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Experimental Refrigeration Test of R134a Mixed With Mineral Oil and (Cuo) Nanoparticle

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ABSTRACT

Evaporating heat transfer is very important in the refrigeration and air conditioning systems. But refrigerant were used in refrigeration process and they were having a global warming coefficient at high level, Though the global warming up potential of HFC134a is relatively high, it is affirmed that it is a long term alternative refrigerants in lots of countries. By addition of Nano particles to the refrigerant results in improvements in the thermo physical properties and heat transfer characteristics of the refrigerant, thereby improving the performance of the refrigeration system. In this experiments comparing the effect of using, CuO-R134a & mineral oil in the vapour compression system on the evaporating heat transfer coefficient. Polyester Oil was tested along with suitability and environmental friendly refrigerant R134a. Results show that Cuo nanoparticle concentration of 0.8wt% is optimal and gives highest heat transfer enhancement and improve the coefficient of performance (COP). An experimental apparatus was build according to the national standards of India. Nano Cuo concentrations ranged from 0.05 to 0.8% and particle size from 10 to 70 nm. The results indicate that evaporator heat transfer coefficient increases with the usage of nano CuO. But economically cost for nano refrigerant.

Keywords: Nano refrigerant , Nanoparticles ,Cop ,R134a Mineral oil

I. INTRODUCTION

Globally, 1, 1, 1, 2-Tetrafluoroethane (HFC134a) is the most used alternative refrigerant in refrigeration equipment such as domestic refrigerators and automobile air-conditioners. According to Bi, et al., (2008), despite the relatively high greenhouse warming potential (GWP) of HFC134a, HFC134a has been accepted as a long-term alternative refrigerant in many countries. In recent times, Nanofluids have been noted as invaluable alternatives to conventional working fluids such as HFC134a, used in refrigeration systems. According to Saidur, *et al.*, (2011), scientists use nanoparticles in refrigeration systems because of its remarkable improvement in thermo-physical, and heat transfer capabilities to enhance the efficiency and reliability of refrigeration and air conditioning systems. One scientist, Elcock (2007) found that TiO2 nanoparticles can be used as additives to enhance the solubility of the mineral oil with the hydrofluorocarbon (HFC) refrigerant. Authors also reported that refrigeration systems using a mixture of HFC134a and mineral oil with TiO2 nanoparticles appear to give better performance by returning more lubricant oil to the compressor with similar performance to systems using HFC134a and POE oil. According to H.K, *et al.,* (2012) traditional mineral oil is avoided as a lubricant due to the strong

chemical polarity of HFC134a in refrigeration equipment. Mineral oil as a lubricant also has the problems of flow choking and severe friction in the compressor. So nanoparticles can be used to enhance the working fluid properties and energy efficiency of the refrigerating system associated with reduction in CO2 emission. The new technology is being introduced in present time that is, nanotechnology by the help of technology In nano technology, a particle is defined as a small object that behaves as a whole unit with respect to its transport properties. Nanoparticles are between 1 and 100 nanometers (1x10–9 and 1 x 10–7 m) in size. Tubes and fibers withonly two dimensions below 100 nm are also nanoparticles. Novel properties that differentiate particles from bulk material typically develop at a critical length scale of 100 nm. They are made from ceramics, metals & metal oxides. nano refrigerants are form Nano refrigerant is nothing but the combination of nano particle to the refrigerant for the sake of better refrigeration process. As compared to alternative refrigerant the nano refrigerant has better heat transfer. We have seen some research has been done by taking the nano refrigerant and they have found better heat transfer and energy consumption. The nano particles like CuO. Now can be form some other nano refrigerant by combining the different nano particles of same size. If it is feasible than we can say that we can make better efforts to refrigeration processes. Refrigeration process will become more efficient and more effective.

II. NANOPARTICLE PRODUCTION TECHNIQUES

Nanoparticles can be produced from mechanical attrition, pyrolysis, gas condensation, chemical precipitation.Methods like dc plasma jet, dc arc plasma, radio frequency induction plasmas, chemical synthesis, gamma rays and laser ablation are used. Inert-gas condensation is frequently used to make nanoparticles from metals with low melting points. Depending upon application (properties) & cost, specific manufacturing technologies are chosen.

III. LITERATURE REVIEW

Here are the applications of nano refrigerants. The researchers have found the advantages by using nano refrigerant in place of alternative refrigerant. They have proved that the nano refrigerant is more efficient as compared to the refrigerant.

Guo-liang Ding [1] This paper determines the CFD simulation of the vapour compression refrigeration system. The different modules of refrigeration system were designed for investigation and the simulation process. The further calculations of the refrigeration characteristics were summarized in detail. **Hao Peng et al.** [2] Refrigeration characteristics were examined by the nano-refrigerant using the nanoparticles of Cu, Al, Al2O3, and CuO. The nanoparticles were used with an average diameter of 20 nm. The R113 and R141b were the refrigerants which were mixed with the nanoparticles to perform the research work and to get the desired solution. RB68EP was the lubricating oil used in this experiment. The result was the comparison of nano-refrigerant with different concentration of nanoparticles which depicts that the pool boiling of nano-refrigerant increase by the decrease of nanoparticle density. **V Timofeeva et al.** [3] The nano-refrigerants are the new concept in the field of refrigeration and air conditioning system and the effect of nano-particles is beneficial to us in terms of increasing thermo-physical properties of the refrigeration and air-conditioning system. The nanoparticles were added to refrigerants with the different particle size and mole fraction so that the comparison can be made and the best combination can the depict for the sake of the healthy environment.**N. Subramani et al.** [4] This review tells about the R134a, which is the most commonly used refrigerant in domestic refrigeration and air conditioning equipments. If we want to improve the performance of these equipments then

we have to add some nano-particles, keeping in mind the refrigeration process should be feasible and should provide us better output. The nano-refrigerant has to work normally in refrigeration system. The power usage is reduced by 25% if the nano-particles of the alumina oxide are mixed with mineral oil in place of POE oil . **T. Coumaressin et al. [6]** When we think about the refrigeration system and air-conditioning system one term comes in mind that is heat transfer. The efficient and widely used refrigerant is HFC R134a in the air-conditioning system and domestic refrigeration system. The drawback of HFC R134a is, its high global warming potential. If we add nano-particles to the refrigerant than we can increase the performance characteristics of the system that will directly lead us to safe environment as well. This paper is on the CFD analysis of the vapour compression system on FLUENT software using CuO-R134a nano-refrigerant. It was found that the nano-refrigerant work efficiently and normally in the system. Al last result indicates that the evaporating heat transfer is improved. **Fadhilah et al. [7]** We have found that the nano-refrigerants have been used in order ti increase the heart transfer and also to reduce the power consumption. It is also found that the researches were done with low concentration of nano-particles to increase the thermo-physical properties up-to a better extent. When we talk about nano-refrigerant thermal conductivity we come to know that the amount of literature is very less in this field. The study shows that the Al2O3nano-particle used with R134a reduce the energy consumption 10.32% while TiO2 nano-particles with R600a reduce amount of energy use to 5.94% with a concentration of 0.1g/L.

IV. BASIC EXPERIMENTAL OBSERVATION OF A REFRIGERATION PROCESS

Equipment Used

Evaporator, Hermatic compresser, Condenser, Expansion valve – Capillary Tube ,Refrigerant – R134a, nanoparticle -CuO

Working

The vapor – compression uses a circulating liquid refrigerant as the medium which absorbs and removes heat from the space to be cooled and subsequently rejects that heat elsewhere. Fig. 1 depicts a typical, single – stage vapor – compression system.All such systems have four components: a compressor, a condenser, a thermal expansion valve and an evaporator. Circulating refrigerant enters the compressor in the thermodynamic state known as a saturated vapor and is compressed to a higher pressure, resulting in a higher temperature as well. The hot vapor is routed through a condenser where it is cooled and condensed into a liquid by flowing through a coil or tubes with cool air flowing across the coil or tubes.The condensed liquid refrigerant, in the thermodynamic state known as a saturated liquid, is next routed through an expansion valve where it undergoes an abrupt reduction in pressure. That pressure reduction results in the adiabatic flash evaporation of a part of the liquid refrigerant. The cold mixture is then routed through the coil or tubes in the evaporator. A fan circulates the warm air in the enclosed space across the coil or tubes carrying the cold refrigerant liquid and vapor mixture. That warm air evaporates the liquid part of the cold refrigerant mixture. At the same time, the circulating air is cooled and thus lowers the temperature of the enclosed space to the desired temperature.

Figure 1. Experimental investigation of the refrigeration setup

Observation

Table: 1

Refrigerants	T_1	T_2	T_3	T_4	P_1	P_2
R134a	24	25.1	11.1	5.1	0.35	7.2
R134a +CuO(0.8%) Concentration	29	26.5	9.9	3.2	4	1

Table 2

Refrigerants	h_1	h_2	h_3	h_4
R134a	370	440	240	240
R134a+CuO (0.8%) Concentration	410	440	260	240

Table 3

Refrigrant	COP
R134a	1.85
R134a+CuO	5

P_1 = Lower pressure

P_2 = High pressure

T_1 = Suction temperature

T_2 = Discharge temperature

T_3 = Condenser temperature

T4 = Evaportor temperature

V. RESULTS AND DISCUSSION

From table values CuO nano particle with R134a refrigerant can be used as an excellent refrigerat to improve the performance in refrigeration system. A successful model has been designed and performance of the refrigerant test has been done. Coefficient of performace result have been optimized at its maximum value for the best of CuO nano particles concentration in R134a refrigeration equipment, when 0.8% volume concentration of CuO mixed with 175grams R134a. Its cop is increased highly in less time less power consumption with high cooling load, cop, energy consumption .From , the experimental investigation it performace characteristics of the system higher with usage of CuO nano particles with 134a refrigerant.

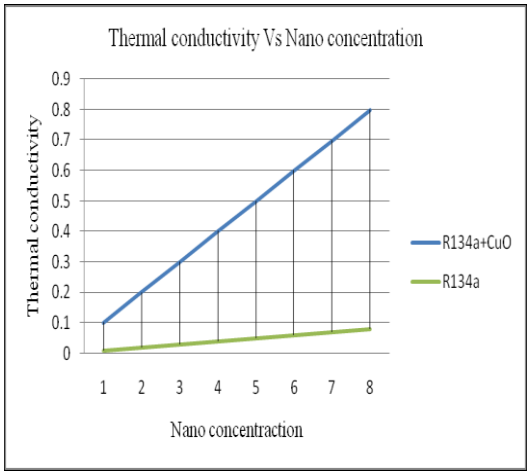

Figure 1. Effect of nano concentration on thermal conductivity

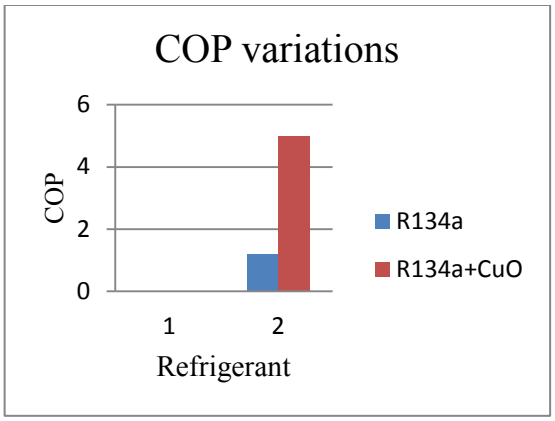

Figure 2. Effect of nano concentrations on Cop

VI. CONCLUSION

A VRCS is experimental investigated, experimentally result show that there is conderable change the compresser with R134a and R134a with CuO, it means compresser work reduce its pumping power , workdone in compresser . Here the development for new refrigeration system with low nano refrigerant is essential .coefficient performance of refrigerantion system which used nanorefrigeration as a working fluid, is higher than that of convetional refrigerant system .The addition of nano particles 0.8% volume concentration, has improved heat trasnsfer properties and reduced power consumption ,compresser workdone.This is the conclusion of my paper .

Opportunites:

- ✓ High heat transfer rate
- ✓ High coefficient of performance
- ✓ Small refrigeration system
- ✓ Light refrigeration system

Challeges:

- ✓ Poor long term stability
- ✓ Low specific heat
- ✓ High production cost
- ✓ Reduction in friction factor

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