

# Performance Improvement of Cooling Tower

Tarun Kumar Ranjan<sup>1\*</sup> Dr. M. K. Chopra<sup>2</sup> Mr. Vivek Singh<sup>3</sup>

<sup>1</sup> PG Scholar of Thermal Engineering, RKDF IST, Bhopal (M.P) India

<sup>2</sup> Professor, Vice Principal Dean Academic & HOD Department of Mechanical Engineering, RKDF IST Bhopal (M.P) India

<sup>3</sup> Assistant Professor, Department of Mechanical Engineering, RKDF IST Bhopal (M.P) India

**Abstract – Latest technological developments have created the water conservation more efficient and use of chemicals a lot of restricted by introducing “Recycling / reusing water practices” and “Chemical free platforms”. With limited options available to the designed and operating cooling tower, these areas could be explored for better and cost effective performance and environment friendly impact.**

**Keywords: Cooling Tower, Water Treatment**

-----X-----

## 1. INTRODUCTION

The Cooling tower is a direct contact type heat exchanger. It is a semi classical, evaporative cooler. The water is sending out over a particular height and weather passes over it. Some water evaporates and also the heat of evaporation is extracted from falling water and close air, therefore water cool.

Cooling towers are a really vital a part of several chemical plants. The first task of a cooling is to reject heat into the atmosphere. They represent a relatively inexpensive and dependable means that of removing low-grade heat from cooling water. The make-up water supply is used to fill up water lost to evaporation. Hot water from heat exchangers is sent to the cooling system. The water exits the cooling system and is sent back to the exchangers or to different units for any cooling. Typical closed-loop system cooling system is shown in Figure 1.

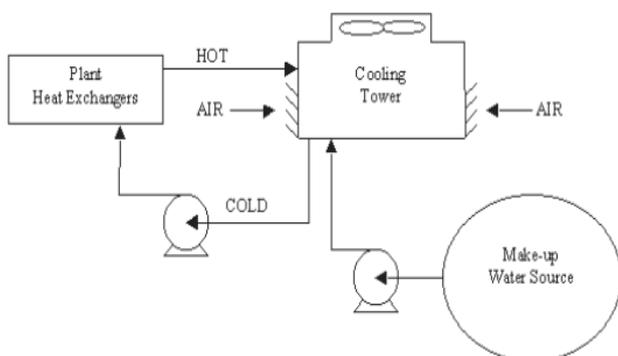


Fig.1 Cooling Water System

## 2. NECESSITY OF COOLING THE CONDENSER WATER

As the cooling water absorb the latent heat of steam within the condenser, the temperature of the water will increase. The new water beginning of the condenser cannot be used once more during a closed system while not pre reaches almost Ts saturation temperature of steam at condenser pressure and therefore the condenser vacuum cannot be maintained. Thus it's completely necessary to pre cool the water beginning of condenser before using once more.

The cooling water demand in an open system is regarding 50 times the flow of steam to the condenser. Even with closed cooling system using cooling towers, the need for cooling water is also significantly giant as 5 to 8 kg/kW hr. this implies a 1000 MW station would require regarding 100 thousand tunes of circulating water per day even with the employment of cooling towers.

## 3. GENERAL IMPROVEMENT PROCEDURES

1. The following might be fruitful choices to enhance energy efficiency of cooling towers:
2. Follow manufacturer's suggested clearances around cooling towers and relocate or modify structures that interfere with the air intake or exhaust.

3. Optimize cooling system blade angle on a seasonal and/or load basis
4. Correct excessive and/or uneven blade tip clearance and poor fan balance
5. In old counter-flow cooling towers, replace old spray sort nozzles with new square spray nozzles that don't clog
6. Replace splash bars with self-extinguishing PVC cellular film fill.
7. Install nozzles that spray during a additional uniform water pattern.
8. Clean plugged cooling system distribution nozzles often.
9. Balance flow to cooling system hot water basins
10. Cover hot water basins to reduce algae growth that contributes to fouling.
11. Optimize the blow down rate of flow, taking under consideration the cycles of concentration (COC) limit.
12. Replace slat sort drift eliminators with low-pressure drop, self-extinguishing PVC cellular units.
13. Prohibit flows through giant masses to style values.
14. Keep the cooling water temperature to a minimum level by (a) segregating high heat masses like furnaces, air compressors, dg sets and (b) isolating cooling towers from sensitive applications like A/C plants, condensers of captive power station etc. Note: A 1°C cooling water temperature increase could increase the A/C compressor electricity consumption by 2.7%. A 1oC drop by cooling water temperature will provides a heat rate saving of 5 kCal/kWh during a thermal power station.
15. Monitor approach, effectiveness and cooling capability to continuously optimize the cooling system performance, however consider differences due to the season and side variations.
16. Monitor liquid to gas ratio and cooling water flow rates and amend these counting on the planning values and differences due to the season. For example: increase water masses throughout summer and times once approach is high and increase air flow throughout monsoon times and once approach is low

17. Think about COC improvement measures for water savings
18. Consider energy efficient fibre reinforced plastic blade adoption for fan energy savings
19. Control cooling system fans supported exit water temperatures particularly in small units
20. Check cooling water pumps often to maximize their efficiency.

#### 4. PERFORMANCE IMPROVEMENT

##### 1. Water Use

The hierarchy of opportunities approach can be used to identify and priorities water efficiency opportunities.

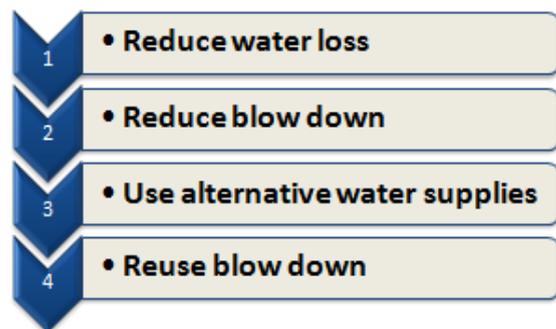


Fig.2 Hierarchy of opportunities

##### Reduce water loss

Reducing water losses reduces the quantity of make-up water required for the system. Potential opportunities to reduce water loss include:

- Fixing leaks
- Reducing splash
- Optimizing overflow
- Eliminating drift – drift losses should be maintained at less than 0.002% of cooling water circulation rate. Repair or install new systems to achieve best practice.

##### Reduce blow down

Equation & Water Losses

$$\text{Water Losses} = \frac{\text{Quantity of Make – up water}}{\text{Cycle of concentration}} - \text{Quantity of Blowdown}$$

As water evaporates from cooling system the contaminants, salts and minerals measured as total dissolved solids (TDS) that accumulate will reason biological growth, corrosion and scale leading to tower damage, poor heat transfer and probably the

growth of harmful bacteria like legionella. The sources of contaminants include:

- Salts and minerals already within the make-up water
- Chemicals else to reduce corrosion, scale and biological growth
- Pollutants getting into the water throughout the evaporation part from the surrounding air like dust.

To reduce the buildup of those contaminants, a little of the water within the tower is bled off (blow down). This water loss from the tower is then replaced with recent incoming make-up water. A conductivity probe or sensor within the tower basin initiates blow down once the levels of dissolved solids exceed a set value. 'Cycles of concentration' (C.O.C.) compare the amount of dissolved solids within the tower's make-up water to the amount of dissolved solids within the tower's bleed water.

Equation 9 Cycle of Concentration C.O.C.

$$\text{Cycles of Concentration (C. O. C.)} = \frac{\text{Total dissolved solids in the make - up water}}{\text{Total dissolved solids in the bled water}}$$

Increasing the number of C.O.C. can reduce the amount of blow down and consequently the volume of make-up water needed by the tower. The maximum C.O.C. for a tower can rely upon the standard of the make-up water and therefore the corrosion resistance of the tower's basin and condenser. C.O.C. over 5 is considered to be efficient however this can be not invariably possible. Scale forming ions like Ca and metal will typically be precipitated out (by water softeners) or kept in solution (by acids) through effective water treatment enabling the tower to work at higher cycles of concentration.

### Use Alternative Water Supplies

Alternative water provides have the potential to reduce potable water needs in cooling towers, through direct substitution and by reducing the cycles of concentration. Different water choices include recycled water, method or rain. Note that health risks got to be thought-about once assessing the viability of alternate water provides. Further water treatment may be needed counting on the standard of water available.

### Reuse Blow Down

Potential opportunities to reuse cooling blow down include:

- Toilet and urinal flushing (treatment is also required)

- Landscape irrigation (may need dilution with potable or rain because of salt content or treatment)
- Cleaning (health risk assessment is also needed and therefore the impacts of corrosion ought to be considered).

## 5. CONCLUSION

Water conservation will not only reduce the load on environment and natural resources, but would also enable the organization to claim for eco-efficiency indicator points – a new brand image perspective. The adoption of chemical free platforms completely or partially will reduce the cost of chemical purchases, dependence of service provider and most important – regional leadership in emerging the cooling water treatment technologies, since the application has only been adopted in Western continents.

## REFERENCE

1. Bonneville Power Administration. (1991, November). Optimizing Cooling Tower Performance. Technology Update, pp. 1-4.
2. Clayton Technologies. (2011). Clayton Cooling Towers. Indore, India: Clayton Technologies India Pvt. Ltd.
3. Daeil Aqua Co., Ltd. (2004, May 10). Cooling Tower Thermal Design Manual. Retrieved August 2011, from Cooling Tower Technical Site: <http://myhome.hanafos.com/~criok/english/publication/thermal/thermallisteng.html>
4. Federal Energy Management Program. (2011). NASA Marshal Space Flight Center Improves Cooling System Performance. Huntsville, Alabama: US Department of Energy.
5. General Services Administration. (2011). Water Management: A Comprehensive Approach for Facility Managers. In Water Management Guide (pp. 1-140). Kansas City.
6. Ken Mortensen. (2003, May). How to Manage Cooling Tower Water Quality. RSE Journal, pp. 1-4.
7. Muhammad Yousuf. (2010). Cooling Tower Treatment Manual. Mirpur Mathelo: Fauji Fertilizer Company.
8. N.C. Department of Environment and Natural Resources. (2009). Water Efficiency Manual. North Carolina: N.C.

Department of Environment and Natural Resources.

9. Pacific Northwest National Laboratory. (2011). Cooling Towers: Understanding Key Components of Cooling Towers and How to Improve Water Efficiency. US Department of Energy.
10. Ray Congdon, Rand Conger, Mike Groh, Roger van Gelder. (2011). Cooling Tower Efficiency Manual. In R. C. Ray Congdon, Cool Tunes (pp. 1-26). Washington DC: Water Smart Technology Program.
11. Saving Water. (2011, August). Improve Control of Cooling Tower Water. WATER SMART TECHNOLOGY, pp. 1-2.
12. SPX Cooling Technologies. (1986). Cooling Tower Performance. USA: Cooling Tower Information Index.

---

#### Corresponding Author

**Tarun Kumar Ranjan\***

PG Scholar of Thermal Engineering, RKDF IST, Bhopal (M.P) India