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Utilizing the Refrigerants R134a and Mixed Nano-Particle Refrigerant in a Comparison Study and Analysis of a Vapour Compression Refrigeration System

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Abstract: Fundamentally, a vapour compression refrigeration system (VCRS) is a device that absorbs heat from a lower internal heat level and rejects it to the body or environment at a higher temperature in exchange for some external work being done on it. It is widely used everywhere, from commercial use in homes and stores to extensive scope and significant cooling loads in companies. They vary in size as well, but only to the extent necessary for cooling. to operate with top blowers, provide large cooling loads with minimal energy or force consumption Many analysts working in the subject of warm designing have always been interested in it. The area of refrigeration is similarly changing as a result of the introduction of nanotechnology in all research and technological fields. not anymore left clean of it. It has been observed that several metals and their combinations have high heat dissipation limits, which formed the basis for their use in refrigeration. Numerous nano size metal mixes have been tested with numerous refrigerants, and suitable fixes have been discovered to ensure an increased VCRS Coefficient of Execution. In this endeavour as well, a unique mixture is used, and research on VCRS will be conducted. Here, the task of finding the best fixations is completed after the mixing of metalCuO nanoparticles with the refrigerant R134a is complete.
Keyword: Cooling fan, Capillary tube, Condenser, Compressor and Evaporator.

I. INTRODUCTION

The word "refrigeration" is rather broad. It defines the method of removing heat from areas, things, or materials in order to keep them at a temperature lower than the surrounding atmosphere[1]. The substance to be chilled just has to be exposed to a cold environment in order to have a refrigeration effect. The warmth will circulate in its usual direction, from the hotter to the cooler substance. That example, using refrigeration to lower the temperature is illegal[2]. Mechanical refrigeration is the process of transferring heat from one material to another using a mechanical device or structure. A refrigeration framework is made up of different functional components that together form the overall refrigeration unit. This real structure represents the various phases of the refrigeration cycle[3]. These frameworks are made up of an expansion valve, condenser, blower, and evaporator. The blower compresses the refrigerant at a low pressing factor in the evaporator to a pressing factor at the condenser[4] in order to cool the evaporator. The condenser eliminates the heat that the refrigerant has accumulated, and the extension valve allows the refrigerant at high pressure to enter the low pressure zone[5]. This illustration of the various refrigeration system components is rather popular. Depending on the use and kind of refrigerant, the refrigeration systems change. Theyare the techniques that allow us to really carry out the refrigeration interaction[6]. Therefore, giving them your whole attention is essential. The use of refrigeration has significantly changedhorticulture, industry, and way of life. settlement patterns But recently, refrigeration has expanded quickly, going from ice-collection to temperature-controlled train cars[7].

A. *Type of Refrigeration*

There are several options for refrigeration. These are a few ofthem.

1) Refrigeration of air.
2) Laser refrigeration and cooling.
3) Solar refrigeration

4) Vapor Absorption cooling.
5) Refrigeration through vapour compression.(6)Magnetic refrigeration

The following components make up a basic vapour compression refrigeration system:

a) Compressor
b) Condenser
c) Expansion valve
d) Evaporato

B. Application of VCRS

In the current state of world development, VCRS has several uses, some of which are asfollows.

1) Ice production
2) Preservation of food
3) Business Applications
4) Business Utilizations
5) Commercial Drying Equipment
6) Air Conditioning in Transportation
7) Unique Applications
8) Business Establishments
9) Future Refrigerants and the Greenhouse Effect

C. Components of Setup

Component Listevaporator compressor. Condenser Capillary tube Fan for coolingThermocouple Pump Voltmeter Ammeter pressure gauge

1) *Compressor:* By using channel or pull valve A, the low pressing factor and temperaturefume refrigerant from the evaporator is moved into the blower where it is packed to a high pressing factor and temperature[8]. Through the convey or release valve, this high pressing factor and temperature fume refrigerant is discharged into the condenser.
2) *Condenser:* The condenser or cooler is made out of a curl of line where high pressure andtemperature fume refrigerant exchanges heat and cools while also condensing. The refrigerantdelivers its inert heat to the surrounding medium, which is often air or water, when it passes through the condenser[9]
3) *Receiver:* The collector is a container where condensed fluid refrigerant is stored before being supplied to the evaporator with the help of a development valve or control valve[10].
4) *Expansion Valve:* Choke valve or refrigerant control valve are other names for it. The development valve's purpose is to allow the fluid refrigerant at high pressure and temperature to pass at a controlled rate once its pressure and temperature have been reduced. When fluid refrigerant passes through the extension valve, a little quantity disappears, while the larger portion disintegrates in the evaporator[11]..
5) *Evaporator:* The fluid-fume refrigerant is dispersed and converted into fume refrigerantin an evaporator's loop of line at low pressure and temperature. The medium (air, water, or saline solution) being cooled by the refrigerant absorbs its idle temperature of vaporisation as it dissipates [12].
6) *Evaporator:* An evaporator is constructed of a cool cage with a fibre body and a drain valve. By drilling a hole in the body of the cool cage, a copper coil is bent into a helical form and inserted within. For the purpose of heat transmission, copper coils transport cooling media(refrigerant) in the evaporator.
   Size (L*B*H) (In MM) 354*220*260
   Capacity of evaporator 12 KLDBody material Fiber
   Cooling coil length (in mm)MOC of cooling coil copper
   Size/length of cooling coil 5/8” & 26 feet

Figure no: 1 Refrigerntion Evaporator

a) *Compressor:* Through the suction valve, the compressor draws in the low temperature andlow pressure vapour refrigerant from the evaporator, where it is compressed to a high temperature and pressure.

Specifications of Compressor

- Model KCN411LAG
- Serial No KOK-962355
- Oil 13 POE
- Volts 230
- Phase 1
- Freq (Hz) 50
- Make Emerson Climate Technologies (India) Ltd

Figure no.2: Compressor

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b) Condenser: In the coils of pipe that make up the condenser, the high pressure and temperature vapour refrigerant is cooled and condensed. As it moves through the condenser, the refrigerant dissipates its latent heat into the surrounding air. condensing substance In the experiment, a typical spiral condenser is employed.Specifications of Condenser

- Size (mm) 0.79&1.12
- Coil MOC Copper
- Length 10 foot each
- Coil-1 (OD) 64 MM
- Coil-2 (OD) 70 MM
- Pitch 15 MM

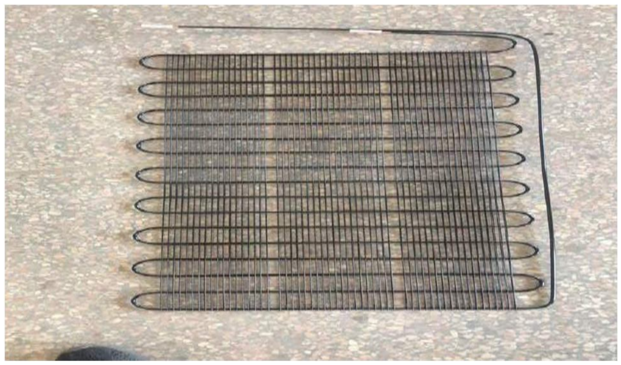

Figure no.3: Condenser

c) Capillary Tube: One of the most often utilised throttling mechanisms in air conditioning and refrigeration systems is the capillary tube. The capillary tube is a copper tube that has a very small internal diameter, a very long length, and is wound around itself numerous times totake up less room. Domestic air conditioners, deep freezers, water coolers, and refrigerators all employ capillary tubes as throttling devices.Specifications of capillary tube Size (mm) 0.79- 1.12

- Coil MOC Copper
- Length 10 foot each
- Coil-1 (OD) 64 MM
- Coil-2 (OD) 70 MM
- Pitch 15 MM

Figure no.4: Capillary Tube

D. Formula to be Used

Energy tests were conducted to calculate the COP in this experiment by comparing the powerconsumed by the heater to the power consumed by the compressor.

COP = kWh of power consumed by heater kwh of power consumed by compressorSystem after Construction and Basic cycle of VCRS

Figure no 5: VCRS Experimental Setup

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The formula will be used to compare the outcomes of tests conducted initially with R134a alone and subsequently with nanorefrigerants, namely R134a+CuO.

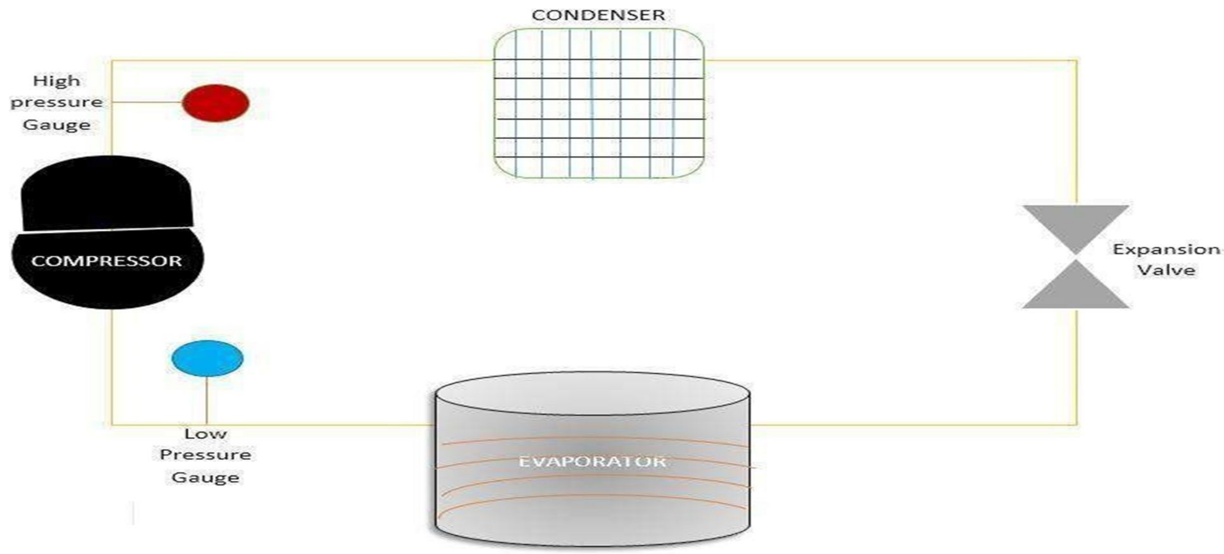

Figure no 6 : Components of Vapour Compression system

II. RESULTS & DISCUSSION

Results Procured After Performing Experiment the construction and execution of the experimentusing the VCRS experimental setup, we obtained the following results.

Table No 1

Atmospheric Temperature = 20°C							Refrigerant R134a = 100 gm		
T1 (°C)	T2 (°C)	Condenser Temperature Drop(T1-T2)	T3 (°C)	T4 (°C)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumed by Evaporator	Time(min)
44.9	29.1	15.8	-2.0	20	210	13	3.71	3.31	00
45.1	29.2	15.9	-2.1	20	215	11	3.72	3.33	20
45.3	29.7	15.6	-2.2	20	215	12	3.74	3.45	40
45.9	29.9	16.0	-2.2	20	225	14	3.76	3.46	60
46.5	28.4	18.1	-2.4	20	230	12	3.82	3.47	80
45.8	28.0	17.8	-3.5	20	225	11	3.84	3.49	100
46.3	28.8	17.5	-2.3	20	230	11	3.87	3.52	120
47.6	30.2	17.4	-3.6	20	225	11	3.92	3.55	140
48.7	31.1	16.6	-3.9	20	230	13	3.96	3.58	160
46.1	28.5	17.6	-2.8	20	220	13	3.98	3.59	180
47.1	31.1	16.0	-3.2	20	230	09	4.01	3.67	200
48.6	30.7	17.9	-2.8	20	230	11	4.05	3.66	220
46.9	30.9	16.0	-2.8	20	230	12	4.04	3.68	240
Difference in final and initial power consumption							4.04-3.70 = 0.34	3.68-3.31 = 0.37	

COP = Heat Consumed by Evaporator/Power consumed by Compressor
= (3.68-3.31) / (4.03-3.7)
= 0.37 / 0.34
= 0.0188

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Table No 2

Atmospheric Temperature =20.5°C					Refrigerant R134a = 100 gm				
T1 (ºC)	T2 (ºC)	Condenser Temperature Drop(T1-T2)	T3 (ºC)	T4 (ºC)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumedby Evaporator	Time(min)
47.1	31.5	15.6	-2.2	28	215	12	4.12	3.66	00
48.9	31.2	17.7	-2.3	28	225	10	4.15	3.67	15
48.8	28.9	18.9	-2.3	28	230	12	4.17	3.77	30
46.4	28.4	18.0	-2.5	28	230	10	4.24	3.76	45
46.1	28.0	18.1	-2.8	28	225	10	4.26	3.78	60
45.9	27.8	18.1	-3.4	28	225	10	4.29	3.83	75
47.4	31.4	16.0	-2.7	28	230	10	4.35	3.84	90
45.7	27.9	17.8	-3.4	28	225	10	4.39	3.92	105
46.7	28.8	17.9	-2.4	28	230	14	4.38	3.96	120
46.1	27.0	19.1	-2.2	28	220	10	4.45	3.94	135
45.4	26.3	19.1	-2.3	28	230	8	4.46	3.97	150
48.9	27.7	21.2	-2.2	28	230	12	4.47	4.12	165
47.0	28.7	18.3	-2.3	28	230	12	4.46	4.19	180
Difference in final and initial powerconsumption							4.46-4.12 = 0.34	4.19-3.66= 0.53	

COP = Heat Consumed by Evaporator/Power consumed by Compressor
= (4.19-3.66) / (4.46-4.12)
= 0.53 / 0.34 = 0.0158

Table No 3

Atmospheric Temperature = 21°C					Refrigerant R134a = 100 gm				
T1 (°C)	T2 (°C)	Condenser Temperature Drop (T1-T2)	T3 (°C)	T4 (°C)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumedby Evaporator	Time (min)
46.0	26.0	20	0.8	30	195	18	4.64	4.02	00
47.5	27.6	19.9	0.7	30	200	20	4.65	4.07	20
48.2	30.2	18.0	0.3	30	210	20	4.66	4.10	40
47.4	27.3	20.1	-0.8	30	210	18	4.71	4.15	60
47.9	27.7	20.2	-1.2	30	210	18	4.74	4.12	80
49.4	26.2	23.2	-1.7	30	215	16	4.75	4.25	100
47.5	24.4	23.1	-2.2	30	215	17	4.76	4.28	120
47.7	24.4	23.3	-2.6	30	215	16	4.84	4.31	140
47.6	25.2	22.4	-2.5	30	210	18	4.84	4.32	160
48.5	27.9	20.6	-2.7	30	215	16	4.85	4.37	180
47.6	28.2	20.5	-2.3	30	215	18	4.92	4.40	200
48.5	28.0	18.5	-2.4	30	215	18	4.94	4.43	220
47.6	29.1		-2.5	30	215	17	4.98	4.49	240
Difference in final and initial power consumption							4.98-4.64= 0.34	4.49-4.02 =0.47	

COP = Heat Consumed by Evaporator/Power consumed by Compressor
= (4.98-4.64)/ (4.49-4.02)
= 0.47/0.34
=1.382

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Table No. 4

Atmospheric Temperature = 23°C					Nanoparticle Weight CuO (0.4 gm) + Refrigerant R134a(100 gm)				
T1 (ºC)	T2 (ºC)	Condenser Temperature Drop(T1- T2)	T3 (ºC)	T4 (ºC)	P1 (psi)	P2 (psi)	Power consumedby Compressor	Power consumedby Evaporator	Time (min)
47.2	29.6	17.6	-1.8	20	240	16	5.05	4.41	00
48.7	29.2	19.5	-2.3	20	240	14	5.07	4.50	20
48.9	29.5	19.4	-1.8	20	230	14	5.09	4.51	40
49.1	29.6	19.6	-1.7	20	230	16	5.01	4.54	60
49.2	29.5	19.7	-2.1	20	235	12	5.13	4.56	80
48.7	28.9	19.8	-2.2	20	235	14	5.14	4.61	100
47.3	29.7	17.6	-2.2	20	235	14	5.16	4.63	120
47.2	29.6	17.5	-2.3	20	235	14	5.21	4.65	140
48.5	28.6	19.9	-2.1	20	230	12	5.22	4.68	160
48.6	28.8	19.8	-2.3	20	230	12	5.25	4.72	180
49.9	28.9	21.0	-2.4	20	230	14	5.36	4.77	200
48.6	28.8	19.8	-2.5	20	225	14	5.37	4.78	220
48.7	28.8	19.4	-2.4	20	230	14	5.39	4.87	240
Difference in final and initial power consumption							5.39-5.05 = 34	4.87-4.41 = 46	

COP = Heat Consumed by Evaporator/Power consumed by Compressor
= (4.87-4.41) / (5.39-5.05)
= 0.46 / 0.34 = 1.352

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Table No. 5

Atmospheric Temperature =23.5°C				Nanoparticle Weight CuO (0.4 gm) + Refrigerant R134a(100 gm)					
T1 (°C)	T2 (°C)	Condenser Temperature Drop(T1-T2)	T3 (°C)	T4 (°C)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumedby Evaporator	Time (min)
45.2	26.4	18.8	-2.2	28	210	11	5.37	4.81	00
45.4	26.7	18.7	-1.8	28	215	10	5.38	4.83	20
46.7	26.8	19.9	-2.3	28	220	13	5.44	4.86	40
46.9	24.8	22.1	-2.4	28	225	13	5.47	4.95	60
46.8	25.6	21.2	-2.5	28	220	15	5.49	4.98	80
47.7	26.7	21.0	-2.2	28	215	15	5.53	4.99	100
47.8	25.7	21.1	-2.2	28	220	16	5.55	5.04	120
49.8	26.6	23.2	-2.3	28	220	16	5.58	5.07	140
49.9	27.6	22.3	-2.3	28	220	17	5.62	5.09	160
49.0	27.8	21.2	-2.5	28	225	17	5.65	5.15	180
48.1	27.7	20.4	-2.5	28	225	18	5.67	5.17	200
48.9	28.6	20.3	-2.3	28	220	18	5.69	5.19	220
48.9	28.5	20.4	-2.3	28	220	148	5.70	5.29	240
Difference in final and21.1 initial powerconsumption							5.70-5.36 = 0.34	5.29-4.80 =0.49	

COP = Heat Consumed by Evaporator/Power consumed by Co mpressor

= (5.29-4.80) / (5.70-5.36)

= 0.49 / 0.34 = 1.441

Table No. 6

Atmospheric Temperature =24°C				Nanoparticle Weight CuO (0.4 gm +RefrigerantR134a (100 gm)					
T1 (ºC)	T2 (ºC)	Condenser Temperature Drop(T1-T2)	T3 (ºC)	T4 (ºC)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumedby Evaporator	Time (min)
47.2	28.1	19.1	-1.4	30	210	11	5.82	5.24	00
47.4	28.2	19.2	-2.0	30	210	13	5.84	5.25	20
47.7	28.6	19.1	-2.1	30	215	13	5.85	5.35	40
47.9	28.7	19.2	-2.0	30	215	13	5.91	5.37	60
47.8	28.5	19.3	-2.0	30	215	14	5.94	5.38	80
47.7	28.3	19.4	-2.2	30	220	14	5.95	5.44	100
47.8	28.2	16.6	-2.3	30	220	15	5.97	5.47	120
47.8	28.3	19.5	-2.4	30	225	15	6.02	5.53	140
47.9	28.3	19.6	-2.2	30	225	17	6.06	5.57	160
48.0	28.3	19.7	-2.1	30	231	17	6.07	5.59	180
48.1	28.3	19.8	-2.2	30	228	15	6.12	5.64	200
47.9	28.0	19.9	-2.3	30	227	12	6.14	5.66	220
47.9	28.1	19.8	-2.2	30	228	11	6.16	5.69	240
Difference in final and initial power consumption							6.16-5.82 = 0.34	5.69-5.24 =0.45	

COP = Heat Consumed by Evaporator/Power consumed by Co mpressor

= (5.69-5.24) / (6.16-5.82)

= 0.45 / 0.34 = 1.323

Table No 7

Atmospheric Temperature = 24.5 °C			Nanoparticle Weight (0.6 gm) + Refrigerant R134a (100gm)						
T1 (°C)	T2 (°C)	Condenser TemperatureDrop (T1-T2)	T3 (°C)	T4 (°C)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumedby Evaporator	Time (min)
45.8	26.0	19.8	-1.2	20	210	20	6.35	5.66	00
46.1	26.2	19.9	- 1.4	20	215	11	6.36	5.72	20
46.2	26.5	19.7	- 2.1	20	210	13	6.38	5.75	40
46.0	27.9	18.1	- 2.2	20	215	11	6.42	5.77	60
48.1	28.9	19.8	- 2.1	20	216	13	6.45	5.78	80
48.6	28.1	20.5	- 2.3	20	220	15	6.47	5.83	100
48.9	29.0	19.9	- 2.4	20	220	15	6.48	5.85	120
49.1	29.0	20.1	- 2.5	20	225	17	6.54	5.88	140
49.9	29.2	20.7	- 2.6	20	225	17	6.56	5.92	160
49.8	29.0	20.8	- 2.2	20	230	18	6.57	5.94	180
48.0	29.3	18.7	- 2.3	20	230	15	6.63	5.97	200
47.1	29.2	17.9	- 2.5	20	235	18	6.65	5.98	220
46.9	29.1	17.8	- 2.	20	235	17	6.69	6.05	240
Difference in fina17.9l and initial power consumption18.7							6.69-6.35 = 0.34	6.05-5.66 =0.39	

COP = Heat Consumed by Evaporator/Power consumed by Co mpressor

= (6.05-5.66) / (6.69-6.35)

= 0.39 / 0.34 = 1.1470

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Table No. 8

Atmospheric Temperature = 25 °C				Nanoparticle Weight (0.6 gm) +RefrigerantR134a(100 gm)					
T1 (ºC)	T2 (ºC)	Condenser Temperature Drop(T1- T2)	T3 (ºC)	T4 (ºC)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumedby Evaporator	Time (min)
45.5	25.1	20.4	-1.0	28	200	11	6.79	6.03	00
45.8	25.5	20.3	-1.3	28	205	11	6.85	6.04	20
46.0	25.5	20.5	-1.5	28	210	13	6.87	6.13	40
46.1	27.5	18.6	-1.7	28	210	13	6.89	6.15	60
46.2	27.4	18.8	-1.9	28	210	13	6.90	6.18	80
46.2	27.5	18.7	-2.0	28	215	14	6.95	6.24	100
46.3	27.5	18.8	-2.1	28	220	14	6.99	6.27	120
48.6	29.7	18.9	-2.3	28	220	15	7.01	6.29	140
48.7	29.8	18.9	-2.4	28	220	15	7.02	6.33	160
48.5	29.5	19.0	-2.6	28	220	16	7.05	6.35	180
48.6	29.4	19.2	-2.7	28	215	16	7.08	6.39	200
48.8	29.7	19.1	-2.8	28	215	18	7.11	6.46	220
48.9	29.7	19.2	-2.9	28	220	18	7.13	6.48	240
Difference in final and initial power consumption							7.13-6.79 = 0.34 kw	6.48-6.03 =0.45 kw	

COP = Heat Consumed by Evaporator/Power consumed by Co mpressor

= (6.48-6.02) / (7.13-6.79)

= 0.45 / 0.34 = 1.323

Table No. 9

Atmospheric Temperature = 25.5 °C			Nanoparticle Weight (0.6 gm) + Refrigerant R134a(100gm)						
T1 (ºC)	T2 (ºC)	Condenser Temperature Drop(T1-T2)	T3 (ºC)	T4 (ºC)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumedby Evaporator	Time (min)
46.3	25.5	20.8	-0.8	30	200	15	7.26	6.45	00
46.6	25.7	20.7	-1.1	30	205	15	7.27	6.50	20
46.8	25.8	21.0	-1.3	30	205	13	7.33	6.54	40
47.1	26.2	20.9	-1.5	30	210	13	7.37	6.58	60
47.4	26.4	21.0	-1.5	30	215	11	7.39	6.62	80
47.5	26.4	21.1	-1.6	30	215	11	7.42	6.66	100
47.7	26.5	21.2	-1.7	30	220	15	7.45	6.70	120
47.6	26.2	21.4	-1.8	30	220	14	7.48	6.74	140
48.2	26.9	21.3	-2.1	30	225	17	7.51	6.78	160
48.1	26.7	21.4	-2.2	30	230	16	7.53	6.81	180
48.6	27.1	21.5	-2.4	30	235	17	7.54	6.85	200
48.5	26.9	21.6	-2.3	30	230	16	7.57	6.89	220
48.3	26.7	21.6	-2.4	30	220	16	7.60	6.92	240
Difference in final and initial power consumption							7.60-7.26 = 0.34	6.92-6.44 =0.48	

COP = Heat Consumed by Evaporator/Power consumed by Co mpressor

= (6.92-6.44) / (7.60-7.26)

= 0.48 / 0.36= 1.411

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Table No.10

Atmospheric Temperature =20°C			Nanoparticle Weight (0.8 gm) + Refrigerant R134a (100gm)						
T1 (ºC)	T2 (ºC)	Condenser Temperature Drop(T1-T2)	T3 (ºC)	T4 (ºC)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumedby Evaporator	Time (min)
46.3	27.1	19.2	-1.7	20	221	12	7.73	6.91	00
46.8	27.5	19.3	-1.9	20	223	13	7.76	6.94	20
46.3	27.8	18.5	-2.1	20	225	14	7.79	6.97	40
47.5	26.1	21.4	-2.4	20	227	14	7.82	7.01	60
47.9	25.3	22.6	-2.5	20	229	17	7.85	7.05	80
48.0	23.8	24.2	-2.6	20	229	16	7.88	7.09	100
48.1	24.8	23.3	-2.6	20	230	15	7.91	7.15	120
48.4	25.0	23.4	-2.7	20	235	11	7.94	7.17	140
48.2	25.4	22.6	-2.8	20	238	14	7.97	7.19	160
49.0	26.4	22.8	-2.9	20	239	15	8.00	7.21	180
49.8	28.1	21.7	-2.5	20	240	13	8.03	7.22	200
49.7	28.1	21.6	-2.3	20	242	14	8.06	7.24	220
49.6	28.8	20.8	-2.2	20	244	14	8.07	7.28	240
Difference in final and initial power consumption							8.07-7.73 = 0.34	7.28-6.91 =0.37	

COP = Heat Consumed by Evaporator/Power consumed by Co mpressor

= (7.28-6.91) / (8.07-7.73)

= 0.37 / 0.34= 1.088

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Table No. 11

Atmospheric Temperature = 25 °C			Nanoparticle Weight (0.8 gm) + Refrigerant R134a (100gm)						
T1 (ºC)	T2 (ºC)	Condenser Temperature Drop(T1-T2)	T3 (ºC)	T4 (ºC)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumedby Evaporator	Time (min)
45.0	22.7	22.3	-1.1	28	190	9	8.18	7.28	00
45.6	25.2	20.4	-1.4	28	200	12	8.20	7.31	20
48.9	25.6	23.3	-1.5	28	210	15	8.21	7.35	40
49.1	21.6	27.5	-1.7	28	212	17	8.22	7.42	60
49.2	22.6	26.6	-1.8	28	216	18	8.34	7.46	80
48.4	22.8	25.6	-1.8	28	216	16	8.32	7.48	100
48.6	23.1	25.5	-1.9	28	215	14	8.35	7.51	120
46.7	24.0	22.7	-1.8	28	220	13	8.33	7.53	140
46.9	24.1	22.8	-1.9	28	225	10	8.40	7.58	160
48.8	27.0	21.8	-1.7	28	225	12	8.42	7.64	180
49.0	27.1	21.9	-1.4	28	230	17	8.44	7.68	200
47.1	28.1	19.0	-1.5	28	235	15	8.50	7.72	220
48.3	25.3	23.0	-1.7	28	220	12	8.52	7.77	240
Difference in final and initial power consumption							8.52-8.18 = 0.34 kw	7.77-7.28 =0.49 kw	

COP = Heat Consumed by Evaporator/Power consumed by Co mpressor

= (7.77-7.28) / (8.52-8.18)

= 0.49 / 0.34 = 1.441

Table No. 12

Atmospheric Temperature = 30 °C			Nanoparticle Weight CuO (0.8 gm) +RefrigerantR134a(100gm)						
T1 (ºC)	T2 (ºC)	Condenser Temperature Drop(T1-T2)	T3 (ºC)	T4 (ºC)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumedby Evaporator	Time (min)
45.4	20.8	24.6	-0.6	30	212	09	8.66	7.75	00
45.8	20.3	25.5	-1.0	30	220	13	8.59	7.77	20
45.9	21.2	24.7	-1.1	30	220	12	8.62	7.82	40
46.2	21.2	25.0	-1.2	30	225	12	8.65	7.84	60
46.4	22.7	23.7	-1.4	30	230	14	8.68	7.91	80
48.5	22.7	25.8	-1.5	30	235	14	8.71	7.93	100
48.7	22.8	25.9	-1.8	30	235	16	8.74	7.95	120
48.8	23.8	25.0	-1.9	30	235	16	8.77	8.10	140
49.0	23.9	25.1	-2.1	30	235	18	8.80	8.13	160
49.2	23.9	25.3	-2.3	30	240	18	8.83	8.16	180
49.3	25.9	23.4	-2.4	30	240	15	8.76	8.17	200
49.1	25.8	23.3	-2.7	30	235	15	8.89	8.18	220
49.0	25.6	23.4	-2.8	30	235	18	9.00	8.20	240
							9.00-8.66 = 0.34	8.20-7.75 =0.45	

COP = Heat Consumed by Evaporator/Power consumed by Co mpressor

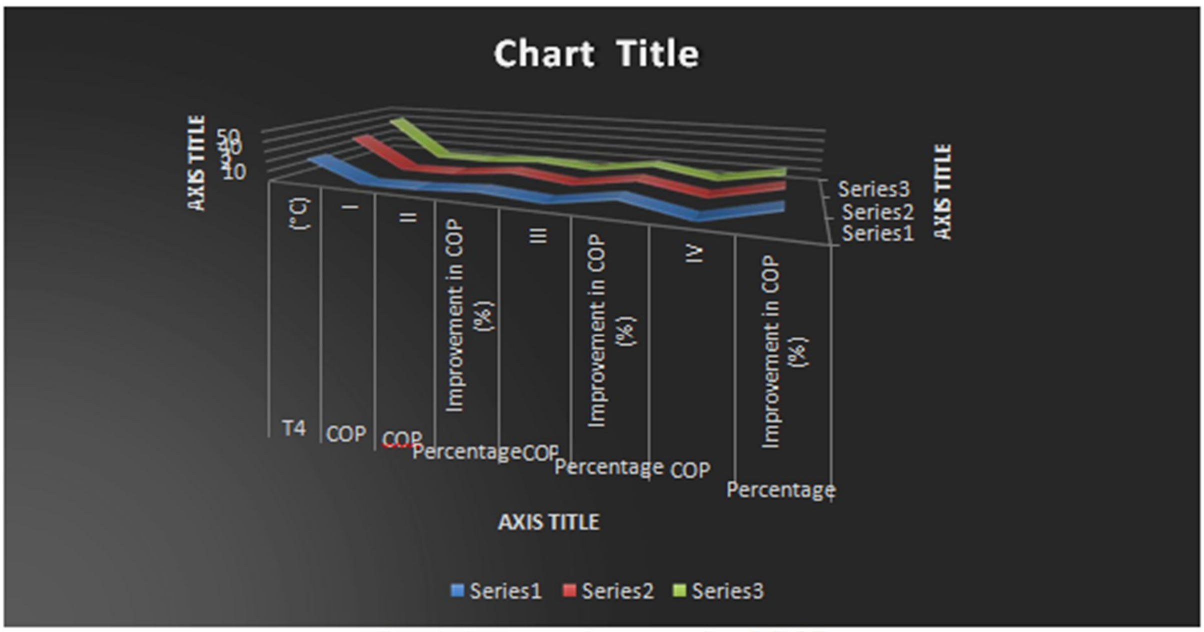
= (8.20-7.75) / (9.00-8.66)

= 0.48 / 0.34 = 1.417

Following the execution of the experimental investigation and the collection of the data, wewill now compare the outcomes using graphs and tables:

Table 13 : Comparison of COP in Various Temoerature							
T4 (°C)	COP I	COP II	Percentage Improvementin COP (%)	COP III	Percentage Improvementin COP (%)	COP IV	Percentage Improvementin COP (%)
20	0.0188	1.352	5.2	1.1470	11.5	0.088	16.3
25	0.0158	1.441	8.0	1.323	11.3	1.441	16.2
30	1.382	1.323	5.5	1.411	11.0	1.417	13.4

Where
T4 = Temperature Maintained at Evaporator Section (°C)COP I = COP when R134a (100 gm) is inserted
COP II = COP when R134a (100 gm) + 0.4gm CuO inserted COP III = COP when R134a (100 gm) + 0.6 gm CuO insertedCOP IV = COP when R134a (100 gm) + 0.8 gm CuO inserted



Graph 1: comparison graph of COP

III. CONCLUSION

Another VCRS arrangement was used in this trial study, and despite having exceptional details regarding its blower type, evaporator shape, size, length of copper tubes used in it, measurement of copper tubes, type of condenser, number of turns in it, length of cylinder and limit of that particular condenser, and type of extension valve used, it was still evident that the results were also exceptional. My primary responsibility was to set up VCRS as flawlessly as possible in order to complete the postulation and the attempt to make it a success, which I accomplished with extraordinary sincerity and care. When everything was complete, the test was launched by first integrating the COP and R134a refrigerant into the framework. The process by which we obtained the results is very clearly explained in sections 4 and 5. The framework was developed by using the energy usage tests. When nanorefrigerants were used in the VCRS framework, a similar approach was used, and finally the results were examined. The theory's declaration of results and its commitments are condensed after focusing on:

1) When nanorefrigerants were included in the VCRS experimental setup instead of merely R134a refrigerants, COP was increased.
2) Using 0.4 gram CuO nanoparticles resulted in an abrupt increase in COP as compared to using 0.6 gram and 0.8 gram, which had a reasonable multiplication rate.

3) A precise improvement of 11.1 percent was noticed when nanorefrigerant was used. R134a was combined with 0.4 gram of TiO2 at evaporator temperatures of 20, 25, and30 degrees Celsius.

Utilizing nanorefrigerants caused the condenser temperature decrease to increase, and nanoparticle fixation caused it to continue increasing. The refrigerant R134a was encapsulatedin a 0.8 gram nanoparticle to provide the best results.

IV. FUTURE SCOPES

In the near future, nanotechnology will play a major role in the refrigeration industry. As a result, there are many nanorefrigerants, nanolubricants, and maybe even new nano-based innovations. Using nanotechnology, some future work in the refrigeration industry should stillbe possible:

1) By combining unique nanoparticles with various combinations of refrigerants and theirmixtures, new types of nanorefrigerants may be made.
2) The applicability of nanoparticles should be specifically examined for use with eco-friendlyrefrigerants that have lower potential for ozone depletion and global warming.
3) Very little research has been done to yet about the differences in properties whennanoparticles are used with any key refrigerant, therefore it's a need a thorough explanation.

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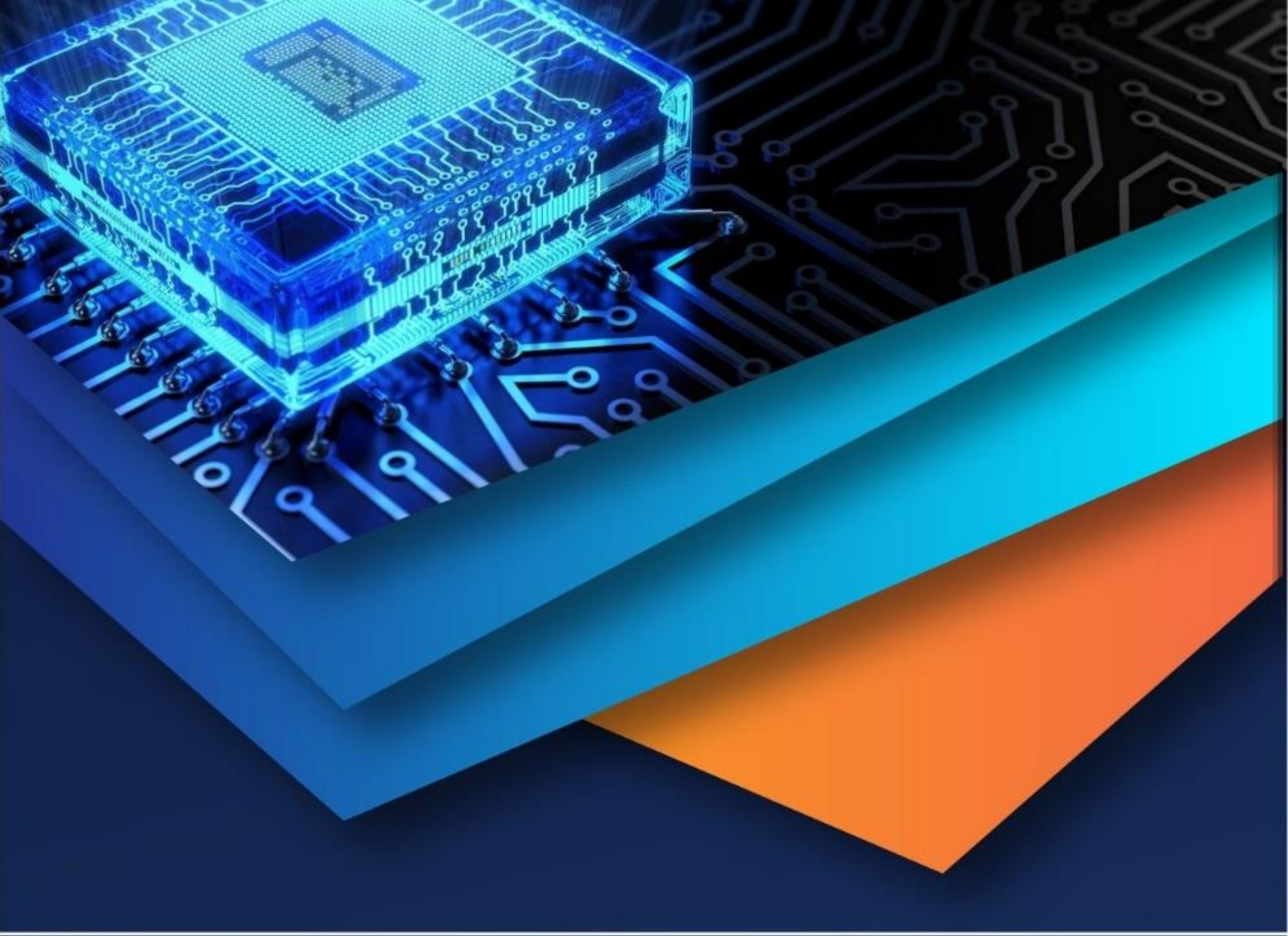

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