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EXPERIMENTAL INVESTIGATION ON VCR SYSTEM WITH SHELL AND TUBE WATER COOLED CONDENSER BY USING R-134a AND R-600a WITH NANO FLUID(Cuo)

[1]C.Lokesh, [2]Prof.M.Yohan

[1]*M.tech ,Mechanical Engineering, JNTUA College Of Engineering, Anantapuram, India.*
[2]*M.tech ,PhD,*Director *of faculty development centreMechanical Engineering, JNTUA College Of Engineering, Anantapuram, India.*

Abstract: The concept of this project is the effect of shell and tube water cooled condenser on the co-efficient of performance of VCR System in which R-600a refrigerant mixed with nano fluid is using. In general VCR System condensers are exposed to air at atmospheric temperature for heat removal through the condenser. The refrigerant in condenser with high temperature should reduce. Here using shell and tube condenser which surrounded by water to high heat removal though condenser. Here water is replacing air to cool refrigerant in condenser. High cooling effect will increase COP.

In this project work with increasing COP by using shell and tube condenser, the refrigerant R-134a,R-600a and R-600a with nano fluid are comparing with their COPs. The main aim of this project work is COP improvement and comparison of different refrigerants.

Keywords—Refrigeration,polyolester oil, shell&tube condenser.

INTRODUCTION

The refrigerant which transfers heat in the form of latent heat is more efficient than the air refrigerant which transfers heat in the form of sensible heat. The refrigerant in the first group continuously change its phase from liquid tovapor and vapor to liquid.However in the second group, the refrigerant exists in the gaseous phase only. The refrigerants which absorb heat in the form of latent heat aremore suitable and widely used in the refrigeration system. The concept of this project is the effect of shell and tube water cooled condenser on the co-efficient of performance of VCR System in which R-600a refrigerant mixed with nano fluid is using. In general VCR System condensers are exposed to air at atmospheric temperature for heat removal through the condenser. The refrigerant in condenser with high temperature should reduce. Here using shell and tube condenser which surrounded by water to high heat removal though condenser. Here water is replacing air to cool refrigerant in condenser. High cooling effect will increase COP.

LITERATURE REVIEW

A.Senthikumar, R.Praveen, et.al. Conducted an experimental investigation on VCR system using CuO-R600a as alternate refrigerant to R134a. In this paper, CuO-R600a was used as a working fluid of domestic refrigerators. The results indicated that CuO-R600a can work normally and efficiently in refrigerator. 0.1 & 0.5g/L concentrations of CuO- R600a can save 11.83% and 17.88% energy consumption respectively and the cooling capacity of the domestic refrigerator is increased by 10 - 20% by using nano – refrigerant. The freezing velocity of CuO-R600a was more quickly than the pure R600a system. So the above works have demonstrated that CuO-R600a can improve the performance of the domestic refrigerator.

M.M. Nasr and M. Salah, et.al Experimental and theoretical investigation of an innovative evaporative condenser for residential refrigerator. In this study evaporative condenser has introduced and working effectively. The condenser temperature increases 0.45^0C for each degree increases in evaporative condenser temperature when the air velocity 2.5 m/s. The condensing temperature 20^0C lower than the air cooled condenser

M.A.Sattaret, et.al. [3] Investigated and compared the performance of the refrigerator using R600a, R600 and a ternary mixture of mixture of R290/R600a/R600 as refrigerants with theR134a. The effects of evaporator and condenser temperatures on COP, refrigerating effect, compressor power and heat rejection ratio were investigated. The results show that the compressor consumed 3% and2% less energy than that of R134a at 28°C ambient temperature whenR600a and R600 was used as refrigerants respectively. The compressor power and COP of hydrocarbons and their blends shows that hydrocarbons can be used as refrigerants in the domestic refrigerator. The COP and other results obtained from the experiments show a positive indication of using HC as refrigerants in a domestic refrigerator

SYSTEMDESIGNANDEXPERIMENTALSET-UP

The layout of the tested refrigeration cycle is shown in Fig. 1. The main components are R134a and R600a compressor, the proposed evaporative condenser, capillary tube expansion valve, and U-shape aluminum plate evaporator. The details of the condenser, are shown in Fig 2.water cooled shell and tube condenser placed. These components were inserted inside a rectangular duct. the water from the basin by wet the tubes. In this experiment the condenser is open to atmosphere for sub cooling and the evaporator coil is immersed into the condenser instead of compressor for superheating. In this work R134a R-600a with CuOnano mixed with Polyolester oil as lubricant instead of R600a with mineral oil and used here. And in evaporative condenser water is used. In the evaporative condenser, to allow for evaporative cooling sheets of cloth were wrapped around the condenser to stuck the water from the water basin (shell and tube condenser) .

Fig 1: Experimentalsetup

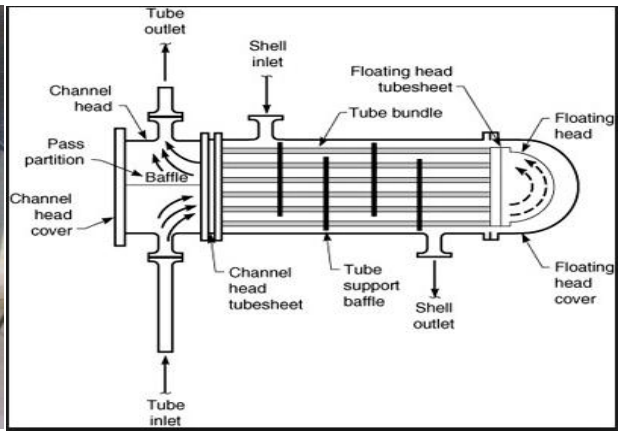


Fig 2. Working of shell&tubecondenser

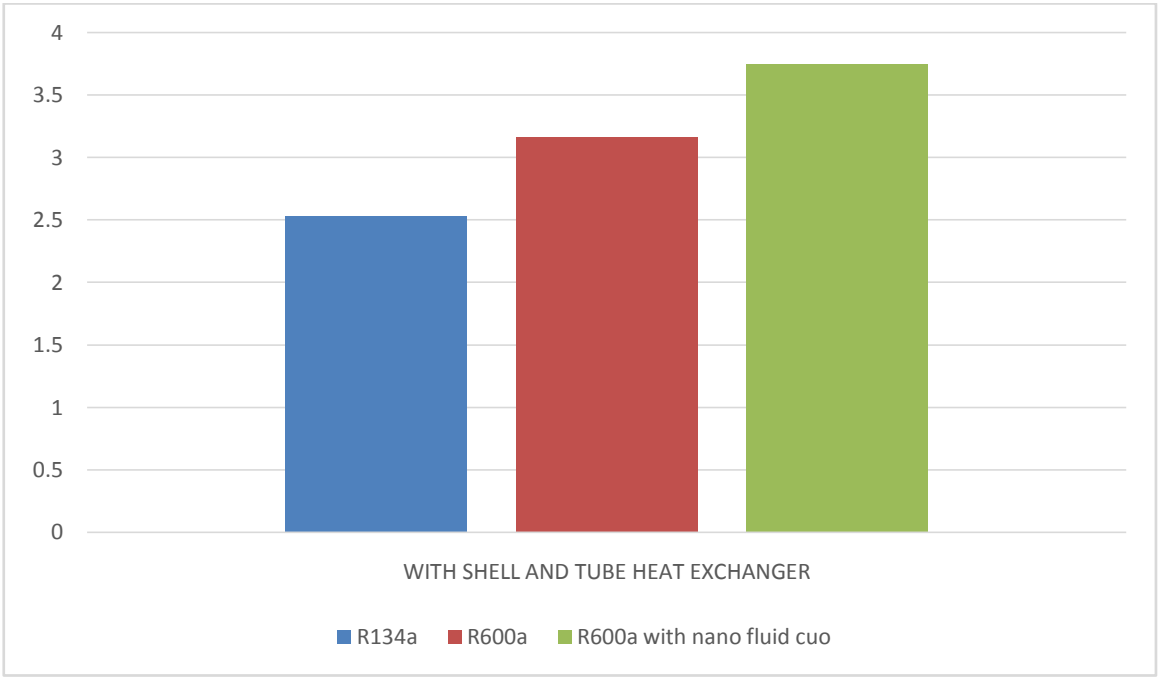
WORKING OF SHELL AND TUBE CONDENSER

Fig 2 shows the working of shell&tube condenser. Shell&tubecondenser consist of series of tubes. One set of these tubes contains the fluid that must be either heated or cooled. The second fluid runs over the tubes that are being heated or cooled so that it can either provide the heat or absorb the heat required. The condenser is a material of copper laid longitudinally on a water tray with a shallow of water.. These components were inserted inside a rectangular duct. The condenser rejects heat to the air by evaporation of some water surrounding the tubes, and the air is evaporative cooled by the basin water .

EXPERIMENTALRESULTS

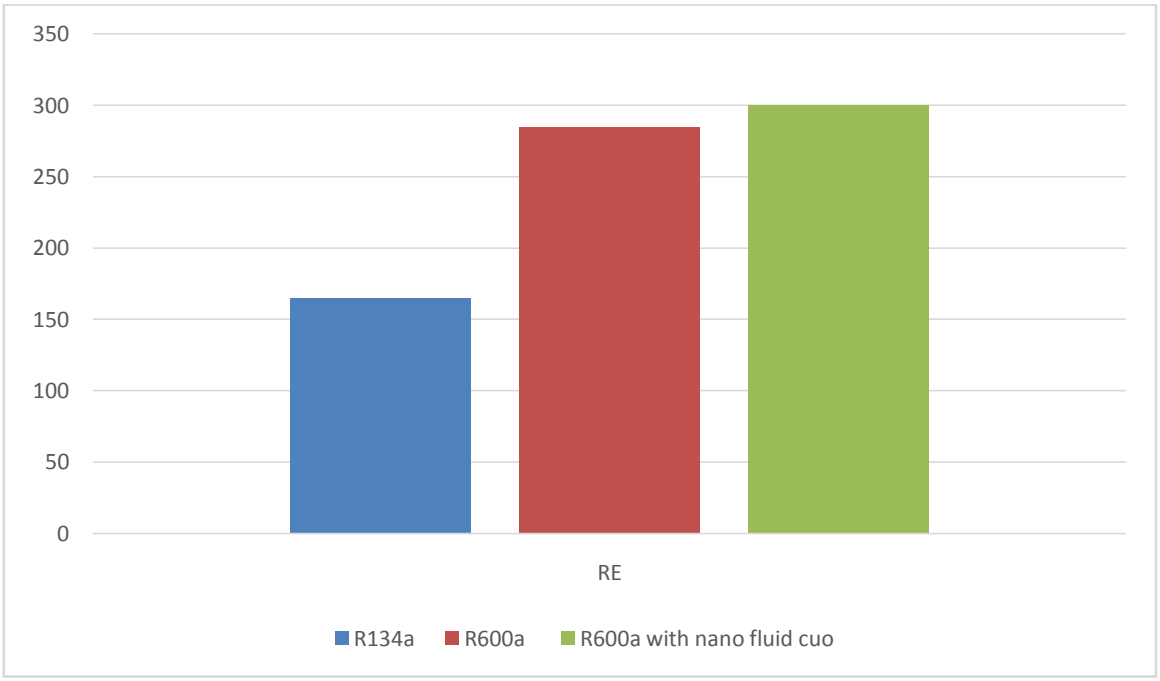
The condensing temperatures for R134a, R600a and R600a/CuO/POE oil with shell&tube condenser has decreased and lower than normal condenser for both the processes. With help of theshell&tubecondenser subcooling has placed and more temperature of condenser decreases enormously.. The condensing temperature of R134a, R600a/CuO/POE oil refrigerant is lower than the R600a because of CuOnano particles has more heat transfer rate than normal lubricant oil. Inboth

A) Comparison of Coefficient of Performance (COP)



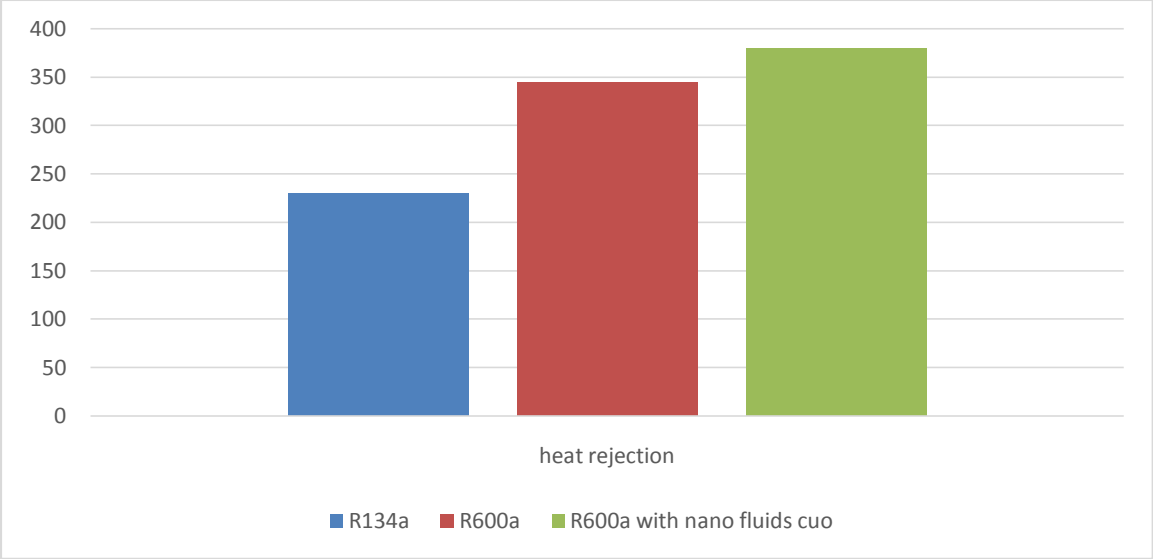
The above graph shows that the comparison of Coefficient of Performance (COP) of a VCR system with shell and tube heat exchanger with R134a,R600a and R600a with cuo nano fluid with POE oil refrigerants this graph is concludes that Coefficient of Performance (COP) VCR system with R600a/cuo/POE oil lubrication has a high Coefficient of Performance (COP) compare with R600a and R134a

B) comparison of refrigeration effect throught the experiment



The above graph shows that the comparison of heat rejection of a VCR system with shell and tube heat exchanger with R134a,R600a and R600a with cuo nano fluid with POE oil refrigerants this graph is concludes that heat rejection system with R600a/cuo/POE oil lubrication has a high heat rejection compare with R600a and R134a

C) Comparison of Heat rejectionthrought the experiment



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CONCLUSION

- the comparison of Coefficient of Performance (COP) of a VCR system with shell and tube heat exchanger with R134a,R600a and R600a with cuo nano fluid with POE oil refrigerants this graph is concludes that Coefficient of Performance (COP) VCR system with R600a/cuo/POE oil lubrication has a high Coefficient of Performance (COP) compare with R600a and R134a

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