Numerical Investigation of Fluidized Bed To Increase Heat Transfer Effect In Cooling Tower

Abhishek Ranjan[1], Dr. M. K Chopra[2]
[1]Dept of Mechanical Engineering
[2]Head of Department, Dept of Mechanical Engineering
[1, 2] Sarvepalli Radhakrishnan University, Bhopal, India

Abstract- *Computational Fluid Dynamics (CFD) has emerged as a powerful tool to optimize design. In present study, Numerical simulations of cooling tower with different shaped fluidized bed are used to identify the temperature distribution with variation in mass fraction in nanofluid (ZnO). Within it has been found out different mass fraction levels have also been found out at different fluidized bed in the cooling tower. The model of the fluidized bed cooling tower has been created in UNIGRAPHICS 8.0 and analysis has been performed using ANSYS 15.0. The simulation has been done for both temperature and effectiveness. Obtained results have been validated with the available base paper experimental work*

Keywords- Fluidized Bed, Cooling Tower, CFD, Nano fluid, Concentric Shaped Bed, Effectiveness, Cost Reduction.

I. INTRODUCTION

In an attempt to build a steady economic progress most of the countries are undergoing rapid industrialisation. Everyone either at domestic, keep, save or company would love to possess as plenty of electrical conveniences as viable. Numerous stages of day by day residing with daily work are greatly associated with the supply of electrical strength centers. A big demand for cooling comes from the strength stations. Most of the economic tactics in trend generate waste heat that must be removed and dissipated. Small portions are effortlessly rejected at once to the atmosphere, but big heat hundreds commonly dissipated via cooling water. Cooling water gadget is a quintessential part of many industries. Thermal pollution is a multi-faceted problem regarding a huge spectrum of questions ranging from its unique effect on aquatic life to the layout of more green electric powered strength vegetation. Hence, a long time studies alone can find a right answer for most of those issues and it'll be more time eating. With the ever growing use of water, water shortages have creeped in almost all of the metropolitan cities. Therefore, using water recuperation systems is confused through all governments.

II. TYPES OF COOLING TOWERS

The phenomenon of cooling tower design could be very huge: It consists of designs seemed as heat exchangers and towering systems wherein water and air are in direct touch. The structures simply cited are the concrete shells of the big herbal draft cooling towers. In those towers, it's miles the natural buoyancy of the new air that reasons it to float upward via the tower. Most of them are "wet" towers, the water and air being in direct touch because the water trickles or splashes over a grid of bars or plates, called packing.

In mechanical draft towers, air is circulated by method of fanatics. They cowl a miles wider variety of sizes than herbal draft towers. Most of them provide for direct contact in the packing and hence are wet, but dry mechanical draft towers also are used.

The choice to combine the benefits of natural and mechanical draft has brought about the design of "assisted draft" towers, resulting in a completely high capability cooling towers. A similar choice to combine the benefits of moist and dry towers had brought about the layout of "wet-dry" towers, which employ each direct and oblique contact between water and air in exceptional elements of the tower. These are normally based totally on mechanical draft.

III. CONSTRAINTS OF CONVENTIONAL COOLING TOWER

The following are the limitations of conventional cooling towers:

- Atmospheric cooling tower has no control over cooling range as the performance depends on atmospheric air only.
- Mechanical draft towers provide wider range of operating conditions but the design conditions are limited by the initial cost rather than ability to perform.
- Space requirement is more.

- Drift loss is another problem associated with these cooling towers.

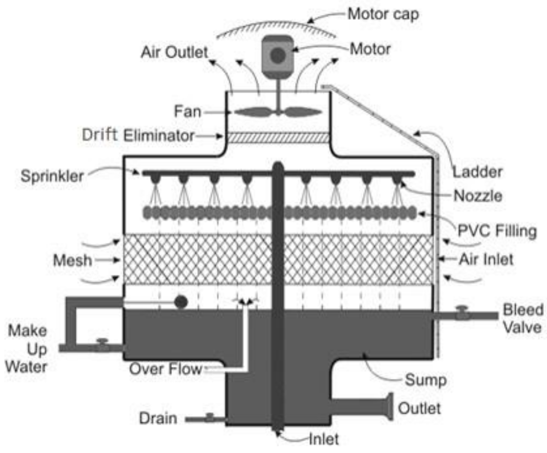

Figure 1 – Conventional cooling tower

IV. METHODOLOGY

Table 3.1: Boundary conditions

Boundary Conditions	Governing Equations
Inlet	Air with varying velocity for different cases
Outlet	Pressure with value 1 atm
Turbulence Model	K-ε Model
Number of Iteration	500
Convergence Criteria	Semi-Implicit Pressure Linked Equation

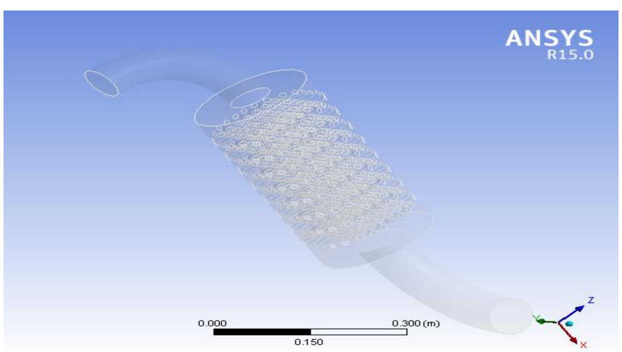

Fig. 2 Metal reticular shaped fluidized bed cooling tower.

Above shown figure 3.1 (a) represent a CAD model of metal reticular shaped fluidized bed here it is shown inlet and outlet pipes which is connected to the cooling tower shell.

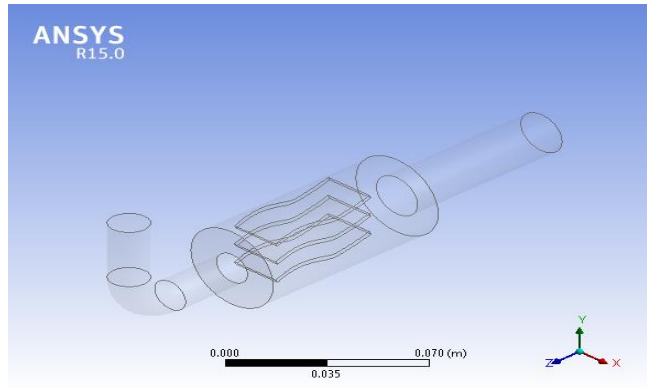

Figure 3: 3D Model of Metal wavy planes shaped fluidized bed cooling tower.

Above shown figure 3.2 (a) represent a CAD model of Metal wavy planes shaped fluidized bed here it is shown inlet and outlet pipes which is connected to the cooling tower shell.

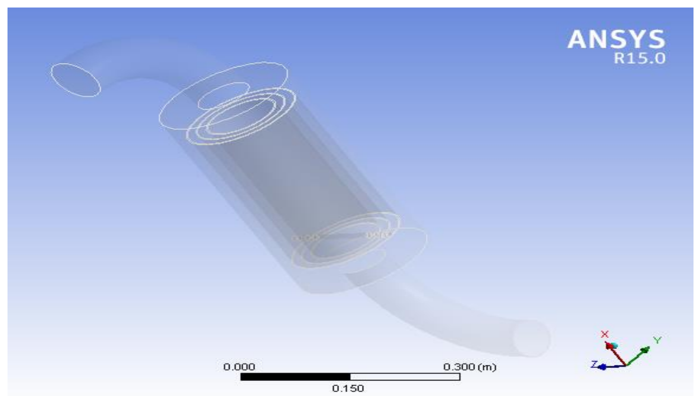

Figure 4: 3D Model of Circular shaped fluidized bed cooling tower.

V. RESULT AND DISCUSSION

5.1 Temperature distribution on cooling tower with different fluidized bed

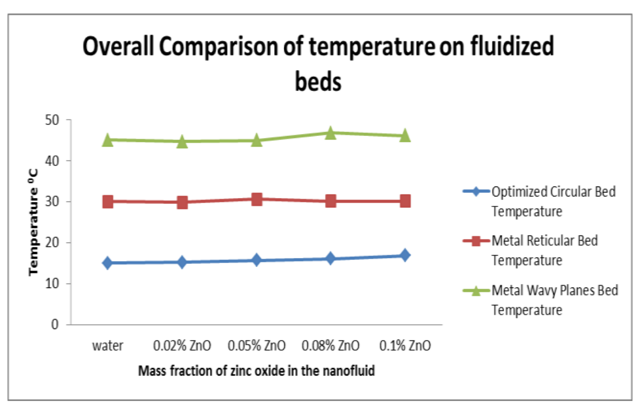

Figure 5: variation in temperature for the fluidized bed cooling tower with different mass fraction of nano fluid

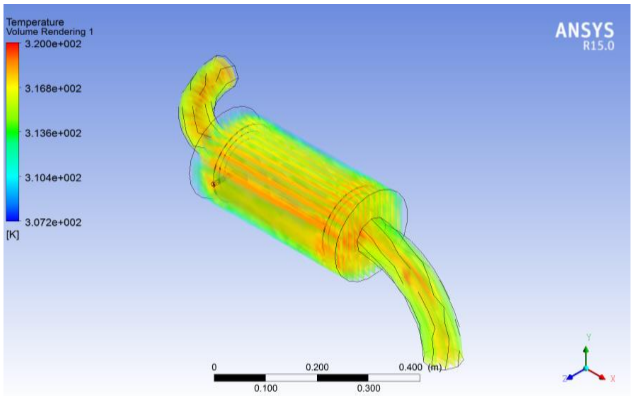

Figure 6: Temperature variation in circular shaped fluidized bed cooling tower at variable mass fraction of ZnO nanofluid.

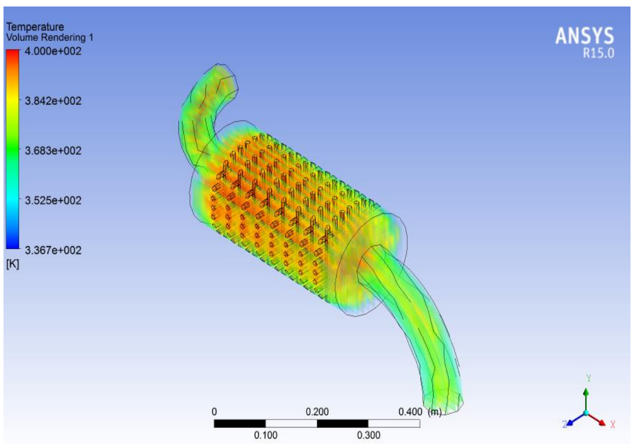

Figure 7: Temperature variation of Metal Recticular Bed shape bed of cooling tower.

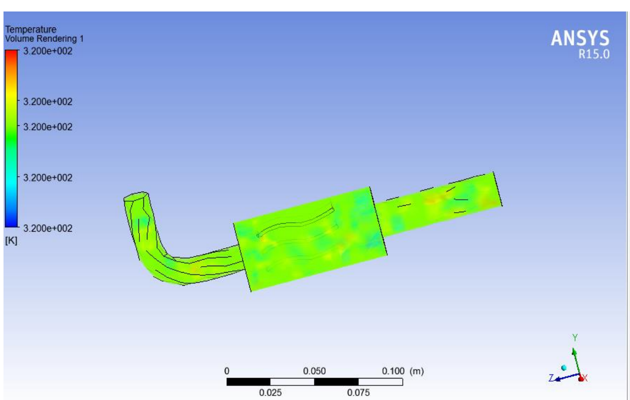

Fig 8: Temperature variation of Metal Wavy Planes Bed of cooling tower.

VI. EFFECTIVENESS OF DIFFERENT SHAPED FLUIDIZED BED COOLING TOWER

Table 4.2 Variation in Effectiveness of different Fluidized Bed Cooling Tower

Effectiveness of different Fluidized Bed Cooling Tower		
Plane Wavy Bed	Metal Reticular Bed	Optimized bed
54.6	55	57.8
55.8	57	60.8
55	57.36	60.38
56.9	60	66.9
58.33	62.38	68.3

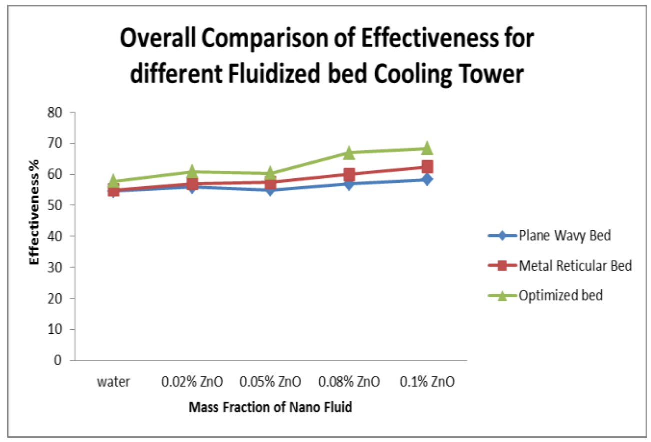

Figure No.9: Variation in Effectiveness of different Fluidized Bed Cooling Tower

VII. APPLICATION FEASIBILITY OF OPTIMIZED CO-CENTRIC FILLS

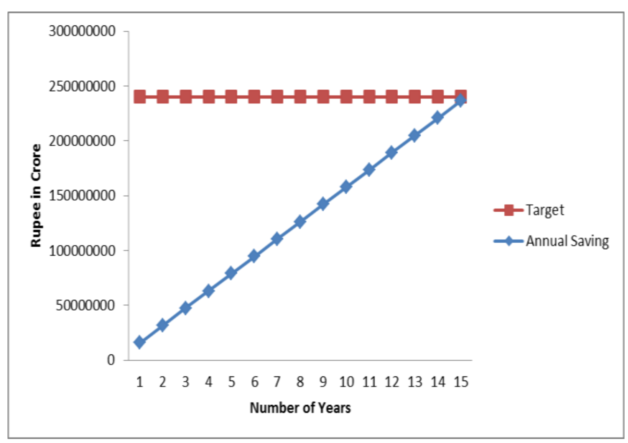

Fig. 10: Represents a Breakeven Pointwith respect to total number of years

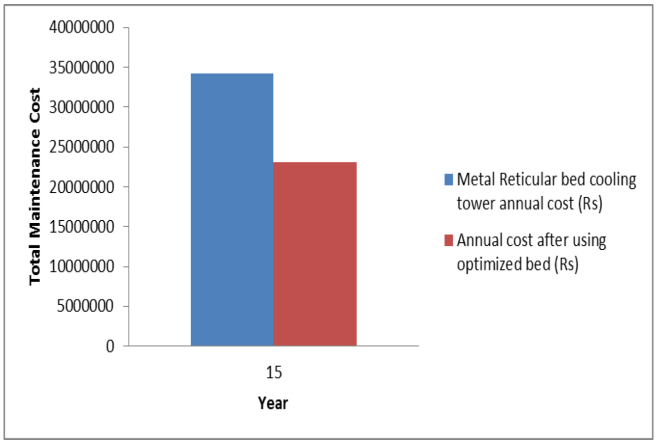

Fig. 11: represents a total maintenance cost with total payback period.

VIII. CONCLUSION

The conclusion of the research work is that thus numerical simulation of fluidized bed cooling tower with respect to mass fraction of ZnO nano fluid shows an optimum result on both temperature and effectiveness and the total annual maintenance cost per year with benchmark, the graph signifies that proposed optimized model promotes less maintenance as compared to existing metal reticular bed fluidized bed.

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