

# PERFORMANCE OF SERPENTINE CONDENSER SUB COOLING EFFECT ON THE VAPOUR COMPRESSION REFRIGERATION SYSTEM USING R600A

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**Abstract:** In this paper, Performance of serpentine condenser sub cooling effect on the vapour compression refrigeration system using R600a is presented, which operates using directly alternatives refrigerants, have poorer energy parameters compared with R134a. The cooling capacity amounts are also desired to be kept constant while changing the refrigerant of the systems originally designed and constructed to work with R134a. In order to achieve this aim, performance of R600a refrigerant was investigated by a serpentine condenser to following Liquid-suction heat exchanger for a refrigerator operating with R134a. Therefore, smaller discharge pressure of the compressor, decreased electricity consumption, increased in sub cooling temperature and enhanced cooling capacity amounts were intended in this study. The results obtained through this study have shown that, in the sub cooling temperature interval from 0°C to 14°C, the condenser additive surface is lower for R600a refrigerant compared to R134a COP increased up to 16.5% under a sub cooling temperature of 8°C to 14°C. The results in increased of COP in vapour compression refrigeration system as a result of using R600a as an alternative to R134a with the presence of a serpentine condenser and Liquid-suction heat exchanger in the system.

**Key words-** Domestic refrigerator, Serpentine condenser, subcooling, Coefficient of performance (COP), LSHE

## 1. INTRODUCTION:

The subcooling effect on the efficiency of vapour compression systems has been studied theoretically and experimentally presented a theoretical study through which it shows that, the refrigerants having a large latent heat of vaporisation tend to benefit less from condenser subcooling. Experimentally studied the condenser subcooling effect on the performance of the refrigeration system. Results show that, the refrigerating COP increases with the rise in subcooling temperature from 6°C to 18°C for all three refrigerants R134a, R12 and R152a. Numerically and experimentally investigated the serpentine condenser performance used in domestic refrigerator using the R134a and R12 as refrigerants under different operating conditions. The energetic analysis of a vapour compression refrigeration system is studied experimentally by Results prove that dedicated subcooling can be used for increasing cooling capacity and efficiency. In the same way, investigated the behaviour of a dedicated mechanical subcooling system for different subcooling temperatures. Analytically, studied the heat transfer correlation for radiation and natural draft from serpentine exchangers used in domestic refrigerators. A comparative study of low GWP refrigerants used in vapour compression refrigerators is presented by. The optimization of serpentine condenser efficiency under various parameters has been investigated by many researchers the purpose of this paper is to study the subcooling effect on the performance of the vapour compression refrigeration system using R12, R134a, and R600a as refrigerants. In the first part, an analysis methodology for a subcooling cycle is presented in order to determine the COP under various subcooling temperatures and different pressure ratios. An analytical development has been presented in second part which is devoted to calculate the condenser additive surface of the application apparatus 350S for different refrigerants.

## 2. RESEARCH METHOD:

### *Experimental apparatus and procedure:*

The tried refrigerator system has an aggregate volume of 215L. The detailed technical specifications of the refrigerator shows that the serpentine condenser SC, and the compressor were located inside the base of the refrigerator. Both the air inlet and outlet grilles were set in the back panel and separated from the serpentine condenser. As is illustrated in the wire diameter, the tube outside diameter and the tube thickness of the serpentine condenser were 1.4 mm, 4.76 mm and 0.71 mm, respectively. The section area of the centre and the gap between the SC and its enclosing structure accounts for about 50% of total area, as is illustrated. Hence, some heat exchange will get around the liquid suction line due to a smaller pressure will be increased in the conventional situation. Consequently, this heat rarely contacted with the serpentine condenser and exchanged less heat with in the refrigerant, thus increase the serpentine condenser performance.

**Test procedures:**

The serpentine condenser is used to improve the performance of the refrigerator. By implementing the serpentine condenser effective cooling takes place in the refrigerator, so that it reduce the compressor work by used liquid suction heat exchanger. The refrigeration system experimentation was carried out with

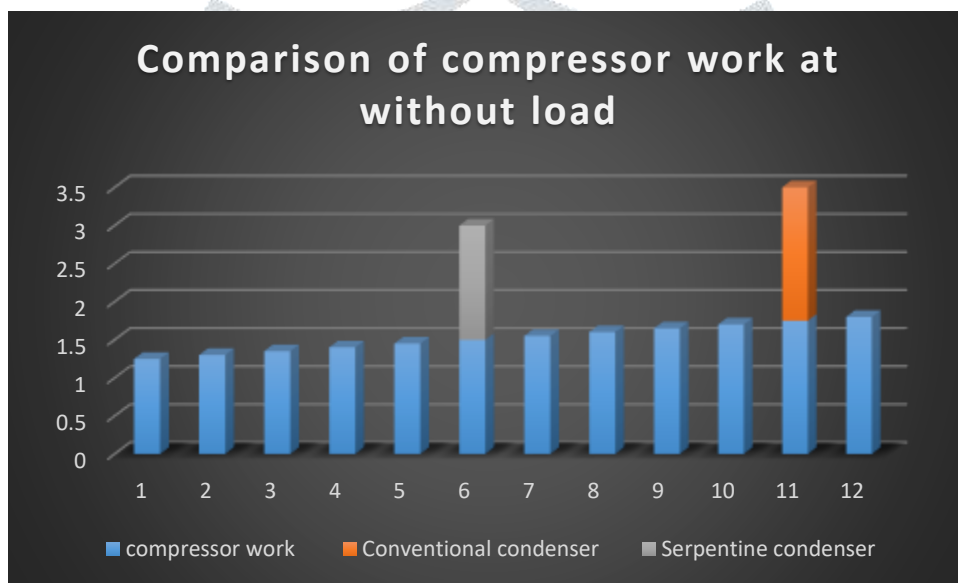
1. Conventional VCR system with R600a as refrigerant.
2. VCR System with R600a as refrigerant with serpentine condenser without load.
3. VCR system with R600a as refrigerant with serpentine condensed with load.
4. VCR system with R600a as refrigerant with serpentine condensed without load subcooling effect
5. VCR system with R600a as refrigerant with serpentine condensed with load subcooling effect

Experiments are tired all cases and also the values of pressures and temperatures are tabulated and calculations are done.

**3. RESULTS AND DISCUSSION:**

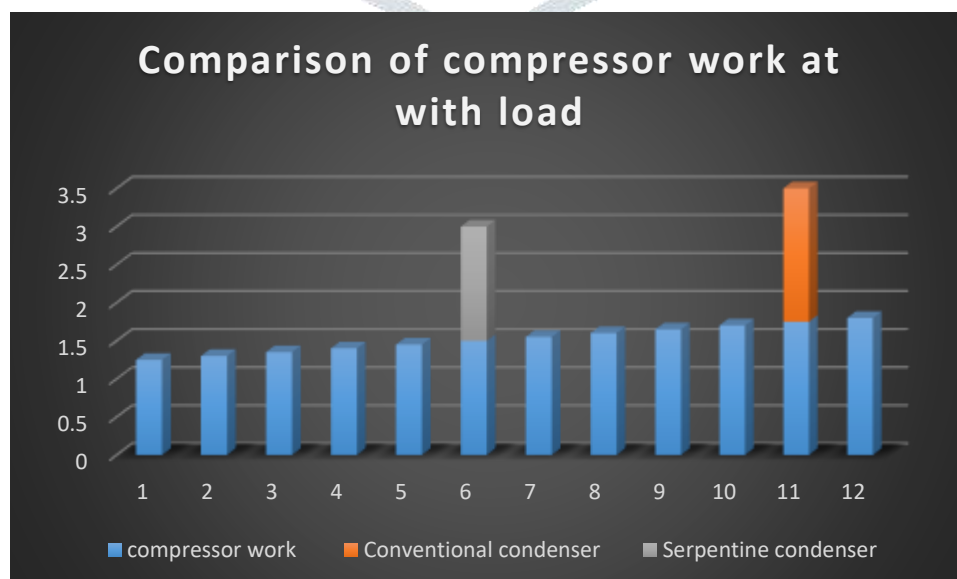
The effect of the sub cooling temperature on the coefficient of performance (COP) obtained numerically for the three refrigerants R12, R134a and R600a, under different cases is showed in below

**3.1. COMPARISON OF COMPRESSOR WORK AT WITHOUT LOAD CONDITION**



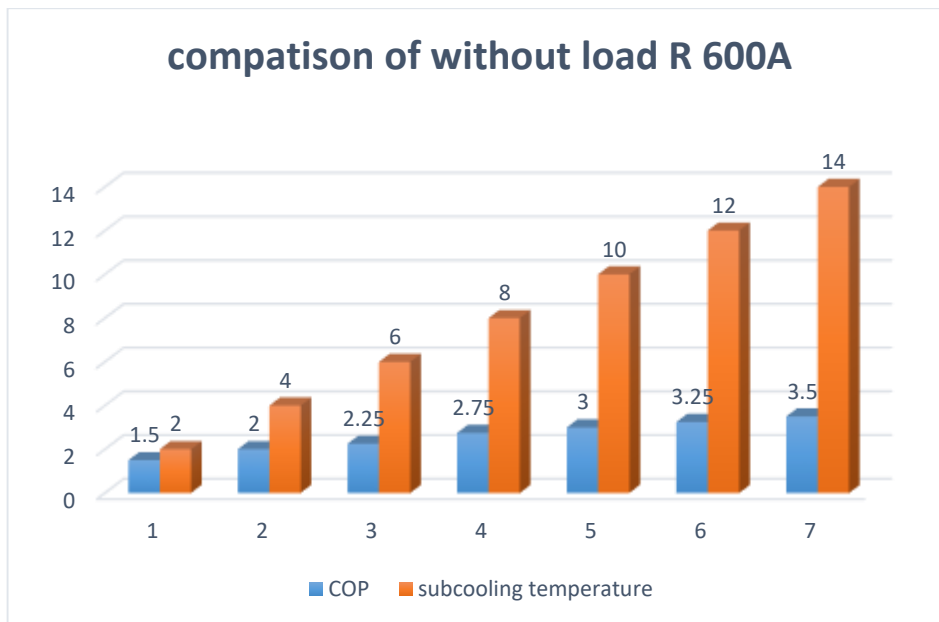
From fig 3.1, It is clear that compressor work of the modification refrigeration system decreased by 25% when compressed with conventional system

**3.2. COMPARISON OF COMPRESSOR WORK AT WITH LOAD CONDITION**



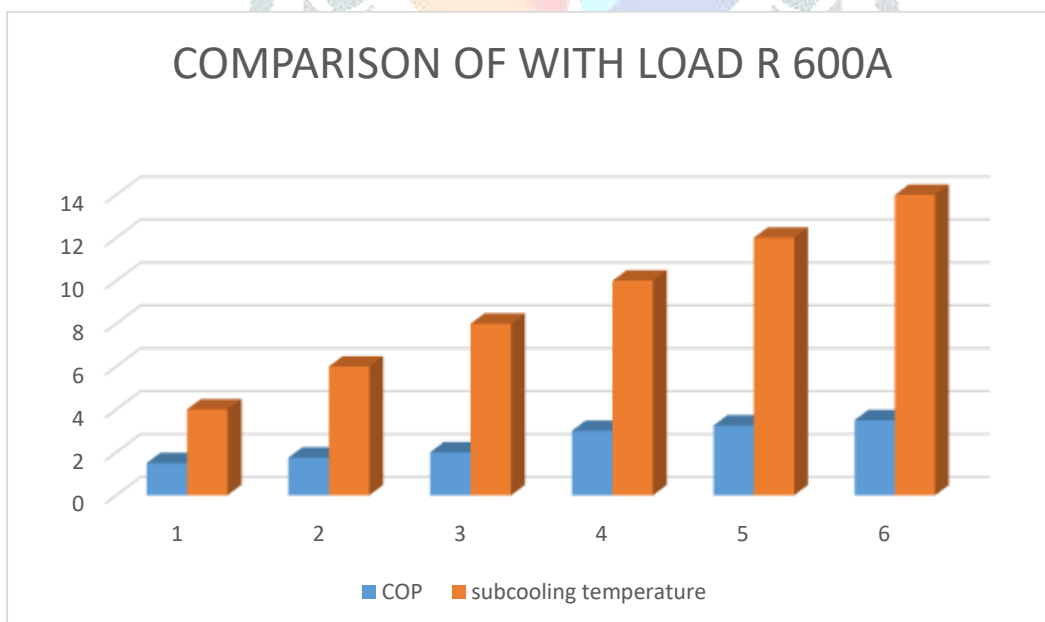
From fig 3.2, It is clear that compressor work of the modification refrigeration system decreased by 16.5% when compressed with conventional system

**3.3. COMPARISON OF COP AT WITHOUT LOAD CONDITION**



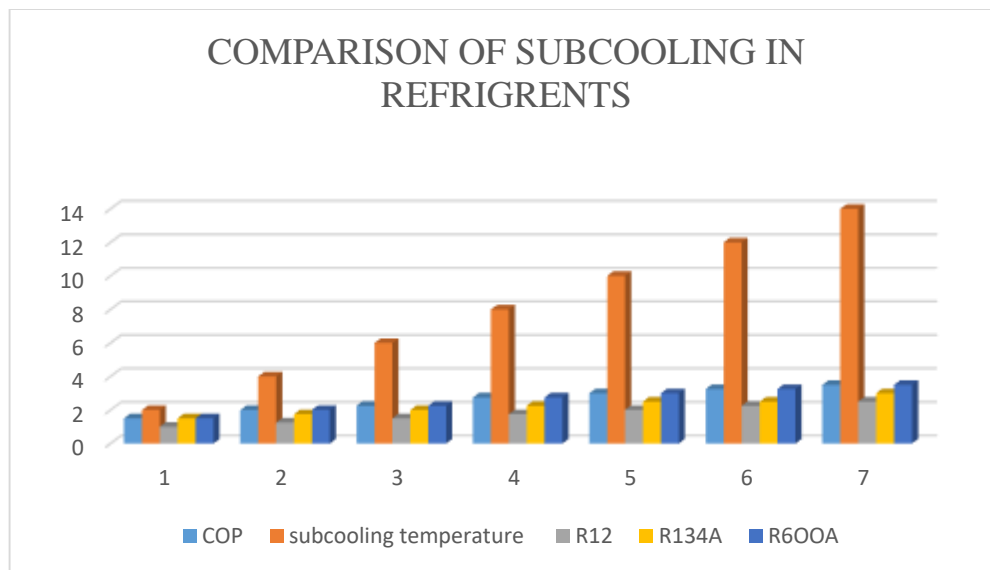
From fig 3.3.1, It is clear that cop will be increased 16.5% when compared with conventional system in serpentine condenser

**3.4. COMPARISON OF COP AT WITH LOAD CONDITION**



From fig 3.4.1, It is clear that cop will be increased 11% when compared with conventional system in serpentine condenser

### 3.5. COMPARISON OF COP AT WITH SUBCOOLING CONDITION



From fig 3.5.1. The effect of subcooling temperature on the performance coefficient of vapour cycle refrigeration operating under different refrigerants (a) R134a, (b) R12, (c) R600a.

### 4. CONCLUSION

This study provides the performance of the subcooling effect on the COP of vapor compression refrigeration system and its serpentine condenser additive surface by using the R134a, R12 and R600a under various pressure ratios. It presents a contribution to the development of a methodology making it possible to predict the condenser subcooling impact. It was found that the COP increases with the increase of the subcooling temperature for all three refrigerants. In the range of subcooling temperature from 0°C to 14°C, R600a presents the greatest COP improvement compared to R134a. Therefore, the substitution of R134a by R600a in this range of subcooling is useful in order to generate a good thermo-economic output. The execution of the refrigeration system is through the condenser assist to increase COP. In the modified system, due to the combined effect of 12mm fins spaced condenser, And the performance of the system is increased by 16.5% , compressor work and power consumption is reduced

### 5. REFERENCES

- [1] Cerri, G, "Identification of Domestic Refrigerator Models including Cold Storage", proceedings of the 20th international congress of refrigeration, 2003, Washington, USA
- [2] Maltini et al, "Design and performances of a constant temperature compartment for domestic refrigerator", proceedings of the 9th international congress on engineering and food, 2004, Montpellier, France
- [3] Belen Zalba et al, "Free cooling of builings with phase change materials", International Journal of Refrigeration
- [4] Azzouz K, D. Leduq, J. Guilpart and D. Gobin, "Improving the energy efficiency of a vapor compression system using a phase change material", proceedings of the 2nd conferece on phase change material and slurry, 2005, Yverdon-les-Bains, Switzerland
- [5] Rezaur Rahman, Md. Arafat Hossain, Shubhrakanti Das & Adhan Hasan, "performance enhancement of a domestic refrigerator by PCM," Global journals of research in engineering mechanical and mechanics engineering, vol.13 issue 10,2013.
- [6] V.S. Hajare, B.S Gawali "Experimental study of latent heat storage system using Nano mixed phase change material," IJETMAS., vol. 3, issue 8, Aug.2015.