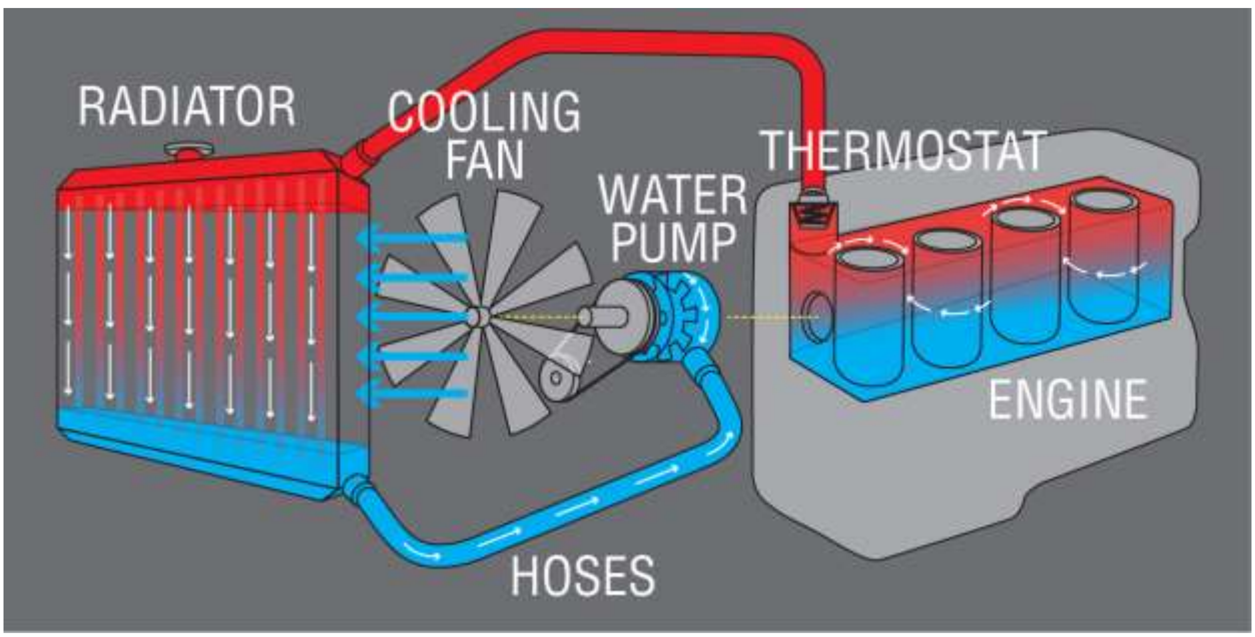
Effect of coolant type on car radiation



Preparation

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Effect of coolant type on performance of car radiation in ared regions

BY

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2022-2023

Acknowledgment

First and foremost, praises and thanks to the God, the Almighty, for His showers of blessings throughout my research work to complete the research successfully.

I would like to express my special appreciation and thanks to my advisor Dr. Qais Hatem who spared no effort in helping me, and was urging me to research, encouraging me in it, and strengthening my resolve for it, and I am proud to work with him, for he is from God May Allah protect him and grant him good health and benefit from his knowledge I also thank all the employees of the College of Engineering Musayab, Department of Automotive Engineering, University of Babylon.

Last but not least, I thank my family for supporting me with all the facilities and support while preparing for this work period

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DEDICATION

Moments of joy, a sip of happiness, and a glimpse of joy envelop them, giving each other the taste of the end of a successful job, quenching the thirst of years of diligence, drawing the luster of joy at its end, and drawing letters for it to be filled with radiance with the elegance of its achievement, and we share these moments in a way that delights our hearts.

A page from the pages of life has turned, a page in which seriousness and diligence have always been a companion, a moment when we bid farewell to study and fatigue and the time has come to harvest, in which we reap the fruit of our diligence.

With all the cordiality and respect, I dedicate my graduation to my parents and to everyone who contributed to my teaching, even by letter, in my school and university life, and to all my friend

ABSTRACT

In this research, a practical investigation was carried out to demonstrate how well the automobile radiator performed in dry environments under various situations. where we connected the radiator system to carry out the practical side. where the air flow temperature (both outside and inside the radiator) and coolant flow temperature (both inside and outside the radiator) were computed.

The coolant (water) temperature before entering the radiator was calculated using four observations since it varied in the first operation between (67.3C and 69.9C). The second procedure measures the coolant temperature (68.2C -65.5C) Four measurements were made to determine the temperature (air flow) before the radiator, which under typical circumstances ranged between (50.9C and 37.4C) with a 10% humidity.

Due to the dry weather, it ranged (70.0 c), with a 10% humidity Considering a constant water flow rate and air flow rate The findings revealed: Under typical circumstances, as the coolant entered the first step, the temperature of the liquid leaving the radiator decreased while the temperature of the air exiting the radiator rose.

The temperature of the liquid leaving the radiator and the temperature of the air exiting the radiator both increased when the coolant reached the second step and under dry circumstances.

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Chapter one: Car radiator in arid region

1.1 Introduction

An automobile engine's cooling system uses a heat transfer medium, such as turning off the coolant, to take heat from the engine and transfer it to the outside environment. Enhancing the lifespan of engine components, engine cooling systems are a decade-advanced technology for safe and effective engine operation. A mini/micro heat exchanger using demineralized water and ethylene glycol (EG) as a heat transfer medium is used in a vehicle performance radiator that has previously been the subject of extensive research. While using highly effective/micro heat exchangers, the cooler's performance still has to be enhanced because of the poor thermal conductivity (TC) of its working fluids, which are H2O and EG. Generally speaking, fresh and creative heat to accelerate the rate of heat transfer in a vehicle's engine and coolant, transfer fluids (HTPS) are required.

An increase in temperature and a drop in humidity level, together with the associated climatic change, has a detrimental effect on the radiator's efficiency. The desire to increase the effectiveness of the cooling system for wheel engines is what drives research activities. Because a portion of automobile engines is built to operate within the normal operating temperature range of between 195 and 220 degrees Fahrenheit, the coolant is used to prevent automobile engine overheating caused by friction. An increase in temperature has an impact on the engine through emissions that come out of the exhaust and the way the engine performs.

An increase in the surface area, the airflow rate, and the coolant flow rate all improve the properties of the coolant. One method we employ to increase the coolant's cooling rate is a radiator with fins and microchannels.

It boosts the rate of heat transmission by expanding the area available for heat exchange. Fins come in a variety of forms. As most radiators transmit the majority of their heat by convection rather than thermal radiation, it can be challenging to adjust the size and shape of the fins to the rapidly increasing airflow from the radiator. Internal combustion engines are cooled by radiators, particularly in vehicles. but also in locomotives, motorbikes, stationary generating plants, and other applications where a comparable engine is used. Engine coolant is frequently used to cool internal combustion engines by moving it through the engine block, where it is heated, the radiator, where heat is lost to the environment, and then back to the engine in a closed loop. Engine coolant is typically water-based but can occasionally be oil-based. Both a water pump and an axial fan are frequently used to drive air through the radiator and the engine coolant to circulate. Water is utilized as a cooling medium in a water cooling system. The life vests are positioned around each engine cylinder, cylinder head, combustion chamber, and valve opening. These jackets remove heat by circulating water through them. The heat from the cylinder walls is transferred to water, which travels to the radiator and is cooled by air passing via a system of cooling fins. The coolant is then circulated back to the engine. No review article has been published so far on this specific issue about the influence of high temperatures and low humidity levels on radiator performance. Nevertheless, several studies have been published to enhance the efficiency of automotive radiator cooling.

1.2 Aims of project

The following are among the objectives of the study:

1. A study of the impact of ordinary water on radiators at various temperatures
2. A study of the impact of distilled water on the radiator at various temperatures
3. A study of the impact of greasy water on the radiator at various temperatures

CHAPTER TWO: Literature review

2.1 View Researches

Franz San gall:

A Russian merchant who was born in Prussia and resided in St. Petersburg between the wars invented the radiator (1855 and 1857). Several scientists have also looked at the radiator's performance.

Oliet :

studied different factors which affect radiator performance such as airflow, fin density, and air temperature. It is observed that heat transfer and performance of the radiator are strongly affected by air and coolant mass flow rate. As the 5 air and coolant flow increases, cooling capacity also increases. When air inlet temperature increases, heat transfer and thus, cooling capacity decreases. Smaller fin spacing and higher louvered fin angles have higher heat transfer. Fin density can increase till it blocks the airflow and heat transfer rate decreases.

M. Naraki and S.M.Peyghambarzadeh:

This study uses an automobile radiator to test experimentally the total heat transfer coefficient of CuO/water Nanofluids in a laminar flow regime (100 Re 1000). In all of the studies, nano fluids were stabilized by varying the pH and adding the proper surfactant. The outcomes demonstrate that the base fluid has a lower total heat transfer coefficient than the nanofluid.

When the concentration of the Nanofluid increases from 0 to 0.4 vol%, the total heat transfer coefficient rises. Conversely, as the temperature of the Nanofluid input rises from 50 to 80 C, the total heat transfer coefficient falls. Using CuO/water Nano fluid at various air and water temperatures, the experimental total heat transfer coefficient in the automotive radiator has been determined in this study as liquid input temperatures, as well as different Nano fluid concentrations and volumetric flow rates. Also, the Taguchi technique has been used to statistically assess the data.

S.M. Peyghambarzadeh, S.H. Hashemabadi, S.M. Hoseini ,M. SeifiJamnani:

To cool the circulating fluid in a car radiator, which was traditionally made of water or a combination of water and anti-freezing substances like ethylene glycol, forced convection heat transfer was traditionally used (EG). The performance of pure water and pure EG for heat transmission has been compared in this research to that of their binary mixes. Additionally, various concentrations of Al2O3 nanoparticles have been introduced to these base fluids, and their effects on the efficiency of heat transmission in the automobile radiator have been assessed experimentally.

For all of the trials, the fluid input temperature and liquid flow rate were both altered, ranging from 2 to 6 liters per minute. The findings show that nanofluids significantly improve heat transmission compared to their base fluid. In ideal situations.

There has been an observed increase in heat transmission of roughly 40% above the basic fluids. been\srecorded

Rahul Tarodiya, J. Sarkar, J. V. Tirkey:

The usage of "Nanofluids" has been developed, and these fluids provide better heat transfer qualities than traditional car engine coolants. To better understand how the flat fin tube vehicle radiator performs, energetic and theoretical performance evaluations have been carried out. Using Cu, SiC, Al2O3, and TiO2 Nanofluids with 80% water and 20% ethylene glycol as a base fluid, the effects of different operating conditions are discussed in this article. With less pumping power required, the use of nanofluid as a coolant in radiators increases efficiency and cooling capacity. Al2O3, TiO2, and Cubase fluid are the next best-performing base fluids in radiators with plate fin geometry, followed by SiC80% H2O-20% EG. the greatest

In comparison to Al2O3, TiO2, and Cu as coolants, SiC exhibits a cooling improvement of 18.36%, 17.39%, and 13.41%, respectively. The results of the current study indicate that nanofluids can be used to increase performance by acting as a coolant in car radiators.

L. SyamSundar, Manoj K. Singh, Igor Bidkin, Antonio C.M. Sousa:

By scattering magnetic Ni nanoparticles in distilled water, a magnetic nanofluid was created. The Nano-particles were created using the chemical co-precipitation process, and they were examined using atomic force microscopy and X-ray diffraction. The dynamic light scattering technique was used to determine the average particle size. Experimental measurements of the thermal conductivity and absolute viscosity of the Nanofluid were made as functions of particle concentration and temperature. In addition, given a constant heat flux situation in a forced convection apparatus with no phase change of the Nanofluid moving in a tube, the Nusselt number and friction factor were experimentally determined as a function of particle concentration and Reynolds number. A particle concentration range of 0% to 0.6% and a Reynolds number range of 3000 to 22,000 were used in the studies. The Results show that as particle volume concentration and Reynolds number rise, so do the Nano fluid's Nusselt number and friction factor. As compared to distilled water with the same flow, the augmentation of the Nusselt number and friction factor for 0.6% volume concentration is 39.18% and 19.12%, respectively.

M. Ebrahimi*, M. Farhadi, K. Sedighi, S. Akbarzade

Experimental research on the effects of adding SiO_2 nanoparticles to base fluid (water) in a vehicle radiator. Compact heat exchangers known as radiators have been assessed and optimized while taking various working situations into account. A car's cooling system, which consists of the radiator and fan as its major components, is crucial to the performance of the vehicle. Engine performance is increased, fuel consumption is reduced, and pollutant emissions are reduced when thermal efficiency is improved. An experimental setup was made with this goal in mind. On the subject of heat transmission, consideration is given to the effects of fluid intake temperature, flow rate, and nanoparticle volume fraction.The findings demonstrate that the Nusselt number rises as liquid inlet temperature, nanoparticle volume percent, and Reynolds number rise.

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CHAPTER THREE: Materials and Methodology

3.1 introduction

This chapter provides a quick overview of the components that make up the device. It is composed of two sections:

3.2 Machine parts

when the radiator is mentioned as a component.

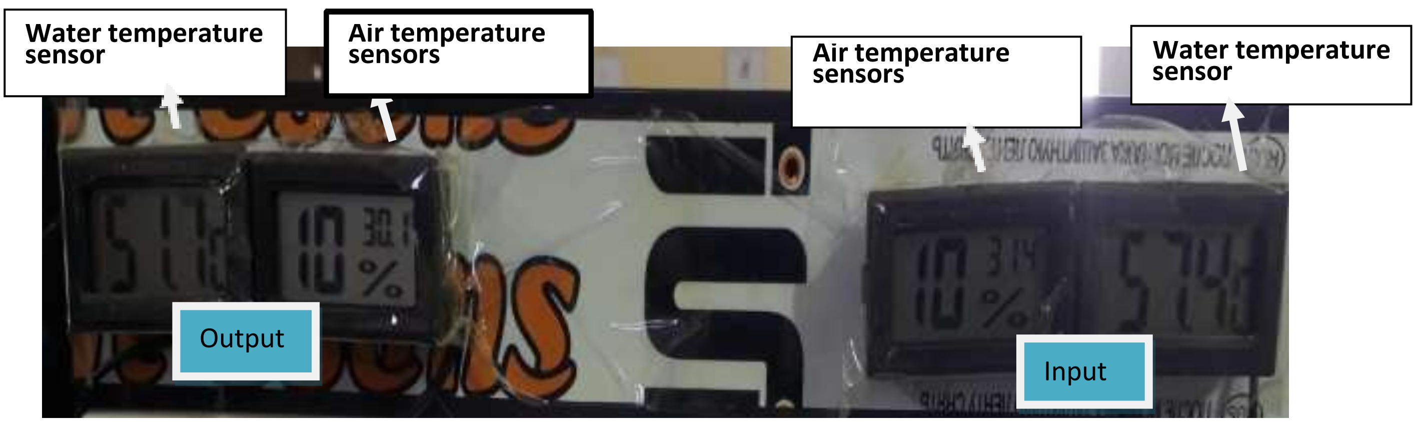


Fig.3-1: sensors

Types of sensors.

a. **Temperature sensor for water:**

It is utilized to gauge the radiator's water's temperature as it enters and exits

b. **Air temperature sensors:**

It is employed to gauge the air's temperature as it enters and exits the radiator. In order to assess the air's humidity, it also has a percentage of air.

Electrical control system:

It is used to turn on and off electrical devices

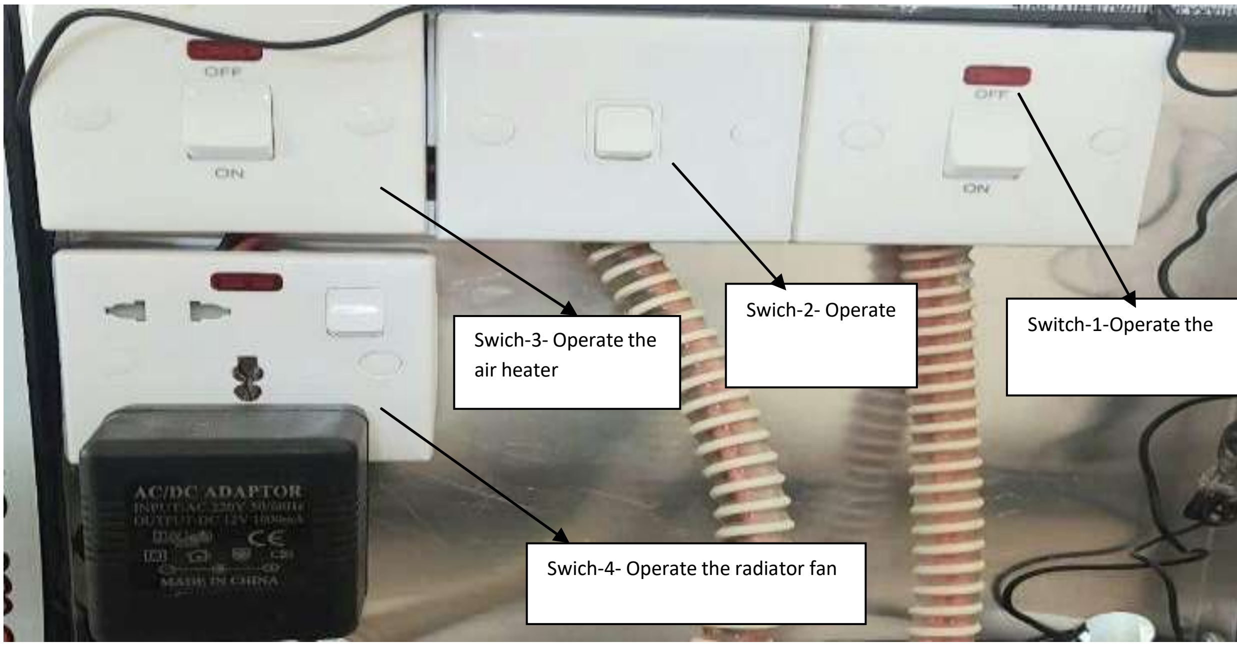


Fig.3-2: Electrical control system

Power transformer:

It is used to convert electrical power from 220 volts to 12 volts so that the radiator fan can run.

Radiator box

The radiator box consists of aluminum and thermal glass) 1 meter long, 30 cm wide, and 40 centimeters high are the dimensions. Aluminum has a 50–60% heat conductivity. Thermal glass: Made mostly of silica and boron oxide, borosilicate glass is a type of heat- and chemical-resistant glass. Borosilicic glass is more resilient to thermal stress than other forms of glass because it has a low coefficient of thermal expansion.

Fig.3-3: Radiator box

Radiator and Fan:

Radiator It consists of two tanks and a number of tiny tubes with Fins, which draw in air and liquid, are used to swiftly disperse heat. working together to help the heated liquid cool

The electric heater: The electric heater:

The purpose of the electric heater is to use this energy to heat the radiator room by converting electrical energy into thermal energy. and creating arid circumstances.

When an electric current flows through a material with high electrical resistance and thermal conductivity, the moving electrons of the current collide with the substance's constituent particles, creating thermal energy.

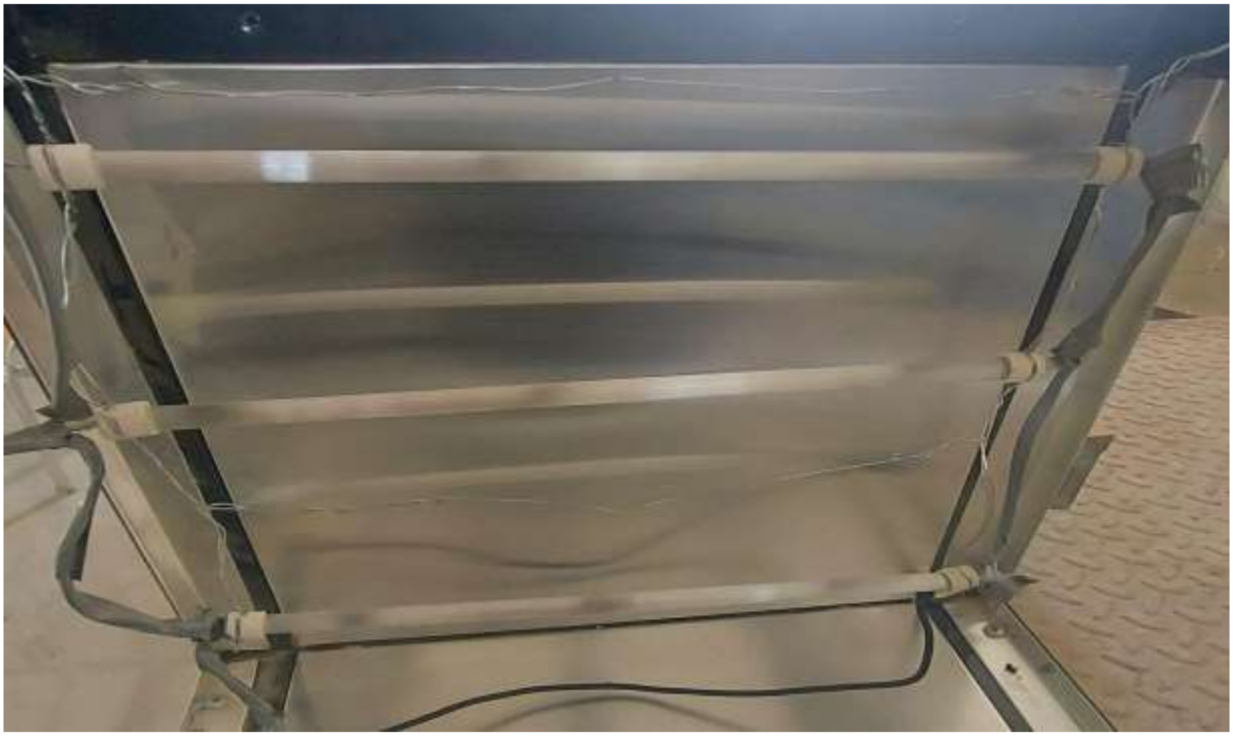


Fig.3-4: The electric heater

Coolant tank:

a metal container with a water pump and an electric heater

Fig.3-5:Coolant tank

Water pump:

Water is recycled and pumped into the cooling system via the water pump.

Fig. 3-7: Water pump

The electric heater:

Works to transform electrical energy into thermal in order to use this energy to heat the coolant, as the when an electric current passes through a material with thermal conduction qualities but high electrical resistance, the moving electrons of the current crash with these particles, creating collision thermal energy.

3.3 How the device works

When starting up, follow these steps:-

1. We turn on the switch (1), which activates the heater (water heater), which raises the temperature of the water in the bowl. This process reflects the heat generated by the engine as a result of its operation, as the radiator circulates water around the engine to remove heat. At this point, the water in the pot begins to clear up.

Fig. 3-6 : The electric heater

2. We switch on the water pump's power source, which moves water from the vessel to the radiator. This procedure here simulates the flow of water through the pipes when heat is removed from the engine and returned to the radiator to cool it.


Fig. 3-7: Water pump

3. We operate the radiator that cools the heated water at point (4). water exiting the vessel, and in this case, the radiator's operation is represented by the process of cooling the hot water as a result of cooling the warm engine.

Fig.3-8: radiator

4. As mentioned in the previous points, the work of the cooler naturally and in a natural atmosphere

And in the second case, which require high temperatures that may reach (50 Celsius or more), spark plugs have been added. Heat that raises the temperature to degrees that keep up with it
Iraq's heat in the summer weather in order to maintain this temperature. And make sure it goes up in line with Engine and coolant temperatures Thermal spark plugs were placed in a Tempered glass and aluminum box Materials that gain a lot of heat

Fig.3-9: The electric heater

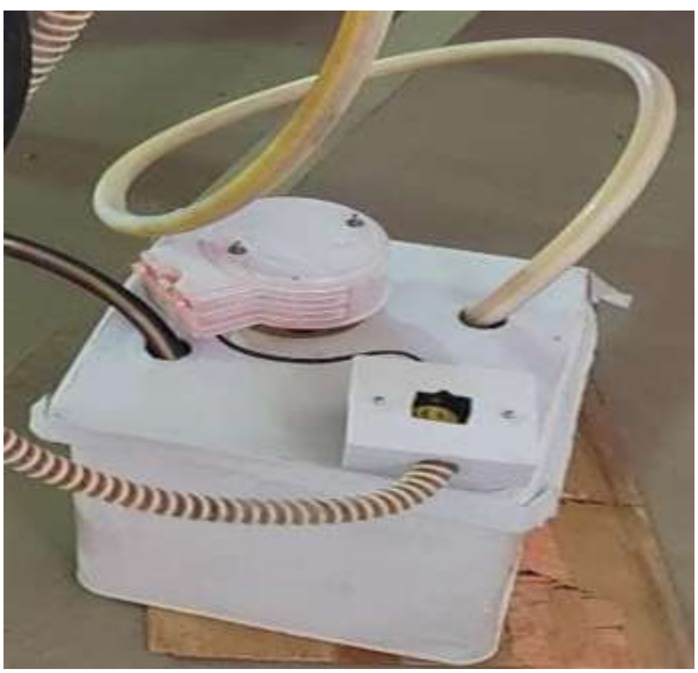
Fig.3-10: box

5. On the basis of point No. 4,, switch (3) has been set to operate. energy delivery of thermal candles that raise the temperature The second case represents the experiment with high scores.

Fig.3-11: Electrical control system

How the device works:-

When the water heater is turned on, it heats the water in the vessel (sink) to a temperature ranging from 50 to 75 degrees Celsius, and then the water pump draws the water from the vessel (sink) and raises it to the radiator through pipes. heat to cool it.



When the hot water reaches the radiator, it cools down, and the temperature ranges between 60 and 65 degrees Celsius. It then sends it back to the basin, and the process continues, but since the cooler is placed in a box with candles, where the temperature ranges between 68 and 72 degrees Celsius, the coolant finds it difficult to lower the temperature as its capacity reaches 50 to 65 degrees Celsius.

3.4 How to measure the temperature difference:

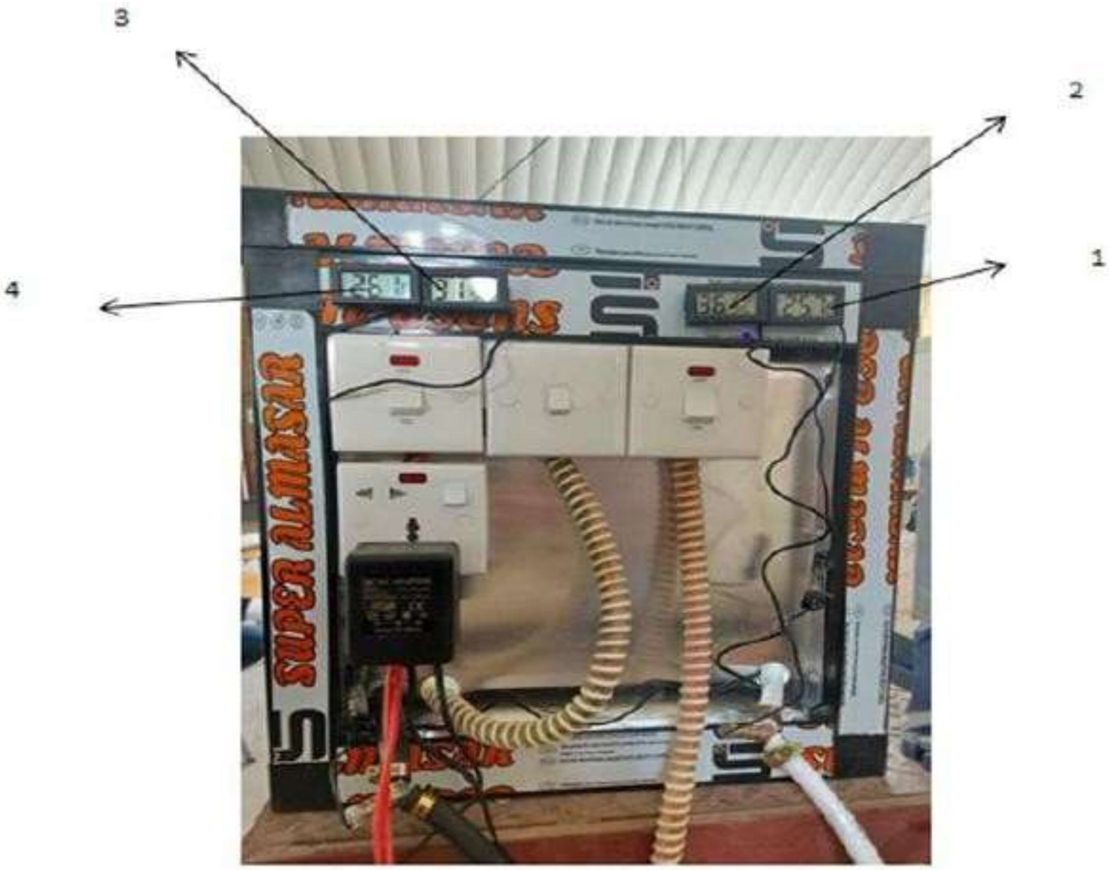
The temperature of air and water inside and outside is measured by a set of sensors and placed in several places, which are displayed as follows:-

a) The sensor that measures the temperature of the water entering it that is transferred from the vessel to the radiator

b) The sensor that measures the temperature of the air entering the radiator.

c) The sensor that measures the temperature of the air leaving the radiator.

d) The sensor that reads the temperature of the water leaving the radiator after cooling.



3.5 Types of coolants used in this experiment

1: Plain water
2: Distilled water
3: coolant water

Effect of coolant types on car radiator performance in dry areas

The effect of plain water

Water is a highly functional liquid that is used as a coolant. It is cheap, possesses good heat transfer qualities, and is readily available. It has a high specific heat capacity. enable it .To be an efficient heat transfer medium between engine and radiator materials. This Allow water to avoid any thermal overloads caused by the overheating of the ingredients. Water It is classified as an ideal coolant due to its ability to absorb and release heat efficiently. separate from Water is a low-viscosity liquid that flows easily. Thus, this property allows Water is commonly used as a coolant. However, water has a very low boiling point. 373 K. Since the temperature in the coolant can exceed 373 K, this can cause the evaporation of water. Loss to Coolant can create gas pockets or voids in the water jackets that can cause localized hot spots. And implosion. Since water freezes at 273 K, this reduces its circulating efficiency as a coolant. radiator. Thus, water cannot be used as a radiator coolant in countries where it is winter as it is eventually it freezes and leads to difficulty starting the vehicle or causes a dangerous engine damage. Ordinary water contains a lot of salts that may accumulate on surfaces and thus cause radiator wear and damage to some of its parts and consumption faster than usual, and the use of ordinary water may lead to the formation of rust and calcification due to its interaction with iron and copper.

Distilled water effect

Distilled water does not contain any minerals that may cause corrosion in the car’s radiator or radiator, so experts urge motorists who want to use water in their car’s radiator to use only distilled water.

The disadvantages of distilled water are as follows:

Distilled water causes, in the long term, deposits that negatively affect the water passages in the engine cooling system and the radiator. And it evaporates at a temperature of 100 degrees. Celsius. In addition, it negatively affects the cooling (conditioning) of the car.

The effect of *coolants* water:

The main component of the coolant is Ethylene Glycol (EG), which represents more than 90% of the coolant content. Chemical corrosion inhibitors are added, each according to the type of metals formed by the engine and the cooling system.

The advantages*:*

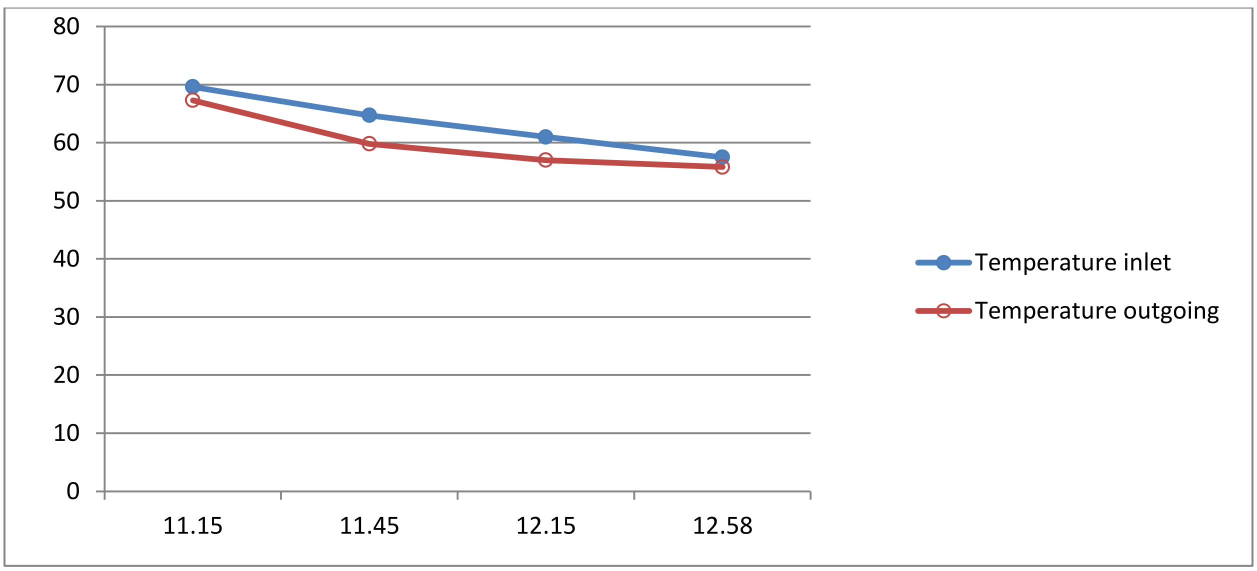
1. Long life coolant that includes carboxylate corrosion inhibitors, combined with the latest Organic Additive Technology (OAT).
2. Provides increased protection of thermostats, radiators and water pumps.
3. Improves heat transfer and provides excellent protection at high temperatures, particularly in modern engines that have aluminium heat exchangers.
4. Non-aggressive to seals, hoses and rubber fittings.

CHAPTER FOUR: Results

4.1 Plain water

4.2 First experience in normal conditions

Time	Temperature inlet	Temperature outgoing
11:15	**69.6**	**67.3**
11:45	**64.7**	**59.8**
12:15	**61**	**57**
12:58	**57.5**	**55.8**



Figure(4-1): Relationship between inlet water temperature and the outgoing water temperature with time

Time	Temperature radiator	Temperature box
11:15	**20.2**	**25.5**
11:45	**27.2**	**30.2**
12:15	**31.3**	**36.6**
12:58	**34.4**	**38**

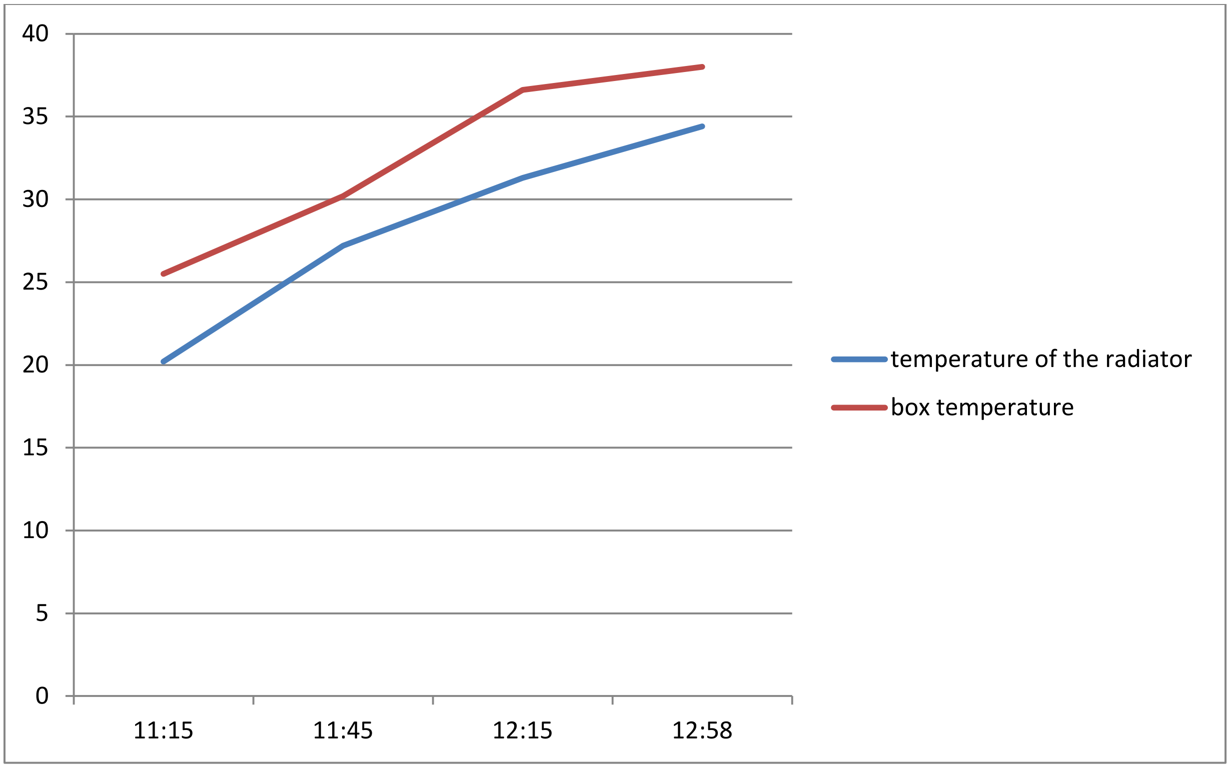
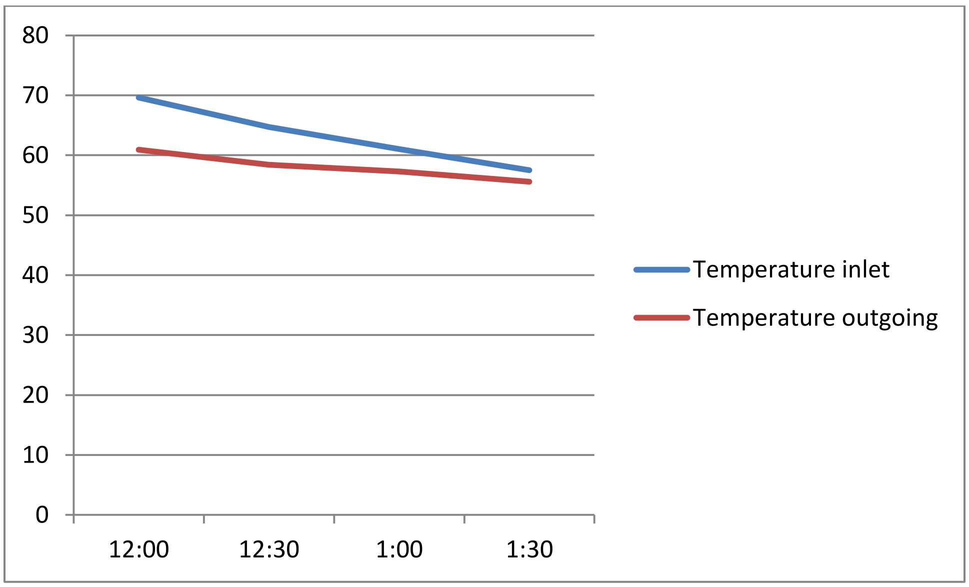


Figure (4-2) Relationship between the temperature of the radiator and box temperature with time

A second experiment under elevated temperature conditions

Time	Temperature inlet	Temperature outgoing
11:15	**69.6**	60.9
11:45	**64.7**	58.4
12:15	**61**	57.3
12:58	**57.5**	55.6



Figure(4-3)Relationship between inlet water temperature and the outgoing water temperature with time

Time	Temperature radiator	Temperature box
11:15	50.9	63.1
11:45	47.8	61.2
12:15	31.1	59.3
12:58	30.7	57.3

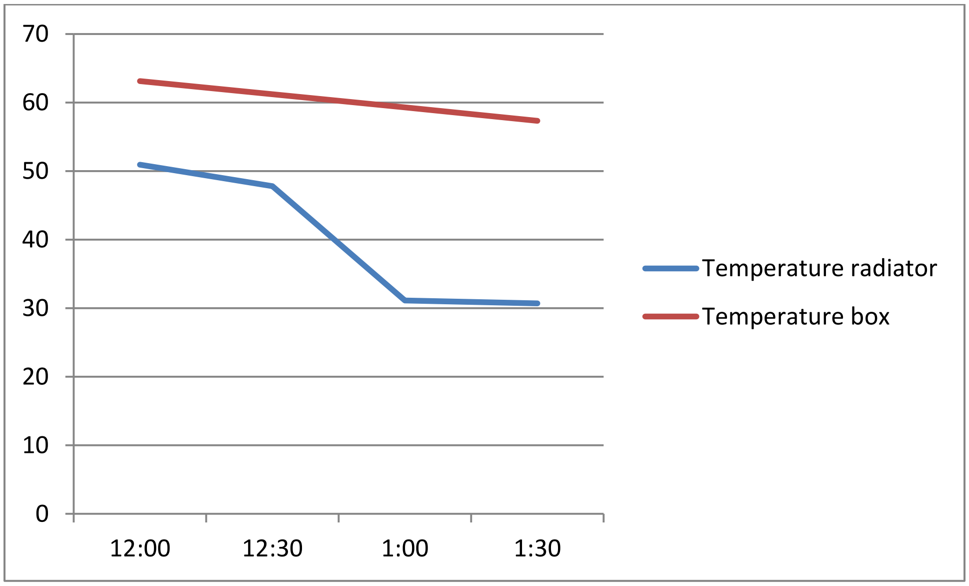
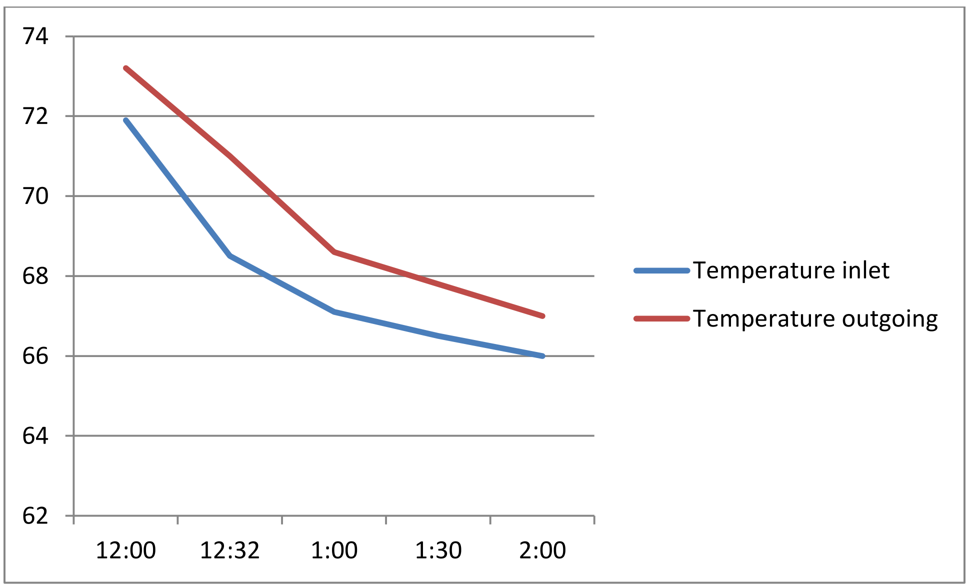


Figure (4-4) Relationship between the temperature of the radiator and box temperature with time

4.3 Distilled water

First experience in normal conditions

Time	Temperature inlet	Temperature outgoing
12:00	71.9	73.2
12:32	68.5	71.0
1:00	67.1	68.6
1:30	66.5	67.8
2:00	66.0	67.0



Figure(4-5)Relationship between inlet water temperature and the outgoing water temperature with time

Time	Temperature radiator	Temperature box
12:00	70.0	70.0
12:32	69.6	68.4
1:00	68.3	67.5
1:30	67.9	66.3
2:00	66.5	65

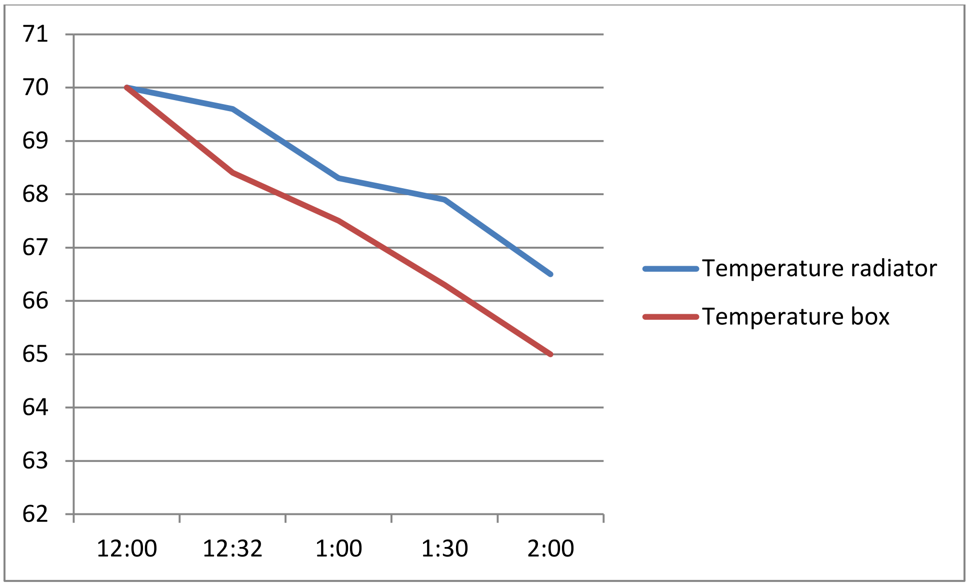
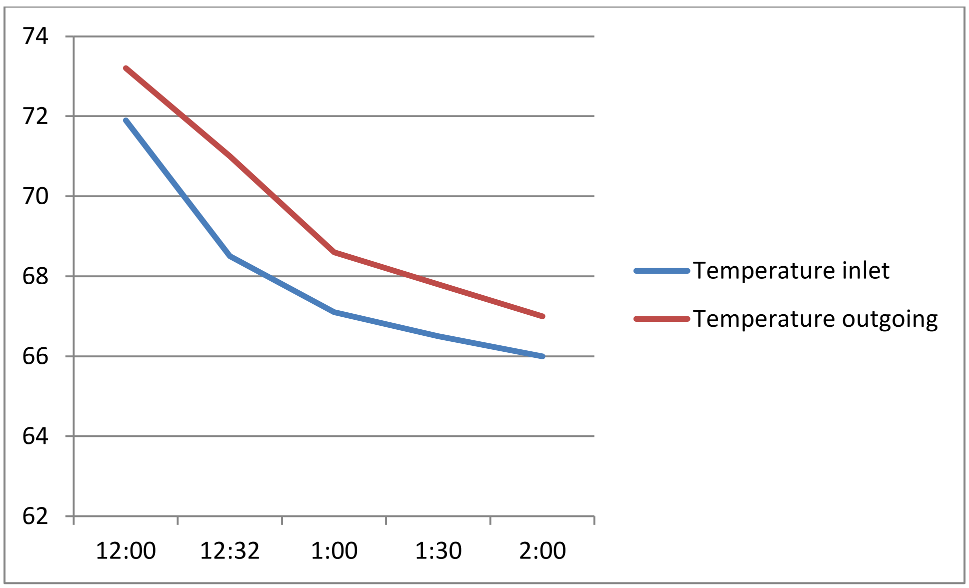


Figure (4-6) Relationship between the temperature of the radiator and box temperature with time

A second experiment under elevated temperature conditions

Time	Temperature inlet	Temperature outgoing
12:00	71.9	73.2
12:32	68.5	71.0
1:00	67.1	68.6
1:30	66.5	67.8
2:00	66.0	67.0



Figure(4-7)Relationship between inlet water temperature and the outgoing water temperature with time

Time	Temperature radiator	Temperature box
12:00	70.0	70.0
12:32	69.6	68.4
1:00	68.3	67.5
1:30	67.9	66.3
2:00	66.5	70.0

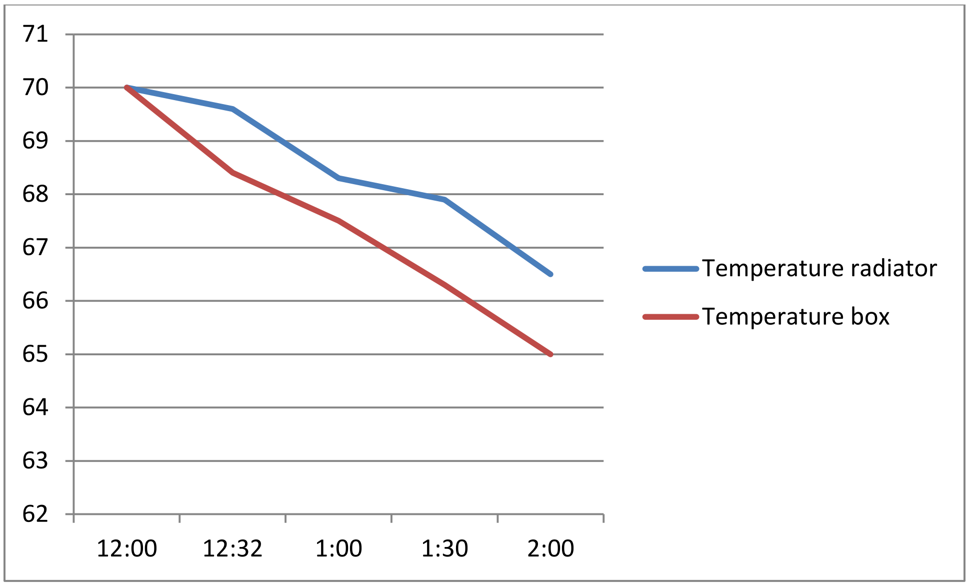
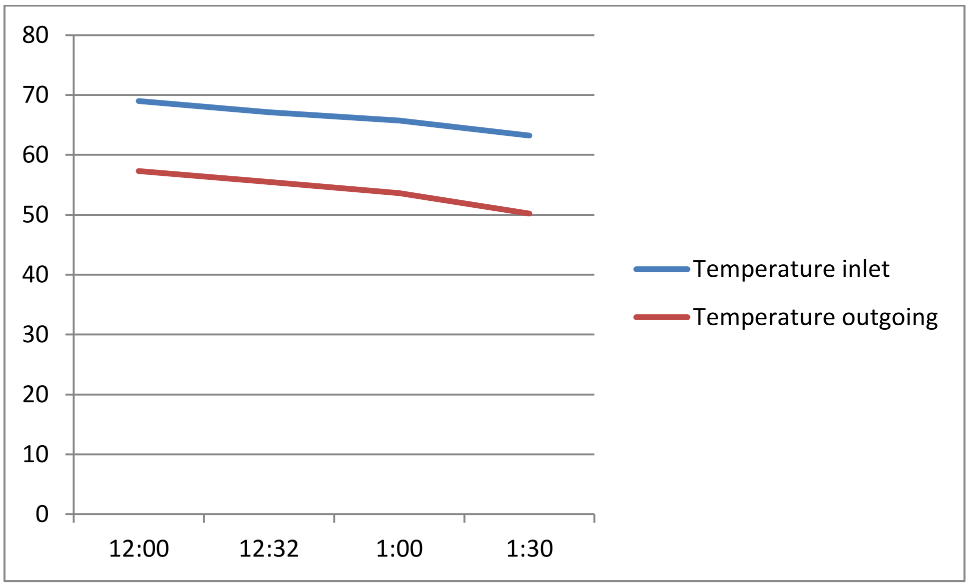


Figure (4-8) Relationship between the temperature of the radiator and box temperature with time

Oily water

First experience in normal conditions

Time	Temperature inlet	Temperature outgoing
12:00	69	57.3
12:32	67.1	55.5
1:00	65.7	53.6
1:30	63.2	50.2



Figure(4-9)Relationship between inlet water temperature and the outgoing water temperature with time

Time	Temperature radiator	Temperature box
12:00	39.1	37.7
12:32	38.8	36.9
1:00	37.7	36.3
1:30	37	35.8

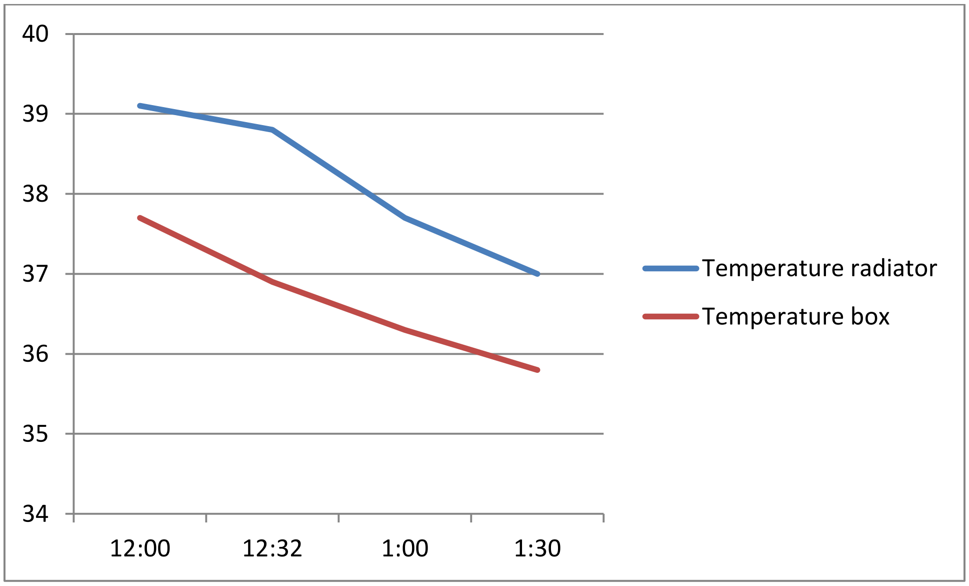
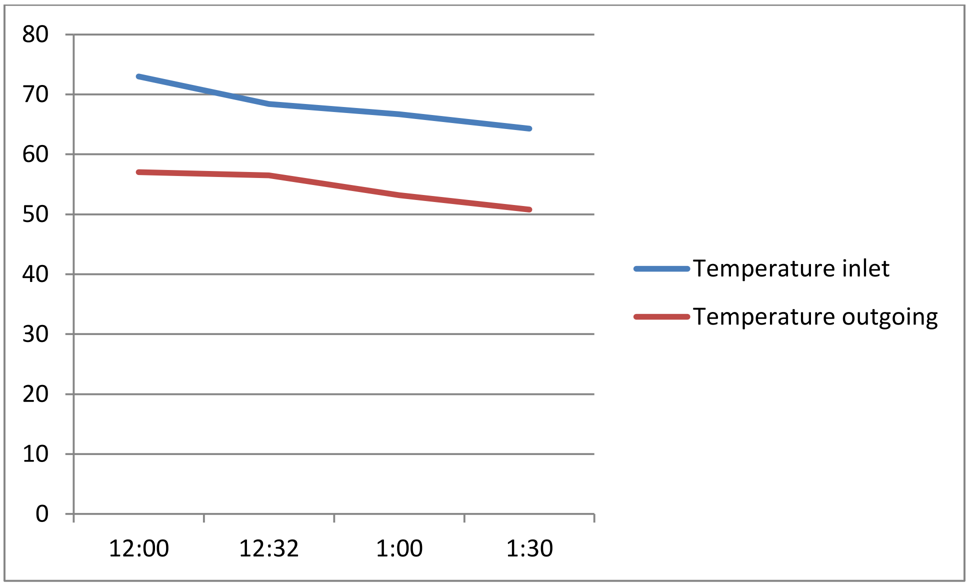


Figure (4-10) Relationship between the temperature of the radiator and box temperature with time

A second experiment under elevated temperature conditions

Time	Temperature inlet	Temperature outgoing
12:00	73.0	57
12:32	68.4	56.5
1:00	66.7	53.2
1:30	64.3	50.8



Figure(4-11)Relationship between inlet water temperature and the outgoing water temperature with time

Time	Temperature radiator	Temperature box
12:00	70.0	51.0
12:32	68.4	50.3
1:00	66.3	49.7
1:30	65	48.3

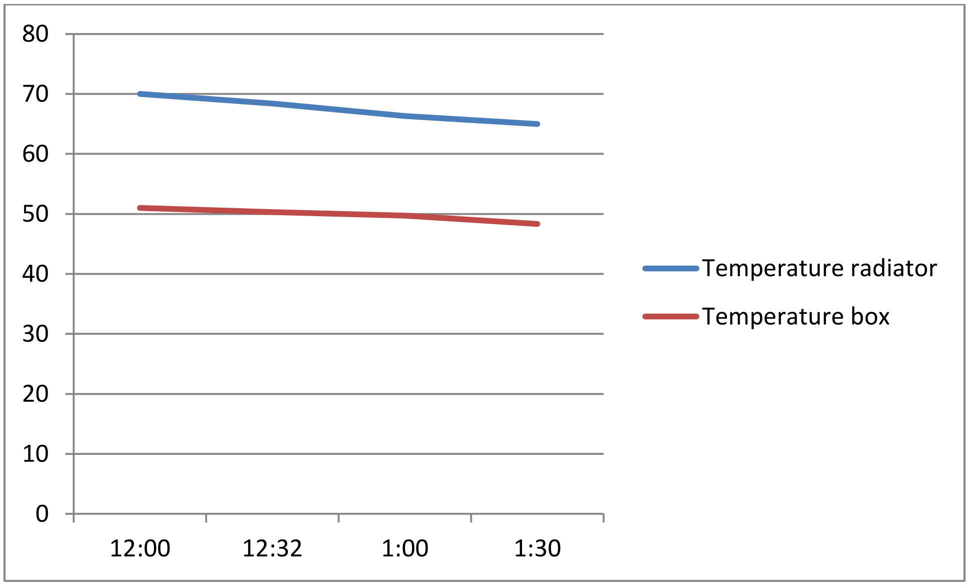


Figure (4-12) Relationship between the temperature of the radiator and box temperature with time

Chapter five: Conclusions and recommendations

5.1 Conclusions

Infer through experiments the three radreter water (regular water, distilled water, oily water).

When the coolant entered the first process, the air temperature was (37.3 °C - 32.9 °C) and under normal conditions, the results were a decrease in the temperature of the liquid leaving the refrigerant, as well as an increase in the temperature of the air leaving the refrigerant.

When the coolant entered the second process and under dry conditions (air temperature 60°C) the results were a decrease in the temperature of the liquid leaving the refrigerant over time, as well as an increase in the temperature of the air leaving the refrigerant..

5.2 Recommendations

Based on the results that have been reached in the scientific research, when the temperature is high and the humidity level is low, the efficiency of the radiator decreases, so we advise the new researchers to the following: -Use a coolant suitable for the radiator -Likewise, the greater the wind flow, the greater the efficiency of the radiator. Therefore, we invite researchers to connect an additional fan to the radiator. -The design of the radiator and the size of the radiator are related to its efficiency.

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