Water & Waste Management At Emami Paper Mills Ltd., Balasore


Panda Nityananda


Sahu Ashok K.


Pati Manoranjan


Khuntia Ramesh

ABSTRACT

Paper Industry is highly water intensive. Day by day availability of water is declining. Freshwater conservation is one of the major stewardship issues for the pulp and paper industry which needs to be addressed. For sustainable management, "Reduce, Recycle & Reuse" is the key principle to encounter the issues like cost, availability, environmental issues and productivity. Closer loop in water circuit increases TDS, anionic trash, deposits, biological growth & corrosion etc. Emami Paper Mills Ltd., Balasore, Odisha has taken various initiatives on fresh water minimization by identifying and segregating water circuit in loops and reused in specified area. Industry has set up a tertiary treatment plant to treat the final ETP water for reuse in various manufacturing processes and also for complying the proposed charter on water recycling and pollution prevention in pulp and paper Industry.

The main solid waste i.e. fly ash from co-generation power plant, primary sludge from ETP are 100% utilized effectively for fly ash brick manufacturing and as fuel in the power boiler respectively & fresh water consumption reduced by 1100M^3 (from 7495M^3 to 6395M^3/day)

Keywords: *Closed water loop, Reduce, Recycle, Reuse; Tertiary treatment of ETP water, Zero discharge from Power Plant, Sludge de-watering plant, Primary sludge as co-fuel, Fly ash brick.*

Introduction

The Pulp and paper industry is one of the major water consuming industries. It is the third largest consumer of fresh water with consumption in the range 80-150 M^3/T of paper depending on the type of raw material being used. Generally water is used for a variety of processes such as pulping, screening, washing and bleaching, stock preparation & paper making. Reasons for high water consumptions are to be understood & proper action is to be taken by following ways:

- Water audit/Water balance/ Assessment of optimum water requirement in individual unit operation.
- Adequate fibre & water recovery system.
- Adequate ETP facilities.
- Awareness through education & training.
- Monitoring & measuring devices.

Due to fresh water scarcity in many parts of India, use of fresh water is a serious concern. Moreover, the withdrawal and return of large amount of water to rivers and streams can have major ecological impacts which become even worse at lean period of the year. Fresh water consumption in paper industry is high due to poor water management practices and obsolete technology. The huge amount of water consumption by this sector leads to lowering of the ground water table. About 79% of the water consumed is discharged in to water

Emami Paper Mills Ltd., Balgopalpur, P.O. Rasulpur Dist. Balasore - 756020

bodies. By 2020, paper production is expected to be doubled resulting further increase in water consumption and there may be a severe shortage of fresh water. There is already growing conflict due to water scarcity and pollution. However in last decade significant reduction in specific water consumption has been observed as per the CREP guideline, still water consumption is high in India comparison to global standards. Integrated approach towards zero discharge means segregation of waste water from various processes & its treatment to obtain clean water which can be reused in the process. The concept of zero discharge is based on "Reduce, Recycle and Reuse". Besides this, in order to maintain the desired quality parameters of the product without disturbing machine runnability, some amount of process water has to be purged out.

The waste generated from different industrial processes is of complex characteristics and composition and hence, their safe management and disposal is also intricate and complex.The disposal and storage of this waste without treatment will lead to contamination of surface and ground water which disturbs the ecological and environmental balance.

Waste Management

Final treated ETP water, its treatment and reuse

The main issues related to water recycling and reuse of water are corrosion, biological growth and other deposits in the system. This is to be addressed properly and control measures are required so that it does not affect the process and runnability issues. Several treatment & control technologies have been developed to reduce waste water or pollutant load discharge to natural watercourse. The two major technologies are

- Production process controls aimed at reducing waste water volume and pollution load.
- Waste water treatment technology.

It was observed that in majority of the paper mills, all raw effluents from various unit operations are mixed together and treated using conventional activated sludge process consisting of primary and secondary treatment. Few of the large paper mills have upgraded their Effluent Treatment Plant (ETP) with installation of tertiary treatment system for better effluent quality, particularly colour and suspended solids. Hence reuse of tertiary treated water is to be focused more in right places.

Utilization of Fly Ash and Sludge

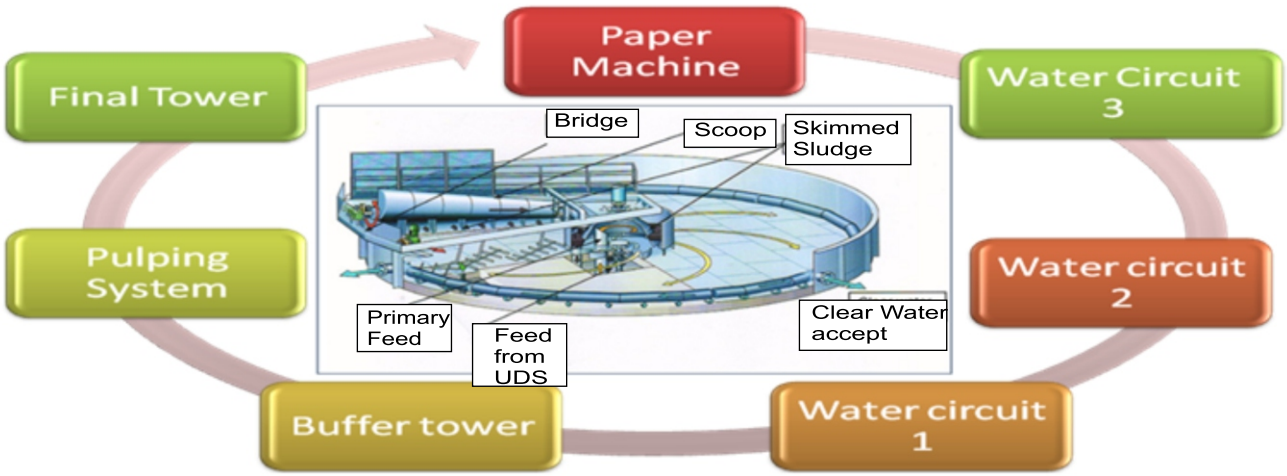
Fly ash generated in power boiler is suitable for wide range of applications viz. manufacture of cement, substitute of cement in concrete, manufacture of building components, like bricks, blocks & tiles etc., as a geo-technical material for construction of embankment and reclamation of low lying areas and degraded/waste lands etc.The Central Fuel Reaserch Institute, Dhanbad has developed a technology for utilization of fly ash for the manufacture of building bricks. Fly ash bricks have a number of advantages over the conventional burnt clay bricks. Unglazed tiles for use on foot paths can also be made from it.

The Pradhan Mantri Gramya Sadak Yojana would be a successful and economically viable project with the utilization of fly ash in road construction in remote and rural areas.

The other major solid waste in pulp and paper industy is primary sludge of ETP which contains tiny fibers, fines and

Fig. 1

Counter flow Water Circuit



fillers. It can be used as a raw material for paper packaging (Side disc, Egg tray, Sundry board etc.) or it can also be used as a co-fuel in power boiler.

Results And Discussion

At Emami Paper Mills, some effective steps are taken towards water conservation, tertiary treated water usage and utilization of fly ash for brick manufacturing & use of 100 % primary sludge as co-fuel in boiler.

Water Management At Emami

Close water loop

In-built water circuit in various areas

Sl. No.	Area	Recovery System Available
1	DIP-1 (W&P Grade)	Disc filter I and II & Potcher washing back water
2	DIP-3 (News Print Grade)	Disc filter I and II, and DAF
3	PM/C-3	Disc filter, condenser cooling water & closed loop Hydraulic cooling system.
4	PM/C 1 & 2	Conical Bird Save all

- DIP#3 is operated with a close loop water circulation system (Fig 1).The makeup water requirement of DIP#3 is fulfilled by the backwater from the paper machine which is clarified in DAF system. Hence, the fresh water consumption is zero in DIP # 3.
- Spiral condenser and pre separators (22M^3/hr.) recycled to warm water tank.
- Vacuum pump fresh water is being recycled through cooling tower.
- Fresh water from reservoir is going to compressor & instrument air dryer for cooling & return back (50M^3/hr.).
- Vacuum sealing water is being used at wire & press shower of PM#II.
- Save all over flow, Uhle box separator, Trivac separator, Tertiary centri-cleaner rejects & Decker shower water of PM#II is going to DIP#III DAF @ 120M^3/hr.

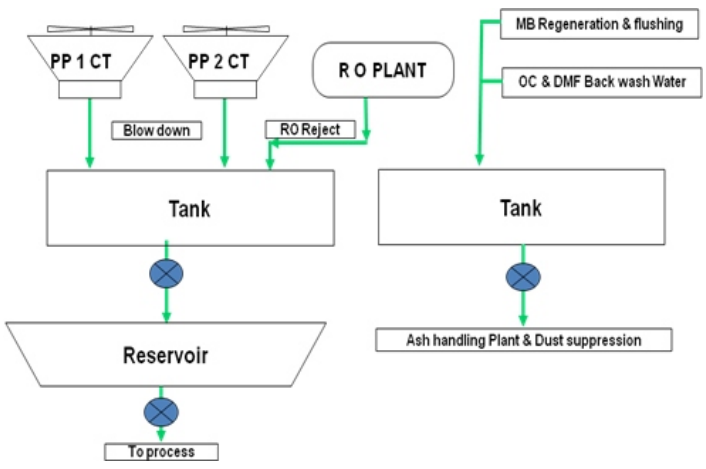
At DIP-I & PM-I

- All wire part shower water along with machine back water is taken to the conical bird saveall to recover water and fibre both. Save all clarified water is being reused as makeup water for deinking and the paper machine process.
- Vacuum pump sealing water is being used in wire lubrication/knock down shower through booster pump in PM#I
- Water of hydraulic pump is being used in high pressure wire/press & edge cutter shower of PM#I

Steps taken to reduce fresh water consumption

1. Cooling Tower Blow down & RO Reject water taken from the collection pit (Fig. 2) to the Mill Water Reservoir. RO rejects of high TDS is mixed with fresh water storage reservoir to reduce TDS and used in other process areas. Cooling tower blow down water is used in the same way.

Fig 2: RO & Cooling Tower Recycling Pit



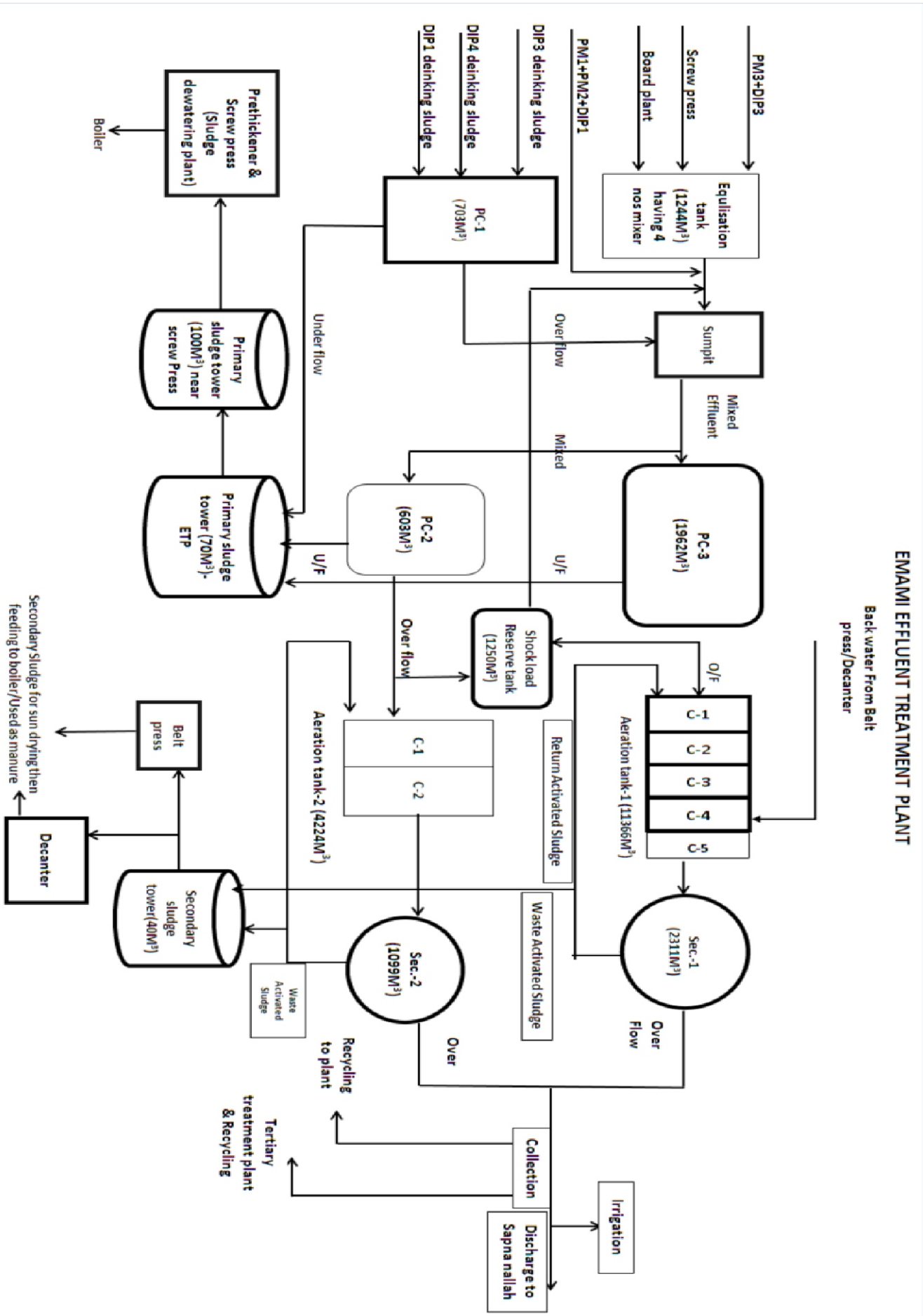


Fig. 3 ETP Flow Diagram

The combined water parameters are suitable for use in process. The quality parameters of water are given below in Table: 4

2. Back wash water from Oxidation Chamber & Dual Media Filter are taken to a common storage tank and the same is being used for fly ash conditioning and sprinkling in coal yard for dust suppression.
3. Back Water generated in Potcher washing system in DIP # 1, is being used in high density cleaner and centri cleaning system.
4. Soap Stone Powder slurry is being prepared with save all clarified water. No fresh water is used here.
5. Installation of Decanter for treatment of the secondary sludge, saves water by 40M^3/day.
6. Surface condenser water is reused for showers.

Table - 1 : Water Consumption Target

Type of Water	Consumption, M^3/day
Fresh water	*6395*
Tertiary treated water	*3000*
Secondary treated water	*3000*

Fig. 4: Tertiary Treatment Plant

7. All hydraulic system return water recycled in the same hydraulic system after passing though cooling tower.

Effective Utilization of RO reject & cooling tower blow down water from cogeneration power plant:

1. The condensate return from the process is almost 85 % (including the direct steaming in DIPs).
2. Evaporation & drift losses are optimized by installing Counter flow Cooling Towers with drift eliminators and

Table - 2: Fresh Water Consumption Before & After Tertiary Treatment

Sl.No.	Area	Before, M^3/day	After, M^3/day
1	*Power Plant 1 & 2*	*1500*	*1400*
2	*ETP & Screw Press Chemical preparation & dilution*	*600*	*600*
3	*Domestic*	*95*	*95*
4	*PM#I*	*650*	*606*
5	*PM#II*	*850*	*824*
6	*PM#III & CAPP*	*2800*	*2190*
7	*DIP#I*	*600*	*580*
8	*DIP#III*	*400*	*100*
Total, M^3		**7495**	**6395**

Table - 3: Section wise Use of Tertiary Treated water M^3/day

Area	Purpose	M^3/day
PM - I	*Floor cleaning, Fan pump cooling*	*50*
PM - II	*Pump gland cooling, Floor cleaning, Fan pump cooling*	*150*
PM - III & CAPP	*Edge knock off shower, Suction box flushing shower, Deculator shower & Vacuum sealing, Gland sealing*	*750*
DIP - I	*Gland sealing, Floor cleaning*	*100*
DIP - III	*Mechanical/Gland sealing, Clarified Tower*	*55*
Sludge dewatering plant	*Screw press & Drum shower, Sludge pump gland sealing, Sludge tower agitator gland cooling, Screw gland cooling, Partly for chemical preparation*	*1400*

Table - 4 : Quality parameters of Ground water, Reservoir Water, ETP Secondary & Tertiary Treated Water

Sl. No	Parameters	Unit	Ground water	Reservoir water after mixing with return water from power plant	ETP final treated water (After secondary clarifier)	Tertiary Treated Water
1	pH	–	6.9 - 7.0	6.9 - 7.2	7.6 - 7.8	7.5 - 7.8
2	Turbidity	NTU	Nil	Nil	50 - 70	20 - 30
3	Silica as SiO_2	ppm	32 - 35	40 - 50	75 - 80	75 - 80
4	TSS	ppm	–	–	35 - 40	15 - 20
5	TDS	ppm	220 - 240	280 - 300	1500 - 1600	1500 - 1600
6	Iron as Fe		0.3 - 0.5	0.4 - 0.6	1.5	0.2 - 0.3
7	Total Alkalinity as $CaCO_3$	ppm	90 - 100	110 - 120	550 - 590	500 - 550
8	Total Hardness as $CaCO_3$	ppm	120 - 140	170 - 180	350 - 400	300 - 350
9	Chloride as Cl	ppm	30 - 35	40 - 45	45 - 65	40 - 55
10	Color	Hazen	Nil	Nil	240 - 290	45 - 55
11	BOD	ppm	Nil	Nil	20 - 25	14 - 18
12	COD	ppm	Nil	20 - 30	190 - 230	150 - 180

Table - 5 : Fresh water reduction in DIP-III by incorporating ETP treated water for equipments gland cooling and sealing

2013 - 14	Brightness Gain Pulper To Final Tower	Sp. Water Consumption (m3/day)	2014 - 15	Brightness Gain Pulper To Final Tower	Sp. Water Consumption (m3/day)	2013 - 14	Brightness Gain Pulper To Final Tower	Sp. Water Consumption (m3/day)
APR	13.2	379	APR	13.1	179	APR	14.1	104
MAY	13.0	378	MAY	13.1	150	MAY	13.9	138
JUNE	12.6	386	JUNE	12.7	152	JUNE	14.1	118
JULY	12.8	364	JULY	12.9	137			
AUGT	12.8	352	AUGT	13.7	124			
SEPT	12.9	372	SEPT	14.1	108			
OCT	12.9	352	OCT	13.9	101			
NOV	12.3	264	NOV	14.0	106			
DEC	12.7	268	DEC	13.7	104			
JAN	13.6	271	JAN	13.8	106			
FEB	13.3	175	FEB	14.4	129			
MAR	12.9	162	MAR	14.2	138			
AVERAGE	**12.9**	**310**		**13.6**	**128**		**14.0**	**120**

maintaining the system parameters.

3. Blow down water from the Cooling Towers and the Boilers are being recycled for the Process.
4. RO Plant rejects are being recycled in the process and ash conditioning.

Recycle and Reuse of Treated Effluent

Emami has an effluent treatment capacity of 10835M^3. Effluent generated from entire plant is treated in full-fledged

Table - 6 : Fly Ash Generation & Utilization

Year	Fly ash generation, MT	Area of use	Utilization %
2013 - 14	85516	Road construction, Low lying area filling, Brick manufacturing	100%
2014 - 15	97380	Brick manufacturing	100%
2015 - 16 (up to June 15)	24744	Brick manufacturing	100%

Table - 7 : Utilization of Primary Sludge

Year	Sludge generation, MT	Area of use	Utilization %
2013 - 14	26252	Use as cofuel in power boiler along with coal	100%
2014 - 15	25972	Use as cofuel in power boiler along with coal	100%
2015 - 16 (up to June 15)	5819	Use as cofuel in power boiler along with coal	100%

Table - 8 Analysis of Primary sludge

Sl. No	Parameters	Unit	Results
1	Ash content	% (w/w)	60.0 - 62.0
2	Dryness	% (w/w)	50.0 - 55.0
3	Carbon	% (w/w)	23.90
4	Hydrogen	% (w/w)	2.67
5	Sulphur	% (w/w)	0.83
6	Oxygen & Nitrogen	% (w/w)	24.71
7	Gross calorific value	Kcal/Kg	1900 - 2150

ETP having two primary clarifiers, one clariflocculator, diffused aeration system and two secondary clarifiers. Chemicals such as coagulant, flocculent and de-foamer are used in ETP to meet the desired quality. Emami has an efficient sludge dewatering plant for treatment of ETP primary sludge and decanter for handling the secondary sludge. The overflow water parameters like suspended solids; color is reduced after doing the chemical treatment at the inlet of primary clarifiers. The final treated effluent is recycled and reused in various areas after tertiary treatment .The Tertiary treatment plant has three major components, namely chemical dosing unit, Multimedia filter & Activated carbon Filter.

- Treated effluent is partly used by farmers for cultivation and partly recycled for use in areas like floor cleaning, sludge dewatering, coal yard (dust suppression), plantation and gardening. (Cultivation + other 3000M^3/day) (Table 1)
- Installed a tertiary treatment plant to treat the final ETP water for reuse in various manufacturing processes, pump gland sealing & cooling & for process make up. (Tertiary treated 3000M^3/day) (Table 1)

Fresh water consumption before and after Tertiary treated water use is given in Table - 2

Section wise use of Tertiary treated water is given in Table -3

Solid Waste Management

Fly ash

About 250-275 MT of fly ash generated from cogeneration power plant is 100% utilized for brick making. About 50 nos. of fly ash brick free of cost as per the directives of SPCB, Odisha. Year wise utilization of fly ash generation & utilization is given in Table 6.

ETP Sludge

The total primary sludge from ETP is taken to sludge tower of sludge dewatering plant. This sludge is treated with organic coagulant & flocculent & taken to pre-thickener to improve the consistency from 3.5% to about 15%. Then it passes to screw press, gets squeezed and dryness becomes 50-55% (Table 8). The primary sludge (50-55 % dryness) from ETP is 100% used as co-fuel along with coal in power boiler (Coal saving 10500 MT/Annum). Year wise utilization of Primary sludge as fuel is given in Table 7 & analysis of Primary sludge is given in Table- 8

The excess secondary sludge (Biomass) generated from the Activated sludge process at ETP is taken to Decanter and sludge bed for thickening. Then it is being utilised as manure in agriculture by the local farmers & some amount is used as landfill. Previously the secondary sludge was thickened through belt press. But after introduction of Decanter, the belt press was stopped and approximately 40M^3/day fresh water saved.

Conclusion

- After implementation of Tertiary treatment system, fresh water consumption reduced by 1100M^3/day & specific water consumption is now reduced to 17.3 from 20.2M^3/MT of paper, resulting savings of Rs. 11000/day.
- Primary sludge from ETP is 100% used as co-fuel in boiler & resulting savings of 30MT coal/day.
- Discharge of effluent to river is reduced by 50% after tertiary treatment and reuse.
- 100% fly ash is used for Brick manufacturing.

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