Design And Thermal Analysis of Existing Heat Pump

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Abstract- Paper deals with modified design and analysis of the heat pumps that are used for heating purpose. Heat pumps are systems that draw heat from ambient air temperature and transfer it to domestically usage work. This operation is described by packing of copper tube in heat pump with polyethylene coting then after the cop of the existing heat pump is increasing this proved by a calculation comparison process in between existing to modified, in which ambient temperature is taken from one body to working medium and then from a working medium to the heated body. Heat changes keep in to the progressing is equal to the temperatures needed for flowing and compression of the working fluid heating losses was reduced by coating tubes this result will be reflected on performance of heat pump efficiency will increasing and also COP increasing up to 5% of useful heat.

Indexed Terms- Heating, Heat pumps, Temperature Control, Thermodynamics, Thermo mechanical Processes, condenser, evaporator, polyethylene.

I. INTRODUCTION

Atmospheric ambient temperature is used in winter for heating purposes. Thermodynamic principle of the heat pump is described by Carnot circular process. For heating purposes thermal energy of ambient temperature is collected in atmosphere - antifreeze solution that is then pump to the heat exchanger (evaporator), in which it transfers heat to refrigerant (like CFC-12). Fig.1. describes process by line between Indoor coil and outdoor. When working medium gets to about 10ºC it goes to compressor there his pressure and temperature rises from 1.32 bar to 6.8 bar and 10 ºC to 52 ºC. This is shown on line from point 2 to point 3. Now the working medium goes through second heat exchanger (condenser), where it transfers his heat to working fluid (water) that is used for heating the building. Passing through the expansion valve from point 4 to point 1, the pressure of the working media fall to starting 1.32bar and process starts again. Working media is a sort of refrigeration gas. In past Freon gas was used, but because its reactivity with hydro fluorocarbons is no longer in used and is substituted with CFC-12. Heat pump systems operate exclusively on the basis of temperature differences. For high temperature differences the transfer of the energy is faster. In point 1 working medium leaves the evaporator in which it took power from the ground; its temperature is around 10 ºC. This temperature is not sufficient to heat the room, so we have to compress the working medium in the compressor to raise his temperature to 55 ºC.

In point 2 the working media leaves the compressor and now the fever goes to the condenser. In the condenser the working medium transfers its heat to working fluid (water) that is used to heat the building. Heated water can be used for floor heating (30 ºC), radiator heating or with additional heating up in the boiler as hot water or steam.

After the working fluid delivered its heat on medium it exits from the condenser (point 3) and enters the liquid container. The purpose of this tank is to balance pressure and volume of media in the entire line of heat pumps.

After the liquid container, working fluid which is still under high pressure pass through thermal expansion valve where his pressure and the temperature is reduced to 1 bar and -6 ºC [6]. After that, the working medium is ready to re-take heat from the soil in the evaporator and thus continues to cycle.

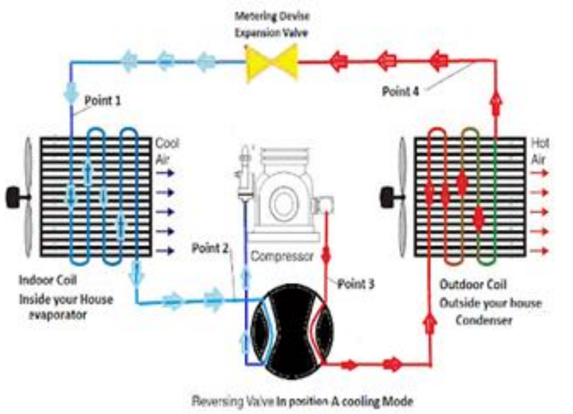

Fig1: Working Process of Heat Pump

II. EXISTING HEAT PUMP ARRANGEMENT OF MODIFICATION

There are 2 basic heat pumps systems in that on was Closed circuit system uses a buried heat exchanger so that the working fluid is never in direct contact with the tank water. Another on was Open system uses working fluid (tank water) from production well and after a process returns it to injection bathroom.

Vertical heat pump system with closed circuit is applied to objects that have a need for greater amounts of heat energy, in areas where the soil type is not suitable for horizontal system for this system it is necessary to place at roof of house.

Polyethylene coated copper tubes were placed in a U-shaped with a strong connection with the existing heat pump. This coated on copper tube with thickness of 2mm from condenser outlet to evaporator inlet connecting pipe.

III. MODIFING PARAMETERS OF HEAT PUMP

1) The value of capacitors thermal power is entered 8 kW
2) The value of the compressors
3) Coefficient of performance (COP)=2.1
4) Pipe line the value of the evaporator was read =6 kW
5) Pipe line of vertical heat pump vertically value of 8 W/m which is for atmosphere of medium conductivity and good exposure to air.
6) At the intersection of abscissa and the bold line require soil surface to put the geothermal exchanger was read
7) Output of compressor line to input of condenser line leads to the horizontal axis, where the required length of the tube exchanger was read 50 m

IV. CALCULATIONS OF HEAT PUMP

Input and output of the heat pump existing heat pump
Input of the condenser 8KW
Out of the evaporator 6KW
To check the accuracy of the parameters of the chart the
Following equality will be used:

$$Q\ evap + P\ comp = Q\ con$$

where:
Qevap – the power of the evaporator
Pcomp – compressor power
Qcon – capacitors power

Compressor power can be calculated from the relation:

P comp = Q com/COP=8/3.8=2.105kw

A. Substituting into the formula we get:

Power to be supplied (P)=8 + 2.105=10.105 $\approx 10kW$

B. Calculation of the heat pump cycle

Object area is 166 m2 and the height of the cylinder is 3 m.

From the known facts, the volume of the object can be Calculated:

$V = A \cdot h = 166 \cdot 3 = 498 m3$

where:
V – Volume of the object
h – Height of the cylinder

Heating factor is obtained:

$f = P/ V$ = 10/498=0.02KW/m³

where:

f – heat factor
In the process of heating, the temperature of the condenser is 55°C and of the evaporator -6°C. From the phase diagram for Freon gas R32.

$i1$=514 kj/kg
$i2$=667 kj/kg

$i3$= $i4$=324 kj/kg
Heat release in the condenser is:
$q= i2- i3$= 667-324=343 kj/kg

where:
q – heat release in the condenser
Evaporator cooling capacity is:
$qe= i1- i4$= 514-324=190 kj/kg

where:
qe – evaporator cooling capacity
Spent compressor work equals:

$J=- i1+ i2$= 524-667=143kj/kg

where:
j – compressor work
It has been checked

$q + j = q0$
190 +143 =333

Heating power is calculated by multiplying the volume of heated space and heat factor:

$Q0 = V \cdot f$ = 498·0,02 =9.96 *Kw*

where: Q0 – heating power
Supply of Freon gas equals: *Df =9.96/333 =0.029 kg/s*

where:

Df – supply of R32

Compressor power is obtained as the input energy per unit of time:

$P\ comp = j\ Df$ = 143.0.029kj/h = 4.27 kw

Heat of vaporization is obtained by acting cooling effect of evaporator per unit time:

$Q = q0 \cdot Df$ = 333.0.029 = 9.657kw

Efficiency of the heat pump is obtained from the equation:
$\eta = Qo/ P\ comp$ =9.96/4.27 =2.3

where:

η – Efficiency

Another way to calculate efficiency of heat pump using the
Freon gas phase diagram is:

$\eta = i2- i3/ i2- i1$ =667-324/667-524=2.3

CONCLUSION

Without specific calculation it is very difficult to specify the costs for installation of heat pumps because their costs are more individual, depending on the thickness of the connection in between outlet of the condenser and inlet of the evaporator pipe and weather conditions, installation and other factors. As an orientation, it can be stated that the cost for installation of update of heat pumps from this polyethylene coating range from 50 to 750 rupees. But this coating improves performance of existing heat pump working condition and reduces consumption of electricity up to 5%. Its improver the coefficient of performance of the heat pump.it mainly reduces the wastage of heat in heat pump copper pipe line.

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