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EFFECT OF VARIOUS COIL SHAPES ON VORTEX FLOW COOLING

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ABSTRACT

With increase in the temperature due to global warming cold air is necessary for human being. Air conditioning system for air cooling is always better option but there is high level of power consumption and to overcome such difficulty vortex flow cooling is the better option. In vortex flow due to geometry more the turbulence in the flow and which dissipates more amount of heat and to enhance the rate of heat transfer cooling water will be circulated and this is nothing but aim of present work.

Introduction

Air conditioners use refrigeration to chill indoor air, taking advantage of a remarkable physical law: When a liquid converts to a gas (in a process called **phase conversion**), it absorbs heat. Air conditioners exploit this feature of phase conversion by forcing special chemical compounds to evaporate and condense over and over again in a closed system of coils.

The compounds involved are refrigerants that have properties enabling them to change at relatively low temperatures. Air conditioners also contain fans that move warm interior air over these cold, refrigerant-filled coils. In fact, central air conditioners have a whole system of ducts designed to funnel air to and from these serpentine, air-chilling coils.

When hot air flows over the cold, low-pressure evaporator coils, the refrigerant inside absorbs heat as it changes from a liquid to a gaseous state. To keep cooling efficiently, the air conditioner has to convert the refrigerant gas back to a liquid again. To do that, a compressor puts the gas under high pressure, a process that creates unwanted heat. All the extra heat created by compressing the gas is then evacuated to the outdoors with the help of a second set of coils called condenser coils, and a second fan. As the gas cools, it changes back to a liquid, and the process starts all over again.

Literature Review Related to Air cooling Systems

Table :Chronological development of Refrigeration and Air-Conditioning

16th Century	First Hygrometer	Leonardo da Vinci at the beginning of the 16th century was credited with inventing the first hygrometer that used a ball of wool to provide this indication of humidity level.
	First Mechanical Air Cooler	Da Vinci was likely the first to use a mechanical air cooler. This air cooler consisted of a hollow water wheel with an air passage constructed to guide the air from the water wheel to his patron's wife's boudoir.
17th Century	Pascal's Rule for Liquid Pressure	Blaise Pascal presented the rule: pressure exerted anywhere on a confined liquid is transmitted unchanged to every portion of the interior and to all the walls of the containing vessel; and is always exerted at right angles to the walls.
	Boyle's Law	Robert Boyle developed one of the four principles that govern performance of evaporative cooling: if the temperature of dry gas is constant, then its volume varies inversely with the pressure exerted on it.
18th Century	Fluid Dynamics	Bernoulli, Euler, Pitot, Chezy, and others applied the techniques of mathematical physics to develop the science of fluid mechanics. John Dalton established the nature of evaporation, and its importance to the global cycle.
19th Century	Flow through Porous Media	Darcy (1856) established an understanding and quantitative characterization of flow through porous media.
20th Century	Psychometric Charts	Willis Carrier's development of a psychrometric chart similar to ones in use today along with the development of a formula that linked the transformation of sensible heat into latent heat during the adiabatic (no external heat input or output) saturation of air.

B.L.Thakor (2015) developed a new concept in which air cooling and air conditioning systems were combined together so cooled air could be obtained at low power consumption. Air cooler gives the cool and humid air. Humidity of air can be absorbed by amalgamation of evaporator at outlet of air cooler. This is chip and effective design conceptualization in comfort application. Evaporative air conditioner is for all pockets in equator and tropical region of earth.

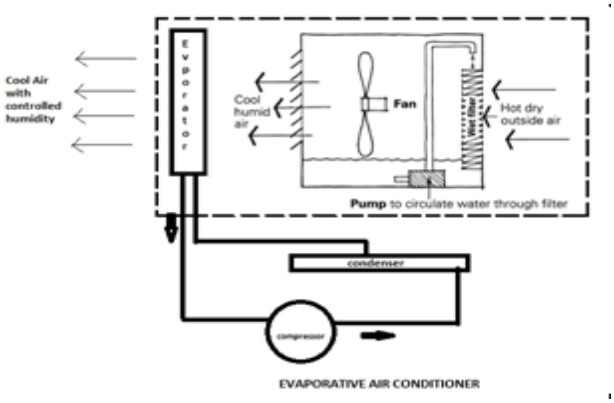


Fig 2.1Proposed Experimental Set up

M. Abbas, M. Saleem Khan, Fareeha Zafar (2011) used the concept of fuzzy logic in air cooling systems. The design and implementation of an autonomous room air cooler using fuzzy rule based control system. The rule base receives two crisp input values from temperature and humidity sensors, divides the universe of discourse into regions with each region containing two fuzzy variables, fires the rules, and gives the output singleton values corresponding to each output variable.

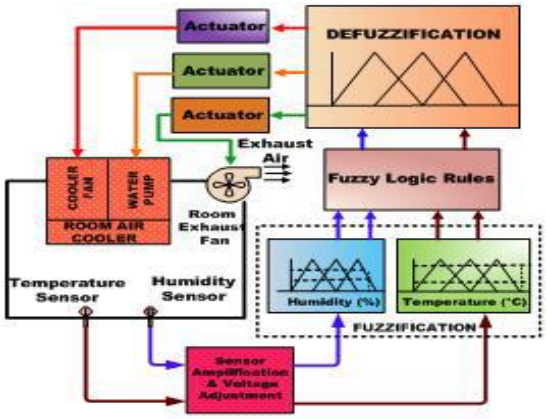


Fig.2.2 Block diagram of Autonomous Room Air Cooler System

Amit Kumar Jain (2012) proposed the new concept about the air cooling system without using pump for water circulation.

Fig. 2.3Modified cooler

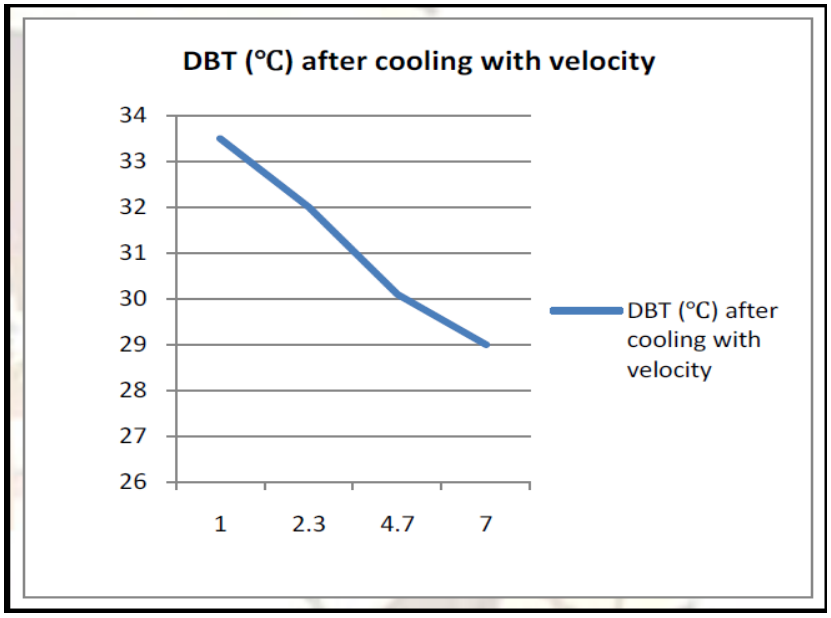


Fig 2.4 Relationship between DBT (^{0}C) after cooling and velocity (m/sec)

Experimental Set up

Problem Associated with Existing System

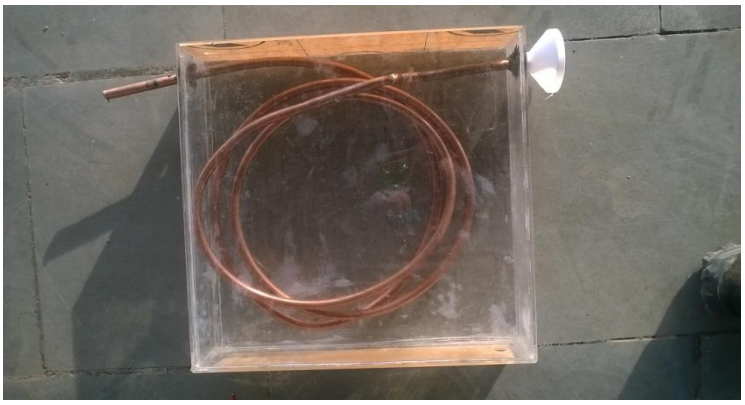
In the present system when air will enter into the spiral shape copper pipe it will dissipates heat to the atmosphere due to vortex effect and so cooled air can be obtained and which can be measured with the help of digital thermometers at the same time when water will circulated through acrylic box using pump more cooling effect may obtain.

Constructional Detail of Experimental Set up

In the present work the proposed idea is to develop such air cooling system which is moisture free as well as compressor less and to achieve the same vortex flow concept is used also to study the effect of various shapes on the thermal performance of the proposed cooling system is studied experimentally.

In the present case total three shapes are consider helical, serpentine and spiral. The air with the help of blower when flow through it due to the shape of copper coil there is turbulence in the flow and due to which more amount of heat will be dissipated to the surrounding and in addition to this as the water is spraying outside the copper pipes of various shapes the heat transfer rate will increase and so better moisture free cold air can be achieved.

Spiral Shape



Spiral Shape in Acrylic Box

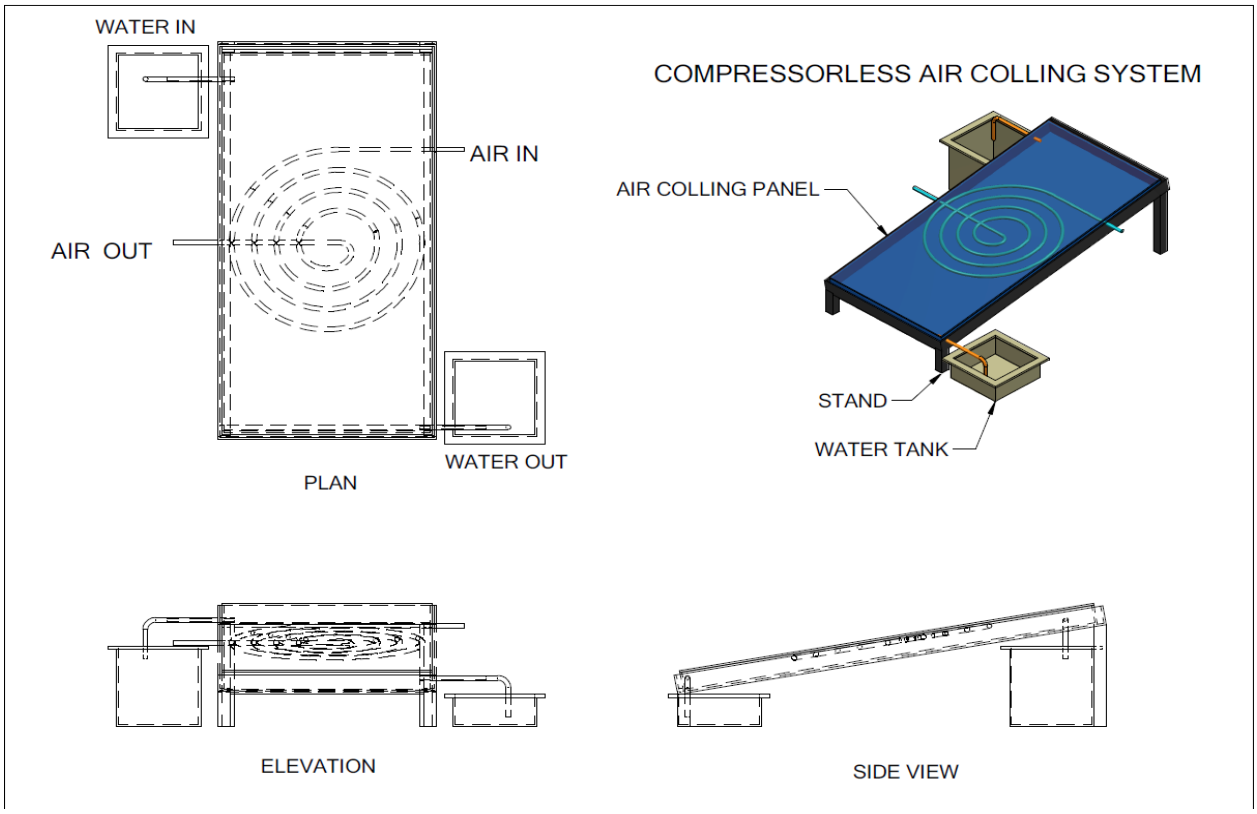
Variable Speed Blower

Pipe and Submersible Pump

Serpentine Shape

Helical Shape

In the present work first of all the copper coil with 3 m length and ½" diameter placed in the acrylic box of provided with proposed various shapes with water in and out facility. Afterwards variable speed blower is connected with system and through submersible pump cold water spray over the copper coil and water will recycle. Digital thermometers are used for temperature of air out temperature.



View of Propose Experimental Set up

Result and Discussion

Observation Table

Sprial Shape

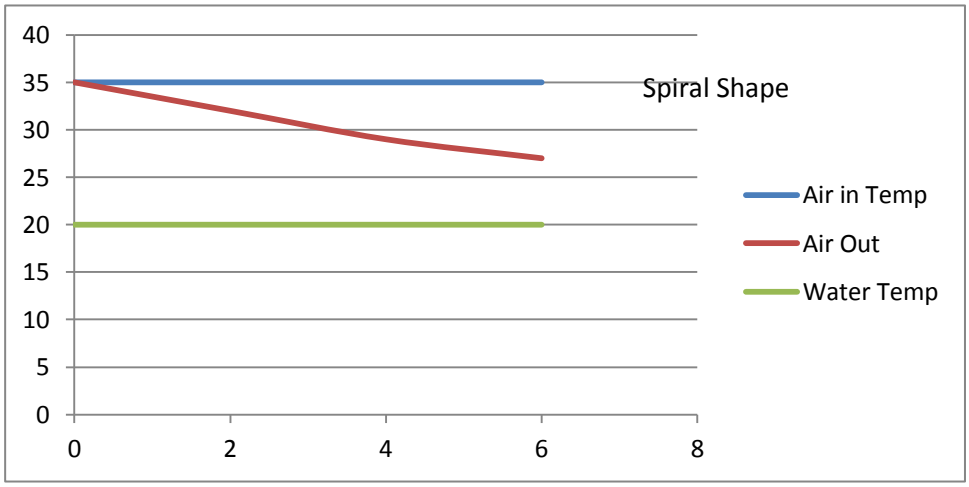
Time	Air in Temp	Air out Temp	Water Temp
0	35	35	20
2	35	32	20
4	35	29	20
6	35	27	20

Helical shape

Time	Air in Temp	Air out Temp	Water Temp
0	34	32	20
2	34	31	20
4	34	28	20
6	34	26	20

Serpentine Shape

Time	Air in Temp	Air out Temp	Water Temp
0	34	32	20
2	34	30	20
4	34	27	20
6	34	25	20



From the above observations it is clear that in case of spiral shape the temperature drop of about 8 to 9 ^{0}C can be obtained depending upon temperature of cold water and velocity of air also. As the velocity of air will increase the turbulence in the flow will increase but due to less retention period less quantity of air come in contact with cold water and so the temperature drop is not apperisiable.

Conclusion

From the present work the major conclusion is in comparison of spiral shape in case of helical and serpentine the cooling of air is better may be because of more turbulence in the flow and high rate of heat dissipation.

References:

1. Baker, R.A., Corning Glass Works, (1987), "Evaporative Recovery of Hazardous Materials", HAZTECH International Conference, August 26- 28, 1987, St.Louis, MO.

2. Veit, P.L., "The Evaporator - A Great Tool, but No Free Lunch", Metal Finishing , November 1989, pp 31-34.

3. McLay, W.J., "Evaporative Recovery" from the 1980 AES Sponsored Environmental Compliance & Control Course.

4. Prutton & Maron, "Fundamental Principles of Physical Chemistry", Revised Edition, The MacMillan Co., New York, 1951, pp 184-185.