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Experimental Investigation of Mini Cooler cum Freezer

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Abstract: *In general cases the refrigerator could be converted into an air conditioner by attaching a fan. Thus a cooler as well as freezer is obtained in a single set up. The freezer can be converted to an air conditioner when the outside air is allowed to flow beside the cooling coil and is forced outside by an exhaust fan. In this case a mini scale cooler cum freezer using R134a as refrigerant was fabricated and tested*
In our mini project work we had designed, fabricated and experimentally analysed a mini cooler cum freezer. From the observations and calculations, the results of mini cooler cum freezer are obtained and are compared.
Keywords: *Mini Cooler, R134a, Exhaust fan.*

I. Introduction

Refrigeration is the technology which makes a major contribution to humanity in many ways including food preservation, control of indoor air quality, gas liquefaction, industrial process control, storage and transport of food and drinks and computer cooling. Without refrigeration modern life is impossible. Inefficient use of energy is waste of valuable resource and it leads to global warming. So to protect the environment and to find the solution for the energy crisis it is essential to develop techno economical viable systems.1,1,1,2-Tetrafluoroethane (R134a) is the most widely used alternative refrigerant in refrigeration equipment such as household refrigerators and automobile air conditioners. Though the greenhouse warming potential (GWP) of R134a is relatively high, R134a has been accepted as a long term alternative refrigerant in many countries.

In general cases the refrigerator could be converted into an air conditioner by attaching a fan. Hence we find wide applications for system which could be used as an air conditioner as well as a freezer. Our main objective is to fabricate mini cooler cum freezer which works with refrigerant R134a.We have fabricated a frame using mild steel, within a thermocole box we have installed the cooling coil. A fan is also incorporated. Air flow into the freezer is made possible through few port created at the surface of the thermocole box. The air entering through the port is converted into low temperature as it passes through the freezer, using this exhaust fan the cool air is given out. A thermostat is installed in order to control the temperature of the freezer.

II. Experimental Setup

2.1. Experimental System

The refrigerator was of 165L capacity, single door, manufactured by Godrej. The refrigerator could be converted into an air conditioner by attaching a fan. Hence we find wide applications for system which could be used as an air conditioner as well as a freezer. Our main objective is to fabricate mini cooler cum freezer which works with refrigerant R134a.We have fabricated a frame using mild steel. Then within a thermocole box we have installed cooling coil. Then a fan is incorporated. Air flow into the freezer is made possible through few port created at the surface of the thermocole box. Then the air entering through the port is converted into low temperature as it passes through the freezer. Then using this exhaust fan the cool air is given out. A thermostat is installed in order to control the temperature of the freezer. The power consumption of the domestic refrigerator was measured by using a digital energymeter. Figure 1. shows the experimental setup. Measuring instruments are used to measure various parameters. Table I shows the specifications of the system

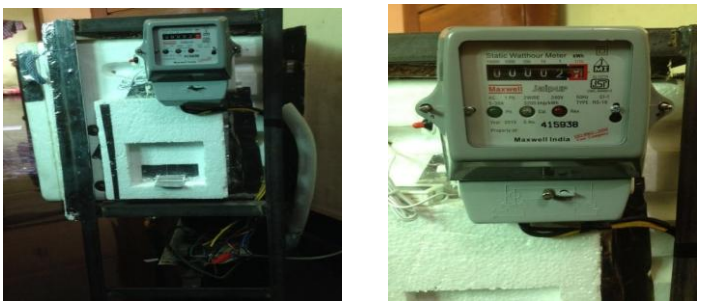

Figure 1: Experimental Setup

Table I: Specifications

Gross capacity	100 L
Refrigerant	HFC134a
Charged mass	140 g
Compressor type	Hermetic
Power	500W
Maximum Current	1A
Maximum Voltage	220V
Condenser type	Air Cooled
Expansion device	Throttling device
Length of air-cooled condenser	7m

Schematic diagram of the experimental apparatus is shown in Figure 2.

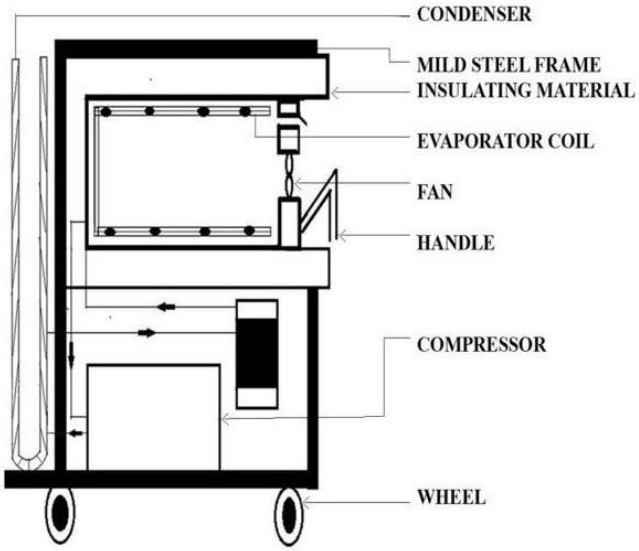

Figure 2: Schematic diagram of the experimental Setup

2.2. No Load Test Cabin Temperature At Load And No Load Conditions

2.2.1. No Load Test

No load test was carried out without applying cooling load to the refrigerator. The temperature at salient points were noted using a digital thermometer

2.2.2. Load Test

Applying different load conditions inside the refrigerator, load test was carried out. Thermal load was applied on the system by placing a known amount of water at a particular temperature in the freezer compartment. The load test was carried and the performance of the system is analysed. The cabin temperatures were noted at regular intervals of time. The results obtained from the various cases are plotted, they are mentioned below:

III. Results And Discussions

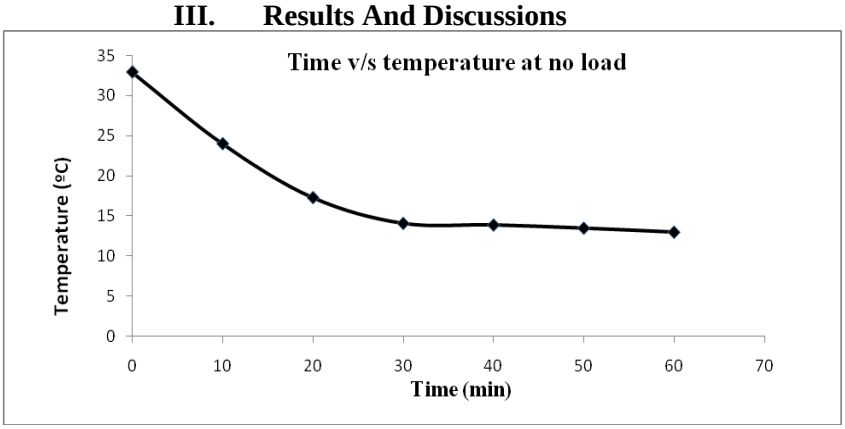

Fig 3. Time v/s Temperature without Load

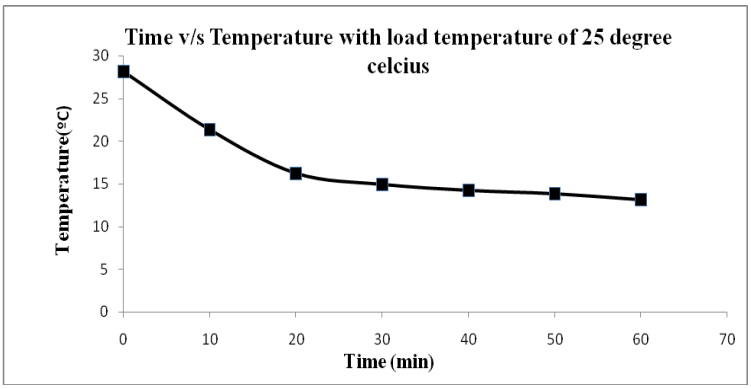

Fig 4. Time v/s Temperature with load

3.1. COP V/s Heat Extracted With Fan and Without Fan

3.1.1. Without Fan

The COP at different load conditions is found out without switching on the fan. In this case the experimental system is working as a simple refrigerator. The initial and final temperature of the load is found out.

3.1.1. With Fan

In this case the experimental system is working as both refrigerator as well as mini air conditioner. The input work done to the system is utilized for both air conditioning and refrigerating effect. The COP found at different loads will be lesser than the above case.

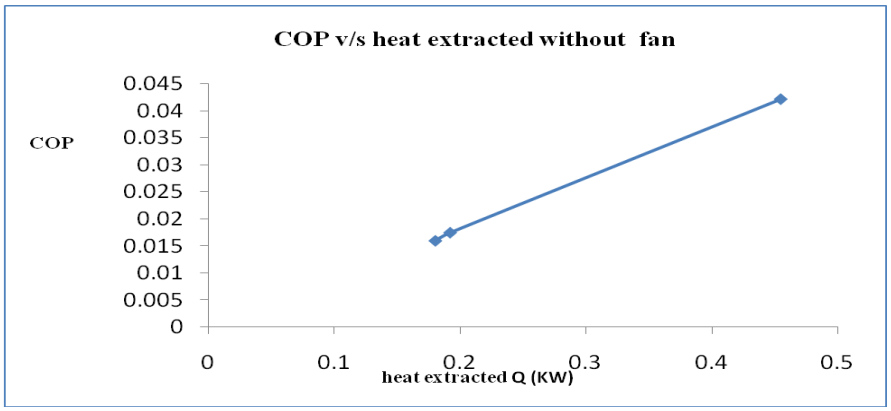

Fig 5. COP v/s Heat extracted without fan

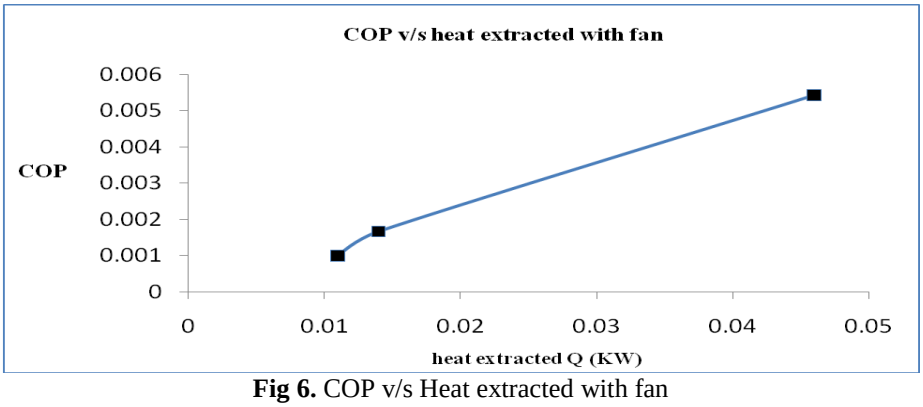

Fig 6. COP v/s Heat extracted with fan

IV. Conclusions

Experimental analysis for a mini cooler cum freezer was carried out. The coefficient of performance of the experimental system was found out by placing a known volume of water in the system. The COP of the system was found out with and without using the fan. Actual COP is usually lesser than unity. This is because the work done on the compressor is very high in actual case and is an isentropic process.

The COP found out was greater when the system was working without a fan. This is because when the system is working with an exhaust fan it extracts the cool air from the cabin hence reducing the cooling effect. Therefore when the system is working as a cooler as well as a freezer the coefficient of performance is comparatively less.

Acknowledgement

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