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Experimental Analysis of Heating and Cooling in Household Refrigerator

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ABSTRACT

Evaporating heat transfer is very important in the refrigeration and air-conditioning systems. HFC 134a is the mostly widely used alternative refrigerant in refrigeration equipment such as domestic refrigerators and air conditioners. 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 nanoparticles 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 current experiments the effect of CuO-R134a in the vapour compression system on the evaporating heat transfer coefficient will be investigated. An experimental setup has built according to the national standards of India. Heat transfer coefficients has been evaluated using nano CuO concentrations ranged from 0.05 to 1% and particle size from 10 to 70 nm. Heat loses has been used for different home appliance. Finally, an obtained result from the experimental analysis is validated by the comparison of the results of an existing refrigerator.

Keywords - Heat transfer coefficient, Nanoparticles, air conditioning system

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I. INTRODUCTION

The rapid industrialization has led to unprecedented growth, development and technological advancement across the globe. Today global warming and ozone layer depletion on the one hand and spiraling oil prices on the other hand have become main challenges. Excessive use of fossil fuels is leading to their sharp diminution and nuclear energy is not out of harm's way. In the face of imminent energy resource crunch there is need for developing thermal systems which are energy efficient. Thermal systems like refrigerators and air conditioners consume large amount of electric power. It is essential to developing energy efficient refrigeration and air conditioning systems with nature friendly refrigerants. The rapid advances in nanotechnology have lead to emerging of new generation heat transfer fluids called nanofluids. Nanofluids are prepared by suspending nano sized particles (1-100nm) in conventional fluids and have higher thermal conductivity than the base fluids. Nanofluids have the following characteristics compared to the normal solid liquid suspensions. i) higher heat transfer between the particles and fluids due to the high surface area of the particles ii) better dispersion stability with predominant Brownian motion iii)reduces particle clogging iv) reduced pumping power as compared to base fluid to obtain equivalent heat transfer. Based on the applications, nanoparticles are currently made out of a very wide variety of materials, the most common of the new generation of nanoparticles being ceramics, which are best split into metal oxide ceramics, such as titanium, zinc, aluminium and iron oxides, to name a prominent few and silicate nanoparticles, generally in the form of nanoscale flakes of clay.

II. LITERATURE REVIEW

Pawel et al. (2005) conducted studies on nanofluid and found that there is the significant increase in the thermal conductivity of nanofluid when compared to the base fluid and also found that addition of nanoparticles results in significant increase in the critical heat flux.

Bi et al. (2007) conducted studies on a domestic refrigerator using nanorefrigerants. In their studies R134a was used the refrigerant, and a mixture of mineral oil TiO2was used as the lubricant. They found that the refrigeration system with the nanorefrigerant worked normally and efficiently and the energy consumption reduces by 21.2%. When compared with R134a/ POE oil system.

Bi et al. (2008) found thatthere is remarkable reduction in the power consumption and significant improvement in freezing capacity. They pointed out the improvement in the system performance is due to better thermo physical properties of mineral oil and the presence of nanoparticles in the refrigerant.

Jwo et al. (2009) conducted studies on a refrigeration system replacing R-134a refrigerant and polyester lubricant with a hydrocarbon refrigerant and mineral lubricant. The mineral lubricant included added Al2O3 nanoparticles to improve the lubrication and heat-transfer performance. Their studies show that the 60% R-134a and 0.1 Al2O3 nanoparticles were optimal. Under these conditions, the power consumption was reduced by about 2.4%, and the coefficient of performance was increased by 4.4%.

Henderson et al. (2010) conducted an experimental analysis on the flow boiling heat transfer of R134a based nanofluid in a horizontal tube. They found excellent dispersion of CuO nanoparticles with R134aand POE oil and the heat transfer coefficient increases more than 100% over baseline R134a/POE oil results.

Bi et al. (2011) conducted an experimental study on the performance of a domestic refrigerator using TiO2-R600a nanorefrigerant as working fluid. They showed that the TiO2-R600a system worked normally and efficiently in the refrigerator and an energy saving of 9.6%.
III. METHODOLOGY
Design, Analysis and Development Of Heating and Cooling System.

III. OBJECTIVES

1. Building up of a test rig for evaluating a performance of domestic VCC.
2. To perform experimental performance for heating and cooling effect.
3. Result analysis of various parameters like COP, Refrigeration effect & work input

SCOPE:

1.Heating effect can be achieved in the same cycle used for cooling effect.
2.No additional cost is required for the set-up.
3.Using same refrigerant cooling as well as heating effect can be achieved in single cycle.

PROCEDURE:
Material selection.
Design of master vcr system.
CAD model generation.
Material please.
Manufacturing

IV. WORKING

Equipment Used:

Evaporator, Reciprocating Compressor, Condenser, Expansion valve – Capillary Tube, Refrigerant – R134a

Working:

The vapour – 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 vapour – 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 aswell. The hot vapour 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 vapour 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.

V. CONCLUSION

In the experiment, we can modify our system like constructional changes in condenser, we induced our condenser works as calorimeter and heat exchanger it removes heat and water gets heated. At the same time the circulating air is cooled and thus lowers the temperature of the enclosed spaced to the desired temperature. Thus heating and cooling effects can be done at the same time. We can increase the coefficient of performance by attending both effects at same time.

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