National Conference on
"Role of Engineers in Nation Building" organized by VIVA Institute of Technology, Mumbai
(6^{th} and 7^{th} March 2020)
International Journal of Engineering Research & Science (IJOER)
ISBN:[978-93-5391-287-1] ISSN: [2395-6992] [Vol-6, Issue-3, March- 2020]

Design and fabrication of compact Cooling Tower

Yash Desai[1], Vaibhav Bharankar[2], Jay Dongrekar[3], Kunal Gaikwad[4]

[1]Department of Mechanical Engineering, University of Mumbai, Mumbai 403 305
Email: number1yash@gmail.com
[2]Department of Mechanical Engineering, University of Mumbai, Mumbai 403 305
Email: vaibhavbha85@gmail.com
[3]Department of Mechanical Engineering, University of Mumbai, Mumbai 403 305
Email: jaydongrekar1999@gmail.com
[4]Department of Mechanical Engineering, University of Mumbai, Mumbai 403 305
Email: kunalgk30@gmail.com

Abstract— *We are constructing a cooling tower which will be compact in size, so that it can be easily installed in the internal combustion engine lab. The sole purpose of this project is that, when engines of the lab are used for experiments, they get heated(due to 2nd law of thermodynamics) and so to cool them down the water is supplied and circulated around the engines. The engines get cooled and the hot water coming out from the engines side is disposed in the surrounding, due to which a considerable amount of water gets wasted. So by building a cooling tower the hot water can be cooled down and can be re-used for further cooling of the engines.*

Keywords— 2nd law of thermodynamics, fiber reinforced plastic, internal combustion engine, thermodynamics.

I. INTRODUCTION

A cooling tower is a specialized heat exchanger in which air and water are brought into direct contact with each other in order to reduce the water's temperature. As this occurs, a small volume of water is evaporated, reducing the temperature of the water being circulated through the tower. Water, which has been heated by an industrial process or in an air-conditioning condenser, is pumped to the cooling tower through pipes. The water sprays through nozzles onto banks of material called “fill”, which slows the flow of water through the cooling tower, and exposes as much water surface area as possible for maximum air-water contact. As the water flows through the cooling tower, it is exposed to air, which is being pulled through the tower by the electric motor-driven fan. When the water and air meet, a small amount of water is evaporated, creating a cooling action. The cooled water is then pumped back to the condenser or process equipment where it absorbs heat. It will then be pumped back to the cooling tower to be cooled once again.

If cooling was only a result of sensible heat transfer, then cooling towers would be enormously large due to massive air flow requirements. Evaporation is the key to maximizing efficiency. The type of heat rejection in a cooling tower is termed as “evaporative”, in that it allows a small portion of the water being cooled to evaporate into a moving air stream to provide significant cooling to the rest of that water stream. The heat from the water stream transferred to the air stream raises the air's temperature and its relative humidity to 100%, and this air is discharged to the atmosphere.

II. PROBLEM DEFINITION

In internal combustion engine lab, there are two test engines, one is petrol engine and another one is diesel engine. These engines are used for experiment purpose. Water circulation system is installed around the setup to provide the cooling effect to the engines. The water which is circulated around the engine, accepts the heat from the engines and becomes hot. But with the lack of cooling system(to cool the water), the hot water itself is again recirculated around the engine. Thus it cannot provide any further cooling to the two engines.

National Conference on
"Role of Engineers in Nation Building" organized by VIVA Institute of Technology, Mumbai
(6th and 7th March 2020)
International Journal of Engineering Research & Science (IJOER)
ISBN:[978-93-5391-287-1] ISSN: [2395-6992] [Vol-6, Issue-3, March- 2020]

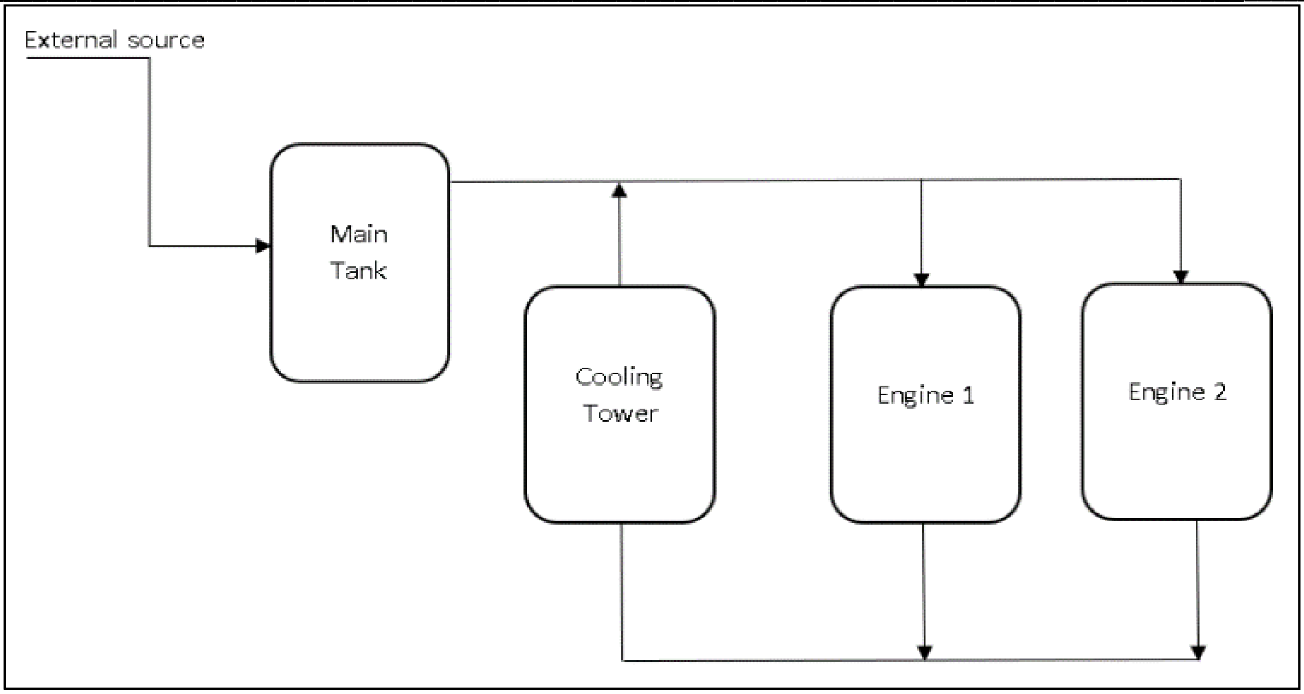

FIGURE 1: Block diagram of current condition in ICE lab

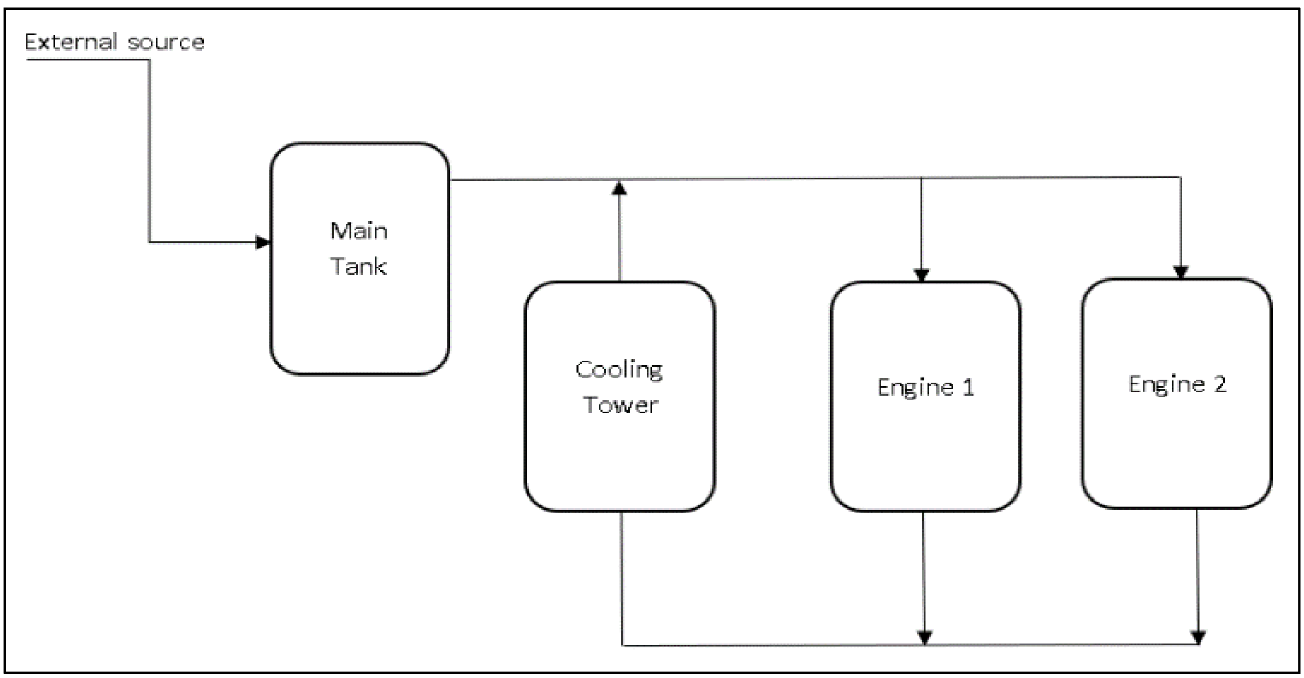

FIGURE 1: Block diagram of solution after implementation of Cooling Tower

III. MATERIAL AND METHOD

Design and fabrication of Compact Cooling Tower is carried out in following steps:–

1. Computational design of the cooling tower is created. The design has satisfied all the requirements for the installation at a provided space of the lab. Software used for this purpose was **SOLIDWORKS 2017**. In designing step frame which is the main structure of machine on which all the other parts are to be mounted. Some of the components which are not available in the market are to be designed and analyzed so that they does not fail during operation

2. Required parts were purchased from the market for the construction of sub-assemblies such as header, collector, drift eliminator and suction unit. The parts have a standard size and shape.

3. The parts which are needed for the frame up and development of compact cooling tower and parts which are available in the market has to be ordered because of their standard size such as nuts and bolts, stainless steel fills, exhaust fan, fiber reinforced plastic sheet, multi hole nozzle, PVC pipes, fan regulator, etc.

4. To make the actual frame from the material ordered. In this step the material has to be cut according to the sizes required, welded where ever needed and bolted for the maintenance purpose. After the frame is ready it will have to be checked for any failure before installing other parts such as stainless steel fill, exhaust fan, drift eliminator.
   In design a to make outer frame having dimensions 60x60x160 cm, with inlet and output pipes having diameter 2 inches each attach to main frame.

5. The two halves of the outer body of the cooling tower was created using a manual molding. Molten material used here to create the outer body was fiber reinforced plastic.

6. The frame is setup the next part is to assemble the following components of machine such as stainless steel fill, exhaust fan, drift eliminator, regulator, lower body for collecting cooled water.

7. To check the working of all the electrical components like exhaust fan ,regulator and motor. The purpose of using this material was that it is light in weight, it is resistant to chemical water and its low cost.

8. Sub-assemblies such as header and drift eliminator were constructed and assembled together with outer body.

9. Connections are made for the thermocouple sensors and temperature indicating display.

10. Testing of the cooling tower was done and checking performance.

11. Finishing the outer body of cooling tower by polishing and painting.

12. Cooling tower is all set perform the operation .

National Conference on
"Role of Engineers in Nation Building" organized by VIVA Institute of Technology, Mumbai
(6th and 7th March 2020)
International Journal of Engineering Research & Science (IJOER)
ISBN:[978-93-5391-287-1] ISSN: [2395-6992] [Vol-6, Issue-3, March- 2020]

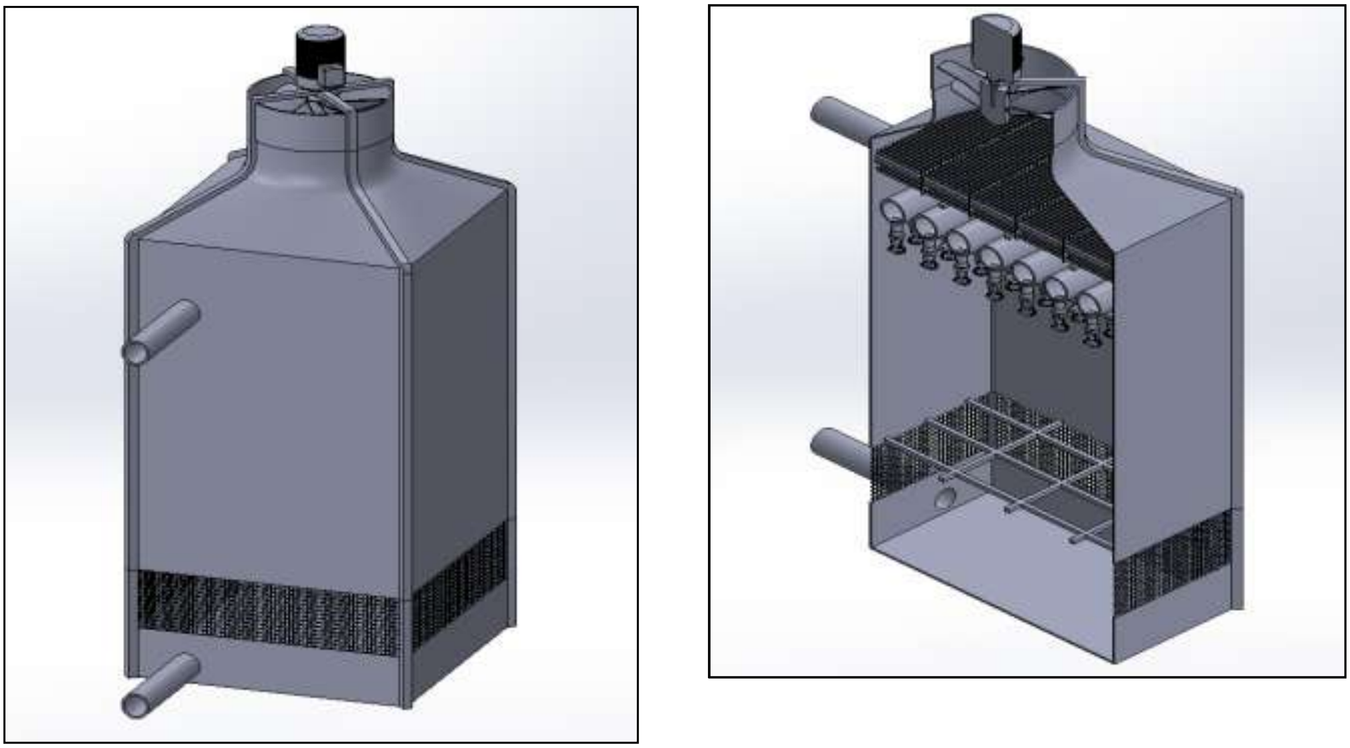

FIGURE 3: Isometric and sectional view of cooling tower assembly in Solid Works

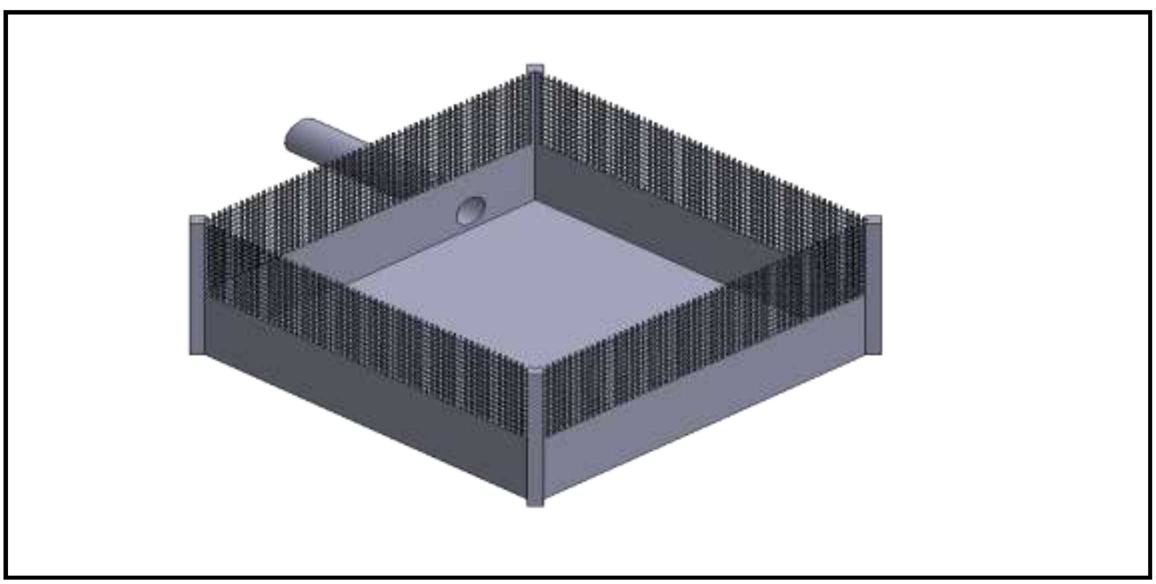

FIGURE 4: Isometric view of lower body of cooling tower

ISBN:[978-93-5391-287-1] ISSN: [2395-6992] [Vol-6, Issue-3, March- 2020]

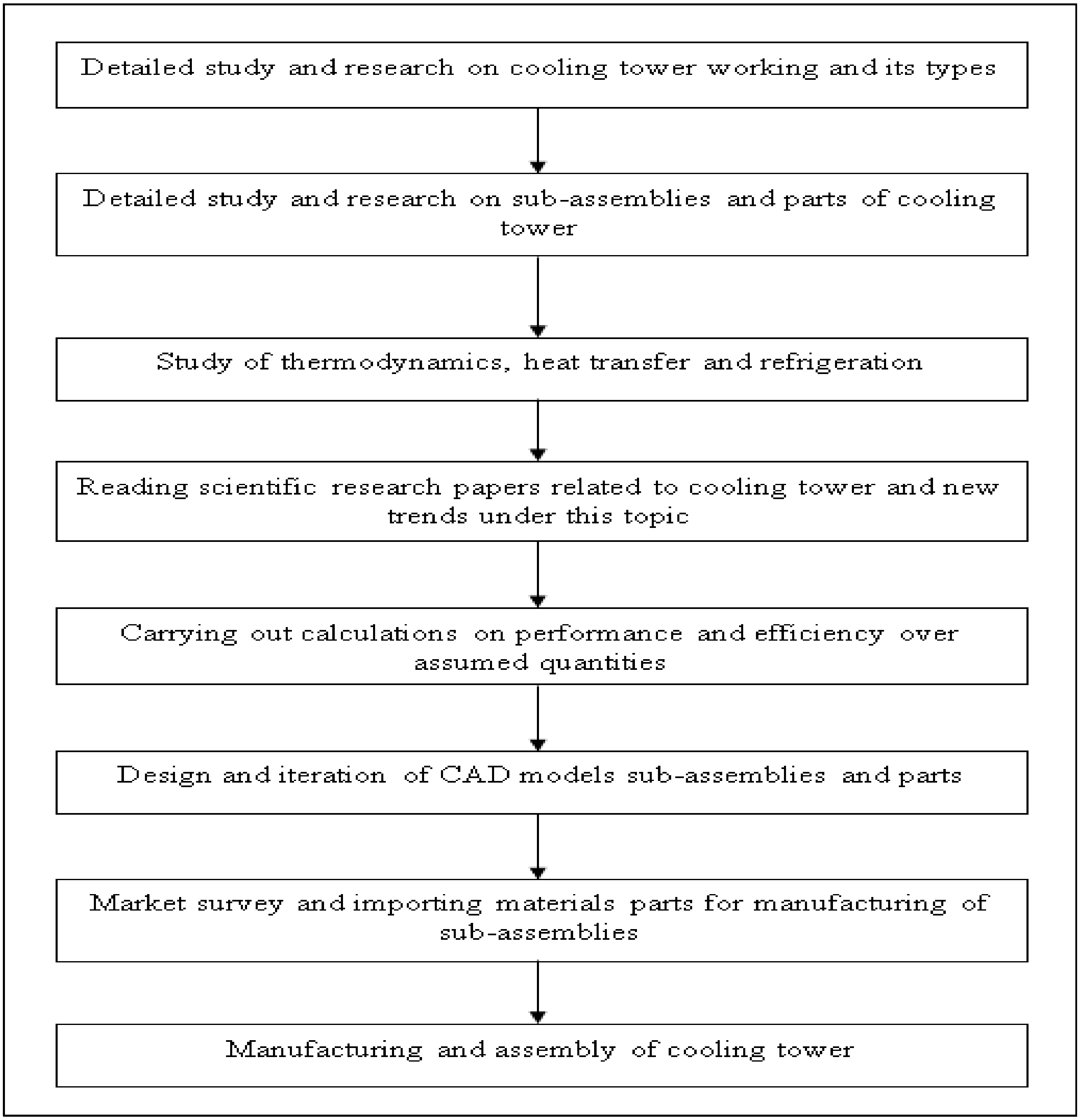

FIGURE 5 : Flow chart of proposed methodology

ISBN:[978-93-5391-287-1] ISSN: [2395-6992] [Vol-6, Issue-3, March- 2020]

IV. CONCLUSION

As we get to know the limitations of conventional cooling towers in the present time, has high lead time and low efficiency. To do so we went through various research papers which helped us to understand the mechanisms and processes. As we get to know the limitations of conventional cooling towers in the present time, has high lead time and low efficiency. We concentrated on reducing lead time and increasing the performance and efficiency. By using the Stainless steel fills and regulator enabled fan, we will achieve efficient cooling from Compact Cooling Tower.

.We concentrated on reducing lead time and increasing the performance and efficiency. By using the Stainless steel fills and regulator enabled fan, we will achieve efficient cooling from Compact Cooling Tower.

REFERENCES

[1] Rohit K. Singla ,Ranjan Das, "Retrieval of Controlling Parameter in Induced Draft Cooling Tower using inverse method', IIT Roper,2016,pp.223-226.

[2] Kayvan Abbasi, Aaron P. Wemhoff, Alfonso Ortega, "Detailed and Reduced Order Modeling of Steady State Counter flow Mechanical Draft Cooling Towers for Analysis of Data Center Energy Efficiency", The NFS center on energy-Smart electronic system,2014,pp.3-11.

[3] Dang Quoc Phu & Dang Tran Tho, "A Study of Energy Effectiveness in a Cooling Tower", School of heat Engineering and Refrigeration, Vol.1.2014,pp.1-5.

[4] Wenhua Zhang, Chunling Meng, "Optimization Design of the GFRP Hyperbolic Cooling Tower Structure", Beijing Technology and Business University ,2013,pp.76-79.

[5] Mr AJ Schutte, R Pelzer & EH Mathews, "Improving Cooling System Efficiency with Precooling". North-West University,2012,pp.1-4.

[6] Limin WANG, Yong SUN, Yongqiang WU & Yongjiang SHI, "An Optimized Solution Method of Cooling Tower Load", Architecture and Training Institute,2009,pp.263-265.

[7] Q. Han, D. Y. Liu, F. S. Chen, Z. Yang, "The Energy-saving Benefit and Economic Evaluation Analysis of Cooling Tower with Flue Gas Injection", National High Technology Research and Development ,2009,pp.1-5.

[8] Rajashekar P. Mandi, R.K. Hegde & S.N. Sinha, "Performance Enhancement of Cooling Towers in Thermal Power Plants through Energy Conservation", CPRI Bangalore,2005,pp.4-10.

[9] ZHANG Xue-lei, WANG Song-ling, CHEN Hai-ping & ZHOU Lan-xin, "Calculation and Influence Analysis for Outlet Water Temperature of Natural Draft Cooling Tower", North China Electric Power University, 2005, pp.496-499.

[10] Geoffery F. Kennedy ,P.H. Margen, "Economic Selection of Cooling Tower for generating stations", North Wales Centre, 1954, pp.279-289.