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Winter Performance and Payback Analysis of Window Air Conditioner Using Vertical Configuration of Ground Coupled Condenser

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Abstract: **The heat transfer models of ground loop heat exchanger are perfect or not is the main factor affecting to promote the GSHP system. The geological formation and ground water flow of which vertical pipe through performance a great influence of its heat transfer. As the initial cost of GSHP system is high so the total emphasis on how much energy is saved by this system every year and how much time will it take to overcome its initial cost. There is further scope of work since the performance of the system is still not available for design and application. Therefore performance evaluation is required with suitable methodology. In general a home owner may save anywhere from 20% to 60% annually or utilities by switching from ordinary system to a ground source system. Capital cost and system life span have received much less study until recently and return on investment is highly variable.Capital cost are known to be benefit from economics of scale particularly from open loop system so they are more conventional heating system in most residential application.The life span of system is longer than conventional heating and cooling system .Good data on system life**

Keywords: **ground coupled condenser, residential building, temperature, energy conservation.**

1. INTRODUCTION

The increasing energy demands the fact that fossil fuels are finite resources and the problem of pollutant emissions has allowed renewable energy sources to be considered and developed ,including geothermal. Air conditioning is now a days is essential for human comfort. Energy consumption in air conditioning is reduced by decreasing the temperature of sink.

2. AIR CONDITIONING

Air conditioning is a collective process that perform many function simultaneously. It condition air, transport it, and introduce it in to conditioned space. It provide heating and cooling from central plant or roof top unit.It also control and maintain the temperature and control the humidity, air movement and cleanliness, sound level and pressure discrepancy. Air conditioning system is a largest energy consumer which is challenge that arises now a days. This problem can be overcome by using Ground Coupled Heat Exchanger in air conditioning system.

3. GROUND COUPLED HEAT EXCHANGER

The GCHE systems for heating and cooling are considered one of the most energy efficient and cost effective renewable energy technology. This type of heat exchanger capture heat from ground or dissipate heat to the ground. They use the earth undisturbed temperature to warm or cool air or other fluid for residential or industrial uses. It usually consist of loop of pipe buried in earth horizontally or vertically. Temperature regime at this depth or beyond is stable with out fluctuation only small variation annually.This improve the COP of air conditioning system and save electricity. In GCHE tubes are placed inside ground in which the refrigerant is drawn.

GCHE Cooling:

In this system the heat is extracted from the residential building and heat exchanger inside the earth release heat to the earth as earth temperature is always less than outside temperature in summer. Earth act as a sink in this system.

GCHE Heating:

In winter the earth temperature is more than the atmospheric temperature so heat is taken from the earth and is released inside residential buildings with the help of heat exchanger. Earth act as a source in this system. Electrical energy is saved as naturally heating of refrigerant is done.Thus by eliminating compressor we can save the energy in many ways by using earth coupled heat exchanger.

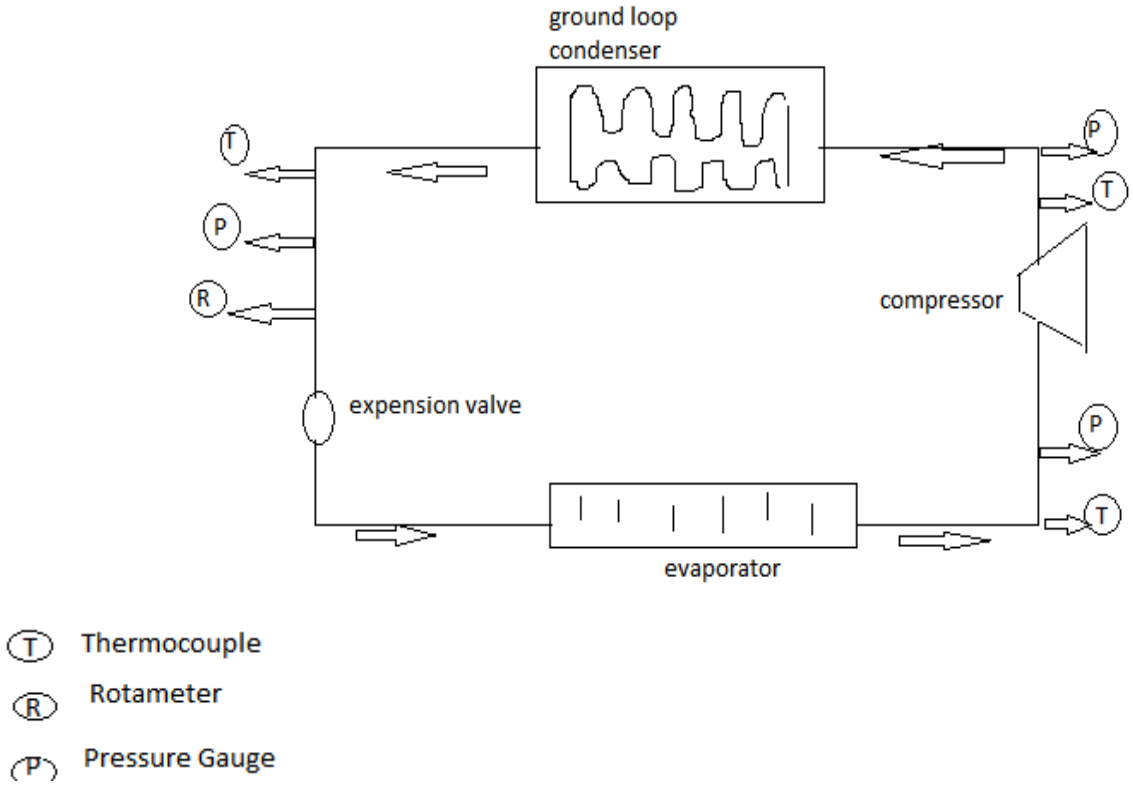

Fig: schimatic diagram of ground coupled air conditioning system

Limitation:

The growth of GSHE technology was slower than other RES or conventional technologies due to many factors: nonstandardized system designs, significant capital costs if compared with other systems and limited individuals knowledgeable in the installation of GSHP systems.

Economics:

Ground source heat pump are characterized by high capital cost compared to other HVAC system. Their overall economics benefits depend on the relative cost of electricity and fuel which are highly variable over time across the world .Based on recent price ground source heat pump currently have lower operational cost than any conventional system almost everywhere in the world. Natural gas is only the fuel with operational cost and only handful of countries where it is exceptionally cheap or where electricity is exceptionally expensive.

Financial Consideration:

First Cost:

In rural areas where the water wells is large enough to handle both the domestic needs of the house and geothermal haeat pumps, there is almost no premium first cost associated with the product .But in many cases either a pair of water wells or a ground loop will be required .This means an additional cost of cooling capacity required for the houses .Let us analyze this cost in terms of payback , return on investment ,life cycle cost and cash flow.

Cost of copper loop

=cost of 130 m copper loop

=7800 Rs

Labour cost =5000 Rs

Total First cost=12800 Rs

Comparison worksheet

Unit1 Conventinal AC

Size=x1 BTUh

Price=y1 and Operating Cost=z1

Unit2 Modified AC

Sixe=x2 BTUh and Price=y2

Operating cost=z2 and let When size x1=x2

Payback in years=Difference in price/Difference in operating cost

4. METHOD USED IN EXPERIMENT

The experiment has been carried out in such a manner according to the room .The test has been done for recording the temperature at the various point of AC system, is divided into five test point. A, B,C , D, A is the inlet of compressor (T1) or outlet of evaporator . B is the inlet of condenser or outlet of compressor (T2), C is the inlet of expansion valve or outlet of condenser (T3) , D is the inlet of evaporator or outlet of expansion valve (T4). After experimental setup the four thermocouple are placed at the 4 test points and record the data .This study is done whole day and work input is compared with the work input of conventional AC . The flow of refrigerant is measured by Rota meter. The electricity consumption is measured by energy meter and the current flow is measured by ammeter in series.

5. EXPERIMENT RESULTS

Saving in cooling:

For conventional air-conditioning average value of work input is calculated=2.28KW.Hr

For Modified air-conditioning average value of work input is calculated=1.75KW.Hr

Difference in work input=2.28-1.75KW.Hr

=0.53KW.Hr

This power is saved in one hour

So the work input saved in one year if AC is working 8 hours in one day

=0.53x8x30x12=1526.4KW.Hr

If one unit of electricity cost=7 Rs

So the total cost saved in one year=1626.4x7=10684.8Rs

Payback=total extra cost/saving in one year

=Total extra cost/total saving in one year.

=12800/(10684.8)

=1.1

Payback=1year approx

Return on Investment:

The investment of 70000 Rs extra has an annual return of 25%- 35% since the annual saving with the system over some highly efficient conventional system.

6. CONCLUSION

There is further scope of work since the performance of the system is still not available for design and application. Therefore performance evaluation is required with suitable methodology.

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