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Performance enhancement of cooling tower

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Abstract – In warm power plant one of the primary parts is consider, which cools the refrigerant when cooling the refrigerant, the frosty water turns into the high temp water. The high temp water temperature is diminished by cooling tower. At the point when high temp water goes into the cooling tower and splashed by spouts, so boiling water is changed over into chilly water. The compelling cooling of water relies on the dry knob temperature and wet globule temperature, estimate, tallness of the cooling tower and speed of air. The venture manages the execution study and investigation of cooling tower, which is one of the main variables utilized for expanding the power plant productivity likewise demonstrating and examination of stream utilizing programming. The productivity and viability of cooling tower relies upon number of parameter like delta and outlet temperature of air and water, fan speed and so forth.

Key words – Power plant, cooling tower, extend, approach, Cooling limit, bay and outlet temperature of air and water.

I. INTRODUCTION

Cooled water is required for, instance, aeration and cooling systems, fabricating procedures or power age. A cooling tower is gear used to lessen the temperature of a water stream by removing heat from water and radiating it to the environment. Cooling towers make utilization of vanishing whereby a portion of the water is dissipated into a moving air stream and in this manner released into the climate. Subsequently, the rest of the dilute is cooled essentially. Cooling towers can bring down the water temperatures more than gadgets that utilization just air to dismiss warm, similar to the radiator in an auto, and are in this manner more financially savvy.

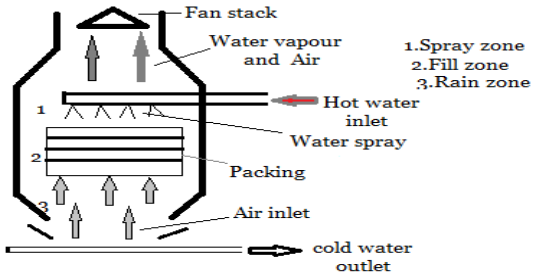

Fig.1 Cooling Tower

II. LITERATURE SURVEY

[1].A.Vijayaragavan, S.Arunraj, (2016), "Performance and Analysis of Cooling Tower",It has been shown that CFD can be used for performance and analysis of cooling tower in terms of cooling efficiencies and effectiveness, water outlet temperature of cooling tower decreases as the air inlet angle decreases, hence the cooling efficiency and effectiveness of cooling tower increases.

[2].G.Kumaresan, S.Satheesh,(2016), "Design and Analysis of Cooling Tower for Thermal Power Plant", the project carried out by us made design an impressing task. Though this type of changes in heat transfer principle and its application etc. therefore,

the main aim from the project is to reduce the time taken and efficiency over the other system.

[3].M.V.H.Sathis Kumar,(2016), "Performance Analysis Of Cooling Tower", effectiveness or efficiency of the cooling tower has been improved during part load operation. This increase in effectiveness may be due to increase in potentiality to absorb heat from cooling water, because of more difference between hot water and wet bulb temp of entering air.

III. COMPONENTS OF A COOLING TOWER

The fundamental segments of a cooling tower incorporate the casing and casing, fill, cold-water bowl, float eliminators, air inlet, louvers, nozzles and fans. These are grouped underneath as

Frame and Casing:

Most towers have basic edges that help the outside nooks (packaging), engines, fans, and different segments. With some littler plans, for example, some glass fiber units, the packaging may basically be the edge.

Fill:

Most towers utilize fills (made of plastic or wood) to encourage warm exchange by expanding water and contact.

Cold-Water Basin:

The chilly water bowl is situated at or close to the base of the pinnacle, and it gets the chilled water that streams off through the pinnacle and fills. The bowl more often than not has a sump or low point for the chilly water release association. In may tower plans, the coldwater bowl are underneath the whole fill? In some constrained draft counter stream outline, notwithstanding, the water at the base of the fill is directed to a border through those capacities as the frosty water bowl propeller fans are mounted underneath the top to pass the air over through the pinnacle.

Drift Eliminators:

These catch water beads entangled noticeable all around stream that generally would be lost to the environment.

Air Inlet:

This is the purpose of section for the air entering a pinnacle. The gulf may take up a whole side of a tower(cross-stream outline) or be found low as an afterthought or the base of the pinnacle.

Louvers:

For the most part, cross-stream towers have gulf louvers. The motivation behind louvers is to even out wind current into the fill and hold the water inside the pinnacle. Numerous counter stream towers configuration don't require louvers.

Nozzles:

These shower water to wet the fill. Uniform water dispersion at the top of the fill is basic appropriate wetting of the whole fill surface. Spouts can either be settled and shower in a round or square patterns,or they can be a piece of a turning get together as found in some roundabout cross-segment towers.

Fans:

Both hub and radial fans are utilized as a part of towers. By and large, propeller fans are utilized as a part of incited draft towers and both propeller and diffusive fans are found in constrained draft towers. Contingent on their size, the sort of propeller fans utilized is either settled or variable pitch. A fan with non programmed movable pitch cutting edges can be utilized over a wide KW run on the grounds that the fan can be changed in accordance with convey the coveted wind stream at the least power utilization. Programmed variable pitch sharp edges can shift wind current in light of changing burden conditions.

IV. TYPES OF COOLING TOWER

Natural Draft Cooling Tower:

The common draft or hyperbolic cooling tower has utilization of effect in temperature between the surrounding air and the more blazing air inside the pinnacle. As hot air moves upward through the pinnacle, crisp cool air is drawn into the pinnacle through an air gulf at the base. because of the design of the pinnacle, no fan is required and there is no flow of hot air that could influence the execution. Concrete is utilized for the pinnacle shell with a stature of up to 200m.these cooling towers are for the most part just for expansive warmth obligations since huge solid structure are costly.

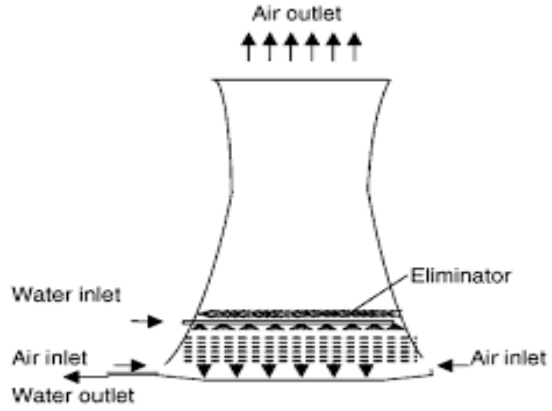

Fig.2 Natural Draft Cooling Tower

Mechanical Draft Cooling Tower:

Mechanical draft cooling towers have extensive fans to power or draw air through coursed water. The waterfalls downwards finished fill surface, which help increment the contact time between the water and the air-this boosts warm exchange between the two. Cooling rates of mechanical draft towers relies on different parameters, for example, fan distance across and aped of activity, fills for the framework protection and so on mechanical draft towers are accessible in an extensive scope of limits. Towers can be either production line fabricated or field raised for instance solid towers are just field raised. Numerous towers are developed with the goal that they can be gathered together to accomplish the coveted limit. Consequently, numerous cooling tower are congregations of at least two individual cooling tower or cells.

Cooling Tower Materials:

Initially, cooling towers were built essential with wood, including the edge, facilitating, louvers, fill and frosty water bowl. Here and there the chilly water bowl wilk,made of solid today, fabricating utilize an assortment of material to develop cooling towers, materials are improved consumption protection, lessen upkeep, and advance dependability and long administration life. Excited steel, different levels of stainless steel, glass fiber, and cement are generally utilized as a part of to development, and in addition aluminum a plastics for a few segments.

Cooling Tower Performance:

This area how the execution of cooling forces can be evaluated. The execution of cooling towers is assessed to evaluate exhibit levels of approach and range against their outline esteems, recognize regions of vitality wastages and to propose upgrades. Amid the execution assessment, compact checking instruments are measure the accompanying parameters:

- Wet bulb temperature of air
- Dry bulb temperature of air
- Cooling tower inlet water temperature
- Cooling tower outlet water temperature
- Exhaust air temperature
- Electrical reading of pump and fan motors
- Water flow rate
- Air flow rate
- Total heat rejection
- Hot water temperature
- Cold water temperature
- Cooling range

Formula used:

1. Cooling tower range

= Hot water temperature-Cold water temperature

2. Cooling tower approach

= Water outlet temperature-Wet bulb temperature

3. Effectiveness= Range/(Range+ Approach)+100

4. L/G ratio =Water flow in kg/Air flow in kg

5. Air mass flow/cell =Flow×Density of air

6. Make up water consumption

=Evaporation Loss/(coc-1)

7. Total heat transfer $Q = k \times s(h_w - h_a)$

8. Cooling load $Q_1 = ma\ (ha_2 - ha_1)$

9. Convective heat transfer ratio

$Q = m_w \times cp_w \times (Tw_1 - Tw_0)$

10. Evaporation loss (m^3/hr)

$= 0.00085 \times 1.8 \times$ circulation rate$\times (T_1 - T_2)$

11.Efficiency = T_1-T_0/T_1-T_{wb}×100

Where,
Tw_1 - Water inlet temperature
Tw_0 - Water outlet temperature
T_1 - Inlet temperature
T_2 _Outlet temperature

V. FUTURE DEVELOPMENT

The present innovation of cooling towers fluctuates from the current cooling towers. A portion of the changes should have been taken into contemplations to enhance the general effectiveness of the cooling tower.

Changing of fan blade material aluminum instead of GRP:

After iron, aluminum is currently the second most broadly utilized metal on the planet. The properties of aluminum include: low thickness and in this way low weight, high quality, unrivaled flexibility, simple machining, superb erosion protection and great warm and electrical conductivity are among aluminum's most critical properties. Aluminum is likewise simple to reuse.

Specification Of Blade Material:

Material name: Aluminum (Al)

Blade length: 4.1 m

Blade angle: 13.7^0

Blade weight: 70kg

Properties Of Aluminum:

Weight:

Extra ordinary compared to other known properties of aluminum is that it is light, with a thickness 33% that of steel, 2700kg/m3. The flap thickness of aluminum represents it being lightweight however this does not influence its quality.

Strength:

Aluminum compounds regularly have rigidities of in the vicinity of 70 and 700MPa.the territory for combination utilized as a part of expulsion is 150-300MPa. at high temperatures, aluminum's quality abatements. At temperature ceaselessly above 1000c, strength is influenced to the degree that the debilitating must be considered.

Linear Expansion:

Compared with other aluminum has a relatively large coefficient of linear expansion. This has to be taken into account in some designs.

Machining:

Aluminum is effortlessly worked utilizing most machining techniques processing, boring, cutting, punching, bending, etc.

Formability:

Aluminum's superior malleability is essential for extrusion. With the metal either hot or cold, this property is also exploited in the rolling of strips and foils, as well as in bending and other forming operations.

Conductivity:

Aluminum is a phenomenal conduit of warmth and power. An aluminum conveyor weights around half as much as a copper transmitter having a similar conductivity.

Joining:

Highlights encouraging simple jointing are regularly consolidated into profile outline. Combination welding, grinding blend welding, holding and taping are additionally utilized for joining.

Reflectivity:

One more of the properties of aluminum is that it is a decent reflector of both noticeable light and transmitted warmth.

Corrosion resistance:

Aluminum responds with the oxygen noticeable all around to frame a to a great degree thin layer of oxide. despite the fact that it is just somewhere in the range of hundredths of a thick 1 is one thousandth of a millimeter, this layer is thick and gives amazing consumption insurance. The layer is self-repairing if harmed.

Table 1: Comparison of Blade Materials

GRP	ALUMINUM
Life time: 5-7 years/blade	Life time: 9-12years/blade
Low weights, less strength compared to Al	Low weight, high strength

Corrosion free but inner surface gets damage	Corrosion free
Sometimes algae formation takes place.	No algae formation
Evaporating loss is low	Evaporating loss is high
External paint coating is needed.	Need not to be coated
Maintenance cost is high	Maintenance cost is low

Table 2: Specification of Fan

FAN		UNITS
No. of fans per cell	1	Nos
.No. of blades per fan	8	Nos
Fan speed	300	Rpm
blade diameter at tip	10000	Mm
hub diameter	2390	Mm
fan pressure(total static)	4.60-5.06	N/mm^2
power input to fan	45.93-49.74	kW

VI. SYSTEM SPECIFICATION

The temperature distribution and heat transfer analysis is need to done for optimizing the parameters which determines the moisture removal rate of the corresponding agricultural crops. This analysis is done using the ANSYS software. Some of the software's used in the determination of regression coefficient are, like solving any problem analytically, you need to define your solution domain, the physical model, boundary conditions and physical properties. You then solve the problem the results. In numerical methods, the main difference is an extra step called mesh generation. This is the step that divides the complex model into small elements that become solvable in an otherwise too complex situation.

VII. RESULTS AND DISCUSSIONS

Table 3: Results for Cooling Tower

Cooling tower approach	6.30	^0C
Cooling tower range	11.60	^0C
Effectiveness	65	%
L/G ratio	2.7164	
Enthalpy of inlet air	65.9	kJ/kg
Enthalpy of exit air	97.41	kJ/kg

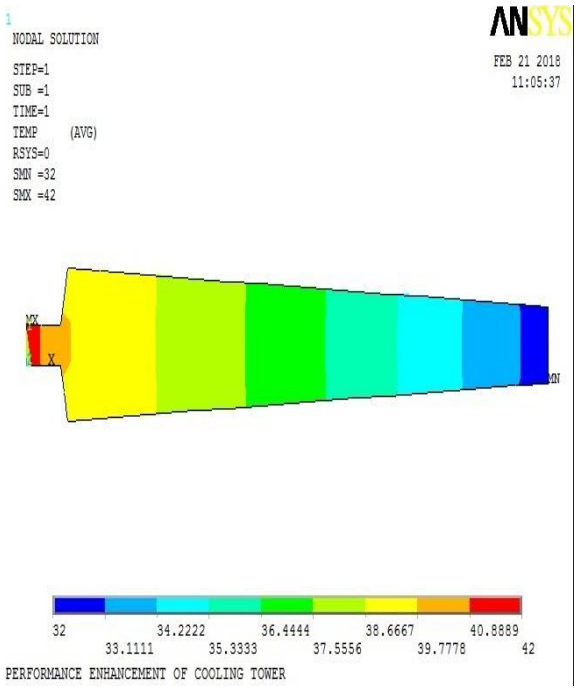

Fig.3 Temperature distribution of fan blade

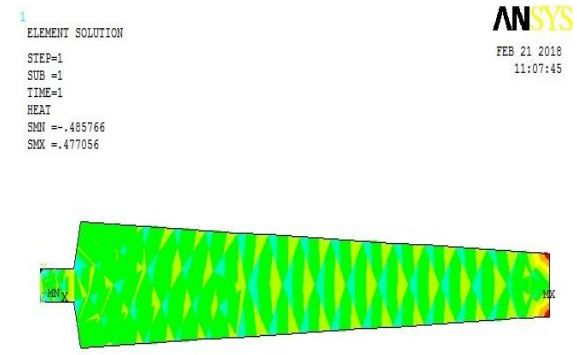

Fig.4 Heat flow distribution of fan blade

Cooling load	106696.01	kJ/hr
Humidity	9.66	
Efficiency	64.80	%
Heat load	162193.2	kJ/hr
Density ratio	15.52	Kg/m^3
Drift losses	41.588	m^3/hr
Total loss	1005.865	m^3/hr

Table 4: Performance Improvements of Cooling Tower

Cooling tower approach	3.2	^0C
Cooling tower range	10	^0C
Effectiveness	75.75	%
L/G ratio	2.7164	
Enthalpyinletair	82.0	kJ/kg
Enthalpy of exit air	109.16	kJ/kg
Cooling load	91966.74	kJ/kg
Humidity	9.66	
Efficiency	75.57	%
Heat load	162193.2	kJ/hr
Density ratio	15.52	Kg/m^3
Drift looses	41.588	m^3/hr
Total losses	945.038	m^3/hr

VIII. CONCLUSION

The fundamental point of the venture is to break down the proficiency of the cooling tower by taking the estimation of the temperature of heated water and chilly water, speed of louver at channel and outlet of the spout and air temperature of bay and outlet.

After the examination, it was discovered that the effectiveness of the cooling tower was just 64.80% which is louver than the execution upgraded an incentive at 75.57% at barometrical condition .we give the recommendation of changing of fan cutting edge material in aluminum.

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