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Comparison Study Analysis of Vapour Compression Refrigeration System by using Refrigerant R134 a and Mixed Nano-Particle Refrigerant

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Abstract: Vapour compression refrigeration system (VCRS) fundamentally is the gadget which retains heat from a lower internal heat level and rejects it to the body or climate at higher temperature at the cost of some outside work done on it. It is broadly utilized wherever going from business use in homes and shops to enormous scope and substantial cooling loads in enterprises. They differ in size also, limit according to their cooling prerequisites. To accomplish high cooling loads with lesser energy or force utilization by the blower and work with elite It has continuously been the space of interest for plenty of analysts working in warm designing field. With the coming of nano innovation in each science and innovation field, the field of Refrigeration is likewise now not left immaculate of it. Its been seen that a portion of the metals and its compounds have high warmth dispersal limit, this framed the premise of its utilization in refrigeration.

Large numbers of the nano size metal mixtures have been tried with a considerable lot of the refrigerants and ideal fixations have been found to guarantee the improved Coefficient of execution of the VCRS.

In this work likewise a special mix is taken and study is to be performed on VCRS. Here the blending of nanoparticles of metal CuO of size 30-50 nm is finished with refrigerant R134a and the endeavor of discovering the ideal fixations is to be finished.

Keyword: Evaporator, Compressor, Condenser, Capillary tube, Cooling Fan.

I. INTRODUCTION

Refrigeration is a general term. It describes the process of eliminating heat from spaces, objects, or materials and maintaining them at a temperature below that of the nearby atmosphere[1]. To make a refrigeration impact, the material to be cooled needs just to be presented to a chilly climate. The warmth will move its regular way that is, from the hotter material to the colder material. That is refrigeration is a counterfeit method of bringing down the temperature[2]. Mechanical refrigeration is the interaction of move heat from one substance to another by utilizing mechanical framework or contraption A refrigeration framework is consisting of various actual segments that make the aggregate refrigeration unit. The various stages in the refrigeration cycle are going through in this actual framework[3]. These frameworks comprise of an evaporator, condenser, blower & expansion valve. The evaporator should be cooled by the refrigerant; the blower packs the refrigerant at the low pressing factor in the evaporator to the pressing factor at the condenser[4]. The warmth acquired by the refrigerant is dismissed in the condenser and refrigerant at high pressing factor is ventured into the low pressing factor by the extension valve[5]. This is a very common picture of the different units in a refrigeration framework. The refrigeration frameworks wander as per the reason and the sort of refrigerant utilized. They are the methods by which we can really do the refrigeration interaction[6]. An unrivaled attention to them is accordingly, fundamental. Refrigeration has largely affected industry, way of life, horticulture and settlement designs. However, refrigeration has rapidly grown somewhat recently from ice collecting to temperature-controlled rail vehicles[7].

A. Type of Refrigeration

There are so many refrigeration methods are available.
Some of those are following.

1) Air refrigeration.
2) Laser cooling/Refrigeration.
3) Solar refrigeration.
4) Vapor Absorption refrigeration.
5) Vapor Compression refrigeration.
6) Magnetic Refrigeration.

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A simple vapor compression refrigeration system comprises of the following equipment

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

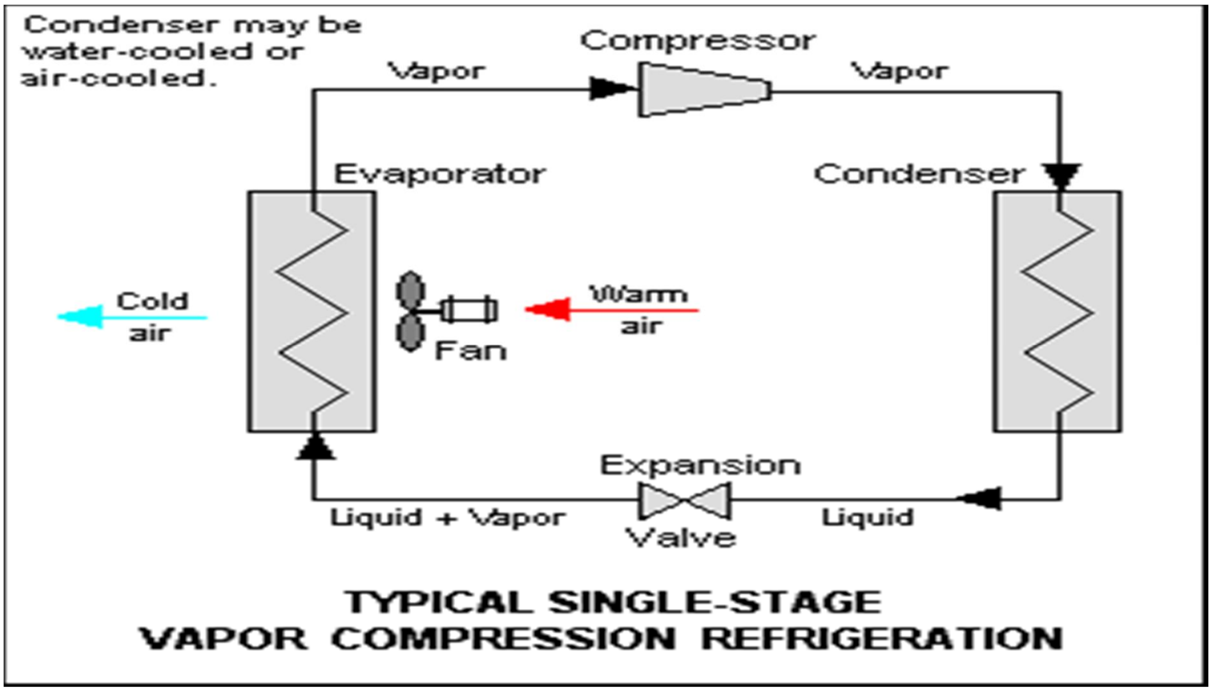

Figure 1 : Simple Vapour Compression System

B. Application of VCRS

There are many applications of VCRS in present globe development, some of them are as.

1) Ice Manufacture
2) Food preservation
3) Commercial Applications
4) Industrial Applications.
5) Industrial Drying Systems
6) Transport Air-Conditioning
7) Special Applications
8) Commercial Establishments
9) Green House Effect and Future Refrigerants

Components of Setup list of component

a) Evaporator
b) Compressor
c) Condenser
d) Capillary tube
e) Cooling Fan
f) Thermocouple
g) Pump
h) Voltmeter
i) Ammeter
j) Pressure Gauge

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- *Compressor* - The low pressing factor and temperature fume refrigerant from evaporator is move into the blower by the assistance of channel or pull valve A, where it is packed to a high pressing factor and temperature[8]. This high pressing factor and temperature fume refrigerant is released into the condenser through the convey or release valve B.
- *Condenser* - The condenser or cooler comprise of curl of line in which the high pressing factor and temperature fume refrigerant exchange it warm and get cooled furthermore, get consolidated. The refrigerant, while going through the condenser, Deliver its inert warmth to the encompassing medium which is ordinarily air or water[9].
- *Receiver*- The collector is a vessel where consolidated fluid refrigerant is put away from where it is provided to the evaporator by the assistance of development valve or control valve[10].
- *Expansion valve* - It is additionally called choke valve or refrigerant control valve. The motivation behind the development valve is to permit the fluid refrigerant under high pressing factor and temperature pass at a controlled rate in the wake of lessening its pressing factor and temperature. A little amount of fluid refrigerant when goes through the extension valve get vanishes, yet the more prominent bit is disintegrated in the evaporator[11].
- *Evaporator*- An evaporator comprises of loop of line in which the fluid – fume refrigerant is dissipated and changed over into fume refrigerant at low pressing factor also, temperature. In dissipating, the refrigerant assimilates its idle warmth of vaporization from the medium (air, water or saline solution) which is to be cooled [12].
- *Evaporator*-An evaporator is made of fiber body cool cage fitted with drain valve. A copper coil is bend in helical shape and fitted in the cool cage by drilling hole in the body. Copper coil carry cooling medium (refrigerant) in the evaporator for heat transfer purpose.

✓ Size (L*B*H) (In MM) 354*220*260
✓ Capacity of evaporator 12 liter
✓ Body material Fiber
✓ Cooling coil length (in mm)
✓ MOC of cooling coil copper
✓ Size/length of cooling coil 5/8” & 26 feet

Fig.2 : Evaporator

- *Compressor*

The low temperature and pressure vapour refrigerant from evaporator is drawn into the compressor through the suction valve, 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

Fig.3 : Compressor

- *Condenser*- The Condenser consists of coils of pipe in which the high pressure and temperature vapour refrigerant is cooled and condensed. The refrigerant gives up its latent heat while passing through the condenser to the surrounding condensing medium. A conventional spiral condenser is used in the experiment.

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

Fig. 4: Condenser

- *Capillary Tube*- Capillary tube is one of the most commonly used throttling devices in the refrigeration and the air conditioning systems. The capillary tube is a copper tube of very little internal diameter and of very long length and it is coiled to several turns so that it would occupy less space. Capillary tube is also used as the throttling device in the domestic refrigerators, deep freezers, water coolers and air conditioners.

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

Fig.5 : Capillary tube

- *Formula to be used*

To find the COP in this experiment, energy tests were performed to calculate COP bymeasuring the power consumed by heater to power consumed by compressor.

COP = <u>kWh of power consumed by heater</u> kwh of power consumed by compressor

System after Construction and Basic cycle of VCRS

Fig. 6: (VCRS Experimental setup)

The formula above will be used for comparing the results obtained firstly, by testing only with R134a and then testing with nanorefrigerants i.e. R134a+CuO.

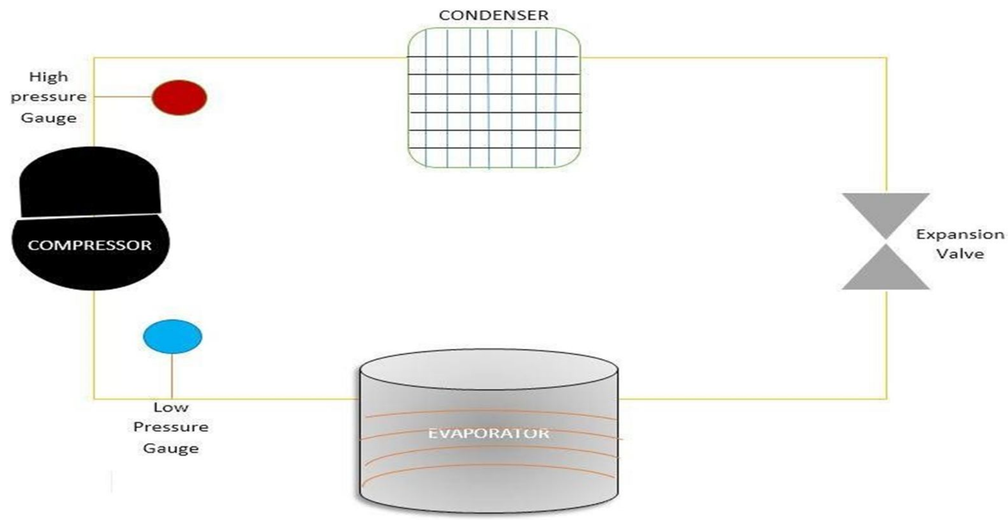

Fig.7:VCRS

II. RESULTS & DISCUSSION

A. Results Procured After Performing Experiment

After constructing and performing the experiment on the experimental setup of VCRSwe procure the results as follows:

Atmospheric Temperature = 20.5°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)
45.9	28.1	17.8	-2.0	20	210	14	3.70	3.35	00
46.1	28.2	17.9	-2.5	20	215	12	3.73	3.38	15
46.3	28.7	17.6	-2.7	20	215	12	3.76	3.41	30
46.9	28.9	18.0	-2.8	20	225	10	3.79	3.44	45
47.5	29.4	18.1	-2.9	20	230	12	3.82	3.46	60
46.8	29.0	17.8	-3.7	20	225	10	3.85	3.48	75
47.3	29.8	17.5	-2.5	20	230	10	3.88	3.51	90
48.6	31.2	17.4	-3.8	20	225	10	3.91	3.53	105
47.7	30.1	17.6	-3.3	20	230	14	3.94	3.55	120
47.1	29.5	17.6	-2.6	20	220	10	3.97	3.57	135
48.1	30.1	18.0	-3.1	20	230	08	4.00	3.60	150
47.6	29.7	17.9	-2.8	20	230	12	4.03	3.63	165
47.9	29.9	18.0	-2.9	20	230	12	4.06	3.65	180
Difference in final and initial power consumption							4.06-3.70 = 0.36	3.65-3.35 = 0.30	

Table 1

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (3.65-3.35) / (4.06-3.70) = 0.30 / 0.36 = 0.833

T1- Condenser Inlet Temp.

T2- Condenser Outlet Temp

T3-Evaporator inlet temp

T4-Compressor inlet temp

Atmospheric Temperature = 20.5°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)
48.1	30.5	17.6	-2.3	25	215	12	4.13	3.65	00
47.9	30.2	17.7	-2.2	25	225	10	4.16	3.68	15
47.8	29.9	17.9	-2.2	25	230	12	4.19	3.71	30
47.4	29.4	18.0	-2.6	25	230	10	4.22	3.74	45
47.1	29.0	17.9	-2.9	25	225	10	4.25	3.78	60
46.9	28.8	18.1	-3.3	25	225	10	4.28	3.82	75
48.4	30.4	18.0	-2.8	25	230	10	4.31	3.86	90
46.7	28.9	17.8	-3.5	25	225	10	4.34	3.90	105
47.7	29.8	17.9	-2.3	25	230	14	4.37	3.93	120
47.1	29.0	18.1	-2.1	25	220	10	4.40	3.96	135
47.4	29.3	18.1	-2.4	25	230	8	4.43	3.99	150
47.9	29.7	18.2	-2.3	25	230	12	4.46	4.02	165
48.0	29.7	18.3	-2.4	25	230	12	4.49	4.05	180
Difference in final and initial power consumption							4.49-4.13 = 0.36	4.05-3.65= 0.40	

Table 2

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (4.05-3.65) / (4.49-4.13)

= 0.40 / 0.36 = 1.111

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 consumed by Evaporator	Time (min)
46.0	28.0	18.0	0.9	30	195	18	4.61	4.05	00
47.5	29.6	17.9	0.6	30	200	20	4.64	4.08	15
48.2	30.2	18.0	0.2	30	210	20	4.67	4.11	30
47.4	29.3	18.1	-0.9	30	210	18	4.70	4.15	45
47.9	29.7	18.2	-1.1	30	210	18	4.73	4.19	60
47.4	29.2	18.2	-1.6	30	215	16	4.76	4.23	75
47.5	29.4	18.1	-2.1	30	215	17	4.79	4.27	90
47.7	29.4	18.3	-2.5	30	215	16	4.82	4.31	105
47.6	29.2	18.4	-2.4	30	210	18	4.85	4.35	120
47.5	28.9	18.6	-2.4	30	215	16	4.88	4.38	135
47.6	29.2	18.4	-2.2	30	215	18	4.91	4.41	150
47.5	29.0	18.5	-2.3	30	215	18	4.94	4.45	165
47.6	29.1	18.5	-2.3	30	215	17	4.97	4.48	180
Difference in final and initial power consumption							4.97-4.61 = 0.36	4.48-4.05 =0.43	

Table 3

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (4.48-4.05) / (4.97-4.61)

= 0.43 / 0.36 = 1.194

Atmospheric Temperature = 22°C					Nanoparticle Weight CuO (0.2 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 consumed by Evaporator	Time (min)
48.2	29.6	18.6	-1.9	20	240	16	5.00	4.48	00
47.7	29.2	18.5	-2.4	20	240	14	5.03	4.51	15
47.9	29.5	18.4	-1.7	20	230	14	5.06	4.53	30
48.1	29.6	18.5	-1.8	20	230	16	5.09	4.55	45
48.2	29.5	18.7	-2.0	20	235	12	5.12	4.58	60
47.7	28.9	18.8	-2.1	20	235	14	5.15	4.61	75
48.3	29.7	18.6	-2.1	20	235	14	5.18	4.64	90
48.2	29.6	18.6	-2.2	20	235	14	5.21	4.66	105
47.5	28.6	18.9	-2.0	20	230	12	5.24	4.68	120
47.6	28.8	18.8	-2.1	20	230	12	5.27	4.71	135
47.9	28.9	19.0	-2.3	20	230	14	5.30	4.74	150
47.6	28.8	18.8	-2.1	20	225	14	5.33	4.77	165
47.7	28.8	18.9	-2.2	20	230	14	5.36	4.80	180
Difference in final and initial power consumption							5.36-5.00 = 0.36	4.80-4.48 =0.32	

Table 4

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (4.80-4.48) / (5.36-5.00)

= 0.32 / 0.36 = 0.888

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Atmospheric Temperature = 23°C				Nanoparticle Weight CuO (0.2 gm) + RefrigerantR134a(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)
47.2	28.4	18.8	-2.1	25	210	10	5.36	4.80	00
47.4	28.7	18.7	-1.9	25	215	12	5.39	4.84	15
47.7	28.8	18.9	-2.2	25	220	14	5.42	4.88	30
47.9	28.8	19.1	-2.3	25	225	14	5.45	4.92	45
47.8	28.6	19.2	-2.2	25	220	14	5.48	4.96	60
47.7	28.7	19.0	-2.1	25	215	12	5.51	4.99	75
47.8	28.7	19.1	-2.1	25	220	14	5.54	5.02	90
47.8	28.6	19.2	-2.1	25	220	14	5.57	5.05	105
47.9	28.6	19.3	-2.2	25	220	12	5.60	5.08	120
48.0	28.8	19.2	-2.4	25	225	14	5.63	5.12	135
48.1	28.7	19.4	-2.4	25	225	16	5.66	5.16	150
47.9	28.6	19.3	-2.2	25	220	14	5.69	5.19	165
47.9	28.5	19.4	-2.2	25	220	14	5.72	5.23	180
Difference in final and initial power consumption							5.72-5.36 = 0.36	5.23-4.80 =0.43	

Table 5

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (5.23-4.80) / (5.72-5.36)

= 0.43 / 0.36 = 1.194

Atmospheric Temperature = 23°C				Nanoparticle Weight CuO (0.2 gm + 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 consumed by Evaporator	Time (min)
47.2	28.1	19.1	-1.4	30	220	16	5.81	5.23	00
47.4	28.2	19.2	-1.5	30	225	16	5.84	5.27	15
47.7	28.6	19.1	-1.6	30	225	16	5.87	5.31	30
47.9	28.7	19.2	-1.7	30	225	16	5.90	5.35	45
47.8	28.5	19.3	-2.1	30	220	14	5.93	5.39	60
47.7	28.3	19.4	-2.1	30	220	14	5.96	5.43	75
47.8	28.2	19.6	-2.0	30	220	16	5.99	5.46	90
47.8	28.3	19.5	-2.2	30	220	14	6.02	5.50	105
47.9	28.3	19.6	-2.4	30	215	14	6.05	5.54	120
48.0	28.3	19.7	-2.5	30	215	12	6.08	5.58	135
48.1	28.3	19.8	-2.4	30	215	12	6.11	5.62	150
47.9	28.0	19.9	-2.3	30	215	14	6.14	5.65	165
47.9	28.0	19.9	-2.1	30	220	14	6.17	5.68	180
Difference in final and initial power consumption							6.17-5.81 = 0.36	5.68-5.23 =0.45	

Table 6

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (5.68-5.23) / (6.17-5.81)

= 0.45 / 0.36 = 1.250

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T1 (ºC)	T2 (ºC)	Condenser Temperature Drop(T1-T2)	T3 (ºC)	T4 (ºC)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumed by Evaporator	Time (min)
46.8	27.0	19.8	-1.4	20	215	10	6.31	5.68	00
47.1	27.2	19.9	-2.0	20	220	12	6.34	5.71	15
47.2	27.5	19.7	-2.1	20	220	12	6.37	5.74	30
47.0	26.9	20.1	-2.0	20	220	12	6.40	5.77	45
47.1	26.9	20.2	-2.0	20	220	12	6.43	5.79	60
47.6	27.1	20.5	-2.2	20	225	14	6.46	5.81	75
47.9	28.0	19.9	-2.3	20	225	14	6.49	5.84	90
48.1	28.0	20.1	-2.4	20	230	16	6.52	5.87	105
47.9	28.2	19.7	-2.2	20	230	16	6.55	5.90	120
47.8	28.0	19.8	-2.1	20	230	16	6.58	5.93	135
48.0	28.3	19.7	-2.2	20	225	14	6.61	5.96	150
48.1	28.2	19.9	-2.3	20	225	12	6.64	5.99	165
47.9	28.1	19.8	-2.2	20	220	12	6.67	6.02	180
Difference in final and initial power consumption							6.67-6.31 = 0.36	6.02-5.68 =0.34	

Table 7

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (6.02-5.68) / (6.67-6.31)

= 0.34 / 0.36 = 0.944

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T1 (ºC)	T2 (ºC)	Condenser Temperature Drop(T1-T2)	T3 (ºC)	T4 (ºC)	P1 (psi)	P2 (psi)	Power consumed by Compressor	Power consumed by Evaporator	Time (min)
46.5	26.1	20.4	-1.3	25	200	10	6.79	6.02	00
46.8	26.5	20.3	-1.5	25	205	10	6.82	6.06	15
47.0	26.5	20.5	-1.7	25	210	12	6.85	6.10	30
47.1	26.5	20.6	-1.8	25	210	12	6.88	6.14	45
47.2	26.4	20.8	-1.8	25	210	12	6.91	6.17	60
47.2	26.5	20.7	-1.9	25	215	12	6.94	6.20	75
47.3	26.5	20.8	-2.0	25	220	12	6.97	6.23	90
47.6	26.7	20.9	-2.2	25	220	14	7.00	6.27	105
47.7	26.8	20.9	-2.5	25	220	14	7.03	6.31	120
47.5	26.5	21.0	-2.3	25	220	14	7.06	6.34	135
47.6	26.4	21.2	-2.2	25	215	12	7.09	6.38	150
47.8	26.7	21.1	-2.4	25	215	14	7.12	6.42	165
47.9	26.7	21.2	-2.2	25	220	14	7.15	6.46	180
Difference in final and initial power consumption							7.15-6.79 = 0.36 kw	6.46-6.02 =0.44 kw	

Table 8

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (6.46-6.02) / (7.15-6.79)

= 0.44 / 0.36 = 1.2307

Atmospheric Temperature = 24.0 °C			Nanoparticle Weight (0.4gm) + 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 consumed by Evaporator	Time (min)
46.3	25.5	20.8	-0.9	30	205	14	7.26	6.46	00
46.6	25.7	20.9	-1.0	30	210	14	7.29	6.50	15
46.8	25.8	21.0	-1.1	30	210	12	7.32	6.54	30
47.1	26.2	20.9	-1.3	30	215	12	7.35	6.58	45
47.4	26.4	21.0	-1.4	30	220	12	7.38	6.62	60
47.5	26.4	21.1	-1.4	30	220	12	7.41	6.66	75
47.7	26.5	21.2	-1.5	30	215	14	7.44	6.70	90
47.6	26.2	21.4	-1.4	30	220	12	7.47	6.74	105
48.2	26.9	21.3	-2.0	30	230	16	7.50	6.78	120
48.1	26.7	21.4	-2.0	30	225	14	7.53	6.81	135
48.6	27.1	21.5	-2.5	30	230	16	7.56	6.85	150
48.5	26.9	21.6	-2.4	30	225	14	7.59	6.89	165
48.3	26.7	21.6	-2.2	30	225	14	7.62	6.93	180
Difference in final and initial power consumption							7.62-7.26 = 0.36	6.93-6.46 =0.47	

Table 9

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (6.93-6.46) / (7.62-7.26)

= 0.47 / 0.36 = 1.305

Atmospheric Temperature =20°C			Nanoparticle Weight (0.6 gm) + 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 consumed by Evaporator	Time (min)
47.3	26.1	21.2	-1.6	20	220	10	7.73	6.93	00
47.8	26.5	21.3	-1.8	20	225	12	7.76	6.96	15
48.3	26.8	21.5	-2.0	20	230	12	7.79	6.99	30
48.5	27.1	21.4	-2.1	20	230	10	7.82	7.02	45
48.9	27.3	21.6	-2.3	20	235	12	7.85	7.05	60
49.0	27.8	21.2	-2.3	20	235	14	7.88	7.08	75
49.1	27.8	21.3	-2.4	20	235	12	7.91	7.11	90
49.4	28.0	21.4	-2.5	20	240	12	7.94	7.14	105
49.2	27.4	21.8	-2.4	20	235	10	7.97	7.17	120
49.0	27.4	21.6	-2.2	20	230	12	8.00	7.20	135
48.8	27.1	21.7	-2.1	20	230	12	8.03	7.23	150
48.7	27.1	21.6	-2.1	20	230	12	8.06	7.26	165
48.6	26.8	21.8	-2.0	20	230	12	8.09	7.29	180
Difference in final and initial power consumption							8.09-7.73 = 0.36	7.29-6.93 =0.36	

Table 10

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (7.29-6.93) / (8.09-7.73)

= 0.36 / 0.36= 1.0

Atmospheric Temperature = 25 °C			Nanoparticle Weight (0.6 gm) + 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 consumed by Evaporator	Time (min)
46.0	23.7	22.3	-1.0	25	195	8	8.18	7.29	00
46.6	24.2	22.4	-1.2	25	210	10	8.21	7.33	15
46.9	24.6	22.3	-1.4	25	220	12	8.24	7.37	30
47.1	24.6	22.5	-1.5	25	215	14	8.27	7.41	45
47.2	24.6	22.6	-1.5	25	215	12	8.30	7.45	60
47.4	24.8	22.6	-1.6	25	215	12	8.33	7.49	75
47.6	25.1	22.5	-1.8	25	210	10	8.36	7.52	90
47.7	25.0	22.7	-1.7	25	215	10	8.39	7.55	105
47.9	25.1	22.8	-1.8	25	220	12	8.42	7.59	120
47.8	25.0	22.8	-1.5	25	220	10	8.45	7.63	135
48.0	25.1	22.9	-1.6	25	225	14	8.48	7.67	150
48.1	25.1	23.0	-1.4	25	220	12	8.51	7.71	165
48.3	25.3	23.0	-1.7	25	220	12	8.54	7.75	180
Difference in final and initial power consumption							8.54-8.18 = 0.36 kw	7.75-7.29 =0.46 kw	

Table 11

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (7.75-7.29) / (8.54-8.18)

= 0.46 / 0.36 = 1.277

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Atmospheric Temperature = 30 °C			Nanoparticle Weight CuO (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 consumed by Evaporator	Time (min)
46.4	23.8	22.6	-0.7	30	210	08	8.66	7.75	00
46.8	24.3	22.5	-1.1	30	220	12	8.69	7.79	15
46.9	24.2	22.7	-1.2	30	220	10	8.72	7.83	30
47.2	24.2	22.6	-1.4	30	225	10	8.75	7.87	45
47.4	24.7	22.7	-1.6	30	230	12	8.78	7.91	60
47.5	24.7	22.8	-1.6	30	230	12	8.81	7.95	75
47.7	24.8	22.9	-1.7	30	235	14	8.84	7.99	90
47.8	24.8	23.0	-1.8	30	235	12	8.87	8.03	105
48.0	24.9	23.1	-2.0	30	235	14	8.90	8.07	120
48.2	24.9	23.3	-2.1	30	240	10	8.93	8.11	135
48.3	24.9	23.4	-2.4	30	240	12	8.96	8.15	150
48.1	24.8	23.3	-2.3	30	235	14	8.99	8.19	165
48.0	24.6	23.4	-2.3	30	235	12	9.02	8.23	180
Difference in final and initial power consumption							9.02-8.66 = 0.36	8.23-7.75 =0.48	

Table 12

COP = Heat Consumed by Evaporator/Power consumed by Compressor

= (8.23-7.75) / (9.02-8.66)

= 0.48 / 0.36 = 1.333

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III. RESULTS COMPARISON

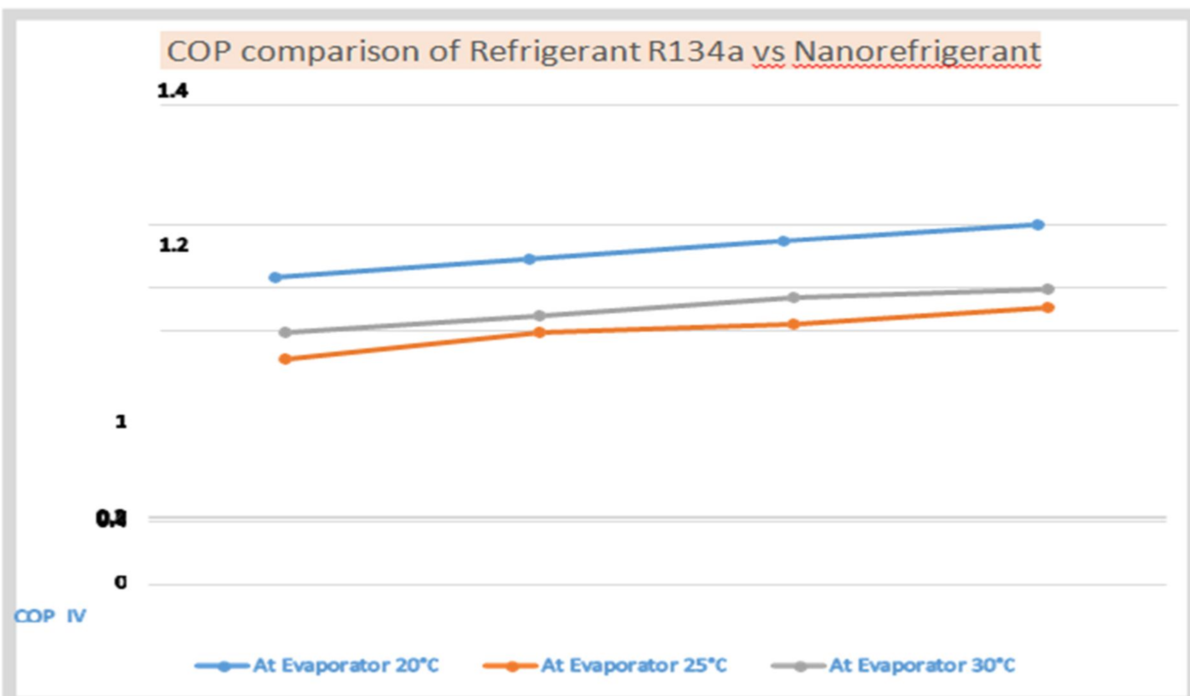
After performing the experimental study and procuring the results, now we willbe comparing the results obtained by using the means of graphs and tables:

A. Comparison of Coefficient of Performance (COP)

T4 (°C)	COP I	COP II	Percentage Improvement in COP (%)	COP III	Percentage Improvement in COP (%)	COP IV	Percentage Improvementin COP (%)
20	0.833	0.888	5.5	0.944	11.1	1.0	16.7
25	1.111	1.194	8.3	1.222	11.1	1.277	16.6
30	1.194	1.250	5.6	1.305	11.1	1.333	13.9

Table 13- Comparison of Coefficient of Performance (COP)

Where,
T4 = Temperature Maintained at Evaporator Section (°C)COP I = COP when R134a (100 gm) is inserted
COP II = COP when R134a (100 gm) + 0.2 gm CuO inserted COP III = COP when R134a (100 gm) + 0.4 gm CuO insertedCOP IV = COP when R134a (100 gm) + 0.6 gm CuO inserted



Graph 1: comparison graph of COP

IV. CONCLUSION

In this trial study, another VCRS arrangement with exceptional particulars all things considered its blowertype; evaporator shape, size, length of copper tubes utilized in it; measurement of copper tubes; sort of condenser, number of turns in it, length of cylinder and limit of that specific condenser; sort of extension valve utilized was created and accordingly it was nevertheless clear that outcomes which was obtained were likewise remarkable. To finish the postulation and the bid to make it a triumph, my key job was initially to make VCRS set up with however much flawlessness as could be expected which I did with incredible genuineness and care.

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After the arrangement was ready, the examination was begun by initially embeddings the R134a refrigerant into the framework and COP of the framework was determined by utilizing the energy utilization tests, the way by which we acquired the outcomes is quite well clarified in section 4 and part 5. The comparable technique was utilized when nanorefrigerants were utilized in the VCRS framework and afterward at last the outcomes were looked at. The theory work's outcomes proclamation and its commitments is closed in after focuses:

1) COP was expanded when nanorefrigerants were utilized in the VCRS trial arrangement when contrasted with that of just R134a refrigerants.
2) Sudden COP improvement was seen when 0.2 gram CuO nanoparticles was utilized when contrasted with when 0.4 gram and 0.6 gram was embedded in which multiplication rate was not unreasonably much.
3) Exactly, 11.1% improvement was seen when nanorefrigerant combination of 0.4 gram TiO_2 was utilized with R134a at evaporator temperatures of 20°C, 25°C furthermore, 30°C.

Condenser temperature drop was expanded when nanorefrigerants were utilized and it continued expanding when nanoparticle fixation was expanded. It was seen greatest when 0.6 gram nanoparticle was embedded with refrigerant R134a.

V. FUTURE SCOPES

Nanotechnology is the future in the field of refrigeration in the impending period and subsequently there is a lot of extent of nanorefrigerants, nanolubricants and may be any new nano based innovation in refrigeration and cooling field. A portion of things to come work which is still should be possible in refrigeration field utilizing nanotechnology:

1) New kind of nanorefrigerants can be created by utilizing distinctive nanoparticles with various arrangements of refrigerants and their mixes.
2) Practicability of nanoparticles ought to uniquely be checked for utilizing it with Eco-accommodating refrigerants who have less worldwide warming and ozone exhaustion potential.
3) Very less investigates till date had uncovered about the property varieties when nanoparticles is utilized with any essential refrigerant, so it's a region which sti require an intensive explanation

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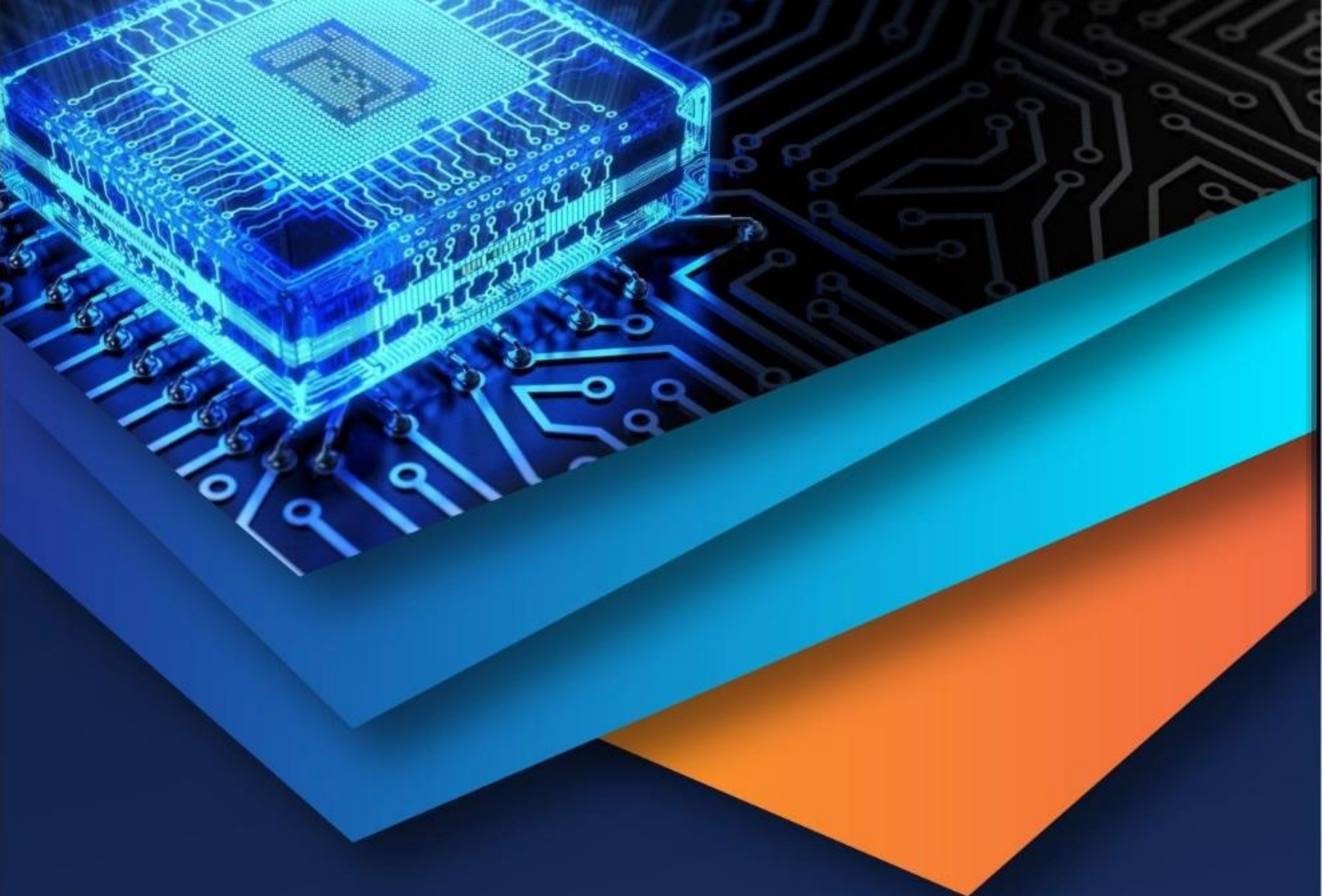

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