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Cooling and Humidification using Vortex Flow for Spiral, Helical and Serpentine

Patel Bhavik R[1], Shiroya Shrey B[2], Krunal prajapati D[3], Patel Dhruv K[4], Ghori Mayur V[5]

[1,2,3,4]*UG Studentsof Mechanical Engineering Department, Sigma Institute of Engineering*
[5]*Assistant Professor, Mechanical Engineering Department, Sigma Institute of Engineering*

Abstract:*The cooling and humidification is having application in evaporative cooling and other industrial application. In vortex flow due to geometry more the turbulence in the flow and which dissipates more amounts of heat and to enhance the rate of heat transfer to the cooling water will be circulated and so cooling effect can be obtained. The cold air passes through water sprinkler which humidified the cold air. The objective of present work is use air instead of refrigerant and then compares the different shapes of tube and by doing an experiment find out in which the performance of cooling is better.*

Keywords:*Cooling, humidification, Vortex flow, Spiral, Helical, Serpentine*

I. INTRODUCTION

The conventional way of 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.

In our system when hot (atmospheric) air flows over the cold water, the air inside the copper tube absorbs heat from the cold water. To keep cooling efficiently, the cold water has to continuously circulate in the heat exchanger with the help of pump. To do that, it requires water tank for the water circulation. All the extra heat from the atmospheric air is transferred to the cold water. As the air cools and the process starts all over again. Think of it as an endless, elegant cycle: air as refrigerant flowing through the blower and cools the refrigeration area.

Evaporation is the oldest and most broadly applied of the separations technologies and has an extensive operating history. In the Surface Finishing Industry, evaporative recovery is classified as a concentrate and return technology and its track record and benefits are well demonstrated. Evaporation is routinely used for point source separation and recovery of plating baths and their associated rinse waters for recycle to the finishing system. Evaporation is also being used successfully to minimize liquid discharges from manufacturing plants by concentrating certain pretreated waste waters, or brines, for haul-away and disposal while recovering additional process water for recycle to the process. Compared to other separations methods, evaporation is more energy intensive. However, it is the only recovery technology which can treat plating rinse waters to separate the solvent (water) from the dissolved chemicals and concentrate the remaining solution back to, or even beyond, bath strength. A basic understanding of the physical and chemical laws governing the behavior of solutions of dissolved substances during concentration, and of the energy requirements for evaporation, will help with the selection and application of evaporators for waste minimization and resource management.

II.BRIEF LITERATURE REVIEW

[1] The study over the topic reveals that the rate of heat transfer can be enhanced using alternative material or incorporating a change in the geometry of the tube. The provision of fins or protrusions to increase the surface area of contact can result in enhanced performance. This work shall mainly focus on arrangement of tubes while varying with pitch and/or the diameter. The requisite mass flow rate shall be calculated to achieve the given temperature (720C) in the specified time. The actual variation to be done shall be discussed upon securing the existing configuration of the shell and tube heat exchanger.

[2] After the above discussion it is easy to say that the shell & tube type heat exchangers has been given a great respect among all the classes of heat exchangers due to their virtues like comparatively large ratios of heat transfer area to volume and weight and many more. Moreover well designed as well as described methods are available for its designing and analysis. The literature survey also shows the importance of this class of heat exchangers. It is also shown by the literature survey that the Computational Fluid Dynamics and other software like ANSYS etc. have been successfully used and implemented to secure the economy of time, materials and efforts.

[3] In this review paper, the discussion had been done about the various configurations for the heat transfer enhancement. Further, the usage of various nanoparticles in the base fluid for the heat transfer enhancement along with these configurations had been studied. A review on the compact heat exchangers had been also done to extract some useful facts regarding heat transfer. The conclusions drawn from literature review are listed below: The achievement of the thermal comfort conditions optimizes the size of the heat exchangers. CWHE could be preferred over STHE depending on the suitability. The provision of baffles in the heat exchangers causes huge pressure drop of the heat transfer fluid. This limitations can be overcome by using dimples, fins, full length twisted tapes and vortex generators. The increase in Nusselt number increases the heat transfer rate. The glycerin based Nano fluid (SiO2-nanoparticle) showed the better heat transfer characteristics. The water based Nano fluid (CuO/ water) showed better heat transfer performances. The proper designs for the fluid flow in compact heat exchangers are essential. The axial heat conduction affecting parameters are Reynolds number (Re), thickness of separating wall (ts) and thermal conductivity ratio (Kr).

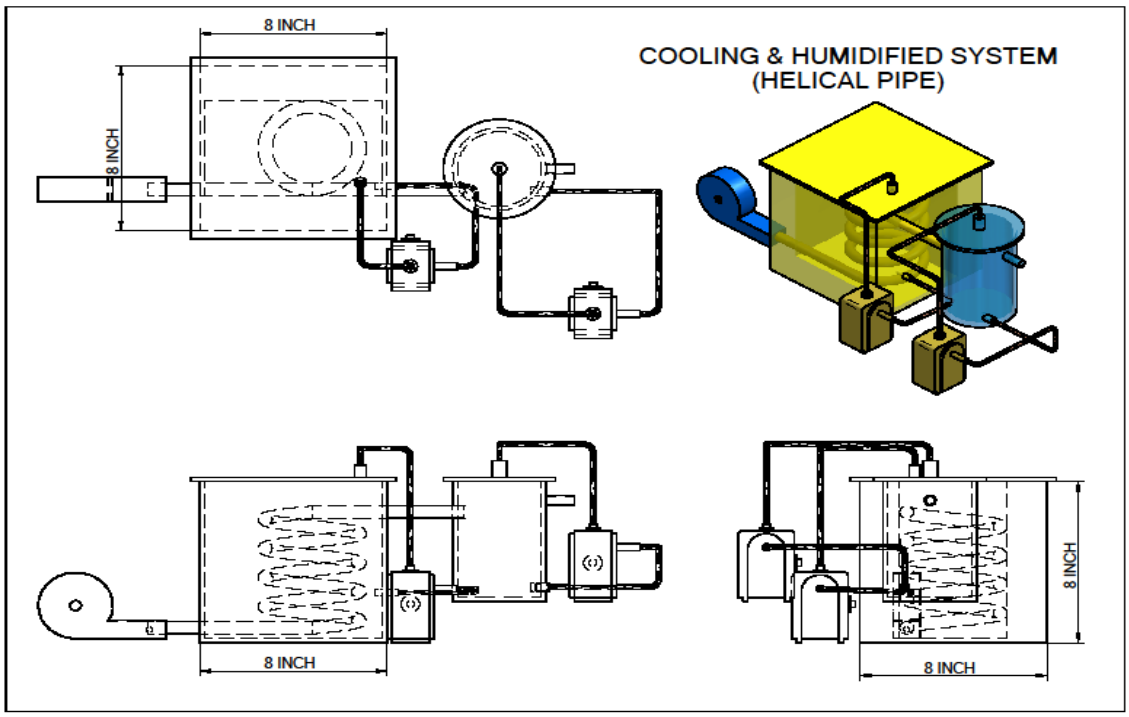
[4] Material performance of the humidifier material is dependent on many factors such as material property and wave length. Humidification is improved with higher wave density, but it also increases flow resistance, paper material performs better than aluminum. However, paper material is worse in bacteria and fire resistance performance.
1. Location of humidifier from experiment, humidifier on the top is preferable than on the bottom, it has no effect on the flow rate and noise, plus significant humidification.
2. Performance of humidifier-AC prototype (1) Performance of the prototype is favorable, humidity level in the room is significantly increased under heating condition. (2) Under constant cooling, the prototype has no effect on the cooling performance. (3) Under constant heating, the prototype has little effect on the heating performance (4) From comparison; the prototype has equivalent performance with commercial humidifier.

III. DESIGN DATA

- 2.5m Copper pipe
- ½ inch diameter
- 500 watt blower single phase AC variable
- Acrylic box
- 100 LPM foot head pump
- Water tank
- K type Thermocouple with indicator
- 3 shapes pipe
    1. Helical
    2. Spiral
    3. Serpentine

IV. DESIGN CONSIDERATION

- Design Concentration in the present project work the main objective is to achieve humidified air using vortex flow to achieve the same objective with indicator cooling of air with cold water copper tube of ½ inch diameter is used because it is available in standard size and can be bend easily into required shape.
- The length of pipe is selected based on cost factor and ease of bending facility and with this two consideration. The length of pipe is taken as 2.5m in shapes like serpentine, spiral, helical. The diameter and curvature in all the three cases are depending upon the size of bender available.
- The size of acrylic box is such selected so that the whole size coil can be kept inside the acrylic box. The acrylic material is selected because it is comparatively good insulator and because it is transparent the water circulation is seen with naked eyes.
- The reading is taken by the experimental study with difference between two reading is 5 minutes. The temperature of atmospheric air is measured 36 c by thermometer.



V. EXPERIMENTAL READINGS

Spiral		Helical		Serpentine	
DBT	WBT	DBT	WBT	DBT	WBT
35	25	35	24	35	26
31	22	30	22	33	24
27	20	27	20	30	22
25	18	24	18	28	21

VI. CONCLUSION

This paper contains a new technique of cooling and humidification. A working model of this system is practically possible. It is designed to meet the low price segment and high level of modularity. After going through we can conclude that the cooling process is done with the different shapes like spiral, helical and serpentine and in helical shape observed higher efficiency than other two shapes.

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