ECO RECOVERY OF EVAPORATION LOSS AT COOLING TOWER OF THERMAL POWER PLANT

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ABSTRACT: The Globe as well as national stage also understands shockingly crucial sustainability threats, i.e., H_2O shortage and pandemic situation (COVID-19). The thoughtful H_2O utilization strength in a variety of brand dominion technology. According to countrywide disorder is a prerequisite for understanding the prospective shock of influence on H_2O reserves. Evaporation loss is 968t/h at Target Sector, this paper review on operational losses to Eco Design 475.5t/h. At the Current Situation power is not sustainable energy with reverence to H_2O preservation, so revision at power should be enhanced to propose and recaptures to reduce losses from 968t/h, to 475.5t/h for Environment sustainability.

Key words: Water Shortage, Eco-Recovery, evaporation losses, sustainable energy, water conservation

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INTRODUCTION

Disagreement among the rapidly claim for H_2O and need of together reserves has steadily develop into one of the biggest interruption to improvement in mainly of the, Liu, 2006 [1], Zhange 2007[2].The power sector is highly dependent on water, by 2035 global water without power will increase by more than 20% compared to 2010, power-Reactor ,2016 [3].There is lot of Question to answer on precise figures on the H_2O expenditure on all type of power, Refinery and Fertilizer such should be addressed by Govt. According to united states Geological survey (USGS) withdrawal removed water from ground while consumption refer to amount of water evaporated from the water environment, Kenny, 2009 [4]. Water is important resource, nature has provided, and there is a need lot of attention to how use it carefully to prevent loss.

The consumption of auxiliary power, specific coal, specific oil and heat rate are all monitored except Specific water consumption, in neighbor country the raw water cost for 2100MW unit in Rs-l Crore/month. The Specific water Consumption is 1.7-1.8 liter/Kwh; they bond all user of power to reduce the Specific water consumption to below $3.5m^3$/MWH to$2.5m^3$/ MWH by Dec 2017, Subramanian, G [5]. With Zero waste water Discharge, water balance, audit reports must be submitted to MOCC and EPA.

MATERIAL AND METHODS

Ideally the H_2O supervision, it is a significant quantifies to make stronger the H_2O administration of the power generation which could help to save water and reduce the consumption for the thermal power station.

It is observable that it is superior to apply the recycle H_2O as the socialize make-up water than the H_2O deliver. Cost price shows when concentration rate is 4 or 5 the healing charges utilizing recycle water is 11.44Rs/ton and 8.35Rs/ton while supply water is 12.87Rs/ton to 15.25Rs/ton [1]. Respectively. TPS (Thermal power Station) is huge H_2O consumer & manufacture reasonably bulky industrial waste-water. So the reprocess of the industrial H_2O might trim down the contamination of the waste-water to the Environment. The waste-water reprocess approach comprise the decentralized cure and the centralized cure, so unit of 600MW should take up integrated cure mode due to wonderful institution and good H_2O class, as the water quality of waste water is very complex.

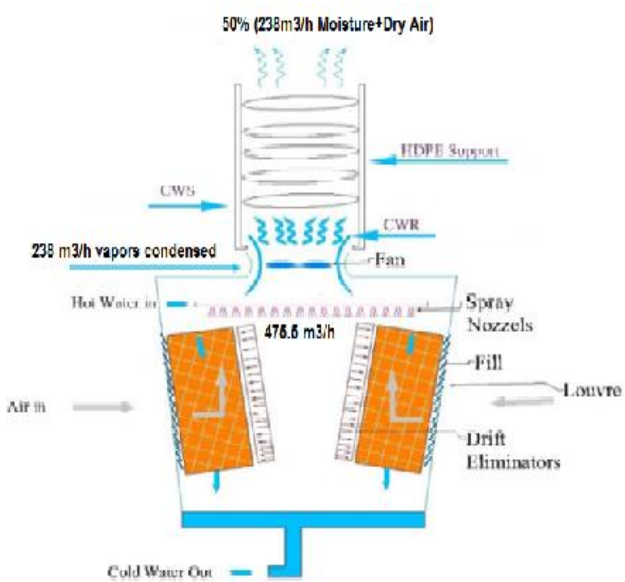

Figure 1. ECO Advance Approach [6].

The Evaporation loss at above phenomena has been overcome at Refinery and Fertilizer by applying the Water behavior changes from cold Water supply to hot Water return and the exhausted Water plus moisture mixture control [5-6]. The compression of dampness air, the accumulation stream rates of dry air stay constant, i-e. No mass transfer between moisture miscalculation and dry air. Only mass of water-vapor in the moisture-air modify. Consequently the quantity of thick water could be computed in the wetness ratio of humidity air. The humidity proportion d is:

$$d = \frac{mq}{mg} = 0.622\ \frac{pq}{pg} = \frac{0.622\ Pq}{P-Pq}$$

Mq = water-vapor mass flow-rate
Mg = Dry air mass flow-rate
Pq = Pressure of water-vapor
Pg. = Pressure of dry-air

Sum of Concentrated H_2O can be deliberated by flowing equations.

Qcond = my (d_1-d_2)
$D_1=d_2$ = Humidity ratios at temperature T_1& T_2

Determination of state point, so equation is

$$Two = Tao + (Tm - TA0)\ \frac{two-TAo}{dm-tAo}$$

Tao = Temperature of ambient air
Two = Temperature of lot side air
Im = Arithmetic mean temp of inlet & outlet
IAo = Enthalpy of ambient-air
Two = Enthalpy of hot side-air
Im = Enthalpy of corresponding to the Tm

Nearby no accumulation transport between 2 flows, the unlimited humidity at frosty channel outlet equals to that at humidity at cold conduit Inlet so M1 is state point in equation below

Mbiw + mciA1 = mim1
Mbdw + mcdA1 = mdm1

Where

Mb = Hot moisture air mass flow rate
Mc = cold air mass flow rate
m = overall air mass flow rate

$$Q = K \times S \times (h^W - h^a)$$ …1 (Markel theory 1938)

$$KS/L = Kav/\ \ L = \frac{G}{L}\ f_{ha1}^{ha2}\ dh/\ \ h_w - h_a$$

$$\frac{Ks}{L} = \frac{Kav}{L} = Cw \times f_{tw1}^{tw2}\ \frac{dtw}{h_w - h_a}$$

NTU=Number of Transfer unit

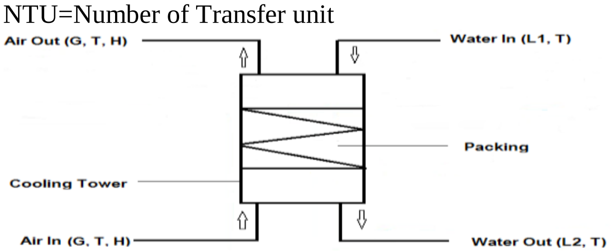

Figure 2. Process Flow Balance [2]

$$\frac{Kav}{L} = Cw \times f_{tw1}^{tw2}\ \frac{dtw}{h_w - h_a} =$$

$$(tw2 - tw1) \times \left[\frac{\left(\frac{1}{dh1} + \frac{1}{dh2} + \frac{1}{dh3} + \frac{1}{dh4}\right)}{4} \right]$$

Simply

$$ha_2 = ha_1 + \frac{L}{G} \times Range \text{.................................}1$$

The Ratio of L/G Is called slop

We know $y = a + b \times x$ **where**

$b = \frac{L}{G}$ **and** $a = ha_1$ **and** $x = Range$

So from Graph

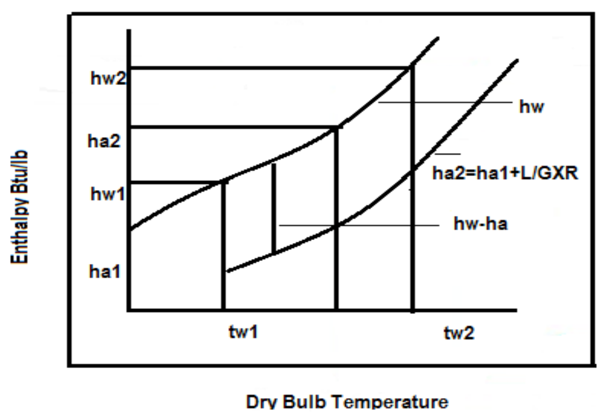

Figure 3. Enthalpy Relationship [1].

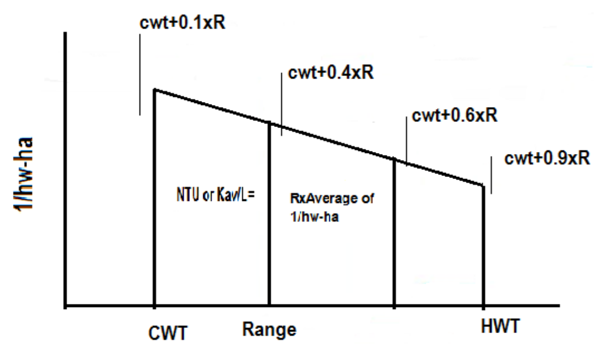

Figure4. Enthalpy Relationship [1].

Enthalpy differences (HW-HA) Vz Temperature differences of exit Air (tw2-tw1)

Than total NTU=Range x Sum (1/hw-ha) = 1.6677: According to revision of this model testing show that make contact with cooling tower air & water a few reheat removed by sensible heat of air get in touch with water about 60% of heat removed by evaporation of circulation water, mass transmit from water to air stream in contrary direction if entering water temperature is lower than the incoming air wet bulb temperature, sensible heat transfer involves an increase in dry bulb temperature of mixture in horizontal angel but evaporation heat transfer involves a alter in humidity ratio of the mixture in vertical movement.

The Proposed make up water savings at above table-4 are actually based at retrofit research of different researcher applied to save the water conservations, the current plant management that was away from retrofit savings, the authors applied and prove savings first and then process the further research at ECO.

Table1. Design Data (Cooling tower TPS).

Item	Description	Cooling Tower Power plant
1	H_2O circulation rate (GPM)	55000m3/h
2	Hot-water temperature (C)	40
3	Cold-water temperature (C)	32
4	Wet-bulb temperature (C)	30
5	Drift loss(%design circulation)(m3/hr)	110m3/h
6	No of fans	06
7	Evaporation loss (m3/hr)	968
8	Bleed(BD) (m3/hr)	968
9	Make up water (m3/hr)	1936
10	Price/Loss m3/hr	3.9
11	Range	8
12	Approach	2

Table-2. Specific water consumption at thermal power station.

Sr. No.	Consumption	Quantity	Percentage
1	Demin water	260 m^3/l	2%
2	Cooling tower	3207m^3 /l	30%
3	Drinking water (Colony+ plant)	640 m^3/l	6%
4	Fire water	476 m^3/l	5%
5	Coal Based+ Ash handling	(4180+130) m^3/l	42%
6	Others	1334 m^3/l	13%

Table-3 Current Make-up Savings Water at TPS.

Sr. No.	COC	Evaporation	Blow Down	Makeup
1	2	968	968	1936
2	3	968	484	1452
3	4	968	322	1290
4	5	968	242	1210
5	6	968	194	1162
6	7	968	161	1129
7	8	968	138	1106
8	9	968	121	1089
9	10	968	108	1075

Table-4 Propose & Make up water Savings at TPS.

Sr. No.	COC	Evaporation	Blow Down	Makeup Proposed	Make-up Current	Saving
1	2	951	968	1919	1936	17
2	3	951	475.5	1427	1452	26
3	4	951	317	1268	1290	22
4	5	951	238	1189	1210	21
5	6	951	190	1141	1162	20
6	7	951	159	1109	1129	20
7	8	951	136	1087	1106	19
8	9	951	119	1069	1089	19
9	10	951	105	1056	1075	19

Table 5. Advance ECO approach Makeup water Savings at TPS.

Sr. No.	COC	Evaporation	Blow Down	Makeup Advance	Makeup Proposed	Saving
1	2	475.5	475.5	951	1919	968
2	3	475.5	238	713	1427	713
3	4	475.5	158	634	1268	594
4	5	475.5	118	594	1189	596
5	6	475.5	95	570	1141	570
6	7	475.5	79	555	1109	555
7	8	475.5	68	543	1087	544
8	9	475.5	59	535	1069	535
9	10	475.5	53	528	1056	528

The Water Conservation from current to propose and then Advanced is the outcome of Researcher Research and by Experiment, the physically, theoretically evidence proof has been achieved in above tables, a handsome amount of water conserved for environment Sustainability, Ref Author previous impact factor research papers at Refinery and Fertilizer cooling tower water Lagging performance Indicators and Thermal Power Plant water conservation targets achieved and performance assurance verified.

2.1 Restructuring the circulating cooling-tower curing method:

2.1.1 Reasonable boosting the Concentration-rate

2.1.2 Increasing the efficiency of the cooling-tower & reducing the utilization for circulation of CT.

2.1.3 Establishing the waste-Recycle method

2.1.4 Perfecting the water-management.

The Concentration-rate is a significant Control factor in the circulating CT. the most favorable concentration-rate should be 4-5 could significantly trim down the water consumption index. Necessity of the water saving transformation is proposed and type of water consumption is analyzed, summarized, Technical reform to reduce water consumption and offer solution for emission reduction are proposed. Increasing the pressure on operator to conserve, Water Power-Reactor 2016 [3].Adopting new water conserving technology can assist lighten the impact of future H_2O shortage.

2.3 Conservation option

2.3.1 Alternative or Degraded water source: ETS effluent treatment sewage source is being used in irrigation and ground water recharge, the other Sources are, sea water, salinity water, mine water, Agri run off, storm water, should be Kept under consideration.

2.3.2 Dry or hybrid cooling: It has good performance, small in size low cost

2.3.3 Increase thermal Conversion Efficiency: As combustion turbine produce two third of the power and can be condensed by Acc (air-could condenser)

2.3.4. Water Recycling: Reuse of water has become the trend of today, H_2O accessibility could turn into a most important concern for all major industries over the next decade and beyond, even though H_2O conservation practices can be implemented for existing plants. The larger conservation occasion using advanced cooling technology is more easily and cost effectively achieved in the Design and new plants EPRI (2012).

Table 6. Temperature and Evaporation Rate.

C	50	45	40	30	20	10
Er	6	4.5	3.5	2	1.8	0

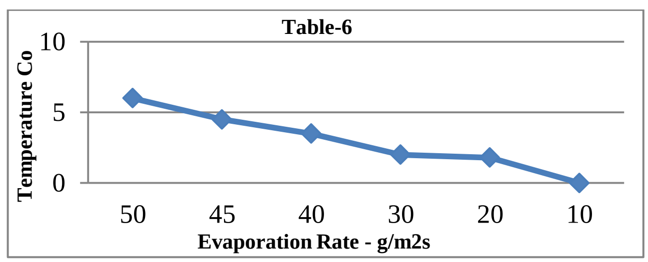

Figure 6. The above figure shows that if temperature is high the evaporation rate is also high mean more water losses faced.

Table 7. Temperature and Relative Humidity

C	10	15	20	25	30	35	40
RH	100	80	60	50	45	30	20

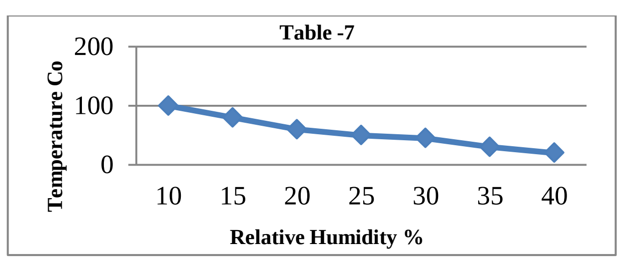

Figure 7. the relationship between temperature and relative humidity are directly proportional. If temperature increases the relative humidity will also increases.

Table 8. Cycle of Concentration and Condensate flow.

N	4	5	6	7	8
Qcond	0.9	1.1	1.2	1.35	1.5

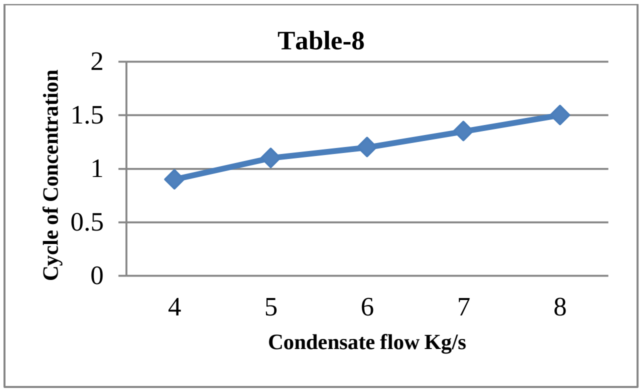

Figure 8. if cycles of concentration increase the condensation of flow wills rises i.e. more water flow condensed which decreases the water losses.

Table 9. Cycle of Concentration and Make up water Rate.

1.8	1.9	2	3.5	4	5	6	7	8	10	16	20
350	345	300	260	200	180	160	150	149	148	148	148

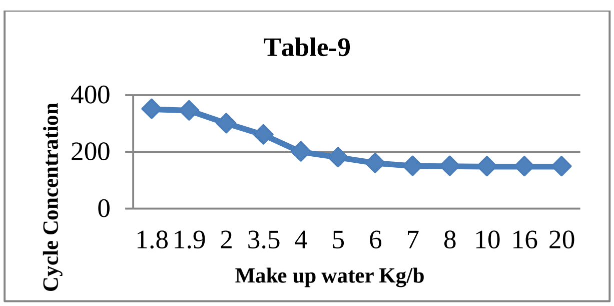

Figure 9. the ratio of make-up water and cycle of concentration are directly influenced with variation in each other. They depends a lot of factors i.e. chemistry of water, surrounding atmosphere (Relative Humidity), Operation Factors (temperature, pressure, structures).

Table 10. Ambient Temperature and Exhaust Gas Temperature.

-5	0	5	10	15	25	35	45
610	611	612	618	621	631	645	660

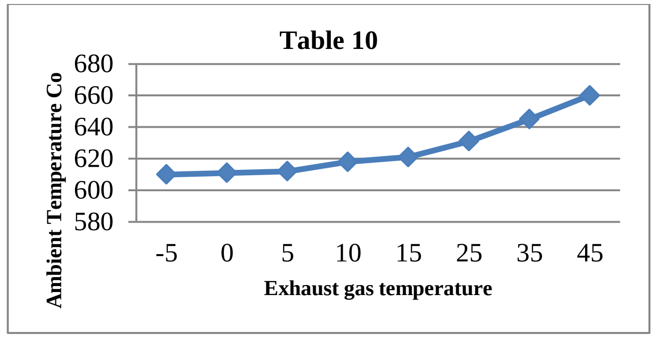

Figure 10. the correlation between ambient and exhaust air temperature somewhat remained influence at extent but after some interval of time with increase in temperature evaporation loss increases as exhaust temperature increases.

Table 11. Ambient Temperature and Pressure Drop.

O	20	40	50	60	70	90
O	37	25	18	15	12	9

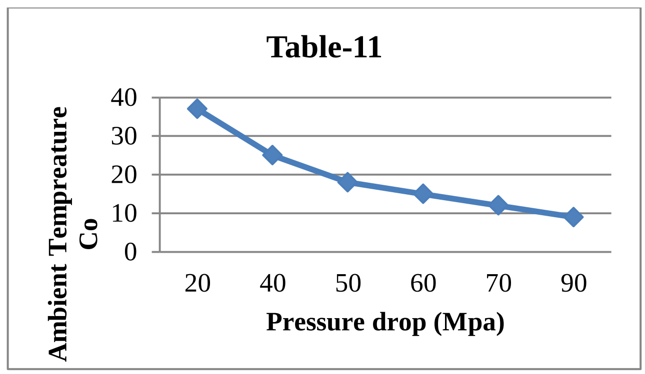

Figure 11. the graph shows that at high ambient temperature and high pressure drop the water losses are high.

Conclusion: Author in his research can assess the situation by physically and experimentally to give, share the right direction as the objective of research has no need, no time bond and it has dignity to overcome the water crisis for future prospective.

Periodically testing & formulating the H_2O consumption equilibrium chart of the entire plant, Exam the water consumption periodically.

Recommendation: This research has reviewed a range of evaporation assessment methods current, proposed and ECO approach. A water balance, audit report approach used at past papers published in field trials and applicable further fundamental research on factors affecting evaporation to predict evaporation loss.

The methodology employed to determine evaporation loss in this project was based on a water balance approach. This project has provided ground breaking work to assessing the performance of ECO approach. The approach and results of this research study provide valuable information that requires ongoing promotion to encourage further adoption of evaporation management system.

Conflict of Interest: The authors proclaim no conflict of interest.

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