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Air Conditioning Unit using Water as Refrigerant

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Abstract – *Air conditioning system is used to provide comfortable atmospheric condition in closed space as per human body needed but by lowering the temperature may affect human health since it has profound effect on our environment. To minimize the effect of air conditioning unit on human health natural water can be used as refrigerant. This paper describes air conditioning unit by using water a refrigerant. In this study the refrigerant from the evaporator goes into compressor is replaced by the cooling tower formed by using desert cooler. Cooling tower is formed by adjusting the desert cooler spider such that the fan can cool the water dropping from wood wool from four side of desert cooler and by using this chilled air is passed from the radiator used as evaporator to condition the room and the worm air is again returned to the cooling tower.*

Key Words: **Air conditioning unit, R22, refrigerant (water), Cooling tower, Environmental impact.**

1. INTRODUCTION

Air conditioning unit is used for conditioning of the air as per need. In winter we used to condition the air that have temperature more than environmental temperature and in summer season we need to lower the temperature of room much lower than the temperature of surrounding. We need to maintain the humidity of the occupied space also according to that human feel comfortable in the temperature range of 20°C-22°C (68°F-72°F) and humidity between 40%-60%. In order to give refrigerating effect the refrigerant is used. This refrigerant is used as heat transfer medium which absorbs the heat from the space to be cooled from the evaporator and transmit to the environment through condenser. Main purpose of refrigerant is to absorb the heat at low temperature and low pressure and release heat at a higher temperature and pressure. Zero ozone depletion potential (ODP), low global warming potential (GWP), short atmospheric lifetime, high efficiency. There are the requirements that are demanding the invention of new generation refrigerant. Currently we are using R22 as a air conditioning refrigerant which belongs to HaloCarbon refrigerant having hydrogen atom in their molecule along with chlorine and fluorine. HCFC (Hydro-Chloro-Fluoro Carbon). And if this R22 refrigerant used under pressure it may explode if heated. So to avoid explosion by heating it may be protect from sunlight and store in a well ventilated place. And by use of water as refrigerant there are no such problems occur as of R22.

1.1 Literature Review

A.Kilicarslan et.al.[2] Water as a refrigerant (R718) is compared with current refrigerants including R717, R290, R134a, R12, R22, and R152a by using a created computer code for calculations of a simple vapor compression refrigeration cycle

Arsha Viswambharan et.al.[3] A commercial building can be made energy-efficient by using a radiant system for heating and cooling when paired up with traditional HVAC system. Radiant system utilizes water temperatures for heating and cooling surfaces available from natural sources like lakes, seas or rivers. It works at temperature close to the surrounding temperature and results in reduction in energy consumption.

C. Pout et.al.[2] This paper summarises analyses of the potential environmental impact of room air conditioner carried out for the European Commission in support of the Energy-using Products Directive. About half the cooling need of buildings in Europe is met by room air conditioners the rest being met by central systems. The paper assesses the likely market for such products over the next 25 years, the consequent environmental impacts and the scope for reducing the global warming impacts by the use of “best available” or “least life cycle cost” technologies.

Selvaraji Muthu et.al.[2] Thomas Midgley (1928) had invented the CFCs & HCFCs, but the large use of these refrigerants had created severe threat to the earth in terms of ozone layer depletion and global warming. McNeill has stated that Midgley "had more impact on the atmosphere than any other single organism in Earth's history. Not only the inventors but all end users are more responsible for the consequences of usage of refrigerants.

O. Tsakiridis et.al.[4] A proactive heating method is presented aiming at reducing the energy consumption in a HVAC system while maintaining the thermal comfort of the occupants. The proposed technique fuses time predictions for the zones’ temperatures, based on a deterministic subspace identification method, and zones’ occupancy predictions, based on a mobility model, in a decision scheme that is capable of regulating the balance between the total energy consumed and the total discomfort cost. Simulation results for various occupation-mobility models demonstrate the efficiency of the proposed technique.

Dr Ljiljana Marjanovic-Halburd et.al.[3] This paper presents a comprehensive, yet easily expandable and easy to use general purpose HVAC equipment classification that covers both the domestic and non-domestic building sectors. The purpose of developing the taxonomy is to facilitate both predictive and statistical building energy end use modeling, surveying fieldwork and analysis of all building types and the allocation of energy to end uses.

Maturi Lavanya et.al.[2] Hence it can be concluded that non air conditioner users have higher FVC, FEV1 and FEV1/FVC when compared to air conditioner users. But there is no significant difference between the PEFR level between Air conditioner and non-air conditioner user.

2. MATERIAL AND METHOD

2.1 Experimental setup of conventional air conditioning system

Refrigeration system can be broadly classified in to two categories. Steady state refrigeration system in which the cooling effect is continuous the refrigerant flow is steady and in one direction. Periodic refrigeration system in which the cooling effect is cyclic or intermittent the refrigerant flow varies periodically with time and is bidirectional. Vapour compression refrigeration system used in domestic refrigerators and air conditioner are typical example of steady state refrigeration system. Sterling refrigerator and absorption system are example of periodic refrigeration system.

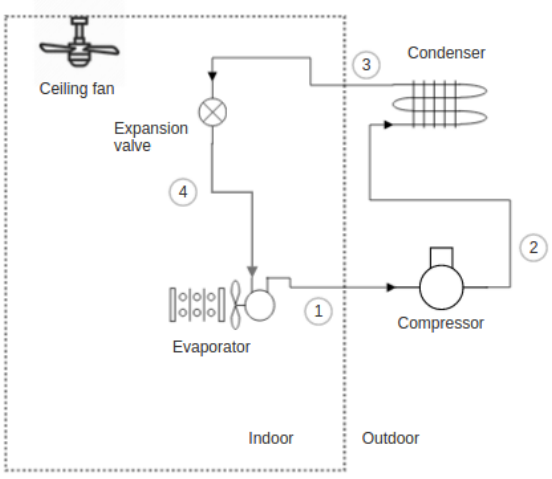


Fig 1 : Schematic of split air conditioning system

The refrigerant vapour is compressed in the compressor (Process 1–2), condensed in the condenser(Process 2–3), expanded in a throttling device (Process 3–4) and evaporated in the evaporator (Process 4–1). Heat from the product to be cooled is added at the evapo-rator and rejected at the con-denser to the ambient.

Process 1–2: Isentropic compression of the refrigerant.
Process 2–3: Constant pressure heat rejection 1 in a heat ex-changer termed as the condenser.
Process 3–4: Isenthalpic expansion 2 of the refrigerant in an orifice, valve or a capillary tube.
Process 4–1: Constant pressure heat addition in a heat exchanger, usually termed as the evaporator.

Performance parameter analysis:
Total power consumption is calculated as

$$W_t = W_c + W_f + W_b$$

where,
W_t = total power consumption.
W_c = power consumption of compressor.
W_f = power consumption of fan in condensing unit.
W_b = power consumption of blower in evaporating unit

Refrigeration capacity (Q_{evap})

$$Q_{evap} = m^{\circ} (h_1 - h_4)$$

where,
m° = mass flow rate of refrigerants.
h_1 = enthalpy of refrigerant at outlet of evaporator.
h_4 = enthalpy of refrigerant at inlet of evaporator.

Coefficient of performance

$$COP = Q_{evap}/W_t$$

Compressor pressure ratio

$$PR = P_{discharge} / P_{suction}$$

2.2 Experimental setup and working of modified cooling system.

In conventional air conditioner compressor, condenser, expansion valve and evaporator are used but in the proposed system, compressor and expansion valve are removed.

Here we used desert cooler as cooling tower where the water with increased temperature from the outlet of evaporator is cooled again.

Referring to fig-2, following components are used in Hybrid cooling system:
1. Cooling tower: Here the desert cooler is used as cooling tower where the water from outlet of evaporator and

surrounding air to come in contact with each other to lower the temperature of hot water.

Desert cooler is converted into cooling tower by reverse fitting of spider such that the surrounding unsaturated air blow on the water dropping over the wood wool.

2. Evaporator: Evaporator is used as heat exchanger in air conditioning system. Where the refrigerant is continuously flowing in tubes of evaporator and fan helps to transfer the heat of refrigerant into conditioning room by blowing the wind with specified velocity.

In this system evaporator is formed by use of car radiator and fan assembly where, the refrigerant (water) is continuously flowing through the tubes of radiator and fan helps to transfer the heat from refrigerant to space to be cooled very effectively.

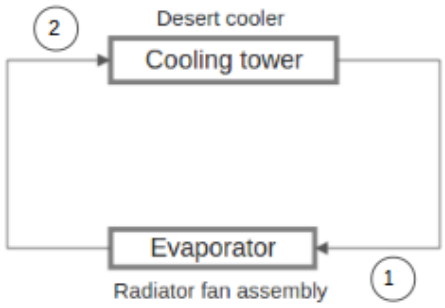
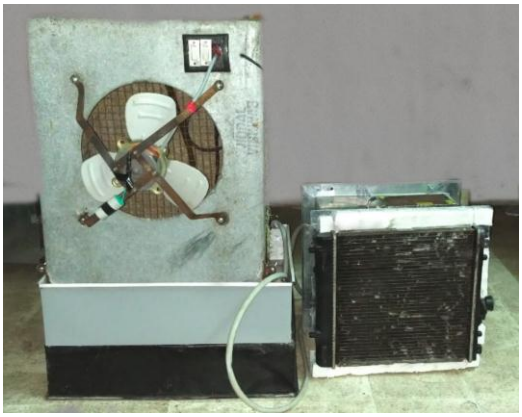


Fig 2 : Schematic of modified system.

Here cooling tower is formed by using desert cooler and radiator and fan assembly as an evaporator. Two pumps are used in condenser one is for the passing of chilled water to an evaporator and return the hot water again into the cooling tower. And another pump is used for circulation of water over the wood wool situated at sides of cooler to cool the water. The evaporator is made by using a car radiator where the water is passing through it and fan located at behind of radiator to carry the heat from chilled water to area to be cooled.



Performance parameter analysis:
Total power consumption is calculated as

$W_t = W_f + W_b$

where,

W_t = total power consumption.

W_f = power consumption of fan in condensing unit.

W_b = power consumption of blower in evaporating unit

Refrigeration capacity (Q_{evap})

$Q_{evap} = m° (h_1-h_2)$

where,

$m°$ = mass flow rate of refrigerants.

h_1 = enthalpy of refrigerant at outlet of evaporator.

h_2 = enthalpy of refrigerant at inlet of evaporator.

Coefficient of performance

$COP = Q_{evap}/W_t$

3. RESULT AND DISCUSSION

Following table shows the comparison between conventional AC system, desert cooler and Modified system.

- In normal AC system R22 refrigerant is used which badly affects on environmental in different manner causing ozone depletion potential, global warming potential. AC system is nor affordable in terms of cost by common people.
- In desert cooler which is mostly used by common people in summer season produces more humidity than AC system. When humidity is high sweat evaporation from our skin is hampered hence we feel sticky.
- While in modified system relative humidity reduces upto 50% of dessert cooler also generates cooling effect like AC. Because of the absence of compressor, power consumption reduces considerably.

- Modified system consumes less energy than air conditioner due to absence of compressor and provide better cooling effect with lower humidity than normal air cooler. This system provides 4°C-5°C lower temperature than conventional cooler and 6°C-8°C more than air conditioner is obtained. In terms of energy consumption this system is very effective as only fan and pump requires electricity.

4. CONCLUSION

Since from many years it has been seen that AC industries has facing a environmental related issues regarding refrigerants. CFC's probably survived as longest running refrigerant till it was proved that they were major cause of ozone depletion. HFC's that are replaced by CFC's have high GWP and need to be replaced. So our "Air conditioning unit using water as refrigerant "system proposes a solution to minimize environmental issue such as ozone layer depletion, global warming potential etc. by replacing harmful refrigerants by water. This solution produces less humidity, consumes less power and very cost effective. It can be very useful in countries which has high temperature and humidity during summer.

5. REFERENCES

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