STUDIES ON PERFORMANCE OF SOLAR ADSORPTION REFRIGERATION COOLING SYSTEM

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ABSTRACT

The heat driving technologies like an adsorption cooling systems and the vapour adsorption systems are environmentally friendly. Here we are using thermal compression in this type of system saves the resource of fast-depleting fossil fuels. The present work what we have done is the development of vapour adsorption based cooling system by using solar energy because of solar energy is environmentally friendly as well as it's a renewable energy. The distribution of a temperature profile of silica gel of single bed has been developed through a method of finite difference method, the test rig is designed based on the materials what we are using. In this present work, we are measured solar heat flux, because of to know the solar panels capacity. In this present, we have been checked the performance of an adsorption phase cooling system for different variables.

KEYWORDS: Silica-gel, Single Bed Adsorption Cooling System Set Up & Vaccume Pump

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INTRODUCTION

The energy cost has been increasing exponentially in a worldwide. In the field of industrial cooling is a one of the most energy using sector. Because of that intention, we have been the plan to use the solar energy for cooling. A solution lies in the adsorption cooling system. By producing adsorption cooling system we are not able to reduce or cut down the energy costs and we can also be preserving the environment. In this type of cooling system, we are not using any of the CFCs so our ozone layer is under safe. Generally, greenhouse gases and their damaging effects on an atmosphere have been received raised the attention of following the release the scientific data by a Programme(UNVP) and the (WMO) that show a carbon dioxide to be the main contributor to improve the global warming. HFC-134a is used to operate the domestic freezers, contribute indirectly on a global warming by the amount of a carbon dioxide produced by means of the power plant by generating the electricity to operate the over a unit of its lifetime.

STUDY ON PERFORMANCE OF SINGLE BED ADSORPTION COOLING SYSTEM

To study the performance of the single bed adsorption cooling system by using the silica-gel and water has the working Pair. For studying the performance of single bed adsorption cooling system the following parts are using mainly an evaporator, adsorber, condenser, vacuum pump, and the solar water heating system etc.

Evaporator

The purpose of using the evaporator in adsorption cooling system is to transfer of heat from water present to the adsorbate in order to reduce the temperature present in the water. Because of the adsorbate enters an evaporator as a liquid vapour mixture, evaporator only divided into superheated and saturated sections.

Adsorber

The adsorber is a one compact tube plate type of heat exchanger. In this adsorber the copper tubes are arranged in four rows with 10 tubes in each row, the plates are made up of aluminum, the space between the copper tubes is 6mm over a length of 10 inches.

Condenser

The function of the condenser is to change from vapour phase to a liquid phase. The change from a vapour to liquid or liquid to vapour occurs at one temperature for the pure fluid compound at given pressure. The condenser is used to convert the water vapour coming from an adsorbent block into liquid water in an adsorption cooling system.

Solar Water Heating System

The main purpose of using the solar water heating system in an adsorption cooling is to generate the hot water by utilizing a waste heat or low-grade heat energy like a solar radiation. To heat the water by means of absorbing solar radiations, to heat the water evacuated solar collectors are using.

Vacuum Pump

The Adsorption cooling system the setup should be kept at full vacuum In the adsorption process. The intensity of vacuum is based on the size and also an operating variables. The vacuum pump is used for to generating the required vacuum level. The valve of shut off type and also an assisted by means of tank separation are used control the connection between the vacuum pump and the adsorbent block.

Temperature Measurement

To measure the fluid secondary at inlet and outlet the installed of thermocouples at different points in the test facility, shell space and that of the surface, adsorbent bed module temperatures.

Vacuum Gauge

The vacuum gauge is a pressure measuring device used for an identifying the vacuum level in a test Rig. In order to have the adsorption cooling effect of entire Test Rig circuit must be depressurized in a proper manner with a help of oil cooled rotary vacuum pump.

From above parts we can study the performance of adsorption refrigeration system by varying some parameters like pressure and temperature by using water and silica gel as a working pair.

RESULTS & DISCUSSIONS

Performance of Adsorption Cooling at Various Inlet Pressures at Temp 80°C

Table 1: For evaporator pressure= 670 mm of hg and Temperature= 80°C

Quantity of Water in ml	Thi in °C	Tho in °C	Tei in °C	Teo in °C	Q _A in KW	QR in KW	COP
500	80	63.5	30.8	11.2	1.727	2.062	1.193
750	80	63.9	31.3	12.1	1.674	2.056	1.22
1000	80	63.8	31.1	12.8	1.6957	1.9151	1.129

Table 2: For Evaporator Pressure= 650 mm of hg and Temperature= 80°C

Quantity of Water in ml	Thi in °C	Tho in °C	Tei in °C	Teo in °C	Q _A in KW	QR in KW	COP
500	80	62.4	31.6	13.2	1.842	1.926	1.045
750	80	65.4	31.3	13.9	1.528	1.8213	1.919
1000	80	66.9	31.3	14.2	1.371	1.789	1.304

Table 3: For Evaporator Pressure= 630 mm of hg and Temperature= 80°C

Quantity of Water in ml	Thi in °C	Tho in °C	Tei in °C	Teo in °C	Q _A in KW	QR in KW	COP
500	80	66.7	31	13.6	1.392	1.8213	1.308
750	80	66.3	30.8	13.9	1.528	1.8213	1.284
1000	80	64.7	31.4	12.8	1.601	1.94955	1.215

The above three tables show the calculated values for a temperature of the evaporator are 80°C and the pressure and the load varies in different ways. By observing the all of above we can understand the which variable will get a better performance of coefficient, in temperature 80°C and the pressure of evaporator is 650 mm of hg and the load is 750 ml we get the better performance of coefficient.

Performance of Adsorption Cooling at Various Inlet Pressures at Temp 70°C

Table 4: For Evaporator Pressure= 680 mm of hg and Temperature= 70°C

Quantity of Water in ml	Thi in °C	Tho in °C	Tei in °C	Teo in °C	Q _A in KW	QR in KW	COP
500	70	56.4	30.6	14.8	1.4235	1.653	1.161
750	70	55.4	30.2	14.7	1.528	1.622	1.061
1000	70	54.6	30.2	14.7	1.611	1.622	1.007

Table 5: For Evaporator Pressure= 650 mm of hg and TEMPERATURE= 70°C

Quantity of Water in ml	Thi in °C	Tho in °C	Tei in °C	Teo in °C	Q _A in KW	QR in KW	COP
500	70	55.9	30.2	14.3	1.4759	1.664	1.1276
750	70	56.8	29.4	14.5	1.38171	1.559	1.1282
1000	70	55.5	29.7	14.1	1.5177	1.632	1.07

Table 6: For Evaporator Pressure= 630 mm of hg and Temperature= 70°C

Quantity of water in ml	Thi in °C	Tho in °C	Tei in °C	Teo in °C	Q _A in KW	QR in KW	COP
500	70	55.8	30.5	15.2	1.48	1.60	1.077
750	70	54.3	30.6	14.4	1.64	1.69	1.031
1000	70	54.3	30.4	14.6	1.64	1.65	1.006

The above three tables show the calculated values for a temperature of evaporator are 70°C and the pressure and

the load varies in different ways. By observing the all of above we can understand the which variable will get a better performance of coefficient, in temperature 80°C and the pressure of evaporator is 650 mm of hg and the load is 750 ml we get the better performance of coefficient. In above reading, the better coefficient of performance is 1.1282.

Effect of Pressure on COP

Figure 1: COP V/S Load (Pressure = 670 mm of hg and Temp is 80°C)

Above figure shows the cop variation with respect to load, we can observe the how the cop varies for different loads for constant temperature. The cop is gradually decreases with respect to load decrease.

Figure 2: COP V/S Quantity of water (Pressure = 670 mm of hg and Temp is 80°C)

The above figure shows the cop variation for different conditions for same temperature as well as the same pressure of evaporator. From above figure, we can find the variation of a cop with respect to load in this condition the load increase the cop decreases because of we have been maintained a constant temperature as well as the pressure.

Figure 3: COP V/S Load (Pressure = 630 mm of hg and Temp is 80°C)

The above figure shows the cop variation for different conditions for same temperature as well as the same pressure of evaporator. From above figure we can find the variation of a cop with respect to load in this condition the load increase the cop decreases because of we have been maintained a constant temperature as well as the pressure.

Figure4: COP V/S Load (pressure = 630 mm of hg and Temp is 70 °C)

The above figure shows the cop variation with respect to the load for a temperature of 70 deg Celsius and the pressure of evaporator is 670 mm of hg the cop is gradually decreased with respect to the load.

Figure 5: COP V/S Load (Pressure = 650 mm of hg and Temp is 70 °C)

The above figure shows the cop variation with respect to the load for a temperature of 70 deg Celsius and the pressure of evaporator is 650 mm of hg the cop is gradually decreased with respect to the load.

Figure 6: Comparison of COP V/S Load for Different Variables

The above figure shows the comparison between cop and load for different variables like the pressure is varied, load is varied as well as temperature is also varies in different conditions. We can observe coefficient of performance variation for different variables.

Effect of Time on Evaporator Temperature

The above figure shows how the cooling effect occurs with respect to time; the temperature goes on decreases when the time increases that we can observe from above figure. The above figure 6.11 shows cooling temperature variation in the evaporator for different loads as well as the different pressures how the temperature decreases for different conditions that we can observe from above graph.

Figure 7: Time v/s Evaporator Temperature

CONCLUSIONS AND FUTURE SCOPE

CONCLUSIONS

We have been understood about the difference between the theoretical as well as the experimental results by referring some papers on a refrigeration adsorption cooling system.

- We have measured the solar radiation heat flux by using pyrometer because we going to know the how much capacity of solar panels are required to run the project.
- We have measured the temperature of water collected inside the solar collector tank by fixing of thermocouples.
- We are used water and the silica-gel for adsorbent and adsorbate pair for checking the performance of equipment.
- We have been checking the performance of single bed silica gel by varying different parameters like pressure, temperature, and a load.

FUTURE SCOPE OF WORK

The following are some list of the suggested future works:

- The Adsorption cooling system also can be a studied with two-bed model to get a continuous cooling.
- The number of adsorber bed designs that can be developed to improve a heat and mass transfer performance.
- CFD analysis can be done as a feature work.

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