International Journal of Advance Engineering and Research Development
Scientific Journal of Impact Factor (SJIF): 4.72
Special Issue SIEICON-2017,April -2017
e-ISSN : 2348-4470 p-ISSN : 2348-6406

Experimental Investigation on Heat Pump

Experiment Testing of Heat Pump

Sharadkumar Chhantbar[1], Kirit Kachhela[2]

[1,2]*Assistant Professor, Mechanical Engineering Department,, Sigma Institute of Engineering*

Abstract — *in this research, the performance of heat pump using refrigerant to water is experimentally investigated. The experiments were performed for the range of 30°C to 35°C atmospheric temperature. The heat pump, using R-134a was set for the various load, maintained by evaporator water flow rate. The performance of heat pump was carried out by varying the parameters like condenser water temperature and mass flow rate, evaporator water temperature and mass flow rate. The heating coefficients of performance were calculated based on experimental values. From the experimental results found that by change in mass flow rate of evaporator water the temperature at evaporator side is increases and increment in atmospheric temperature the, C.O.P of the system lies to range1.4 to 1.9. It is seen that C.O.P of heat pump is mainly depends upon parameters such as mass flow rate and temperature. Temperature of condenser water outlet is achieved up to 45°C.*

Keywords-*Heating performance, Compressor work, cooling rate*

I. INTRODUCTION

A heat pump is a device that transfers heat energy from a higher region called “heat source” and a lower region called a "heat sink". Heat pumps are develops to work on thermal energy in the opposite direction of heat transfer by absorbing heat from a cold space and releasing it to hot region. An external power is used to run heat pump to transfer energy from the heat source to the heat sink

The air conditioners and freezers are examples of heat pumps, the term "heat pump" is mainly used for HVAC (heating, ventilating, and air conditioning) devices which are castoff for space heating and cooling application. When a heat pump is used for heating, it works on the same basic refrigeration-type cycle used by an air conditioner or a refrigerator and if it works in the opposite direction - releasing heat into the conditioned space rather than the surrounding environment. [1] In this use, heat pumps generally draw heat from the cooler external air or from the ground for climates with moderate heating and cooling needs, heat pumps offer an energy-efficient alternative to furnaces and air conditioners. Like your refrigerator, heat pumps use electricity to move heat from a cool space to a warm space, making the cool space cooler and the warm space warmer. [2]

During the heating season, heat pumps move heat from the cool outdoors into your warm house and during the cooling season, heat pumps move heat from your cool house into the warm outdoors. Because they move heat rather than generate heat, heat pumps can provide equivalent space conditioning at as little as one quarter of the cost of operating conventional heating or cooling appliances. The capacity and performance of air source heat pumps decrease rapidly with decreasing ambient temperature during the heating reason, And with increasing ambient temperature during the cooling season [3].

II. EXPERIMENTAL SETUP

Experimental setup is shown below. The mechanism consist compressor run by electric power, water cooled condenser, thermal expansion valve and evaporator to cool water. The water inlet temperature for evaporator and condenser is set as atmospheric condition (Minimum 26°C to Maximum 35°C) and outlet temperature range of evaporator is set to 0°C to 0°C. The refrigerant flow rate of the system is controlled by thermostatic type expansion valve. The Rota meter is placed on a cooling line and heating line to control the mass flow rate of water for evaporator and condenser respectively. All the flow pipes are insulated to minimized heat loss from the system.

Table 1. Details of system components.

System Components	Details
Compressor	Emerson climate tech, Copeland brand, 1 ph 180-260 V AC
Condenser	Concentric tube type heat exchanger, inner tube ID mm, outer tube ID
Expansion valve	Thermostatic expansion valve
Evaporator	Concentric tube type heat exchanger
Rota meter	Range: 40 to 400 LPH water
Accumulator	Connection size 1/2", Design pressure : 2068 Kpa

The sensor is attached with the experimental setup to record temperature of evaporator line, condenser line and refrigerant line. The power utilization by compressor is calculated by meter reading installed with setup itself. The test were performed at different temperature dependent on atmospheric condition and particular mass flow rate. Each experimental data recorded after water flow rate and temperature were stable.

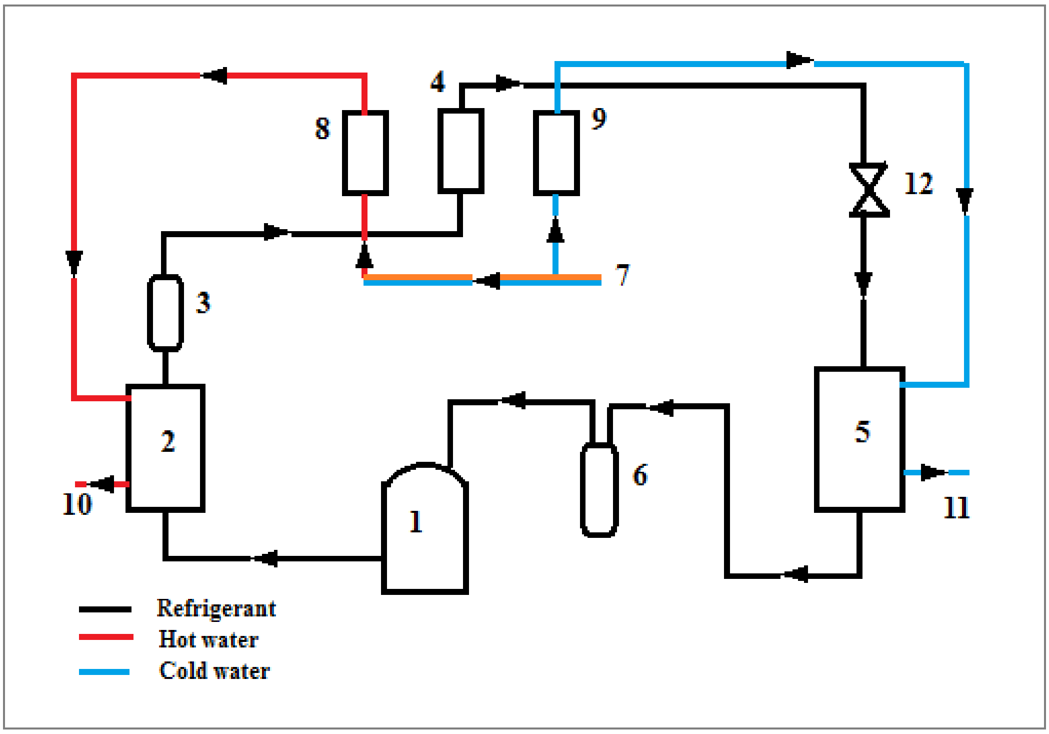

Figure 2.1 Schematic of Heat Pump System

From the figure 2.1, observed that the refrigerant flows from 1-Compressor to 2-Condenser and passes through 3-Receiver. The flow of refrigerant is measured by 4-rotameter and passed to 5-evaporator through 12-expansion valve. The condenser and evaporator are concentric tube type heat exchanger. Refrigerant flows through inner tube which is surrounded by water flow and flow rate is measured by 8, 9- rota meter. Point 7 indicates water inlet and 10, 11 shows outlet from condenser and evaporator respectively.

The heat transfer and heating coefficient of performance (C.O.P) of the heat pump were calculated from following equation:

$$Q_c = m_c c_{pc}(T_{ci} - T_{co}) \tag{1}$$

$$Q_h = m_h c_{ph}(T_{ho} - T_{hi}) \tag{2}$$

$$COP_{heat} = \frac{Q_c}{W_c} = \frac{m_c c_{pc}(T_{ci} - T_{co})}{W_c} \tag{3}$$

Where, Q_h is the rate of heat transfer removed by condenser, Q_c is the rate of heat transfer removed by evaporator, mc and mh indicates, mass flow rate of cold water and hot water respectively. Th and Tc show, hot water and cold water temperature respectively. mc and mh represents, mass flow rate of cold water and hot water respectively. Wc is work supplied to compressor.

III. EXPERIMENTAL RESULTS AND DISCUSSION

To experiments were conducted for four different conditions. Each reading taken at time interval of 100 minutes. The first trial readings for the performance were, atmospheric temperature 26°C, mass flow rate for condenser was and for evaporator was and mass flow rate of refrigeration was and power consumption was for 10 pulse of energy meter.

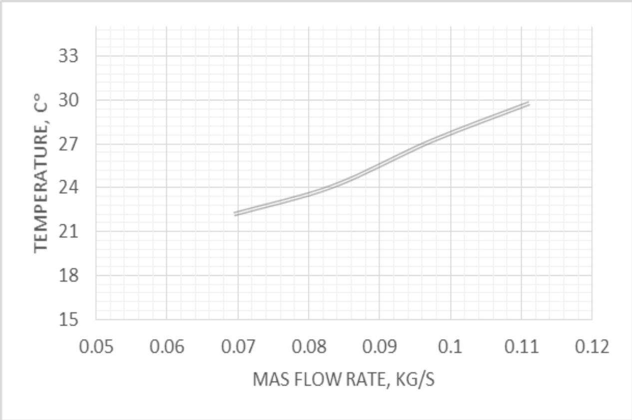

Figure 3.1 Temp Vs Mass flow

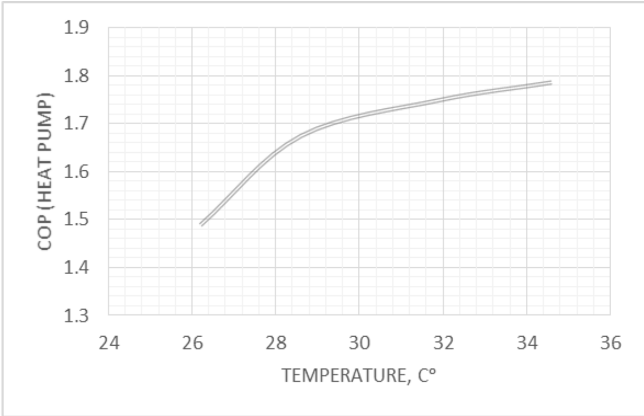

Figure 3.2 COP hp Vs Temp.

Figure 3.1 shows the relation between mass flow rate and evaporator temperature. From the graphical representation we observed that the exit temperature of water form evaporator varies with mass flow rate when compressor works at steady. Figure 3.2 represents variation in COP of heat pump with change in atmospheric conditions while the exit temperature of evaporator kept constant, due to increase in atmospheric temperature the COP of heat pump is slightly increases.

IV. CONCLUSION

From the experiment we conclude that the COP of heat pump is mostly dependent on rate of heat transfer in condenser side and atmospheric temperature. When temperature of evaporator side kept constant, the heating COP was increases. It is why the temperature difference between cooling side and heating side is increases. The lower temperature from evaporator varies with mass flow rate of water.

REFERENCES

[1]. Quinghai luo, Guangfa Tang and Guangcai Gong, Experimental Study on Thermoelectric Heat Pump for Energy Recovering and Local Heatingin Buildings, International Journal on Architectrual Science, Volume 6, Number 4, Page. 173-177, 2005

[2]. Chung Won Cho, Ho Seong Lee, Joung phil Won and Yeon Lee, Measurement and Evaluation of Heating Performance of heat Pump System using Wasted heat from Electric Devices for an Eectric bus, Energies 2012,5,658-669

[3]. Buyukalaca, Ekinci, Yilmaz T, Experimental investigation of Sehyan river and dam lake as heat source-sink for a heat, Energy, 28, 157-169.