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Performance Assessment of Hydrocarbon Refrigerant in Air Conditioner

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Abstract: *Now a days the hydro-chlorofluorocarbons (HCFC) and hydrofluorocarbons (HFC) are the mostly used refrigerants in air conditioning sector. These refrigerants have strong influence on global warming and HCFCs impact on the ozone layer. To reduce this effect the refrigerants such as ammonia (NH3), carbon dioxide(CO2) and Hydrocarbons (HC), having minimal impact on the environment, are being considered. So far, HCs have only been safely used in domestic refrigeration. Ammonia has been used mainly for industrial refrigeration whereas CO2 is still under study. The refrigerants like R12 and R22 contain chlorine atoms which are main reasons for the emission of Chlorofluorocarbon. This is responsible for the ozone depletion. Therefore we are using the alternate refrigerants like R-134a and hydrocarbon mixture(R290/R600a). These refrigerants have zero ozone depletion potential and negligible global warming potential. We are doing the experimental analysis of R134a and various ratios of R290/R600a refrigerants. This investigation thermodynamically analyses a vapour compression refrigeration system which compares R134a and R290/R600a refrigerants.*

Key Words: **Hydrocarbon Refrigerant, Low GWP, Negligible ODP, More COP.**

1. INTRODUCTION

We all know that day when temperature of the earth goes on increasing; the ozone layer on the earth decreases and also greenhouse effect decreases so in order to save our earth from ultra violet rays coming from sun on earth we need to take preventive action. Refrigerant is also the responsible for the decreasing of the ozone layer. So we are testing R290, R600a, LPG refrigerants in Air Conditioner this refrigerants having very less greenhouse effect and zero ozone layer depletion. By using this refrigerant the greenhouse effect is decreases or will not be responsible for the ozone layer depletion. This refrigerant reduces the percentage of depletion. CFCs and HCFCs are the potential contributor to the global warming. There is an urgent need to phase out traditional refrigerants (CFCs and HCFCs). In this project we are going phase out the R134a and R12 by R600a and R290 with proportion in air conditioner. so for that we have to first check the COP and other properties of refrigerants in air conditioned room.

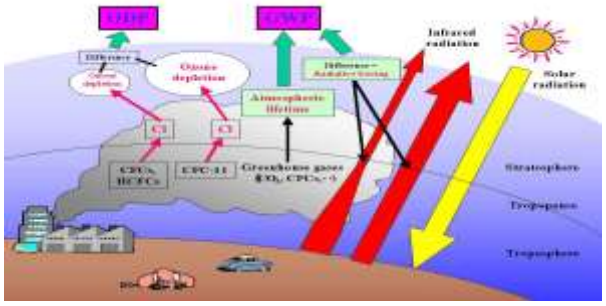


Fig 1. Global Warming Phenomena

1.1 Experimental Setup

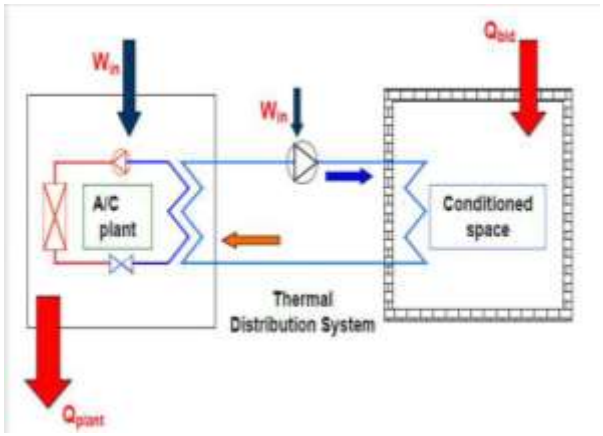


Fig: 2 Working Of Experiment

The mixture of R600a and R134a refrigerant, is fed into the compressor by using special procedure with the help of charging equipment's in one of the window air conditioner. There are two conditioned rooms, the window air conditioner is placed in each room. In first room air is conditioned by using one AC, so that constant surrounding air condition is maintained. In second room window AC is placed which cools the room air and heat is released to first room. The mixture of R600a and R22 refrigerant, is fed into the compressor of the second AC.

This setup is like a cascade system. The refrigerant In second AC takes the heat from second room through the evaporator and releases this heat to first room air through condenser of second AC. Then this heat is absorbed from first room air by evaporator of first AC and released to the atmosphere through the condenser of the first AC.

1.2 Methodology

A Test Setup design methodology has been outlined. Steps of the design process include:

- Design calculation
- Modelling of Window AC
- Building of Test Room
- Instalment of Window AC
- Testing
  Comparing result with other refrigerant test
- Concluding result
-

1.3. Literature review

In 2018, Shalaka S. Hastak and Jagdeep M. Kshirsagar [1]. This Paper presents comparative performance analysis of R600a and R436a as an alternative of R134a refrigerant in a domestic refrigerator. he system was modified by replacing HFC compressor with HC compressor and using optimized capillary. In the modified system, for 45g of R436a, the power consumption reduces by 41.66% as compared to R134a in original system also it reduces by 15.66% than optimized charge of R600a in modified system. COP for optimized charge of R436a with modified system increases by 60.25% than R134a and 27.11% R600a.

In 2017, Neeraj Agrawal, Shriganesh Patil, Prasant Nand [2] This paper presents system performance of an existed 134a domestic refrigerator with propane/isobutene (50/50%) zeotropic blend is measured as a drop-in substitute. An inhouse experimentations test facility was developed. The experiments are conducted under various charge condition to find optimum charge. Experiments were conducted at constant load condition. The optimum charge is measured as 60 g with R290/R600a (50/50%) zeotropic blend and the lowest temperature is recorded as -3.5°C.

In 2017, R. K. Dreepaul [3] The most frequently used refrigerants in the refrigeration and air conditioning (RAC) sector in Mauritius are currently hydrochlorofluorocarbons (HCFC) and hydrofluorocarbons (HFC). However, because of their strong influence on global warming and the impact of HCFCs on the ozone layer, refrigerants such as ammonia (NH3), carbon dioxide (CO2) and Hydrocarbons (HC), having minimal impact on the environment, are being considered in this paper.

In 2017, Barathiraja.K, Allen Jeffrey.J, Attinkishore.R, Brito Raj.S, AshwathRaj.A, Jayakumar.S [4] In this paper, the experimental analysis of R134a and various ratios of R290/R600a refrigerants have been analyzed. In the present work performance comparison between R-134a and hydrocarbon mixture (R290/R600a) has been carried out in domestic refrigerator. Generally, the overall performance of the applied mixtures was much better than that of R134a.

In 2017, Anusha Peyyala and N V V S Sudhe[5] The aim of this paper is to present the experimental analysis of Coefficient of performance [COP] values using R134a [HFC] & R600a [HC] as Refrigerants in Domestic refrigerator using conventional and nonconventional energy sources. Based on the results, usage of R600a in domestic refrigerators will reduce the ODP and also GWP problems which fulfills the nominal requirements of human beings without any effects.

2. Experimental test procedure

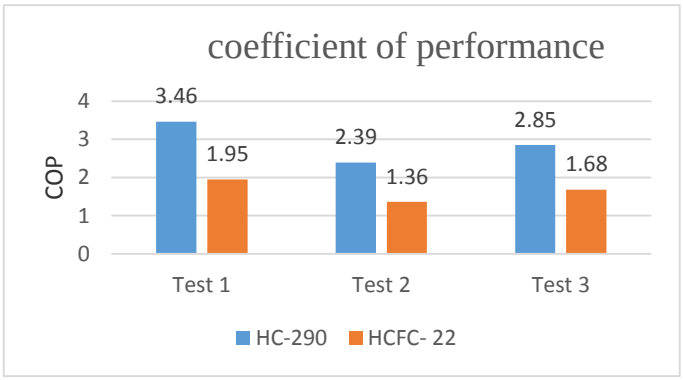
The performance of test is started with providing electrical supply to Test Rig. Further which the main switch is kept on to have electrical supply to all monitoring devices. System was kept in running condition for at least 10 min to achieve steady state. The steady state achievement can be obtained by observing the readings given by temperature indicator and pressure gauge. Further Voltmeter and ammeter reading are also taken into consideration. This test is carried out at ambient temperature and pressure conditions. Three different readings were taken for R22 and R290 at different times. The test were carried out at the highest compressor speed by using speed regulator. Different readings taken are as follows:

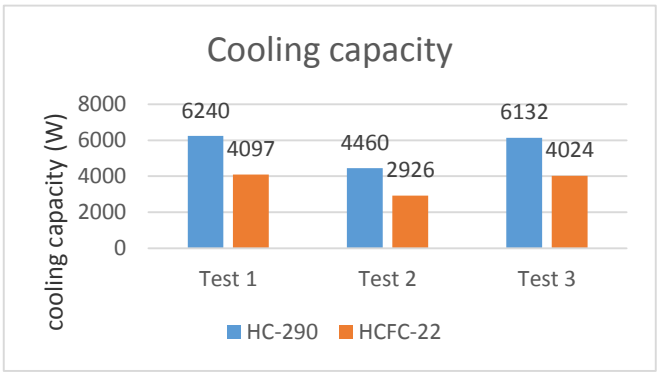
i. DBT, WBT At inlet and outlet conditions, in 0C
ii. Pressure gauge readings of evaporator (P1) and condenser (P2), in psi.
iii. Energy Meter reading, in kWh.
iv. Voltmeter reading, in Volt.
v. Ammeter reading, in Ampere.

- **Table -1:** Input Data From Experiment

Operating Conditions	HCFC-22			HC-290		
Test No.	Test 1	Test 2	Test 3	Test 1	Test 2	Test 3
Refrigerant Mass Flow Rate(Kg/hr)	120	120	120	60	60	60
Inlet Quality of Refrigerants	0.2	0.2	0.2	0.2	0.2	0.2
Inlet Temperature of Air(°C)	27	27	29	27	27	29
Inlet Pressure of Air(bar)	1.07325	1.07325	1.07325	1.07325	1.07325	1.07325
Mass Flow Rate of Air(kg/min)	4.39	4.39	4.39	6.69	6.69	6.69

2.1. Result





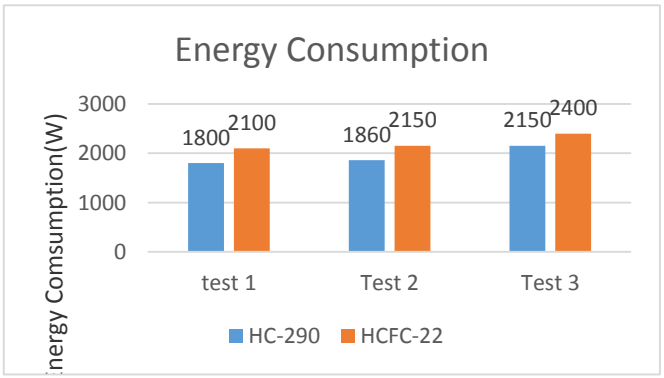


Chart -1: Result

2.2. Expected Outcomes

- Increase in COP.
- Maximum temperature difference.
- Maximum cooling effect.
- Reduce the size of the Tube.

3. CONCLUSIONS

1. The cooling capacity of the system with blend is comparatively more than HCFC-22.

2. It can be concluded that R290 (45/55%)can be a good option as a replacement of HCFC-22. However, the flammability aspect of the hydrocarbons needs to be addressed.

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