Theoretical study and performance of vapour refrigeration system along with additive of zro_2

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Abstract

The objective of work is ZrO_2 nano-oil was planned as a hopeful lubricant to improve the behavior of VCR system. The ZrO_2 nanoparticles stability in the oil was tested. It is established the nanoparticles are steadily balanced in the mineral oil at a fixed situation for more period of time. The nano-oil with specific concentration such as 0.15%, 0.2% and 0.35 % in volume fraction was added in the system compressor. The VCR system was performed with the nanoparticles and investigates by by means of energy consumption test. The reading shows COP of experimental systems were superior by 5.65%, 7.15% & 10.95%, respectively.

Keywords: COP, VCR, Oil

1. Introduction

In energy resource there is desideratum for rising thermal energy systems were more energy efficient. The thermal energy systems like air conditioning and refrigerator takes substantial quantity of electric puissance. There is necessary to build up energy efficient in air conditioning and refrigeration system by means of nature cordial refrigerants. The quick advance in nanotechnology has escort to rising of incipient making heat transfer fluid known as nanofluid.

The fluid is comparatively incipient class of fluids which consist of a base fluid and nano-sized particles balanced within system. This particles are usually a metal oxide, convection coefficients and increment conduction, sanctioning for additional heat transfer from the coolant, provide excellent example of nanometer with millimeter to recognize pellucidly as can be optically discerned in Figure 1.

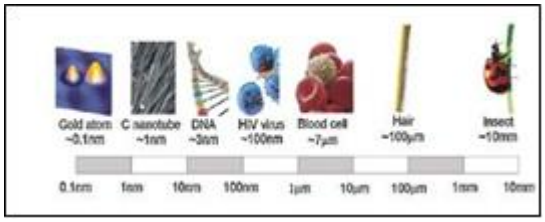

Figure 1. Length scale and some examples related

Many researchers are utilized nanoparticles in VCR systems since of its amazing amelioration in heat transfer capability to improve the system efficiency and dependability of VCR system.

Performance investigation of a VCR System utilize the Nano Fluid and paramount enlarge in the thermal conductivity when compare to the base fluid and moreover establish that integration of nanoparticles results in paramount increase in the critical heat flux.

2. Experimental Set Up

The VCR system test rig consist of a compressor unit, condenser, evaporator, cooling chamber, controlling contrivances and quantifying instruments those are fitted on a stand and a control panel. Electric power input to the compressor is given through thermostatic switch.

Table 1. Refrigeration System Specifications

Capacity	500 watt at rated test condition
Condenser fan	Induction type
Compressor	Hermetically
Condenser	Forced convective air cooled
Drier / filter	Dryall make
Expansion	Capillary tube
Refrigerant	R-134a

Figure 2. Experimental set up

The temperatures at various components of the experimental setup were quantified utilizing resistance thermocouples. Six resistance thermocouples were utilized for the experimentation. The suction pressure and discharge pressure at compressor are quantified with the avail of pressure gauges. The potency consumption of the system was measures by a energy meter. A digital energy meter is withal connected with the experimental setup.

Table 2. Measurement Equipment

Refrigerant flow measurement	Rota meter
Evaporator for refrigeration test rig	Immersed tube type , direct expansion coil
Energy meter	3200 imp/kwh
Insulation for water tank	Puf
Temperature indication	Digital led
Supply	230 volts, 50 Hz, 1 phase , AC.
Heater	1000w
Pressure indication	Pressure gauges , 2 nos provided

3. Experimental Procedure

3.1 Preparation of nano- Refrigerant

Nanoparticles of ZrO_2 are integrated to the refrigeration system by integrating them to the lubricant in the compressor of the system. The preparation and stability of this lubricant and nanoparticle amalgamation is very paramount. The lubricant oil, a type commonly utilized in refrigeration and air-conditioning systems was POE oil. This oil is culled owing to its prevalent utilization and superior quality.

3.2. Nano- Refrigerant Concentration

Nano-particles with 0.1%, 0.2% and 0.3% (by mass) concentration ZrO2 in the POE oil is yare and tested in the setup.

4. Performance Test

Fugure 3. Ultrasonicator

Figure 4. Nanoparticles

$$(C.O.P)_{actual} = \frac{\text{Refrigerating effect}}{\text{Work done by compressor}}$$

4. Result & Discussion

4.1. Compressor work Vs Nanoparticle concentrations

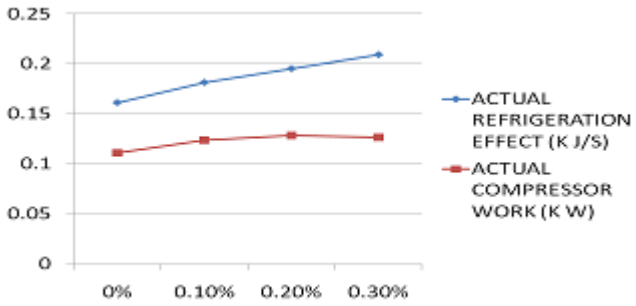

Figure 5. Compressor work Vs Nanoparticle concentrations

The result shows that nanoparticles concentration increases with minimize the compressor work.

Table 3. Compressor Work

Nanoparticles concentration (%)	Compressor work (kW)
0%	0.49
0.1%	0.45
0.2%	0.4245
0.3%	0.4327

4.2 % change in COP

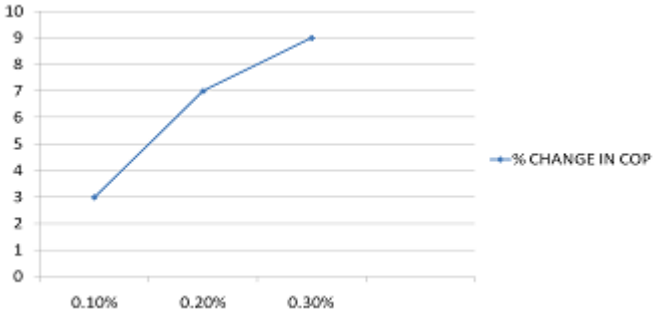

Figure 6.Percentage change in COP

It showed the percentage increase in COP with respect ti increase in concentration.

Table 4. Variation in COP

Nanoparticles concentration (%)	Variation in COP (%)
0.1%	5.61
0.2%	7.05
0.3%	10.90

5. Conclusion

From the experimental work, it concludes that the thermal conductivity of nano refrigerants were more than conventional refrigerants. It was shows that the incremented thermal conductivity in nano refrigerants and commensurable with the incremented thermal conductivities of extra nanofluid. It has noted that the energy preserving can be utilized from a minimum value of 7.23% to a higher value of 12.45% utilizing nanolubricant compare to conventional refrigerants. The exact mechanism is used to enhanced heat transfer of nanofluid is unmoving obscure as ststed by researchers. The Nanofluids stability and its cost are main factor to obstruct the commercialization. For facing these challenge, can be expected the nanofluids can utilize considerable impact on heat exchanger contrivances.

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