



## **Exploratory Evaluation of Vapor Compression Cooling Device with GWP Halogen (VCRS) Alkane to Enhance Coolant Overall Performance Cooling Machine**

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### **ABSTRACT**

In the contemporary thesis paintings a tribulation exam is made for take a gander on the presentation of home refrigeration framework which follows up on (Hydrocarbon+ CuO) Nano refrigerants. To behavior the investigation all vital arrangement is superior in accordance with requirements of countrywide principles of India, and did to encompass underneath various instances. After consultations & dialogue it transformed into chose to use hydrocarbon as head refrigerant that is alternate craving for R1132a, R1141, R1150, R134a, due to its GWP and ODP risks, because of beyond regular time in transporter R1132a, R1141, R1150 refrigerant can be utilized as substitution of R134a consequently of getting carefully similar to thermo-real homes and eco-accommodating nature. Cupric oxide (CuO) nanoparticles having size (20-30nm) had been placed into development in this refrigeration unit with three range focuses (zero.15, zero.25 and 0.35)gm of particular nanoparticles. here statistics is accepted for a quantity take the direction of least resistance fee of 3.5LPH and for the two warm temperature movement in evaporator supplied at 25–260C and 35–360C. further, up push of evaporator temperature (2.85% – five.forty eight%) has been visible. An augmentation in COP (three.18% – 11.57%) is visible at some level inside the evaluation .It became received for the span of 25–26 C evaporator temperature load conditions. The identical headways moreover are zero visible at the same time as cooler is running at 35–36 C temperature of evaporator. A decrement of the 00 admission of team spirit (13.5% - 19.7%) along side quicker cooling (from forty C – 25 C) is obtained while test changed into completed with the manual of utilising Nano refrigerant. The exploratory examination well-knownshows that the plain refrigerating unit works normally worked thru Nano refrigerants. Henceforth, for making upgrades to the overall exhibition of hydrocarbon based refrigeration device cupric oxide (CuO) nanoparticles might be practiced without revision in current structures. Catchphrases: Cupric oxide nanoparticles, Nano refrigerant, hydrocarbon, heat conductivity, cooling limit, strength utilization, COP

### **INTRODUCTION**

Refrigeration frameworks converse with the selective real elements that make up the complete refrigeration unit. The unusual reaches in the refrigeration cycle are gone through in those actual buildings. these frameworks envelop an evaporator, a condenser, a blower and an assortment valve. The evaporator is the gap that wants to be cooled thru the refrigerant; the blower packs the refrigerant from the low strain of the evaporator to the pressure at the condenser. The warm temperature won thru the refrigerant is dismissed at the condenser and the exorbitant pressure refrigerant is expanded into the low strain evaporator through the improvement valve. this is a very vast representation of the various devices in a refrigeration machine. The refrigeration structures range with reference to the reason and the form of refrigerant utilized. they're the method with the aid of which we will truly play out the refrigeration manner.

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- Vapor strain frameworks
- Absorption frameworks
- Air or gas development frameworks

### **Refrigeration tactics**

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- Evaporation-on this interplay, the refrigerant dissipates at a lower temperature than that of its environmental elements, engrossing its inert warm temperature of vaporization.
- Superheating - Saturated refrigerant fume is generally superheated to assure that fluid refrigerant would not circulation into the blower.
- Compression - Refrigerant is compacted to a better pressing factor and temperature for buildup.
- Condensation - Gaseous refrigerant is consolidated to fluid shape with the aid of being esuperheated, then, at that factor dense, lastly sub cooled, transferring its idle warmth of buildup to a coolant.
- Throttling and extension - The better-stress fluid refrigerant is choked to the lower vanishing strain and is prepared for dissipation.

The accompanying refrigeration measures manifest at some point of the pastime of an air or gasoline development refrigeration framework:

- Compression - Air or fuel is packed to a better urgent thing and temperature.
- warmth discharge - warmth is introduced to the environmental factors at steady pressing thing to lower the temperature of the air or fuel.
- Throttling and extension - Air or fuel is choked and prolonged so its temperature is introduced down.
- warmth retention - heat is assimilated from the environmental elements in view of the lower air or gasoline temperature. Refrigerants

The going for walks professional in a refrigerating system that assimilates fuses or deliveries warmth from the district to be cooled or refrigerated is probably named as a refrigerant. This glow switch for the maximum part takes location by using a portion change of the refrigerant. "Refrigerant is the liquid applied for heat switch in a refrigerating device that keeps heat for the span of vanishing from the location of low temperature and stress, and deliveries warmth during buildup at an area of better temperature and urgent issue."

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## **LITERATURE SURVEY**

Fatouh M. et al. (2006) turn out to be made an examination on circle of relatives cooler by using placing R134a with the hydrocarbon refrigerant over a big spot of evaporator temperature (- 35 to - 100C) and condenser temperature (forty to 600C) with two or three percentage of propane in propane/butane/isobutene combo of refrigerant. The check out demonstrates that hydrocarbon refrigerant with 60% propane mass charge is high-quality and it revises the C.O.P. Over using R134a and furthermore diminishes stress drop thru eleven.1% as associated with R134a.

Somchai Wongwises et al. (2005) Checked the success of vehicle-cause weather manage structures by way of using alternative of HFC-134a container with hydrocarbon refrigerant. They considered on 4 in place of percent of hydrocarbon series and got that the whole propane/butane/isobutene (half of/40%/10%) is the best reasonable collection to alternate HFC-134a and having top of the road achievement with admire to C.O.P., the sphere capability and craftsmanship contribution to blower.

Somchai Wongwises et al. (2004) toiled at the location of hydrocarbon refrigerant in return of HFC134a subject in a gave area tool. Hydrocarbons taken are disrespectful, overpowered and isobutene. For notion about system they implemented force burning-via take a look at (ECT) approach wherein refrigerator remove temperature has been see at lengths of one min for 24 hours after that energy utilization is decided in KWh. Likewise, they assessed the blower compositions and cited temperature and resist significant additives. This method arise as chosen with three top notch refrigerant mixes. this is three hydrocarbon blends, hydrocarbon mixture and hydrocarbon and HFC134a combination. right here a larger part of those examinations were finished at 250C barometrical temperature. After assessment every of the 3 commixture refrigerant with HFC134a refrigerant tentatively the yields displays that strength consumption diminished through 0.69% as connected to HFC134a and give up-product additionally famous that propane 60% and butane forty% blend is the maximum reasonable danger of HFC134a.

Hammad M.A. et al. (1998) tried the viability of own family refrigerator via taking four proportions of propane, butane and isobutene to refresh R12 refrigerant. Adjusted extents of hydrocarbons are seventy five% propane 19.1% butane five.9% isobutene, half of propane 38.3% butane 11.7%

isobutene and 25% propane 57.5% butane 17.5% one hundred% propane isobutene. The C.O.P And cooling load had been decided based totally on precise proportions and exam of yields end up finished with R12. The remark appears to be that propane 100% gives most C.O.P. besides 1/2 propane total is the best in preference to R12 on the muse of COP.

Jwo Ching track et al. (2009) tested the running of home refrigerators with the guide of R-290/R-600a hydrocarbon refrigerant in region of R134a. on this check they has taken 1/2 of everything about 290 and R-600a with range in mass and determined the results in contrast with R134a. They reasoned that the R-290/R-600a hydrocarbon refrigerant with 90g mass has extra wellknown presentation in contrast with 150g R-134a this is faded to forty%. it's miles moreover important that trade in fridge temperature is in like way duplicated with quicker cooling price in assessment to R-134a and deal in strength utilization with the guide of 4.four%.

Rasti M. et al. (2012) has finished an inspect choice of R134arefrigerant with the R436A (a total of fifty six% R290 and 40 4% R600a) in a 238L homegrown idea process cooler. They charged variant quantities of R436a refrigerant and estimated energy usage and temperature at mind-blowing piece of the system. the numerous diagrams were attracted to evaluate the influences of R436 with the R134a. It changed into found that there was lower in accused quantity thru 48% of regard to R134a and the evaporator temperature is additionally diminishes by means of the usage of 330C. Likewise power admission is restrained thru the usage of 13.6% and electricity efficiency Index is reached out from E to D.

Joudi et al. (2014) Investigated the working of break up weather manage systems through the usage of using four every other refrigerants to R22. They has taken break up forced air system frameworks of potential 1TR and 2TR in which they assessed C.O.P., strength admission and condenser heat dismissal. here the compartment air is controlled at consistent temperature anyway the air scenario have become changed. After take a look at it come still up in the air that refrigerant R410 has maximum electricity admission and cooling potential conjointly it moreover has maximum warmness disposal from condenser. R290 has the extra COP in evaluation with an extra 1 refrigerants and it's likewise a legitimate longing at some point of R22 on the indistinguishable time as R407 has a first-class strain proportion.

Rasti Mehdi et al. (2013) targeting the impact of hydrocarbon refrigerants in preference to R134a refrigerant in family cooler. This check turned into made for individual exam through making use of styles of blower one is HFC blower and a few different is HC blower within the cooler. now not sincerely set in stone that in assessment to 105g R134a charged in refrigerator the R436a and R600a charged 60g and 55g while the usage of HFC blower ventured ahead final results is gotten that electricity use transformed into dwindled via 14% and 7%. on the other hand due to utilization of HC kind blower the charged degree of R436a and R600a is to 50g handiest and the admission of strength come to be reduced by way of 14.6% and 18.7%.

BiShengshan et al. (2011) concentrated on the overall exhibition of home cooler the use of TiO<sub>2</sub>-R600a Nano refrigerant with groupings of nanoparticles. They boosted the adequacy of ice chest at 0.1 and zero.five g/L groupings of TiO<sub>2</sub>-R600a and saw that at 0.1 g/L top class the strength utilization confined thru 5.Sixty 4% and at zero.5 g/L mindfulness it introduced down via nine.60%. moreover, the freezing usefulness of TiO<sub>2</sub>-R600a is in like way more as identified with R600a everyday refrigerant.

Subramani N et al. (2011) concentrates on referenced that the hobby of refrigeration contraption with Nano refrigerant is not unusual and affords progressed impacts. It turned into reasoned that the freezing capacity upgrades and the pressure usage abridges by using 25% whilst POE oil is took over through a blend of mineral oil and alumina nanoparticles. end result additionally exposed that development problem inside the evaporator is 1.53 even as Nano refrigerants have been taken in vicinity of normal refrigerant.

Kumar S.D et al. (2012) Has accomplished the examination on Nano refrigerant thru using Al<sub>2</sub>O<sub>3</sub>-PAGoil in R134a fume pressure refrigeration shape. The machine operating emerge as taken into consideration on the floor of force utilization check and thwart restrict look into. It emerge as seen that Al<sub>2</sub>O<sub>3</sub>Nano refrigerant demonstrations normally and properly within the refrigeration framework. It have become inspected that working of refrigeration device arise as better than normal ointment with R134a strolling liquid, a 10.32% lesser power turn out to be applied at the same time as 0.2% quantity of the mindfulness taken inside the device. what's greater warmth switch coefficient raiseswith the acknowledgment of nanoparticle Al<sub>2</sub>O<sub>3</sub>. in this manner, tutoring Al<sub>2</sub>O<sub>3</sub>Nano refrigerant in refrigeration device works on the general with the aid of and big execution of the system.

Mahbulul I.M. et al. (2015) Investigated the thermo-real homes and their effect on COP. 5% degree of Al<sub>2</sub>O<sub>3</sub> nanoparticles are blended at temperature of 283-308 ok. The consequences show that the palatable and loosened up conductivity of Nano refrigerant Al<sub>2</sub>O<sub>3</sub> progresses on increasing temperature i.E. 8.12% to twenty-eight.fifty eight% for 208K to 308K. The thickness and consistency of Nano refrigerant also raised by way of making use of way of thirteen.sixty eight% and 11% for the indistinguishable temperature boom. The change in heat conductivity, thickness and consistency additionally dietary supplements the COP through 15%, 3.2% and multiple.6%.

Mahbulul I.M et al. (2012) broke down the volumetric and temperature reaction over thickness of R123-TiO<sub>2</sub>Nano refrigerants for five°C to 20°C temperatures up to two % quantity meeting of nanoparticles. additionally impact of pressure fall with the blast in thickness has furthermore been examined. In mild of the examinations it altered into discovered that thickness of Nano refrigerant supplements to blast of nanoparticle quantity fixations and lessens with the benefit in temperature and besides stress fall increments strikingly with the collection of quantity focuses. For this layout it is coordinated to use little convergence of nanoparticles for extra widespread typically speakme exhibition.

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## EXPERIMENTAL SETUP AND METHODOLOGY

in this portion a complete clarification of the factors utilized in experimentation of a family fridge along side their taking walks is provided. right here, we furthermore deliberated approximately method of charging and evacuation of Nano particles inside the tool.



Fig 4.1: Experimental Setup

Above figure is the test set up used in actual vapor compression refrigeration system (domestic refrigerator) in which pure HC refrigerant is taken as the working fluid with the addition of nanoparticles?

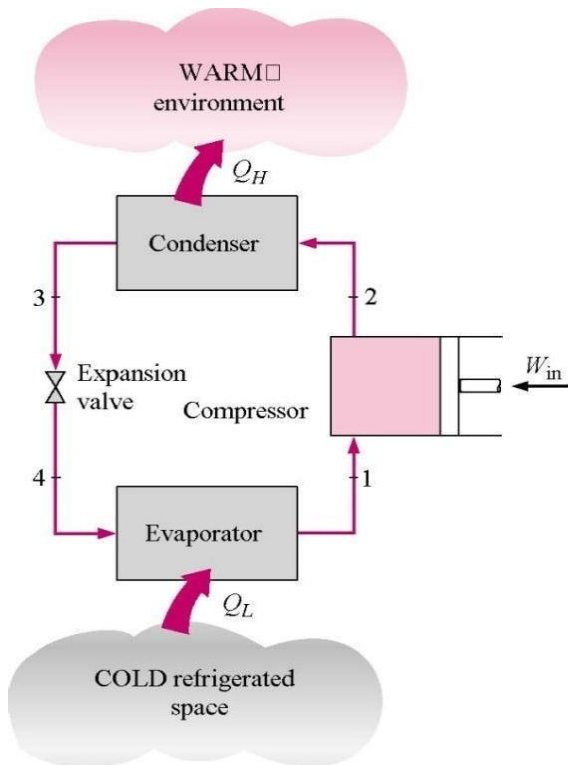


Fig.4.2: Simple VCR System

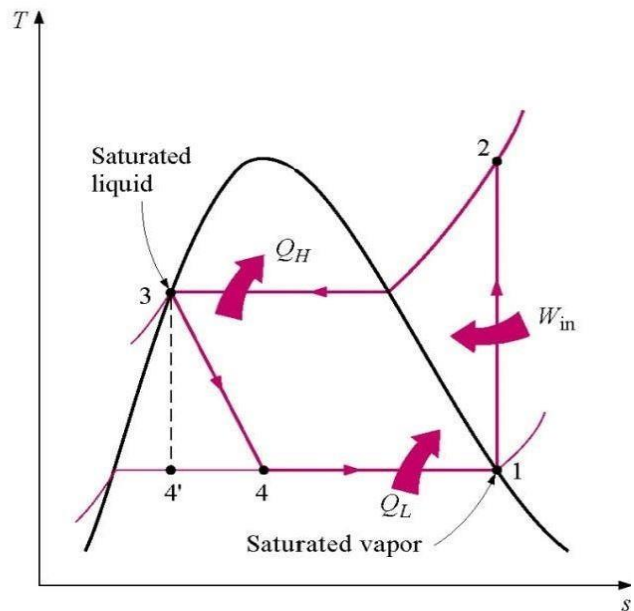


Fig.4.3: T-S Diagram

## COMPONENTS OF SETUP

Table 4.1: Components of Experimental Setup

S. NO.	COMPONENTS	QTY.	SPECIFICATIONS
1	Compressor	1	165 liter
2	Expansion Device	1	Asper compressor
3	Condenser	1	Finned type
4	Evaporator	1	Coiled Type
5	Filter	1	Without Silica Gel
6	Pressure Gauge	4	Low and High Pressure
7	Heating Element	1	230 W
8	Rotameter	1	2-30 LPH
9	Refrigerant	190 gms	Pure Hydrocarbon
10	Voltmeter	1	0-300 volt
11	Ammeter	1	0-15 Amp.
12	Energy meter	2	
13	Digital Temperature Controller	1	
14	Hand Shut Valve	4	For ¼ inch pipe
15	Temperature Gauge	4	Mercury Glass thermometer (-1500 C-20 C)
16	Flexible Charging Line	1	
17	Vacuum Pump	1	

## 5. RESULTS AND DISCUSSION

within the wake of appearing take a look at with unadulterated R290/R600a hydrocarbon refrigerant, nanorefrigerant with diverse extent a part of CuO in R290/R600a refrigerant, readings were amassed for pressure, temperature, electricity utilization at 3.5 LPH circulate price at two sorts of transitions given to the evaporator at specific temperature. Charts are plotted beneath constant kingdom for coefficient of execution (COP) of refrigeration framework, temperature drop in condenser, temperature enhance in evaporator and time taken for decline in temperature from 400C to 25 0C. every one of the barriers are summed up in the obvious structure as follows

Table 5.1: C.O.P., pressure and temperature for R290/R600a refrigerant and nano refrigerants

Refrigerant	Evaporator Temperature load at (25-26 <sup>0</sup> C)									
	C.O.P.	P1 (kg/c <sup>2</sup> )	P2 (kg/c <sup>2</sup> )	P3(kg/cm <sup>2</sup> )	P4 (kg/c <sup>2</sup> )	T1 (0 <sup>c</sup> )	T2 (0 <sup>c</sup> )	T3 (0 <sup>c</sup> )	T4 (0 <sup>c</sup> )	Tatm
Pure R290/R600a	1.18	20.37	249.45	239.30	27.28	26.61	73.95	49.81	-0.76	29.32
R290/R600a +0.15gm CuO	1.20	20.22	260.20	246.22	26.75	27	78.36	50.74	-1.15	30.35
R290/R600a + 0.25gm CuO	1.21	19.96	257.10	242.38	26.27	26.62	76.81	48.52	-1.76	30.10
R290/R600a + 0.35gm CuO	1.24	19.73	254.20	238.60	25.80	26.37	75.26	46.28	-2.5	29.65

Table 5.2- C.O.P., pressure and temperature of pure R290/R600a and Nano refrigerant

Refrigerant	0 Evaporator Temperature load at (35-36 C)									
	C.O.P.	P1 (kg/c <sup>2</sup> )	P2 (kg/c <sup>2</sup> )	P3 (kg/cm <sup>2</sup> )	P4 (kg/c <sup>2</sup> )	T1 (0 <sup>c</sup> )	T2 (0 <sup>c</sup> )	T3 (0 <sup>c</sup> )	T4 (0 <sup>c</sup> )	Tatm
Pure R290/R600a	1.90	20.37	244.75	234.13	26.68	34.18	81.95	49.15	-1.0	28.25
R290/R600a +0.15gm CuO	1.96	20.37	256.91	246.94	26.36	34	84.64	47.81	-1.26	29.70
R290/R600a +0.25gm CuO	2.12	20.68	258.63	248.31	27.3	34.56	85.47	47.57	-2.13	30
R290/R600a +0.35gm CuO	2.32	21.1	260.33	249.69	28.23	35.12	86.34	47.35	-3	30.33

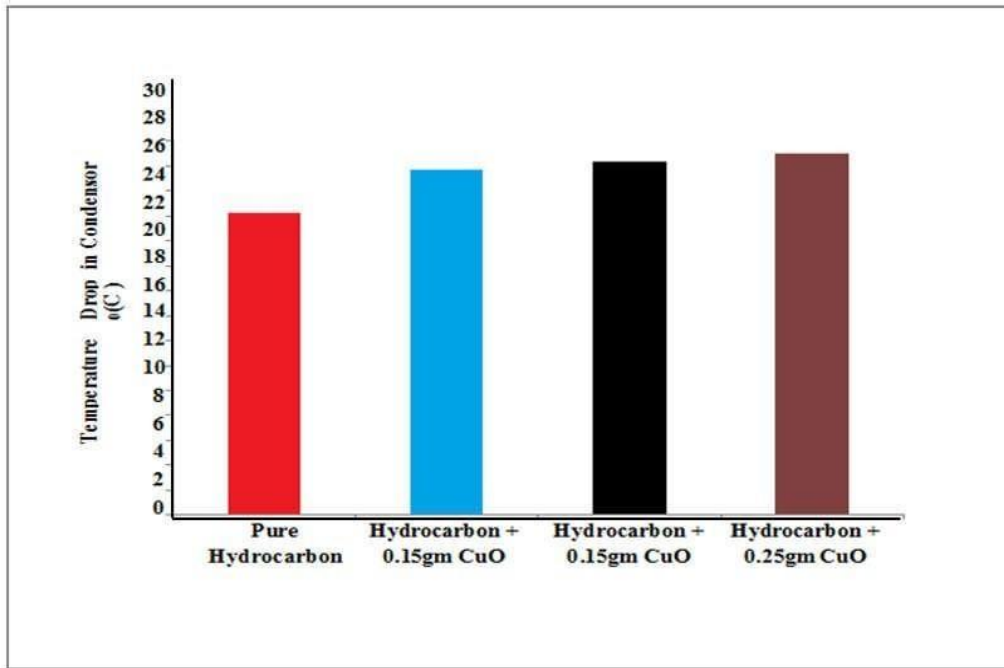


Fig. 5.1: Temperature drop in condenser for Nano refrigerant at evaporator heat flux 25-26°C

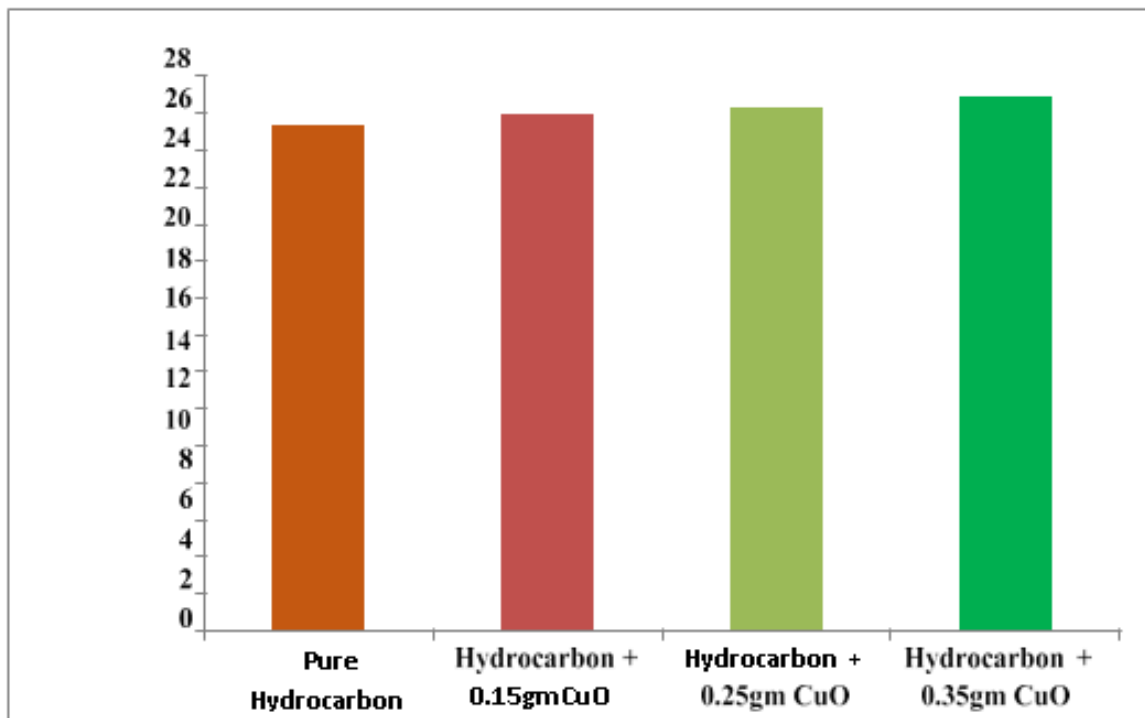


Fig 5.3: Temperature gain in evaporator for Nano refrigerant at 25-260C heat flux

## CONCLUSIONS

The modern exploration work named "An Experimental assessment of the overall performance of homegrown fridge dependent on Nano refrigerant" (R1132a, R1141, R1150+CuO) turned into deliberate to utilize nanoparticles regarding hydrocarbon refrigerant. thus exam, CuO nanoparticles of size 20-30 nm has been taken on. Variegated quantity extent of nanoparticles had been utilized for examination the operating of refrigeration framework.

- (i) The framework was accused of Nano refrigerant R1132a, R1141, R1150+CuO 0.15gm mass, zero.25gm mass and zero.35 gm mass of nanoparticles.
- (ii) Readings were assembled at 3.5LPH extent stream charge and for two warmth motions in evaporator at temperature 25–260C and 35–360C.
- (iii) Temperature increase in evaporator, temperature drop in condenser, Coefficient of execution (C.O.P) of the framework and temperature-time diagram have been study for unadulterated refrigerant and Nano refrigerant in any respect volumetric focuses being applied.
- (iv) It became known as attention to that adding of CuO nanoparticles to the refrigerant consequences in advancement within the thermo-actual elements and heat circulate capacities of the refrigeration unit.
- (v) This was inspected that there's more temperature drop over the condenser for the nano refrigerant (14.forty two% – 20.05%) in equality to unadulterated R1141. In comparable manner, an addition of (2.85%-5.48%) turned into located for evaporator temperature. An development in coefficient of execution turned into likewise acquired throughout the examination (three.18% – eleven.fifty seven%). It become executed for regular evaporator load at 25-260C.
- (vi) comparable result were additionally visible whilst refrigerator is labored at heat load 35–360C evaporator temperature. A decrement in usage of pressure (13.5% to 19.7%) along temperature drop (from 400C – 250C) is likewise received when nanorefrigerants are applied.
- (vii) The trial translation suggest that cooler works palatable with Nano refrigerant with out change in actual framework.
- (viii) Refrigerating effect improvements with the increase in attention (zero.15gm to 0.35gm) of nanoparticles in refrigerant.

#### FUTURE EXTENSION

The cutting-edge exploration paintings was coordinated for unmarried nanoparticle, three volumetric focuses and single refrigerant. however, now not many extraordinary limitations are moreover exist which is probably shifted at some stage in the experimentation and framework execution may be assessed.

- (i) A diverse blend of nanorefrigeran twith modified focuses might be utilized.
- (ii) there are numerous refrigerants apart from hydrocarbon are available which is probably tilized to virtually take a look at the execution of the structure.
- (iii) by utilising profoundly precise and specific temperature and pressure and different estimating gadgets for higher results.
- (iv) other factors which may be modified for execution assessment is distinct pace of stream, numerous evaporator masses, at diverse herbal situations for various measure of refrigerant.
- (v) machine can likewise be made to paintings with nanoparticles in diverse mixture of oil.

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