Initiatives towards water recycling as well cost optimization in thermal plant

Dr R K Sharma
Ex AGM(Chem), NTPC Ltd
Email: drsharmark04@yahoo.co.in
Mob: 9650992886

Contents

- Initiatives for water conservation at NTPC Station/s
- RO Plant modification and benefits toward cost optimization
- Potential areas / technologies for water conservation

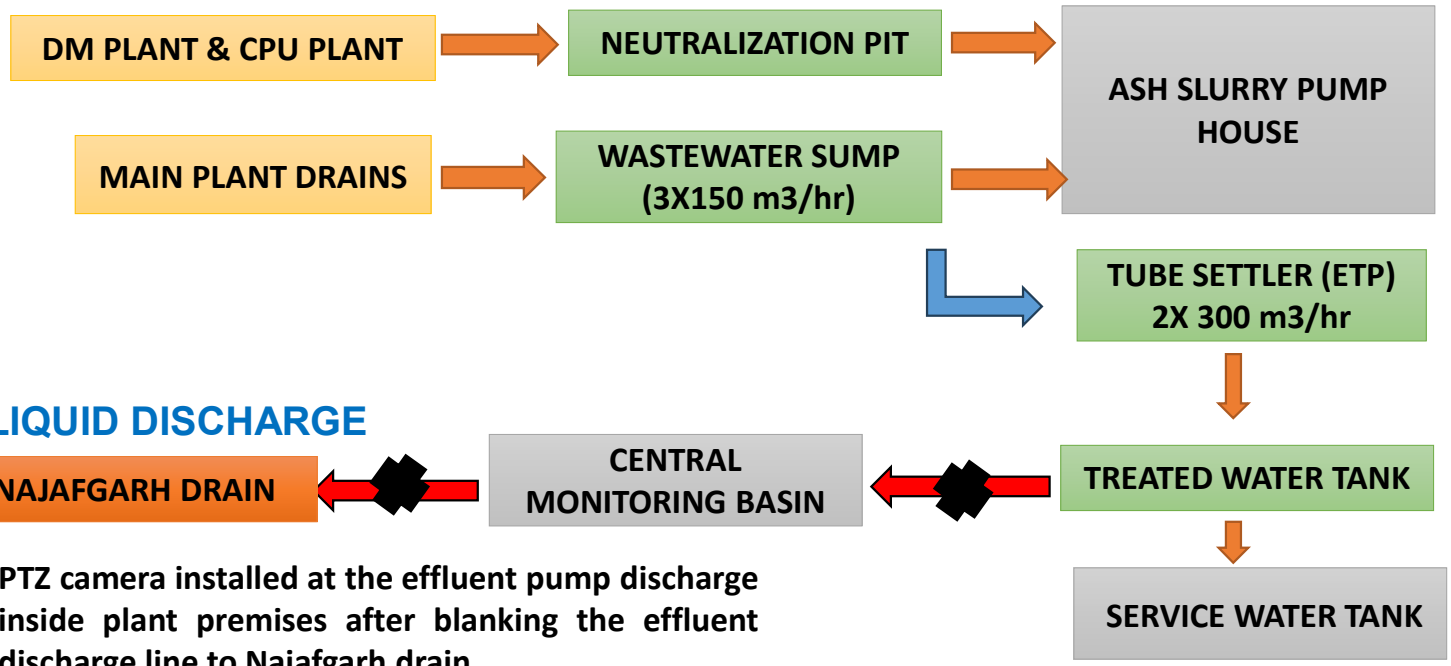
Initiatives towards Water Conservation

1. **Increased Cycle of Concentration(COC) thru chemical treatments**
2. **Zero discharge : NTPC-JV, Jhajjar is zero discharge Plant.**
3. **Ash Water Recycling System (AWRS)**
4. **Liquid Waste/ effluent Treatment Plants from Wastewater pit**
5. **Sewage Treatment Plants (STP):**

   Consent has been given to Haryana Water Resource Authority (HWRA) for use of 44 MLD Treated Waste Water from STPs of Gurugram in cooling towers of power plant. This will further reduce water requirement by approx. 36%.
6. **RO Plant for recycling CW blowdowns**
7. **Coal Slurry Settling Pit (CSSP)**
8. **Rainwater Harvesting (IIT-G)**

WASTEWATER MANAGEMENT TO ACHIEVE ZERO LIQUID EFFLUENT DISCHARGE

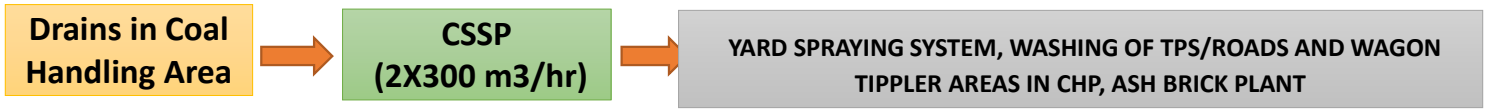
WASTE WATER MANAGEMENT IN MAIN PLANT AREA



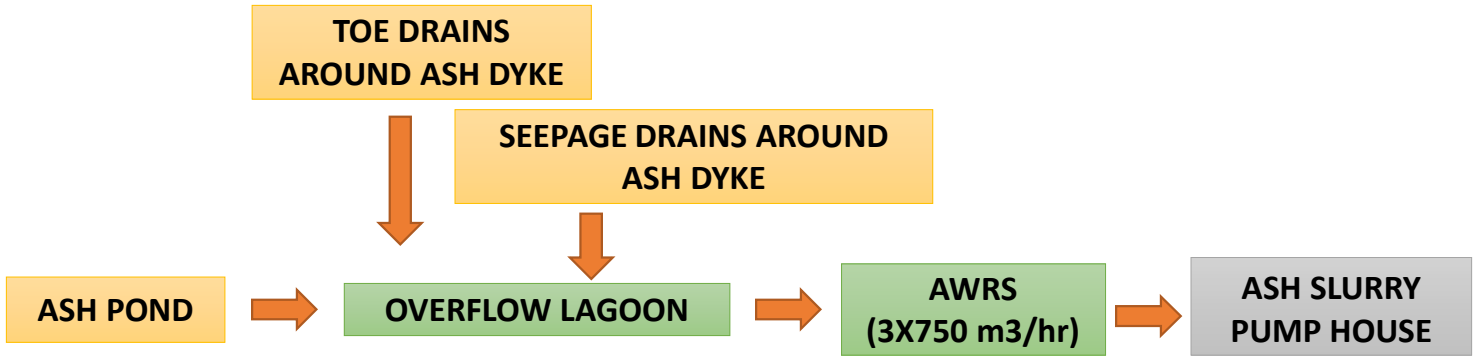
ZERO LIQUID DISCHARGE

PTZ camera installed at the effluent pump discharge inside plant premises after blanking the effluent discharge line to Najafgarh drain.

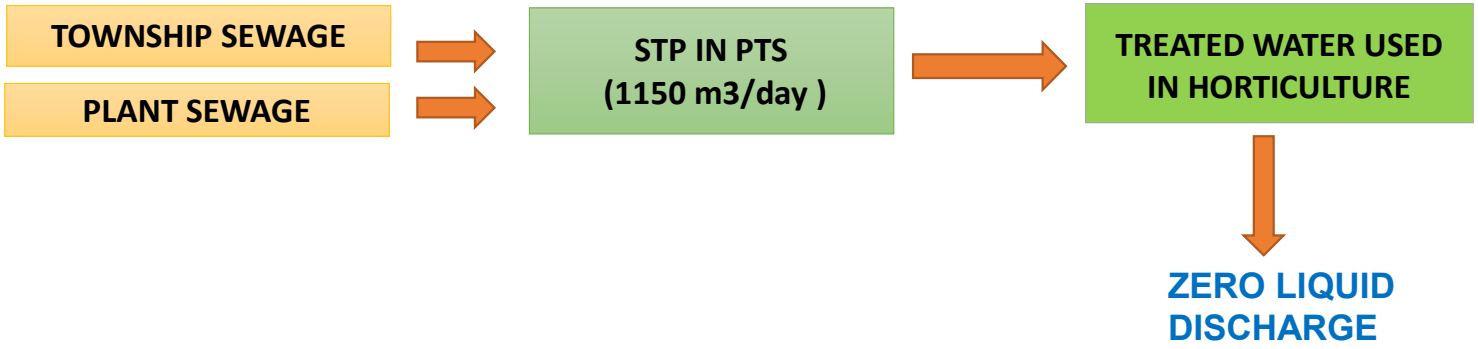
WASTE WATER MANAGEMENT COAL HANDLING AREA



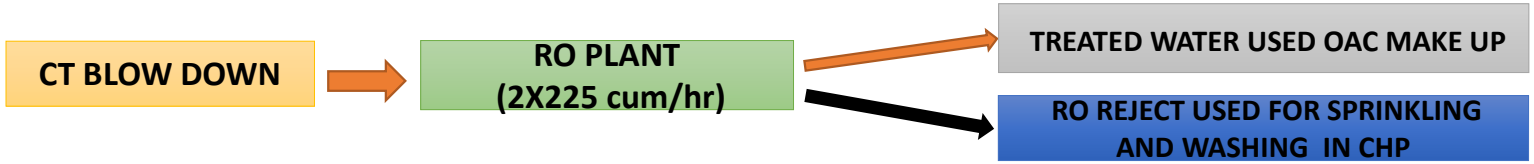
ASH WATER RECIRCULATION SYSTEM (AWRS)



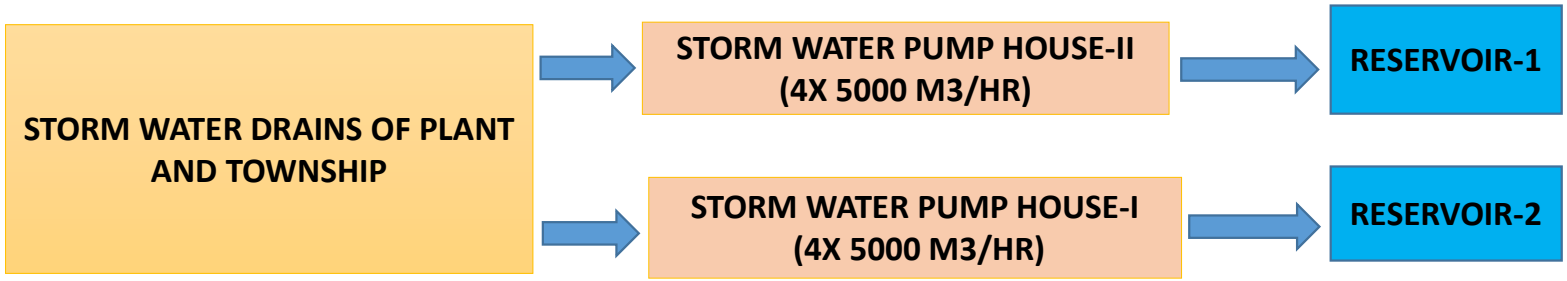
SEWAGE WATER TREATMENT SYSTEM (STP)



RO Plant



RAINWATER HARVESTING SYSTEM (RWH)



As per study done by IIT, Guwahati , based on past precipitation data, NTPC Jhajjar Plant has the potential of 6584.7 m3/day RWH (From township 2006.51 m3/day + From Plant 4578.16 m3/day)

Water conservation through maintaining higher COC

In re-circulating type of cooling, a definite concentration of scale forming salts are allowed to retain in the system, beyond which salts are likely to precipitate to form scale

$$COC = \frac{TDS\text{-}CW}{TDS\text{-}MU}$$

$$BD = E/COC\text{-}1$$

Concentration of Calcium in make up water as $CaCO_3$ in ppm	Concentration of Calcium in CW System as $CaCO_3$ in ppm	(COC) Cycle of Concentration
250	250	1
250	500	2
250	750	3

To attain the above, blowdown of water from the cooling cycle and fresh water is required to be taken into the circuit. At COC-5 blowdown of CW is required when TDS in terms of $CaCO_3$ are exceeding 1250 ppm.

CW Treatment Chemicals

Following treatment chemicals are used routinely at station in CW system:

1. **Zn based corrosion inhibitor:** Zinc based corrosion inhibitor (non-toxic) and a liquid formulation which is easy to handle. Active content of Zinc as Zn is 20%.

2. **PBTC: Phosphono butane tri carboxylic acid:** As high-efficient agent of scale and corrosion inhibitor, PBTCA is the excellent stabilizer for zinc salt. Active content in terms of PBTC acid is min. 50%.

3. **Polymeric dispersant:** A low molecular weight (>4000 & < 5000) organic polymers combination to meet system fouling requirement and control the fouling very effectively. The polymeric dispersant disperses / stabilizes / prevents scaling with $CaCO_3$, $CaSO_4$, $Ca_3(PO_4)_2$ and Iron complex as well as any other foulants based with dosing level of 5 - 10 mg/l in all the CW systems.

4. **Microbiological control:**

i. **Cl_2 dosing**: On continuous basis to maintained 0.5 ppm FRC.

ii. **ClO_2 Dosing:** In addition to Chlorine, Chlorine dioxide (ClO_2) is being added in the system in all the three cooling towers by providing in-situ generation system for controlling microbiological fouling (??).

5. Bio-dispersant: A bio-dispersant being dosed (3 mg / l) in the system on continuous basis for effective Chlorine / biocide penetration to kill the microorganism. The bio dispersant is min. 90% active ingredient to dislodge sessile bacteria from metallic surfaces.

Cost optimization required wrt water saving and expenditure towards specialized chemicals

Water & Chemical saving by adopting higher COC regime

Water Saving

Cycles in 2018	Blow Down (M3) per annum in 2018	Cycles in 2023	Blow Down (M3) per annum in 2023	Water Saved (M3) per annum	Cost Saving in Rs per annum
4.00	8619840	6.00	5150880	3468960	Approx 7 CR

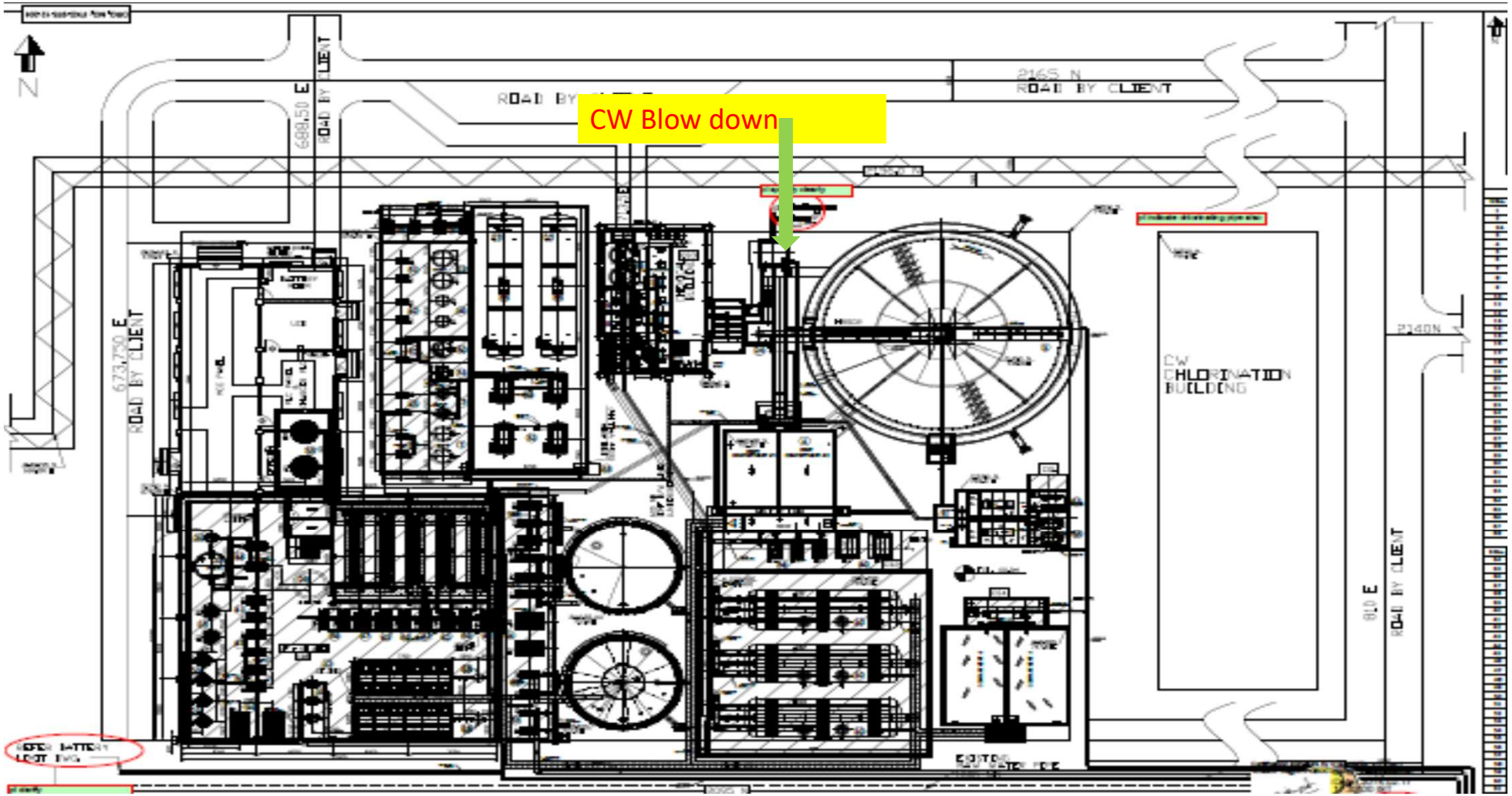
CWT Chemicals Saving

Chemical Names	Consumption (KG) at COC-4	Consumption(KG) at COC-6	Quantity(KG) saved per annum	Cost Saving in Rs per annum
Bio Dispersant	28670	17202.00	11468.00	Approx 75 lakhs
Polymeric Dispersant	86096	51658	34438.00	
PBTC	43048	25827	17221.00	
Zinc	43048	25827	17221.00	

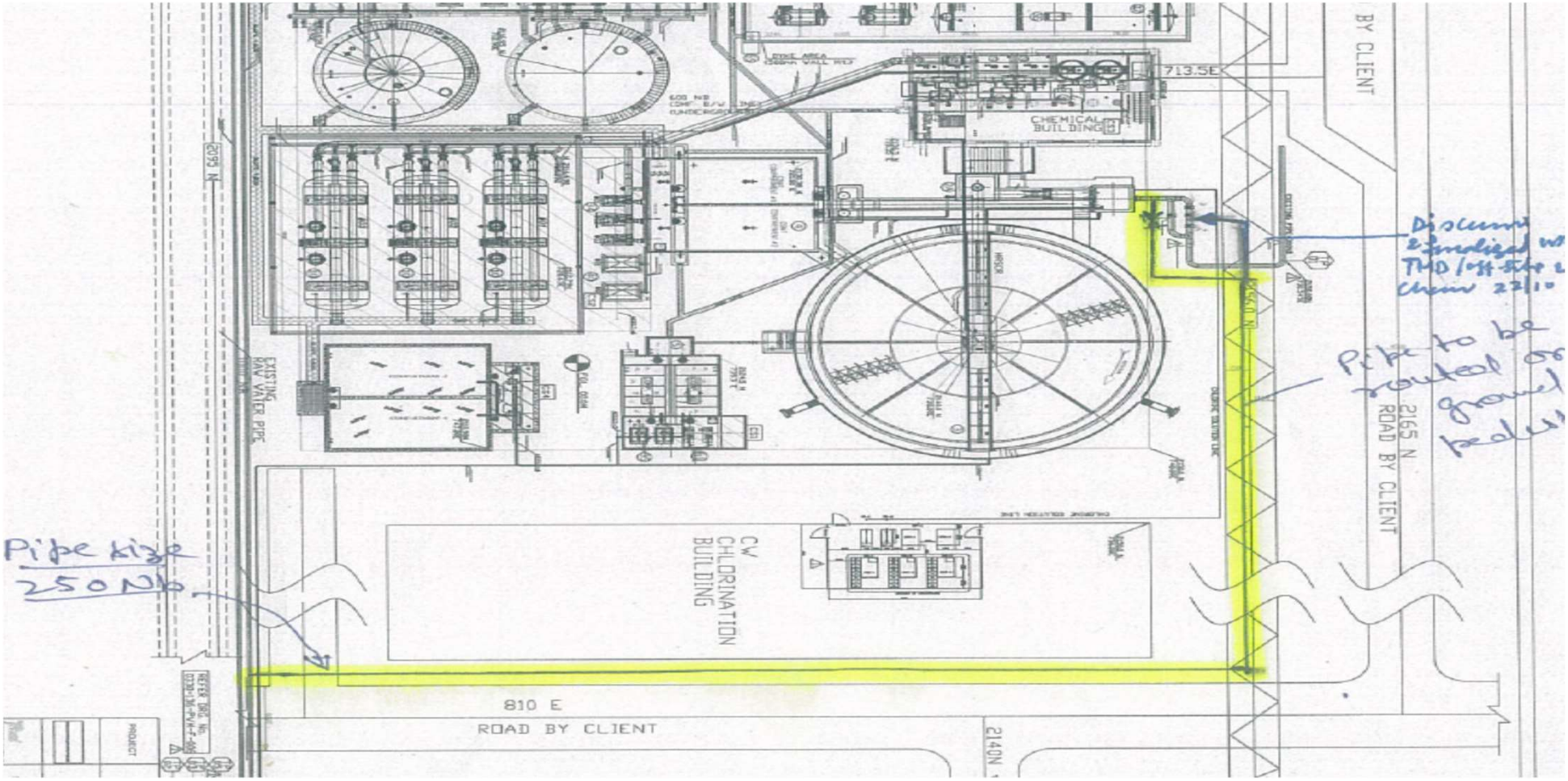
RO PLANT COST BENEFITS ANALYSIS AFTER MODIFICATION

1. Original System
2. Modification (to reduce chemical handling & with low CW blow down)
3. System after modification
4. Benefits from modification

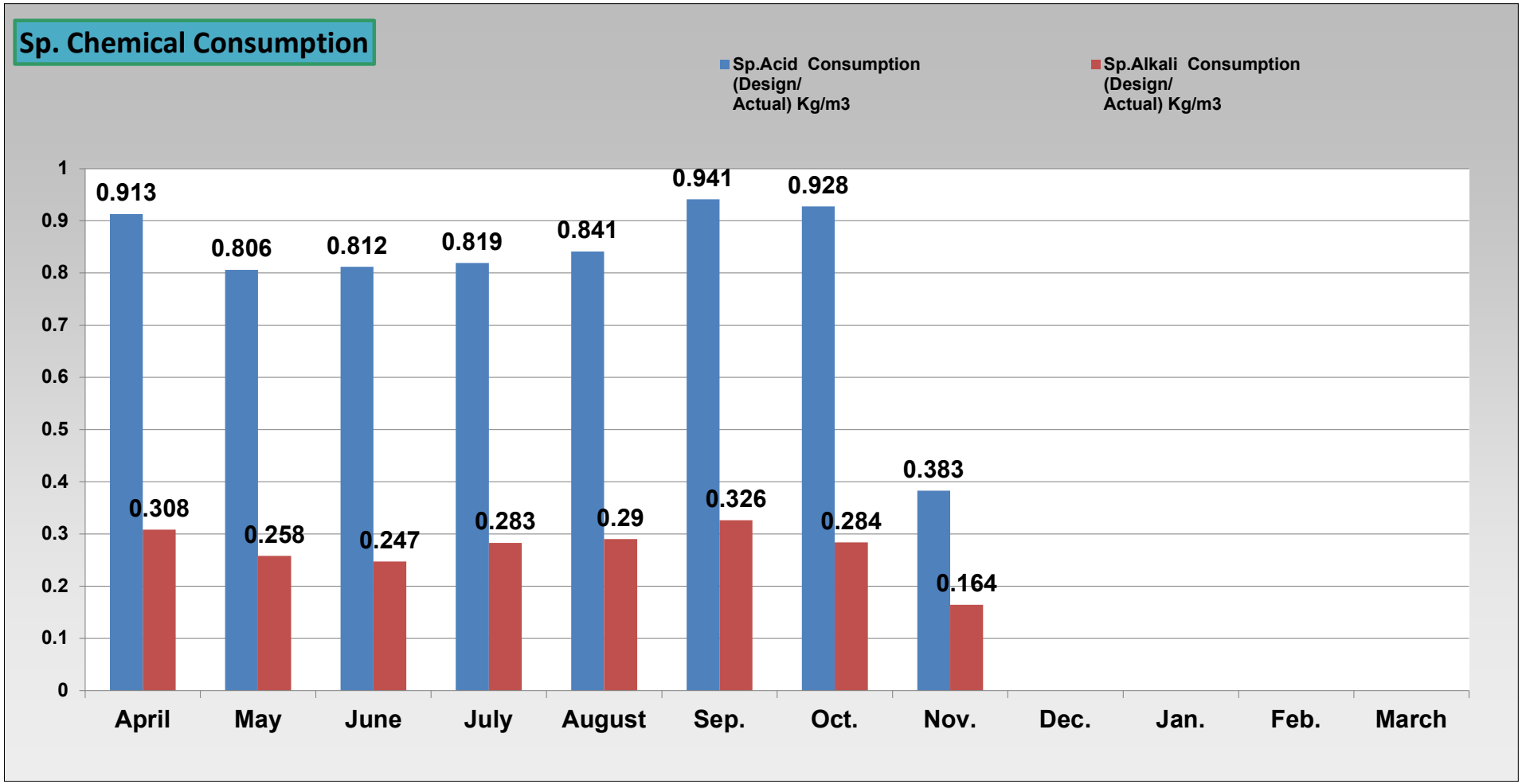
CW BLOW DOWN ,FEED FOR RO PLANT



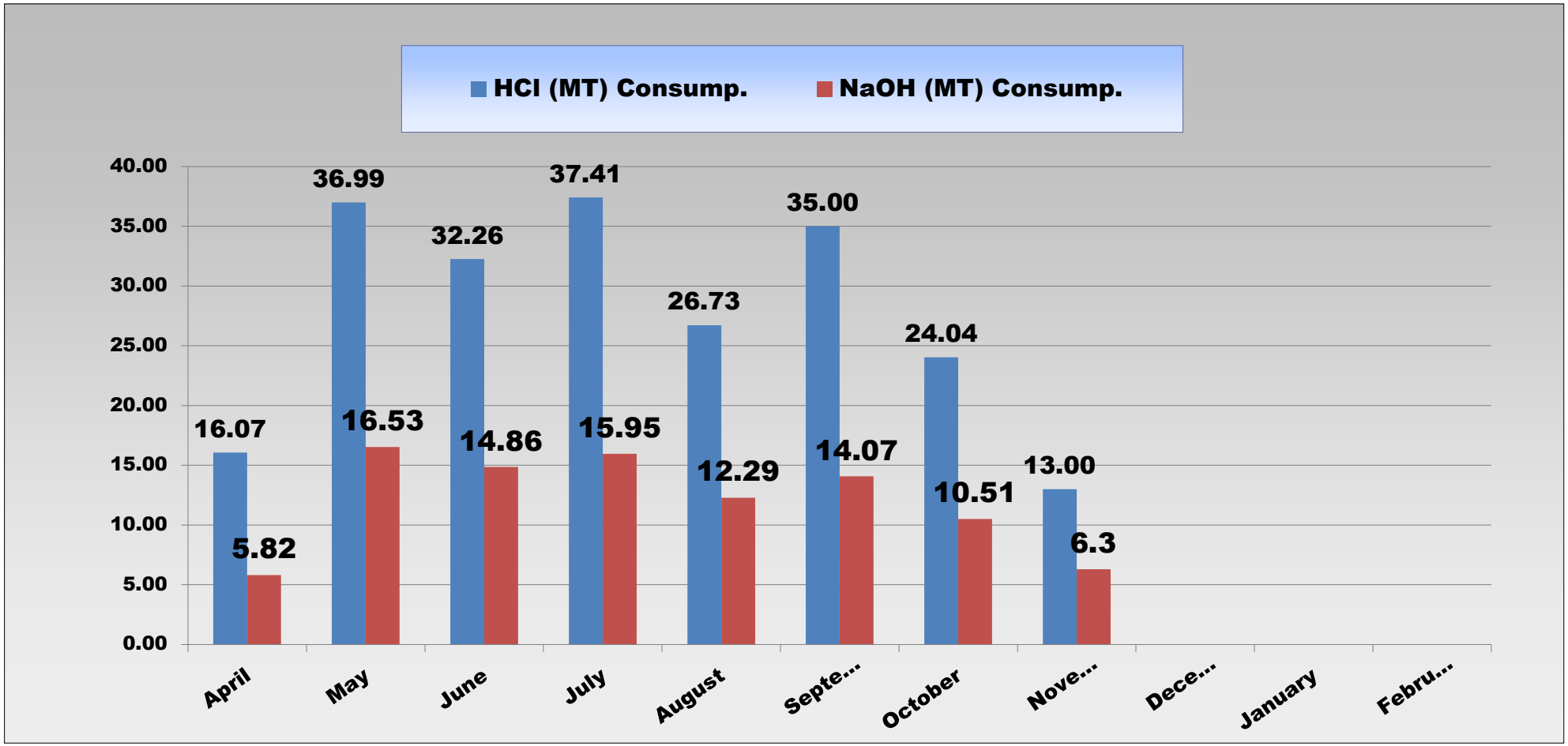
MODIFICAION,RAW WATER FEED TO RO PLANT



Decrease In Specific Chemical Consumption after modification



Decrease in Chemical Consumption after modification

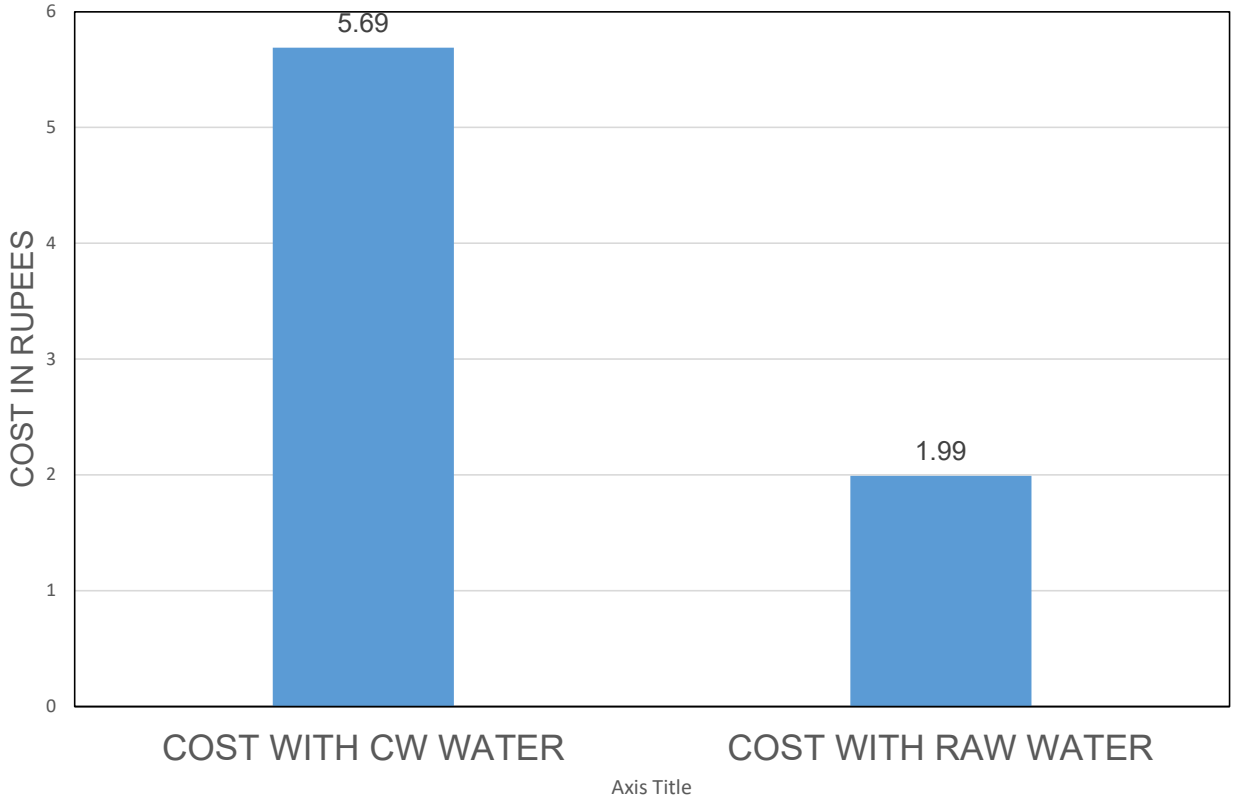


Advantages achieved after modification

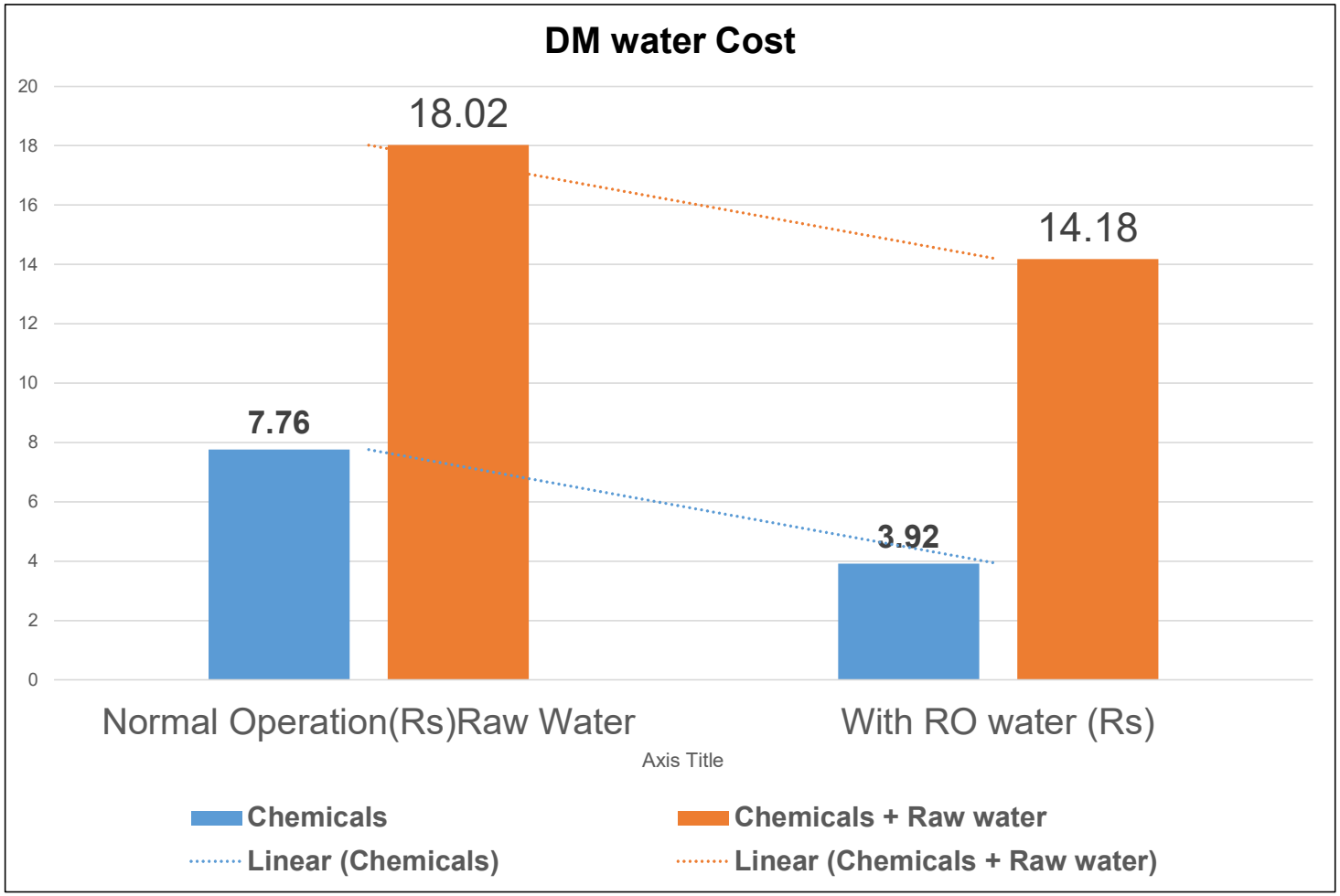
1. Decrease in RO production cost i.e. reduction in chemicals used in pre-treatment.

S.N.	Chemical	Dosing Rate Before Modification (ppm)	Dosing Rate after Modification (ppm)	Quantity/ day(Kg)	Quantity after modification (kg)
1	Ferric Chloride	35	5	800	50
2	Hydrated Lime	50	0	1200	0
3	Polyelectrolyte	2	0.25	4	1

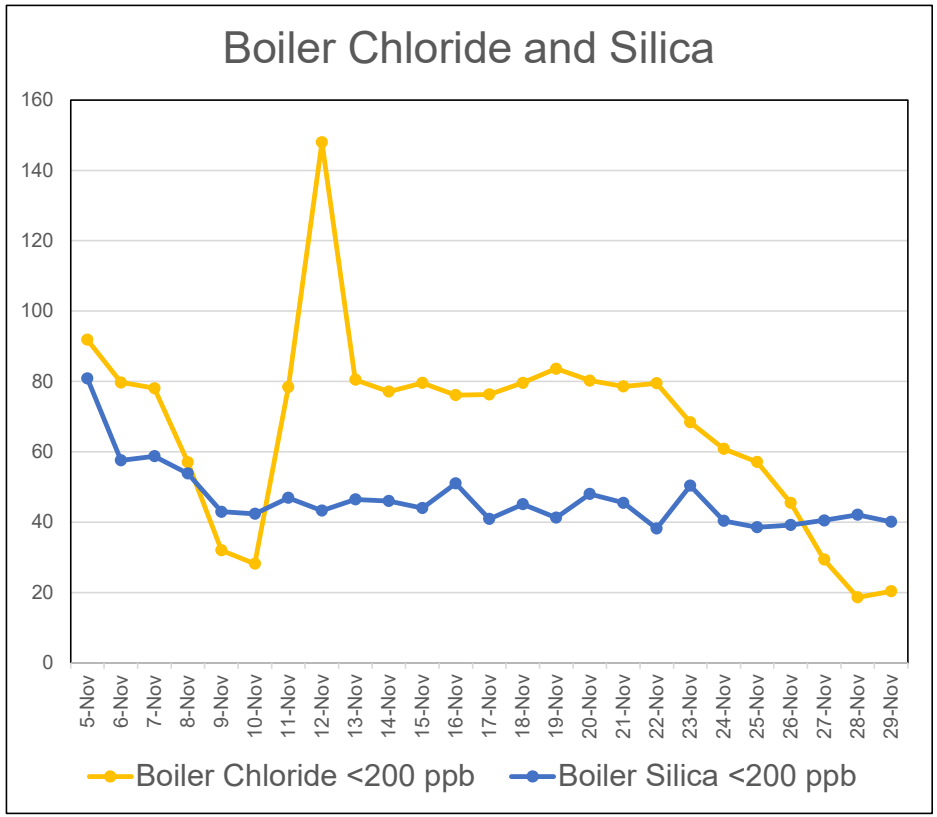
2. RO COST ON CHEMICAL CONSUMPTION ONLY



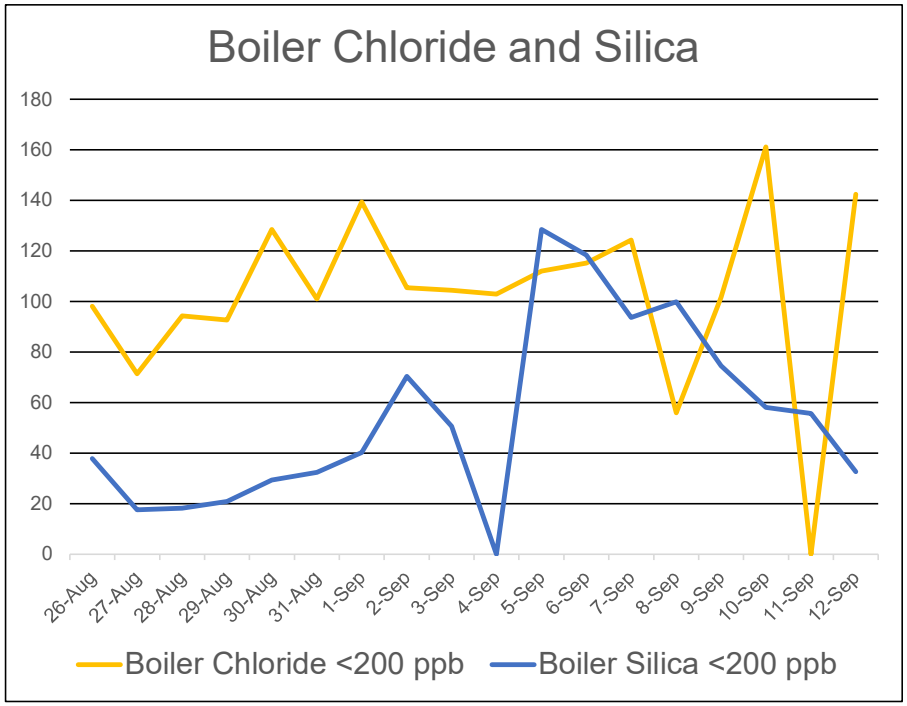
3. Decrease in DM water production cost



4. Decrease in Boiler Chloride and Silica



Nov, Month Average Chloride is 67.38 and silica is 46.56 #1



U-2 Sep, average Chloride 108 and silica is 58 ppm

Additional advantage: Lower CBD opening, no colloidal silica carry over

New technologies for water conservations

1. Wastewater management by sludge thickening process from PT Plant sludge.
2. Forward osmosis (95% recovery, TDS 200000, lower APC)
3. Electro coagulation of RW for silica removal (higher DM Stream OBR)
4. Activated Filter Media in Sewage Treatment Plants(reduction in BOD)
5. Air-cooled Condensers (NKP)
6. Managing evaporation loss by Floating Solar or environmentally friendly chemicals in Reservoirs
7. Desalination of sea water for drinking water (Solar/ Flue gas based)

Water Dashboard based monitoring with periodical water audits will help to assess the quantified gain in water conservation.

(Atharv-Ved, 3:13:6), prays the significance of water: “The ability to see, hear and speak, are useless in the absence of adequate water. Water is the basis of life. Most life forms are born in water and live in it. O! Water stream come near me. You are the Elixir of immortality”.

Above is possible only with collective wisdom.

Please save each drop of water.