

Testing and Performance Analysis on Air Conditioner cum Water Dispenser

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Abstract:-The work on developing the heat pumps for space conditioning and water heating has been gone for half a century. The earlier water heating pumps and air to water heating pumps gives only hot water and space conditioning. But in this air conditioning cum water dispenser we get hot and cold water with hot and cold air, thus the system becomes multifunctional. The actual cycles and operating conditions for air and water cycle present in this paper. The paper introduced basic design principles and the test analysis performed in the laboratory. The test results were found encouraging especially the parameters of dispenser output along with air conditioner. The paper also introduced comfort conditions and suitable coefficient of performance with respect to atmospheric condition, without sacrificing the air conditioning output.

I.INTRODUCTION:

Energy saving is one of the key issues not only from the view of energy conservation but also for the support for global environment. Heat pumps were first used by peoples in 1950s for space heating and for domestic water heating.

One major barrier that has affected the popularity of the water heater, water cooler & air conditioner is its primary cost. If a domestic air-conditioner, water-heater & water cooler can be combined, only one set of their key components (like the compressor, the heat exchangers, etc.) is used, the primary cost will be reduced considerably (when compared with using three separate units) and the new equipment becomes multi-functional. An attractive point is that this air conditioner cum water dispenser system can produce hot & cold water as well as hot & cold air.

The space conditioning and water heating system can operates in five modes: water-heating only, space cooling and water heating, space heating and water heating, space cooling, space heating.

II.TEST SET UP AND SYSTEM DESIGN.

The test set-up were manufactured which operates on water heating and cooling as well as air heating and cooling, air and dispenser modes as shown in fig 2.1. which is given as follow:

- 1) Air cycle (mode of operation air conditioning)
- 2) Water cycle (mode of operation dispenser)
- 3) Air/water cycle (mode of operation for air-conditioner cum dispenser).



Fig.2.1 Actual set-up of air conditioner cum water dispenser system



Fig.2.2 Hot water chamber Fig.2.3 Cold water chamber

Fig (2.2) shows an actual diagram of hot water chamber known as condenser in which coil length doubles than that of cold water chamber i.e. evaporator. Length of coil of condenser is 96 feet and 48 numbers of turns. The coil size will be varying for various sizes of drums and requirement of different temperature of water. The selection of a condenser depends upon the capacity of refrigerating system, the type of refrigerant used and type of cooling medium available.

Fig (2.3) shows evaporator in which length of freezing coil is 54 feet and 27 numbers of turns. The evaporator coils cool by using refrigerants latent heat of vaporization to absorb heat from the medium being cooled.

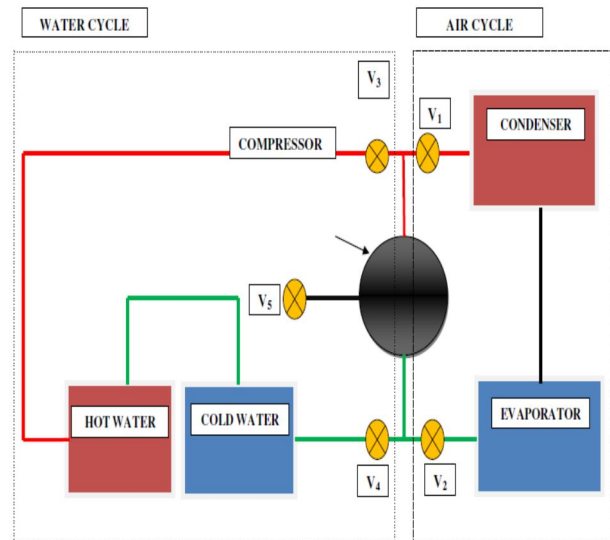


Fig (4):- Schematic arrangement of air conditioner cum water dispenser

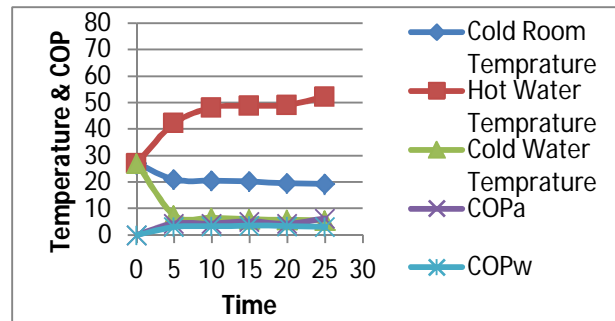
III. WORKING PRINCIPLE OF AIR-CONDITIONER CUM WATER DISPENSER

The schematic diagram of air conditioning water heater system is shown in Figure (4). In this air conditioner cum water dispenser, both the air cycle & water cycle runs on vapour compression refrigeration cycle (VCR cycle). The condenser consist of coils of pipe in which the high pressure & temperature vapour refrigerant is cooled & condensed. The refrigerant, while passing through the condenser, gives up its latent heat to the surrounding condensing medium which is normally air or water. An Evaporator consists of coil of pipe in which the liquid-vapour refrigerant at low pressure and temperature is evaporated and changed into vapour refrigerant at low pressure and temperature. In evaporating, the liquid vapour refrigerant absorbs its latent heat or vapourisation from the medium (air, water) which is to be cooled. The low pressure and temperature vapour refrigerant from evaporator is drawn into the compressor through the inlet or suction valve, where it is compressed to a high pressure and temperature. This high pressure and temperature vapour refrigerant is discharged into the condenser through the delivery pipe

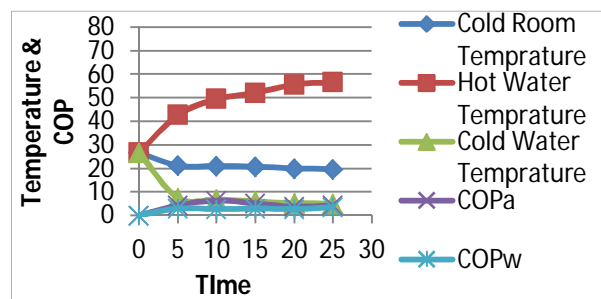
When the water cycle is running, the valves V_3 & V_4 are open whereas the valve V_1 & V_2 are closed. And at the time of air cycle valve V_1 & V_2 are open while valves V_3 & V_4 are closed as shown in Fig (4).

IV. RESULT & DISCUSSION:

From the performance of the test-rig, graphs are plotted between Time (min) vs Temperature ($^{\circ}\text{C}$) at different ambient temperature for air cycle and water cycle which is shown as follows.



(a) Ambient Temperature at 26.6 $^{\circ}\text{C}$

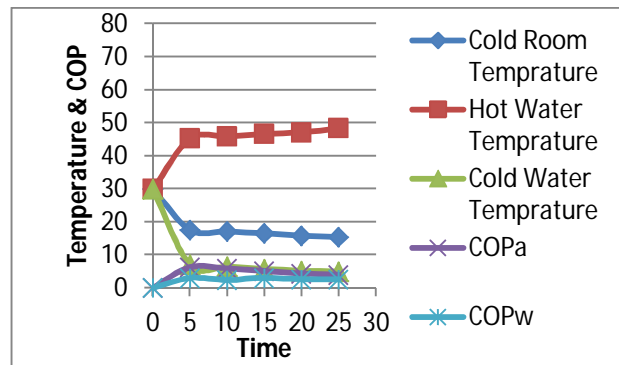


(b) Ambient Temperature at 27.1 $^{\circ}\text{C}$

From above graph(a), It can be observed that cold room temperature is first decrease from 28 $^{\circ}\text{C}$ to 20 $^{\circ}\text{C}$.

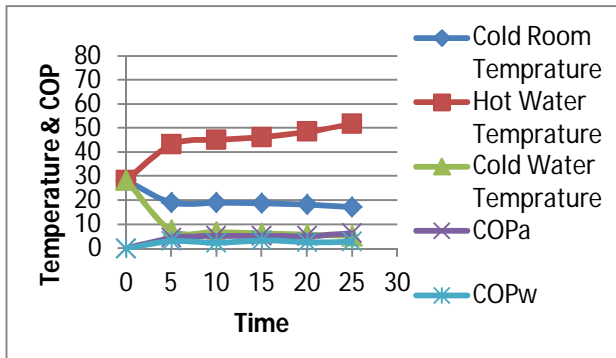
Hot water temperature is increases from 28⁰C to 58⁰C. Cold water temperature is decrease from 30⁰C to 5⁰C respectively. The COP of air is is first increase upto 5 and futher varying in the range 4 to 5 . COP of water is firstly increase upto 3 and then steady.

From graph (b), It can be observed that cold room temperature is first decrease from 28⁰C to 19⁰C . Hot water temperature is increases from 28⁰C to 53⁰C. Cold water temperature is decrease from 28⁰C to 4⁰C respectively. The COP of air is is first increase upto 5 and futher varying in the range 4 to 5 . COP of water is firstly increase upto 3 and then steady.

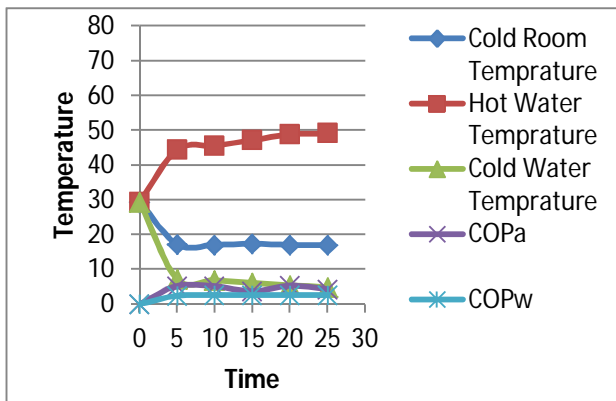


(e) Ambient Temperture at 29.9 °C

From above graph (e), It can be observed that cold room temperature is first decrease from 30⁰C to 17⁰C . Hot water temperature is increases from 30⁰C to 48⁰C. Cold water temperature is decrease from 30⁰C to 5⁰C respectively. The COP of air is is first increase upto 5 and futher varying in the range 4 to 5 . COP of water is firstly increase upto 3 and then steady.



(c) Ambient Temperture at 28.3 °C



(d) Ambient Temperture at 29.4 °C

From above graph(c), It can be observed that cold room temperature is first decrease from 30⁰C to 18⁰C . Hot water temperature is increases from 30⁰C to 52⁰C. Cold water temperature is decrease from 30⁰C to 5⁰C respectively. The COP of air is is first increase upto 5 and futher varying in the range 5 to 6 . COP of water is firstly increase upto 3 and then steady.

From graph (d), It can be observed that cold room temperature is first decrease from 30⁰C to 18⁰C . Hot water temperature is increases from 30⁰C to 49⁰C. Cold water temperature is decrease from 30⁰C to 5⁰C respectively. The COP of air is is first increase upto 5 and futher varying in the range 4 to 5 . COP of water is firstly increase upto 3 and then steady.

By considering all the graph and tables shown in above it should be noted that, The cold room temperature line shows that, the room temperature is decreased from 28.26 °C at higher rate in first five minute upto 19.22 °C then it should be decreases at slow rate and maintained upto the required temperature in range 18-20 °C. The COP of air cycle increases gradually at starting and decreases at the ending. Between 5-10 min it shows highest value of COP.

The hot water and cold water temperature line starts from the ambient temperature i.e. 25.58⁰C. Hot water temperature increases upto 43.52 °C and at the end of 25 min it maintain between 40-60 °C while the cold water temperature available upto 13.3 °C and at the end of 25 min it maintain between 4.5-5.5 °C. The COP of water cycle increases gradually at starting and maintained upto 2.85 on an average.

V. CONCLUSION:

The air-conditioner cum water dispenser was manufactured for air, water & air-water cycle combined. The air cycle provides good results with conventional optimum efficiency. The water cycle also predicts better results, but then water cycle alone is not useful. Hence the combine air conditioner cum dispenser by utilizing conventional air-conditioning. The dispenser gives required efficiency in terms of coefficient of performance.

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