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DESIGN DEVELOPMENT & ANALYSIS OF HYBRID AIR-CONDITIONER

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ABSTRACT

An Air Conditioner is a system which is used to control temperature, humidity as well as the velocity of air. In our world the major problem is that how to make air conditioning system more efficient and less energy consumption able for better saving of energy. This can be achieved by using non-conventional energy source with conventional energy source. For that here in this paper I purposed a method which is a combination of conventional energy source and non-conventional energy source for preparing hybrid air conditioner. Hybrid air conditioner can be prepared by combination of peltier model, earth heat exchanger and simple vapor compression cycle. Which is also more efficient which can be proved by showing increase in coefficient of performance of system.

Keywords: Air Conditioning, Non-Conventional Energy Source, Earth Heat Exchanger, Heat Pipe, Peltier Model.

I. INTRODUCTION

An air conditioner is a home appliance, system, or mechanism designed to dehumidify and extract heat from an area. The cooling is done using a simple refrigeration cycle. In construction, a complete system of heating, ventilation, and air conditioning is referred to as "HVAC". Its purpose, in a building or an automobile, is to provide comfort during either hot or cold weather. Domestic or commercial air conditioner is basically categorized as Window AC or Split Ac system depending upon the method of mounting and placement. The conventional AC systems use the Vapor Compression cycle for operation. Besides, if the relative humidity in occupied spaces and low-velocity ducts and plenums exceeds 70%, fungal contamination such as mold, mildew, etc., can occur and threatens public health. Therefore, from the requirement of keeping good indoor thermal comfort and air quality, and of reducing the risk of catching disease, it is a strong recommendation to keep the supply air humidity below 70%. This means that relative humidity control in the air supply is important aspect. But if conventional cooling coils are used to improve the indoor thermal comfort and air quality, external energy will be used to reheat the air stream from the apparatus dew-point to the required air supply state. To solve this problem, a Peltier Module and Earth heat Exchanger air-handling coil can be employed.

II. RELEVANCE

The increasingly worldwide problem regarding rapid economy development and a relatively shortage of energy, for residential homes, some countries set minimum requirements for energy efficiency. In the some countries, the

efficiency of air conditioners is often rated by the seasonal energy efficiency ratio*)*. The higher the SEER rating, the more energy efficient is the air conditioner. The SEER rating is the BTU of cooling output during its normal annual usage divided by the total electric energy input in watt hours (W·h) during the same period.

In the present age with depleting sources of energy there is always a target to get the best energy ratios so that there will be minimum electric power consumption in operation of the air conditioning units. Many methods and ideas from evaporative cooling, thermoelectric cooling etc have been tried to keep the electricity consumption to a minimum in air conditioning applications. Individually these ideas do not stand good but by combination of two or more concepts in a collaborative manner stands a possibility to develop an energy efficient method of air conditioning. Thus there is a proposal to use the conventional vapor compression cycle in conjunction to thermoelectric cooling and earth heat exchanger technique to reduce the power consumption of the air conditioner and thereby increase the COP of system.

III. LITERATURE REVIEW

In view of proposed paper work concerned, following few of the researchers have done their experimental study and investigated results which have been review as follows:-

A.M. Alklaibi [1] evaluated; a loop heat pipe can be integrated to the air-conditioning system to perform the reheat process for the purpose of reducing the energy consumption. They introduced the possible configurations of incorporating the loop heat pipe into the air-conditioning system, evaluate them and compare them to the conventional way of performing the reheat process. It compares the overall coefficient of performance (COP) of the system, power required by compressor, total power supplied to the system and the refrigerant mass flow rate circulated in the air-conditioning unit. The results show that all the configurations considered have higher coefficient of performance than the conventional way of performing the reheat process. In humid climate when RSHF is low, using loop heat pipe can improve the COP by approximately 2.1-fold higher than that when heating element is used. Moreover, the energy consumed by the compressor is reduced. Thus using LHP in air-conditioning system eliminates the energy required by the heating element and results in a noticeable improvement of the COP, thus reducing the energy consumed by the compressor as part of the thermal load is removed by the loop heat pipe.

J.W. Wan et al [2] investigated the effect of heat-pipe air-handling coil on energy consumption in a central air-conditioning system with return air. By taking an office building as an example, the study shows that compared with conventional central air-conditioning system with return air, the heat-pipe air-conditioning system can save cooling and reheating energy. In the usual range of 22–26.8ºC indoor design temperature and 50% relative humidity, the RES (rate of energy saving) in this office building investigated is 23.5–25.7% for cooling load and 38.1–40.9% for total energy consumption. The RES of the heat-pipe air-conditioning system increases with the increase of indoor design temperature and the decrease of indoor relative humidity. The influence of indoor relative humidity on RES is much greater than the influence of the indoor design temperature. The study indicates that a central air-conditioning system can significantly reduce its energy consumption and improve both the indoor thermal comfort and air quality when a heat-pipe air-handling coil is employed in the air-conditioning process.

Girja Sharan et al [3] studied experimentally that, a single pass earth-tube heat exchanger (ETHE) was installed to study its performance in cooling and heating mode. ETHE is made of 50 m long ms pipe of 10 cm nominal diameter and 3 mm wall thickness. ETHE is buried 3 m deep below surface. Ambient air is pumped through it by a 400 w blower. Air velocity in the pipe is 11 m/s. Air temperature is measured at the inlet of the pipe, in the middle (25 m),

and at the outlet (50 m), by hermistors placed inside the pipe. Cooling tests were carried out three consecutive days in each month. On each day system was operated for 7 hours during the day and shut down for the night. ETHE was able to reduce the temperature of hot ambient air by as much as 14ºC. Based on the results it can be stated that ETHE holds considerable promise same as to cooler heat ambient air for a variety of applications such as the live stock building sand greenhouses.

Yat H. Yau [4] experimentally investigated that, how the sensible heat ratio (SHR) of HPHX was influenced by each of three key parameters of the inlet air state, namely, dry-bulb temperature, and relative humidity and air velocity. On the basis of this study, it is recommended that tropical HVAC systems should be installed with heat pipe heat exchangers for dehumidification enhancement and saving the energy.) The experimental results demonstrated that for all cases examined, the overall SHR of the HVAC system was reduced from the maximum of 0.688 to the minimum of 0.188 by the HPHX as inlet DBT to the HPHX evaporator increased. These results implied that the moisture removal capability for the HVAC system with HPHX was increasing as inlet DBT for HPHX evaporator increased. On the basis of this study, it is recommended that tropical HVAC systems should be installed with heat pipe heat exchangers for dehumidification enhancement.

Yat H. Yau[5]studied experimentally, a heat pipe heat exchanger to dehumidification enhancement in tropical HVAC systems a baseline performance characteristics study, the author had established the baseline performance characteristics of the eight-row wickless heat pipe heat exchanger (HPHX) for a vertical configuration under a range of conditions appropriate for a tropical climate. Now, the same basic experimental set-up was to be used in the present research with the HPHX tilted 30º C. In this configuration, the gravitational force would be expected to enhance drainage of any condensation forming on the extended fin surfaces of the HPHX evaporator section, and therefore, the effectiveness of the HPHX could be anticipated to be better than the vertical configuration, particularly when processing inlet air with high RH. The investigation has been carried out for 32 experiments with typically high RH .The results suggested that the possibly adverse influence of condensate forming on the fins of the HPHX was negligible, and therefore the HPHX in a typically-used vertical configuration could perform equally as well as it would if the HPHX was installed in an inclined position. An inclined HPHX configuration would almost definitely increase the complication and cost of ductwork, especially for a retrofit. Moreover, that added complication would increase the pressure drop penalty (i.e. the fan penalty), as would any condition to run the HVAC systems at a higher air velocity than would be applied otherwise. The HVAC system was tested with the wickless eight-row HPHX in an inclined position to examine the influence of condensate forming on the fins of the HPHXs and affecting its effectiveness.

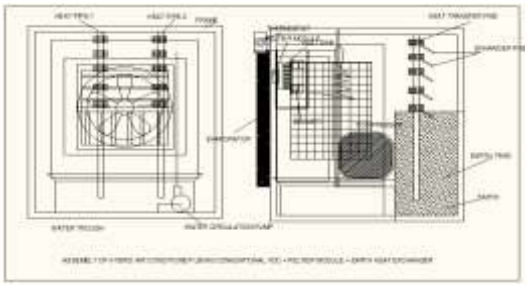
IV. PROPOSED WORK

In order to study the performance of hybrid air conditioning system and analysis of the variation of COP in different combination of vapor compression system, earth heat exchanger and Peltier Module, the experimental setup is being designed and fabricated, along with vapor compression system. Testing and performance analysis of newly designed air conditioning system will be done at different experimental setup, and then affecting system parameters will be analyzed. Suitable manufacturing methods will be employed to fabricate the components and then assemble the test setup. The fabrication will be carried out as per layout shown below. Test & Trial on hybrid peltier air conditioner

determine, temperature gradient, cooling ability (tonnage) and COP of system, under given conditions and derive performance characteristic.

V. PROPOSED EXPERIMENTAL SET-UP

Suitable manufacturing methods will be employed to fabricate the components and then assemble the test set –up. The fabrication will be carried out as per layout shown below



Experimental setup consists of conventional vapor compression system, Peltier module, Earth heat exchanger. Peltier module and Earth heat exchanger located parallel to evaporator which is minimize the incoming temperature of air and pass to space where area to be conditioned through evaporator. And check the validity of experimental results with theoretical calculations. Carry out comparative study of experimental and experimental analysis results to decide the optimization of number of peltier units and heat-exchanger units to achieve a desired temperature gradient.The fabrication will be carried out as per layout shown below. Test & Trial on hybrid peltier air conditioner determine, temperature gradient, cooling ability (tonnage) and COP of system, under given conditions and derive performance characteristic.

VI. EXPECTED OUTCOME

The proposed study includes design of hybrid air conditioning system, from this proposed study; it is expected to decide feasibility hybrid air conditioning system. The outcomes of this dissertation work will helps to design modification and manufacture a kit based on hybrid air conditioning system for improvement of performance, dehumidification enhancement, lower cost of refrigeration as the heat load is reduced by non-conventional earth heat exchanger cooler I can find applications in post-harvest handling of horticulture and floriculture produce. It can be applied to low cost domestic cooling, commercial installations, and industrial installations

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