material of the plates as it has one of the best thermal conductivities, is relatively cheaper than other high conductivity metals and is soft enough to be fabricated easily.

CHAPTER 4. CONSTRUCTION AND WORKING

WORKING

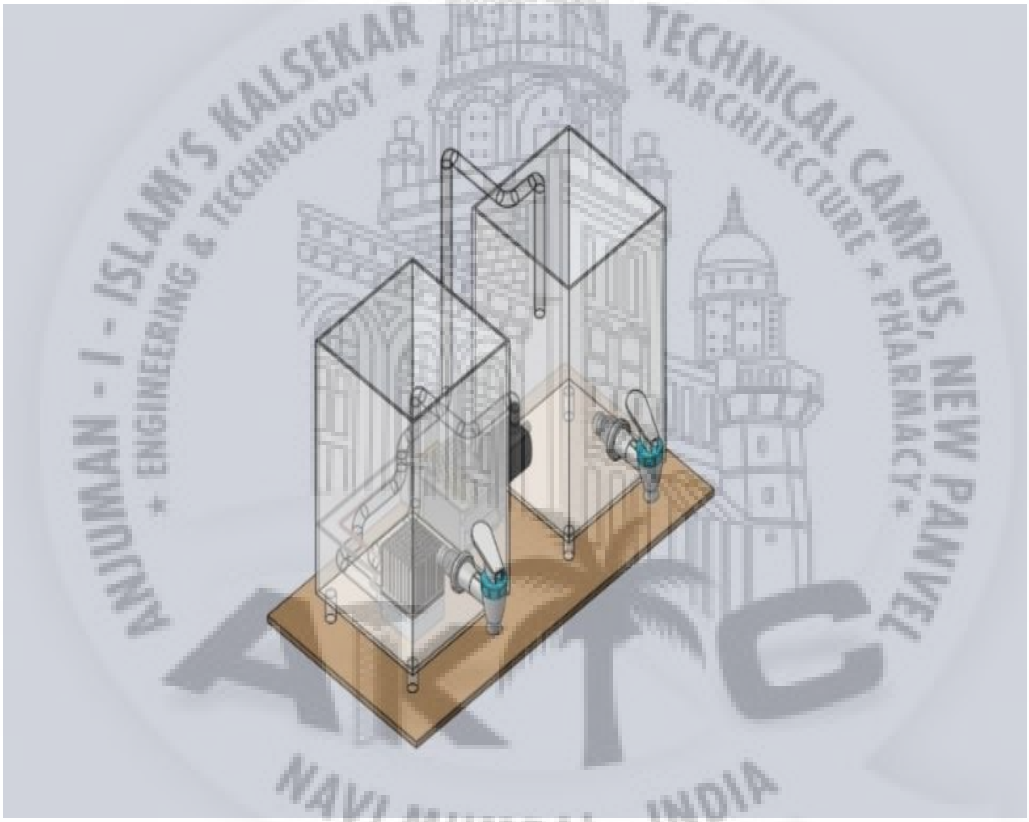
The Thermoelectric cooling and heating system works on the principale of peltier effect when the current is supply through the Ac source which is 250 volts and 50Hz source

AC to DC conventer it converts AC current into 12 volt DC current which is further supply to the Thermoelectric module or peltier module Due to this effect creates temperature differenes or either side of TEM Thermoelectric module the heat is removed from one stgrother kide moduleiand Side of module and its start cooling at other side it strt heating The Thermoelectric module are Sandwiched Between the two heat exchanger which are further and directly connected to the Weter block and heating and cooling of water takes place in same system



2-D DIAGRAM OF THE PROJECT

The aluminum water block heat exehanger is used whuch acts as a heat sink and transmit heat to the water through internal forced Convection and deposit on the water container there are two water resaviours is there cold water resaviour and hot water resaviour The water is continously pumped from water pump from water resaviour to the heat exchanger using a water pump which circulate water to the cold water resaviour.by this process large quantity of water can be cooled and heated with the help of thermoelectric module or peltier module.The temperature is distributed Uniformly and theamal 'boundary layer does not effect the performance of system Thus we get hot and cold water in Single System in less cost and without use of refigrants and other heavy components and lost for long time

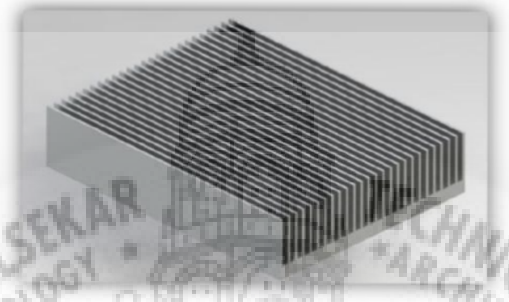


3D DIAGRAM OF PROJECT

Design of Parts

4.1 Design of heat sink

heat sink is a passive heat exchanger that transfers the heat generated by an electronic or a mechanical device to a fluid medium, often air or a liquid coolant, where it is dissipated away from the device, thereby allowing regulation of the device's temperature



4.2 TEM

The thermoelectric cooler is also known as TEC or Peltier Module creates a temperature differential on each side. One side gets hot and the other side gets cool. They use to either warm something up or cool something down; above all, you can use either side

A thermoelectric cooler (TEC) module is a semiconductor-based electronic component that functions as a small heat pump. By applying the DC power source to a TEC, heat will be transferred from one side of the module to the other. It creates a cold and hot side. They are widely useful in industrial areas, for example, computer CPU, CCDs, portable refrigerators, medical instruments, and so on.

4.3 POWER SUPPLY

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load

The power supply of an electrical system tends to generate much heat. The higher the efficiency, the more heat is pulled away from the unit. There are many ways to manage the heat of a power supply unit. The types of cooling generally fall into two categories -- convection and conduction. Common convection methods for cooling electronic power supplies include natural air flow, forced air flow, or other liquid flow over the unit. Common conduction cooling methods include heat sinks, cold plates, and thermal compounds.

4.4 PUMP

A pump is a mechanical device, that is used to pick up water from low-pressure level to high-pressure level. Basically, the pump changes the energy flow from mechanical to the fluid. This can be used in process operations which needs a high hydraulic force.

This process can be observed within heavy duty equipment. This equipment needs low suction and high discharge pressure. Because of low force at suction part of the pump, the liquid will pick up from certain deepness

4.5 PLASTIC PIPE

Plastic tube conveys the water from the sump to the peltier device which is employed at the upper side of the evaporator box. One end of the tube is connecting to the water pump and another is connected to a section attached to the peltier. The thickness of pipe 2mm material pvc is used.

4.6 CONTAINER BOX

A Container box is a cubiodal shape water container in which pump is employed for circulation of coolant .the size of the sump employed in this project is 100*130*190 mm. Container serves as a base part of peltier cooler, on which evaporator is mounted. The peltier that is attached to the bottom side of the evaportor is fixed with heat sink over it which is submerged in the water of the sump

Dimension of Container is (100*130*190)mm

4.7 PLASTIC TAP

A Tap is a valve controlling and release of the water .Water for sink and basins can be provided by separate hot and cold taps mixer taps are commonly used. In this case, hot and cold water from the two valves is mixed before reaching the outlet allowing the water to emerge at any temperature between that of the hot and cold water supplies.

4.8 DIMENSION OF THE COMPONENTS

1. CONTAINER - (100*130*190) mm

2. TEM – 40*40 mm

3. PIPE – 1.5 cm

4. POWER SUPPLY – 91*4.33*1.97 inches

4.9. BILL OF MATERIAL

COMPONENT	QUANTITY	COST IN RUPEES
CONTAINER	**2**	**100**
TEG	**1**	**200**
POWER SUPPLY 12V/5A	**1**	**450**
HEAT EXCHANGER (ALUMINIUM AND COPPER)	**2**	**500**
PUMP	**1**	**300**
PLASTIC PIPE (1M)	**2**	**20**
INSULATOR APPROX COST	**1**	**50** **RS 1770/-**

4.10. EXPERIMENTAL ANALYSIS

The model was fabricated and the measurements were taken at the room temperature. The chart below shows the temperature change of water with respect to time. The initial temperature of water was measured to be 27℃ at room temperature. The TEC modules were powered using 12V 240W dc power supply. The sample test of 5L of water on two reservoirs was tested and the change in temperature for every 5 min was measure for a period of 30 min. The change in temperature with respect to the time is plotted in a chart shown below.

The Table 5.1 shows the rise of temperature on the hot side heat exchanger. The temperature of water rises from 27 ℃ to 45 ℃. The Table shows the fall of temperature on the cold side heat exchanger. The temperature of water falls from 27 ℃ to 17 ℃ .

Time (min)	T_h(° C)
0	27
5	31
10	34
15	37
20	40
25	42
30	45

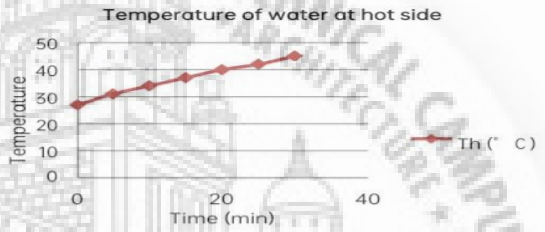


Table 5.1 Temperature vs time on hot side heat exchanger

Time (min)	T_c(° C)
0	27
5	25
10	23
15	21
20	19
25	18
30	17

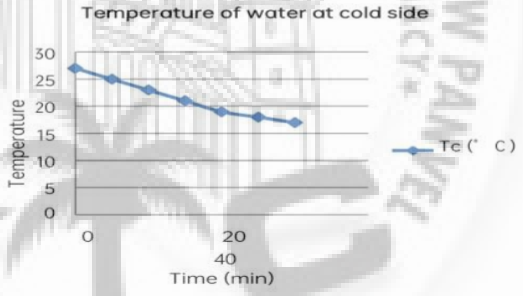


Table 5.2 Temperature vs time on cold side heat exchanger

CHAPTER 5 RESULT AND DISSUSSION

5.1 RESULT DATA

Hence then temperature at cold side goes to 17 degree Celsius and at the hot side goes to 45 degree celcius from normal room temperature in 30 minutes of time thus effectiveness is increased and single heating and cooling system is created in minimum cost.

HOT WATER TEMP

COLD WATER TEMP

NORMAL WATER TEMP

5.2 FUTURE SCOPE

1. Efficiency of TEM Module should be increased by using different types of semiconductors in the manufacturing of TEM module or Peltier module.So that we get higher temperature difference between hot and cold side of the modules. Which gave higher output.

2- This kind of technology can be used in Air conditioners so that bulky elements like compressor should be eliminate.

5.3 APPLICATION

The Peltier effect is employed for building Peltier devices. These are solid-state devices that use this effect for cooling or heating. Commonly used devices include the Peltier heater, heat pump, cooler, and solid-state refrigerator.

When a direct current flows through a Peltier device, heat passes from one side of the device to another, allowing it to act as a heater or cooler. All Peltier devices function in this manner, by transferring heat from one side of the device to another against temperature gradient by using electric current.

The following are a few uses of Peltier devices:

1) Water Extraction: The Peltier effect is used in dehumidifiers for the process of extraction of water from the air.

2) DNA Synthesis: A thermal cycler make use of this effect for the process of DNA synthesis.

3) Spacecrafts: The Peltier effect is used in spacecrafts to balance the effects of sunlight on both sides of the craft. It helps in dissipating the heat due to direct sunlight on one side of the spacecraft to the other side which doesn't receive sunlight, and so is much cooler.

CONCLUSION

The thermoelectric cooling and heating system for water cooler and heater (Water dispenser) is working with satisfactory conditions. This system produces hot and cold water simultaneously. It is a solid state heat transfer system which requires no use of refrigerants coolant .When open the valve for hot side, get hot water simultaneously at cold side with help of heat sink we get cold water.. Hence there is no emission of CFC. In the paper arrangement is effective and maintain the temperature difference with these minimize the cost. And our objective satisfied.

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