

Design and Development of Modified Air Cooler and Storage Box

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ABSTRACT: The “modified air cooler and storage system” is a type of conventional air cooler which is used for reducing room temperature as well as refrigeration systems. The system consists of a tank which is a mud pot whose outer side is filled by sand slurry. The tank and the slurry are held by a larger mud pot, i.e., a pot-in-pot system. The lower tank is filled with water and it is connected to the upper tray through a pump. The water in the upper

tray is passed through a cooling pad which is used for absorbing the water. A fan is fixed next to the cooling pad and is provided a vent system. The tray is connected to the cold storage box. Hence providing the right temperature for storage of preservative items.

Keywords: Evaporative Cooling, Heat Transfer, Air Cooler, Pot System.

SYMBOLS:

Symbols	Meaning
CFCs	Chlorofluorocarbon
mm	Metric measure
Hz	Hertz
COP	Coefficient of Performance
PH	Potential of Hydrogen
AC	Alternating current
RPM	Revolution Per Minutes
AMPS	Ampere
GI	Galvanized Iron
SS	Stainless Steel
MS	Mild Steel
°C	Degree Celsius

I. INTRODUCTION:

India is a country in which most of the regions have very low temperatures during the winter and very high temperatures during the summer seasons. Hence, it is not a very soothe experience and highly uncomfortable. Though

cheaper methods of heating are available during the winter season, methods of cooling down the hot temperatures during the summer do not have wide variety of options. Air conditioners have high initial and running costs, which cannot be afforded by all the people in a developing country like India.

Air coolers are relatively cheap, but provide unsatisfactory results; there is a need for developing a cheaper room cooling system. Conventional air conditioning is one of the major contributors of CFCs into the atmosphere. An alternative type of cooling, which does not expel CFCs is highly desirable as one important step in the correction of this problem. So, this is why adiabatic cooling is environmentally friendly because it is a passive cooling method that does not expel CFCs. It is 100% fresh air-cooling which even helps to clean the air it cools. With the help of Evaporative Technology swamp coolers provide cooling at cheaper than central air or larger air conditioners.

PROBLEM DEFINATION:

- 1) Conventional Air cooler requires more energy.
- 2) In this condition, air cooling systems have high cost.
- 3) Cold storage system which is generally used to store vegetables, fruits but this cold storage system produces CFC gasses which are harmful for environment and produce greenhouse effect.
- 4) So, modified air cooler and cold storage box provides both air cooling as well as cold storage.

OBJECTIVES:

- 1) The modified air cooler and storage box is a type of conventional air cooler which is used to provide room cooling as well as refrigeration systems.
- 2) The trays connected to the cold storage box, hence providing the right temperature for storage of preservative items.

SCOPE OF PROJECT:

In this system, parameters such as room cooling and provision of cold storage box for storing preservative items are done. Development of the working parameters can be done in order to produce an effective and efficient system.

METHODOLOGY:

1. Design
2. Manufacturing
3. Assembly

1. DESIGN:

For designing modified air cooler with cold storage box. We are designing air cooler with 0.5 tons of refrigeration effect. So, we are designing following parts,

- 1) Cooler body.
- 2) Cooling fan.
- 3) Cooling pad.
- 4) Cold storage box.
- 5) Pot in Pot System.

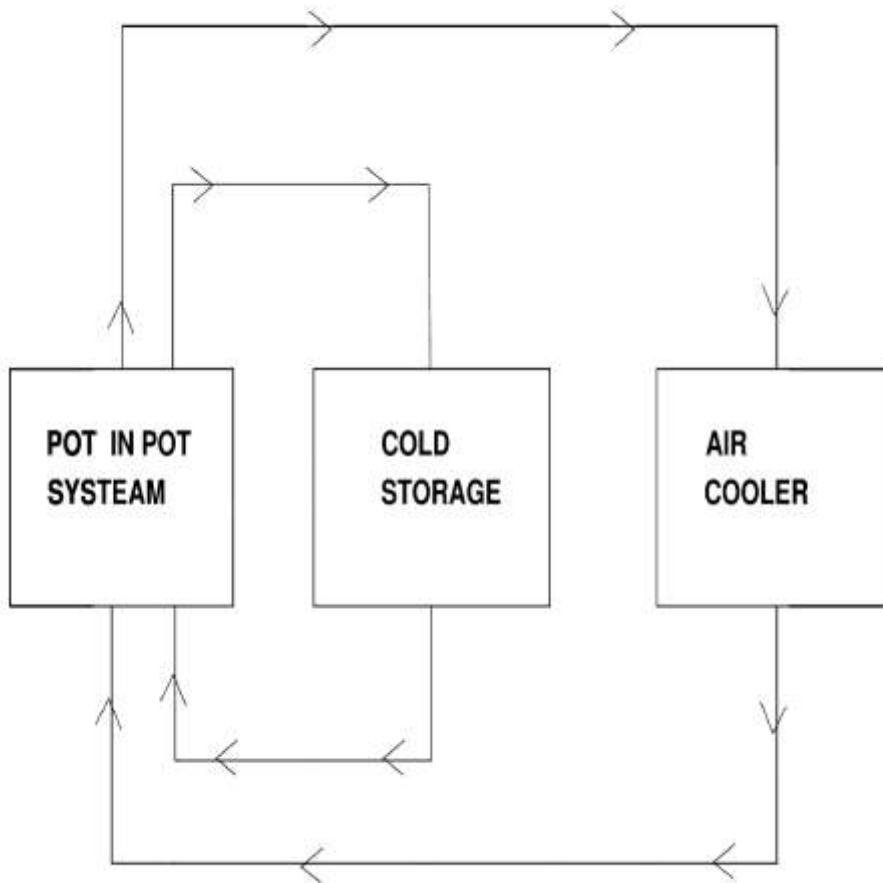


Fig: Block Diagram.

1) COOLER BODY:

For designing the cooler body, we consider lot of things in which material, size and shape etc. For designing body, we use galvanized iron material with thickness of 1mm. Which is corrosion resistant.

Specification:

- a) Powder coated Galvanized iron material.
- b) Approximate thickness- 1mm.
- c) It is corrosion resistance.

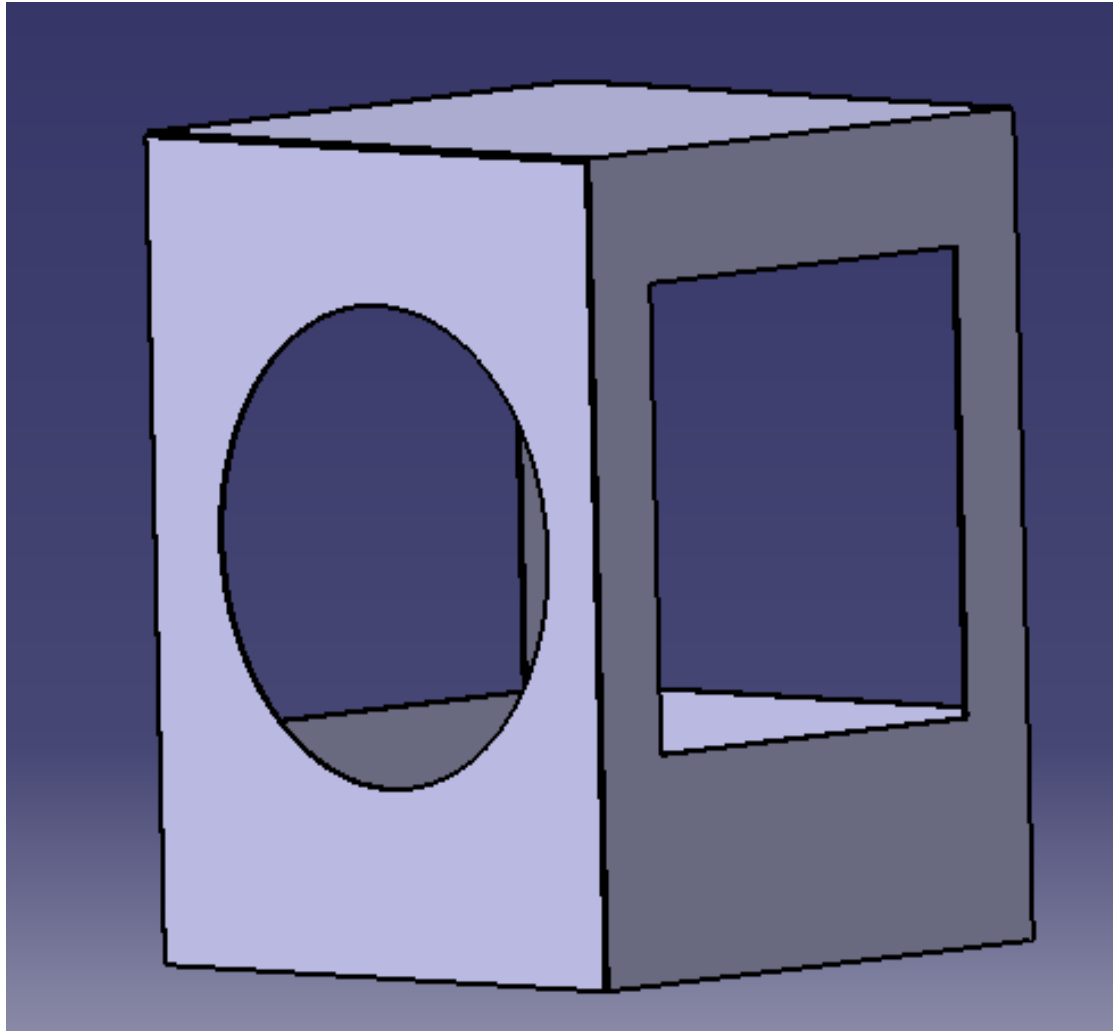


Fig: Cooler Body.

2) COOLING FAN:

Form the body of air cooler we are designing the fan which is high power type capacitor start and run. Which is working on 220v, 50Hz AC 1 PH.

Specification:

- a) RPM – 2800.
- b) Watts – 35.
- c) AMPS - 0.45.
- d) Capacitor start and run.
- e) 220v,50Hz AC 1PH.

3) COOLING PADS:

Most of the cooling pads are made of either as pen fibre or cellulose. A cellulose pad typically needs more air and water flow than does ahoneycomb pad. More evaporation can take place through a 6-inch pad than a 4-inch pad.Large number ofEvaporative Cooling Pad is available in

the market. Evaporative Cooling is the process in which air is cooled by using the heat in the air to evaporate the water from an adjacent surface. A temperature reduction of 10 to 20°C can is achieved by passing the hot fresh air through the wetted pads. The hot air is first passed through the cooling pads the cooling pads which already absorbed the cool water are ready to transfer the cooling to the air the cool air came out of the cooling pad immediately circulated outside with the help of fan.

Specification:

- a) Product dimensions 23×4×23.
- b) Material is made up of wood shaving.
- c) Light in weight and easy to install.
- d) Total no. of pads = 3.

4) COLD STORAGE BOX:

We design cold storage box for getting cooling effects and it is used to store items. It is made up of steel material as it has good thermal conductivity. It has hollowed box and the cold water is made to flow in the hollow space.

Specification:

- a) Material used is stainless steel.
- b) Size = 12×12×7.
- c) It is corrosion resistance.

5) POT IN POT SYSTEM:

In this arrangement of pot – in – pot system the inner pot is filled with water and the gap between the outer and inner pots is filled by sand slurry this pot is filled with water and is pumped with the help of a pump. After the completion of the cycle, the water comes back to the tank. The cooling process takes place by evaporative cooling. The cooling is based on the physics principle that when evaporation takes place, cooling occurs. This is because for evaporation to take place, the water needs to change into vapor or gas and this only happens when there is heat in the surroundings. When water is poured into the pot, a small part of it exits through these pores and evaporates from the surface of the pot, thus making the pot (and remaining water) cooler than before. It is effective only when the outside temperature is high. Hence it is used only during summer and sometimes in winter.

Specification:

- a) It is made up of clay.
- b) Getting good cooling effect.

2. MANUFACTURING:

For making modified air cooler with cold storage box, we are manufacturing various parts in which they are as follows:

1) Cooler body:

For manufacturing Cooler body, we select G.I. material with approx. 1mm thickness. This material is corrosion resistant. So, we are manufacturing cooler body with following details.

2) Cooling Fan:

Following are the fan details,

High power type capacitor starts and run. Which is working on 220v, 50Hz AC 1 PH. This fan is used for cooling purpose.

3) Cooling Pads:

We have brought cooling pads by online shopping in which there are total 4 pads and the material of the pad is pen fiber, cellulose and each pad is about approximately 4 to 6 inch because of this material and size of the pad we get maximum amount of cooling effect from our cooling unit.

4) Cold Storage Box:

We have manufactured cold storage box form fabricator in our city for this we select S.S material which is corrosion resistance. We have divided this unit in two parts in which outer unit is used for circulating cold water to keep the fruits and vegetables fresh in inner unit.

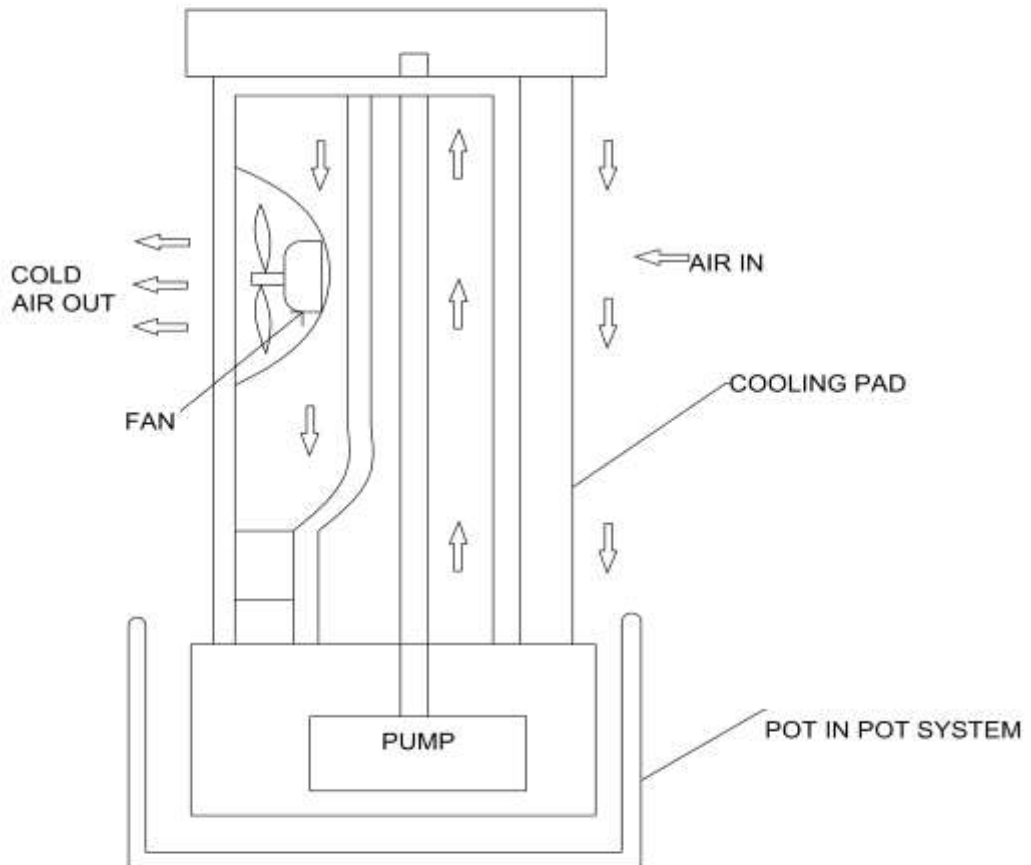
5) Pot In Pot System:

We got pots from pot makers in our city this pot is made of clay and the specification of this material is to keep the water cold for long time and then the cold water from this pot is passed to cooler and cold storage box.

3. ASSEMBLY:

- 1) First of all, we construct outer-body of air cooler by using G.I sheet with thickness approximately 1mm.
- 2) After that we assemble cooling fan by using nut and bolt after that we joint cooling pad by using the support of M.S grill.
- 3) We arrange pot in pot system through which we circulate cold water by means of submersible pump through pipes to air cooler and cold storage box.
- 4) We connect submersible pump and fan to main body.

Fig: Working of Modified Air Cooler Cum Storage System.



III. WORKING:

- 1) The modified air cooler cum storage system consists of two tanks, i.e., an upper and a lower tank. The upper tank is made up of SI and the lower tank is a pot-in-pot system. The lower tank is made of mud pots because the porosity of the mud absorbs the water and helps in evaporative cooling process. The mud pot has its outer periphery filled by sand slurry. The lower tank and the slurry are held by a larger mud pot. The lower tank is filled with water and it is connected to the upper tank through a pump.
- 2) The water in the lower tank is passed through a cooling pad which is used for absorbing the water. Aspen material has high saturation efficiency and cooling capacity and hence can be used in the air cooler system.
- 3) A fan is fixed next to the cooling pad and is followed by a dehumidifier layer and a vent system. The vent system is used for directing the air flow into the room and the dehumidifier is used for absorbing the moisture from the cool air.
- 4) The cold storage box is made up of steel as it has high thermal conductivity. The box is hollow in nature and the water circulates throughout the layers of the box and return back to the lower tank. The components are connected to each other by the help of connecting pipes which are made of polymers to avoid heat losses.
- 5) When the system is switched on, the pump and the electrical fan start running as they are the only components utilizing power in the system.

The water in the lower tank is pumped by the positive displacement pump. The water then reaches flows into the cooling pad. The cooling pad absorbs the water particles coming from lower tank. The surrounding air particles absorb the chillness of the water particles. The fan which is placed next to the cooling pad drives the cold air towards the room. A dehumidifier is placed next to the fan and it absorbs the moisture in the air and the air now has only low temperature and not moisture.

- 6) The air is then flown in the required direction by the vent system. The vent system is used for passing the air in the required direction and not blindly into the room. On the other side, water also flows towards the cold storage box and flows around the hollow box. As the box is made of steel, the box gets chilled and it can be used for storing perishable items.
- 7) The water then returns back to the lower tank and the cycle is repeated. By using this system, room cooling can be done effectively than a normal air cooler and cheaper than an air conditioner with addition to providing a storage system.

IV. RESULT & ANALYSIS:

The experimentation is carried out to record observations in a 100 square feet room for five hours, dimensions of the room considered for experimentation is,

- 1) The flooring is concrete.
- 2) Two sides of the room are covered by concrete walls.

Sr. No	Conditions	Temperature
1	Room Temperature	37
2	Temperature of water in earthen pot	33
3	Temperature inside storage box	35

Initial condition

Sr.NO	Time in minutes	Conventional air cooler (°C)	Modified air cooler (°C)
1	0	36	36
2	30	34	30
3	60	32	29
4	90	30	28

5	120	29	27
6	150	29	26
7	180	29	26
8	210	28	26
9	230	28	26
10	250	28	26
11	280	28	25

Observed from table 2 that in five hours the room temperature decreases from 36°C to 28°C by using conventional air cooler, in last two hours the temperature of room remains constant at 28°C.

While using modified air cooler the room temperature decreases up to 24° C, which is 4°C less than conventional desert cooler.

Sr. No	Time in minutes	Conventional Pot (°C)	Pot-in Pot system (°C)
1	0	33	33
2	30	30	29
3	60	28	28
4	90	27	27
5	120	26	25
6	150	26	24
7	180	26	23
8	210	25	22
9	240	24	21
10	270	24	21
11	300	24	21

V. APPLICATIONS:

The modified air cooler cum storage system have lots applications are present in which they are as follow,

- 1) It is used for domestic use.
- 2) It is used in workshop in which it gives cold air as well as cold water.
- 3) It can also be used in shops.

VI. CONCLUSION:

The “Modified air cooler cum storage system” provides both air cooling as well as cold storage systems.

It provides better cooling effects than a normal air cooler and consumes lesser energy than air conditioners. That is, the temperature of 40-50°C less than the conventional coolers is obtained where as a temperature range of 60-80 °C more than the air conditioners is obtained.

It reduces the cost of electricity. On running for 5 hours, 0.8 kWh of energy is consumed. It also has a very low initial, running and maintenance costs which can be consider as a good part.

It is very useful in the countries suffering from high temperature and humidity.

VII. FUTURE:

- 1) Selection of suitable heat exchanger materials and size of the tubes are to be studied for uniform heat flow considering the cost aspects.
- 2) Studies can be extended to higher storage capacity for longer duration as per requirement.
- 3) In this project, parameters such as room cooling and provision of cold storage box for storing preservative items were done. Optimization on the working parameters can be fulfilled in order to provide an effective and efficient system.

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