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The Sub cooled Air-conditioning System using Evaporative Condenser

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***Abstract*—The paper is the analysis of improvement of coefficient of performance of Refrigeration and Air Conditioning Test System. The most used method to increase the coefficient of performance of system is sub cooling of refrigerant [1]. Here paper indicates the set up used for experimental analysis to improve the COP of the system.**

The key components selected for experimental analysis of COP are mainly evaporator, hermetically sealed compressor, air cooled condenser, thermo static expansion valve etc. The function of condenser in refrigeration system is to desuperheat and condense the compressor discharge vapour, frequently to sub cool the refrigerant.

Here the set up includes the evaporative condenser instead of air-cooled condenser. The comparative analysis shows there is an increase in COP of the system by 9.5%

Keywords—Subcooling, Evaporative condenser, COP

I. INTRODUCTION

In conventional set up, air-cooled condenser is used. In the modified set up, instead of air cooled condenser, evaporative condenser is used. Sub cooling is used to increase the refrigeration effect. In Technical terms, Sub cooling is simply the amount of heat removed below the refrigerants condensing temperature at a particular pressure or it can defined as the process by which a saturated liquid refrigerant is cooled below the saturation temperature, forcing to change its phase completely.

The modified condenser consists of condenser tubes, which are already in air-cooled mode. Cold water is circulated all over the tubes carrying the refrigerant. The refrigerant within the tubes is desuperheated and then it quickly reaches the saturation temperature where the gas is condensed into liquid.

II. METHODS TO IMPROVE COP OF AIR-CONDITIONING SYSTEM

The commonly used methods to improve coefficient of performance of systems are:

(1) Sub cooling

(2) Adding additives to refrigerant

(3) Liquid Pressure Amplification

Among all these methods, Sub cooling is used in the experimental analysis of improvement of COP of the system [5]. The process of sub cooling is carried out by circulating more quantity of cooling water over the condenser tubes [4].

III. EXPERIMENTAL METHOD SELECTED TO IMPROVE COP OF AIR CONDITIONING SYSTEM

As shown in Fig. 1 evaporative condenser is used to improve the COP of the system. It consists of a coil in which refrigerant is flowing and condensing inside, and the other surface is wetted with water and exposed to steam of air to which heat is rejected principally by evaporation of water. The coils are made of copper in multiple circuits and passes. The coil has arrangement for cleaning water under fouling water condition

The wetting of coil is done with the help of re-circulating of water pan due to assembly of submersible pump. The water distribution mainly comprises of nozzles for spray of atomized water on the coils.

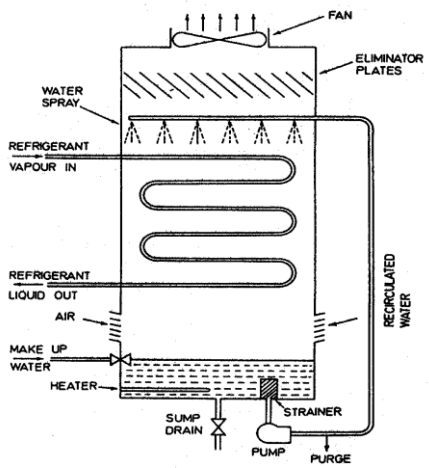
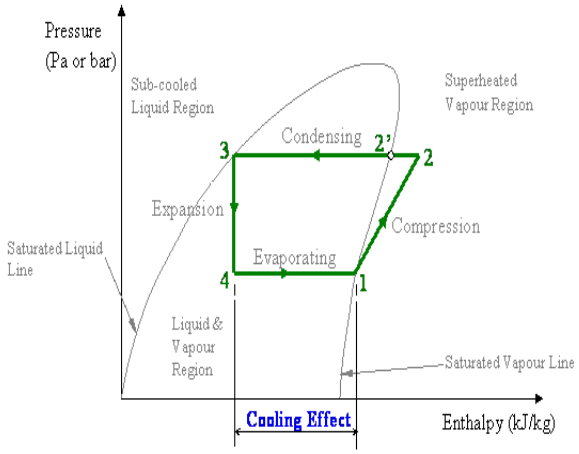


Figure 1: Line diagram of Evaporative condenser

Modified evaporative condenser utilizes forced circulation of air with a fan to either blow or to guide air through unit. Effective elimination of moisture from the leaving air steam by plates is essential to prevent projection of rust, which can deposit moisture on the surrounding surfaces.

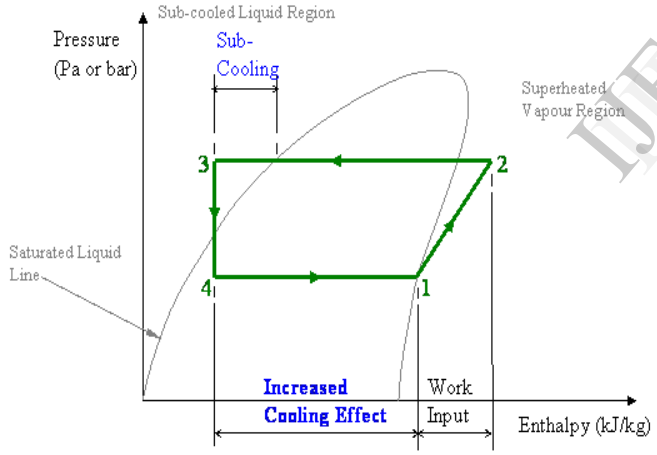
IV. COMPARISON OF P-H DIAGRAMS

P-h diagram for conventional refrigeration cycle is shown in the Fig. 2



p-H Diagram of Refrigeration Cycle

While Fig. 4 shows P-h diagram for refrigeration cycle with sub cooling. This indicates that the refrigerating effect is improved by sub cooling method. Sub cooling is taken placed when the refrigerant is cooled through some more degrees before entering the throttle valve



p-H Diagram of Refrigeration Cycle with Sub-Cooling

The Fig. 3 shows the refrigerant, during condensation process 2-3' is cooled below the saturation temperature before expansion by throttling. Such a process is called sub cooling of refrigerant and is generally done along the liquid line. The ultimate effect of sub cooling is to increase the COP under the same set of condition.

V. SPECIFICATION OF EXISTING EXPERIMENTAL SET UP

Fig. 4 shows the line diagram for existing experimental set up with following specification:

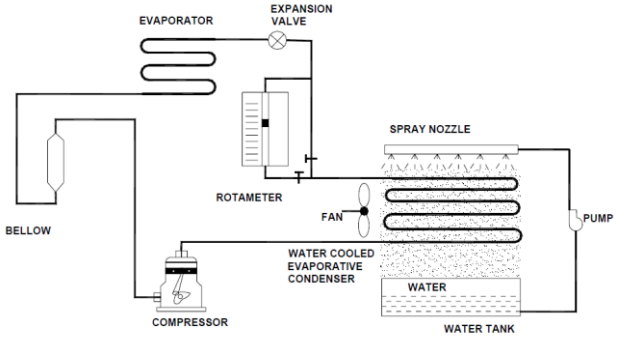


Figure 4: Line diagram of existing experimental set up

(I) Compressor : Kirloskar, R22 refrigerant, 1.5 ton
(II) Condenser : Air cooled system
(III) Evaporator : Cooling coil, fin type
(IV) Expansion valve : TXV type

VI. MODIFICATION IN EXISTING SET UP

Fig. 5 shows the modified experimental set up.

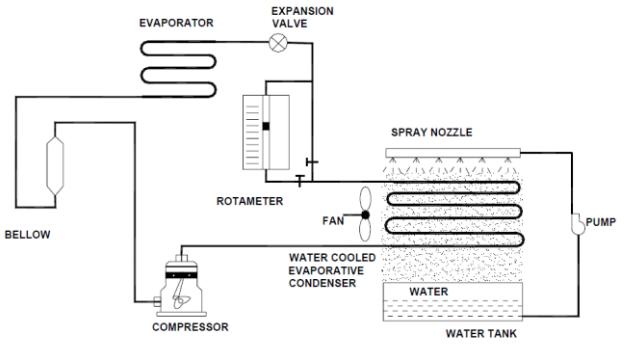


Figure 5: Modified experimental set up

The mofication are as follows:

a) Water cooling system: Evaporative condenser

b) Pump: Submersible pump is attached to the base of water filled tube to circulate water over the condenser coils.

c) PVC pipes: 2 nos, Length- 2 ft, Diameter- 1.5 inch

d) Clamps: Various fittings like clamps, nuts, bolts were used to told the set upin place

VII. COP COMPARISON

The comparison of COP of air cooled and water cooled condensing system

Sr.No	COP (Air cooled Condenser)	COP (Water cooled Condenser)
1	1.64	1.78
2	1.82	1.98
3	1.94	2.09

The comparitive analysis of COP shows that it increases by nearly around 9 to 9.5 % for water cooled condenser which is quite outstanding.

VIII. FUTURE SCOPE

There are so many limitations for evaporative condenser like the construction of water cooled condenser is complicated and thus design is not quite compact. The initial cost of the system is high so does the maintenance cost. The corrosion may take place in the pipes which carrying water inside, therefore fouling effect are high.

IX. CONCLUSION

The main aim of any system is to get maximum possible output using least possible input. Experimental analysis shows that, the evaporator condenser has high COP nearly about 9 to 9.5 % compare to air cooled condensing system. The sub cooling can be used more effectively to improve the refrigeration effect. Though there is an enough future work can still be done to improve the performance of the system.

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