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High Efficiency Agro Based Integrated Chemical Recovery Plant at M/S Bindals Papers Mills Ltd.

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Abstract: *Bindals Papers Mills, established in 2009 at Muzaffarnagar (U.P.) produces writing & printing (non-surface size, SS Maplitho & copier) grade papers with a capacity of 1.1 Lakh tons per annum. BPML has always been eager to adopt new technologies for a Greener & Cleaner approach in the Pulp & Paper making process by continuously improving operations for achieving the cost reduction, better efficiency in chemical and heat recovery. Paper is made from cellulosic fiber, which is separated from cellulosic contained raw material i.e. wood and agro based residues (Bagasse & wheat straw etc). Cellulose fiber is bonded with lignin which is a cementing agent. During pulp making process, cellulose is retained and lignin is extracted in liquor with the help of cooking chemical i.e. caustic, in continuous digester under high temperature and pressure. Dissolved lignin in the form of weak black liquor (WBL) is recovered from counter current brown stock washing in pulp mill and received in chemical recovery plant for recovery of cooking chemical as well as generation of steam. Initially, Mill had installed Low Temperature Incinerator (LTI) at the time of inception to recover cooking chemical by converting Black Liquor solids to soda ash and to avoid any drop of Black Liquor going outside of the Mill premises but without utilizing the heat of Black Liquor solids. Later on, to recover the heat also along with chemical recovery, BPML has installed a state of art agro based integrated Chemical Recovery plant in the year 2012 for handling 400 MT of black liquor solids. Plant consists of Multiple Effect Evaporators plant of 90 MT/hr water evaporation & Chemical Recovery Boiler of 400 MT Black Liquor handling capacity with Electrostatic Precipitator. Chemical Recovery plant was commissioned in Jan' 2015 & since then it is running with more than 100% capacity, meeting all Environmental control norms. The Overall chemical recovery efficiency of the plant is 95.5 % which has reduced the cost of cooking chemical through production of recovered alkali by 70 % in comparison to LTI's recovered chemical cost and it has also saved approx 50,000 MT of coal per annum. This Paper gives all the details and strategies adopted in plant selection / installation and various steps taken for operating the plant with industry's best practices & efficiencies.*

Key words: Chemical Recovery, Pulp Making, Paper Mills

1. Introduction

Pulp making process used cellulosic contained raw material i.e. wood and agro based residues (Bagasse & wheat straw). In this process cellulose is retained and lignin is extracted in liquor with the help of cooking chemical (caustic /White Liquor) in continuous digester under high temperature and pressure. Subsequently in chemical recovery process, treatment of the residual liquor (Black Liquor) generated after pulping of cellulosic raw material is done which includes evaporation of black liquor, efficient generation of steam and electrical power from the fuel value of black liquor and effective conversion into fresh cooking liquor (Caustic /White Liquor) along with regeneration of lime from lime mud.

Though the chemical recovery operation is more efficient for wood based raw materials but it is more complex and rather difficult to control in mills using agro based raw materials and the presence of higher amount of chlorides and silica contents makes black liquor processing very difficult in evaporation as well as in recovery boilers in recovery plant.

As part of achieving its environmental sustainability goals and reducing production cost, Bindals Papers Mill Ltd. situated in Muzaffarnagar (U.P.) took a crucial step to order an integrated Chemical Recovery plant in 2012 and installed & commissioned in Jan -2015. Mill achieved the target of reduction in recovered chemical cost along with other benefits. The Black liquor Low Temperature Incinerator (LTI) plant which was in use to convert Black liquor solids without utilizing the heat of black liquor was stopped after commissioning of new plant.

This paper gives the details of significant challenges the mill had faced in designing various equipments and subsequently optimizing the operations for controlling air emissions as per stipulated norms, reducing fresh water consumption, developing efficient process control for improved energy utilization and producing cooking chemical at reduced cost..

Features of the Different sections of Recovery plant

❖ **Multiple Effect Evaporator Plant of 90 Mt/hr evaporation plant**
• Plant consists of 10 no's bodies of falling film bodies (1 + 7effects) having steam economy of 6.7.
• The plant is capable to concentrate WBL of 10% total solids to 55% total solids.
• Plant is having fan less cooling tower to cool the surface condenser water achieving efficient operation with increased saving in power consumption.
• Configuration is designed with one spare body to regularly by pass the jammed effects for regular & timely cleaning of tube surfaces for maintaining the plant performance.

❖ **Recovery boiler of capacity of BL solids 400 MT per Day**
• Black liquor solid handing capacity - 400 MT /day.
• Furnace area - 4.74 m depth * 4.24m width.
• Boiler Pressure - 67 Bar.
• Steam Temperature - 460 °C.
• Steam Flow - 39 MT /hr.
• Boiler contains two no's of cascades to concentrate Black Liquor total solids from 55 % to 74 %.
• For Maintaining the cleanliness, 17 no's of soot blowers are installed.
• Recovery boiler is being run continuously for more than 3 months before water wash.

Steps taken for Improvements in Environment control

- BPML is situated in rural area in Muzaffarnagar district surrounded by green fields and villages.
- The main concerns in air emission have historically been particulate matters, TRS, SO_2 and recently NO_2 emissions.
- The particulate emissions are mainly from recovery boiler and smelt dissolving tank. Hence BPML decided to keep these emissions at a minimum level by installing an Electrostatic Precipitator (ESP) and wet scrubbers in dissolver vent.

Installation of highly efficient ESP system and later on it was modified to reduce emission and improving dust collection

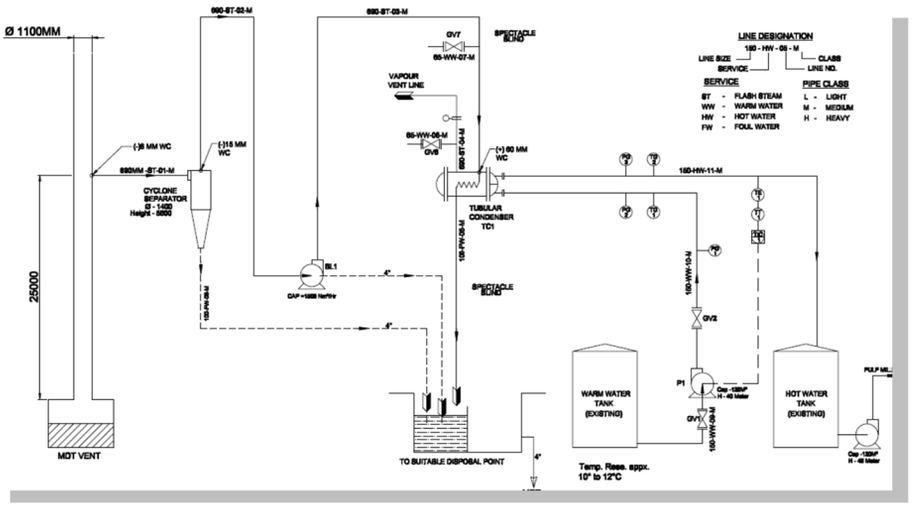
- This ESP is designed with multiple scrapper conveyors and full length ash conveyor to collect ash & transport it to ash mixing tank.
- To reduce control emissions from ESP, one high frequency transformer was installed to improve dust collection.
- ESP HT field's configuration was also modified to improve dust deposition & collection.

Heat and Chemical Recovery from Vapours of dissolver vent

Even with installation of demister Pads & washing system in dissolving tank, Vapours from dissolver vent are always visible due to presence of maximum amount of water vapours and also the heat contained in the vapour was going waste.
To overcome this, mill developed a state of art technology to recover both waste heat & chemicals from the vapours which also has reduced the emission of condensable gases from vent.

This system as shown in Figure-A, consists of collecting & drawing vapour from dissolver vent by a fan passing the vapour from cyclone to
reduce /separate the condensate. Then these vapours are passed through tube & shell heat exchanger where the heat of these hot vapours is passed on to the condensate which is being sent to pulp mill. The temperature could be raised by 12 degree C. Condensed vapour is collected in the form of condensate having alkali recovered from these vapours. This dissolved chemical in condensate is re-cycled back to dissolver tank.
A Variable speed drive is installed to control the speed of fan according to loading of boiler (Black liquor firing).
The temperature of condensate is controlled by controlling the flow of condensate through the heat exchanger. The separate tanks are installed for both condensate & hot water with level controller to run the plant smoothly.
The installation was done in two phases modifying the sizes of duct, blower and re positioning of cyclone as per the result achieved during trial.

Now the system is running without any problem since December -2017



Benefits achieved from this system

- Heat recovery in the form of raising temperature of condensate being supplied to pulp Mill by about 11-12 ^{0}C.
- Recovery of chemical of about 4.5 MT per month, this dissolved chemical in condensate is added back to dissolver.
- Total annual saving of Rs 35 Lakhs /year.

Table B - 1

From Evaporator	6 MT
From Dissolver	6 MT
From ESP	8 MT
From Slacker Grits	6 MT
From Mud Filter	10 MT
Considering 75 % Recovery from dissolver Vapors	4.5 MT /Month @ 21 Lakhs/Annum (Rs 39000 /MT Caustic)

Heat Recovery in MDT VENT System of Recovery Boiler

Table B - 2

Q=m*s*temperature difference
Where m=mass=120m3/hr=120 Tons/hr
S=specific heat=4.186KJ/Kg degrees centigrade
temperature difference =12 degrees centigrade
HEAT (Q)=120*4.186*12
=6027.84 KJ (1 KJ/Sec.=0.083 Tons)
=6027.84*.083=0.1389 Tons/Hr
=3.33 Tons/Day @Rs 1200 per ton
=Rs 4000/day=Rs 14 Lakh / Year (Taking 350 days)

Steps taken for steam /energy conservation in Recovery Plant

1	In new evaporator all the bodies water boiling & tube cleaning schedule maintained to keep the tube surface in optimum clean state, able to maintain steam economy more than 6.7.
2	Maximized LP steam consumption in oil & liquor heating. Maximized consumption for smelt shattering.
3	Reduced MP steam consumption in air heating for secondary air heating. Condensate flash tank steam is used for first coil.
4	No steam used for hot water heating.

Steps taken for water recycling & to reduce fresh water consumption

1	Causticizing plant's pumps & vacuum pump sealing water collected in water pit and pumped to pit in new evaporator area near hot water tank.
2	Tube cleaning pumps sealing water and pumps pressure control valve discharged recycled in pit near hot water

	tank.
3	In new evaporator all pumps sealing water & vacuum pump sealing water collected in pit and pumped to old cooling tower for makeup.
4	Recovery boiler pumps sealing water, cascade bearing cooling water, spout cooling water to water pit near tube cleaning pumps & recycled to new cooling tower for makeup.
5	In old evaporator all glands cooling water, vacuum pump sealing water & surface condenser water taken to old cooling tower for makeup.
6	In recovery boiler dissolver vents recovery heat exchanger condensate water taken to dissolver.
7	Two collecting pit made to collect all spillage, tube cleaning water after sludge removal & pumped back to ESP ash tank/mud filter for dilution.
8	Dregs washer dregs pumped to mud filter & discharged through mud filter.

Water consumption saving was achieved of about 22m^3 /hr.

Figure C1- Details of Water Scheme

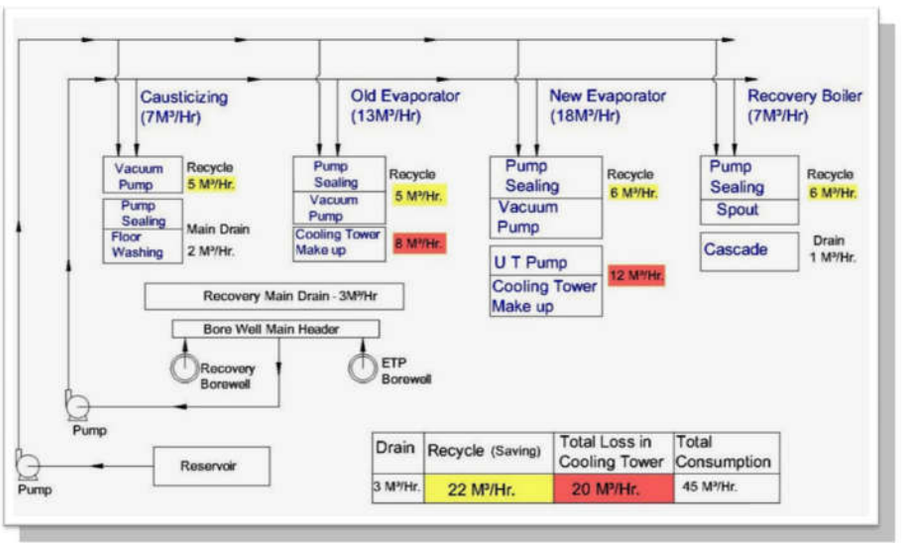
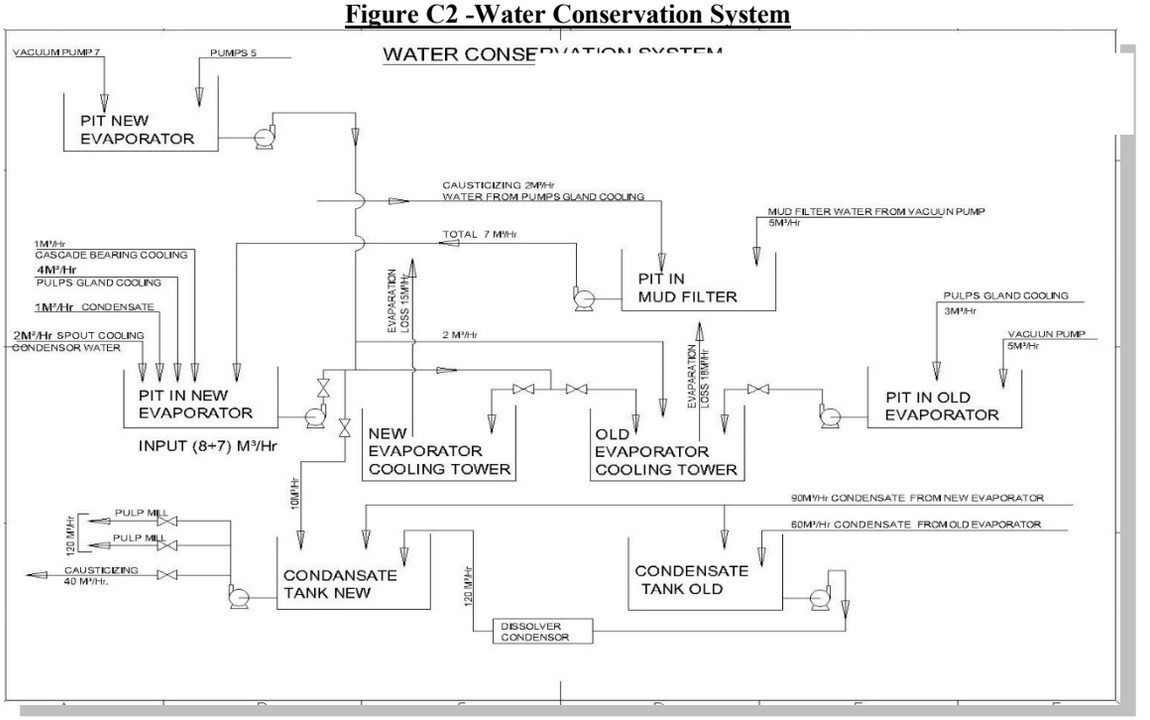


Figure C2 -Water Conservation System



Plant Performance Data:

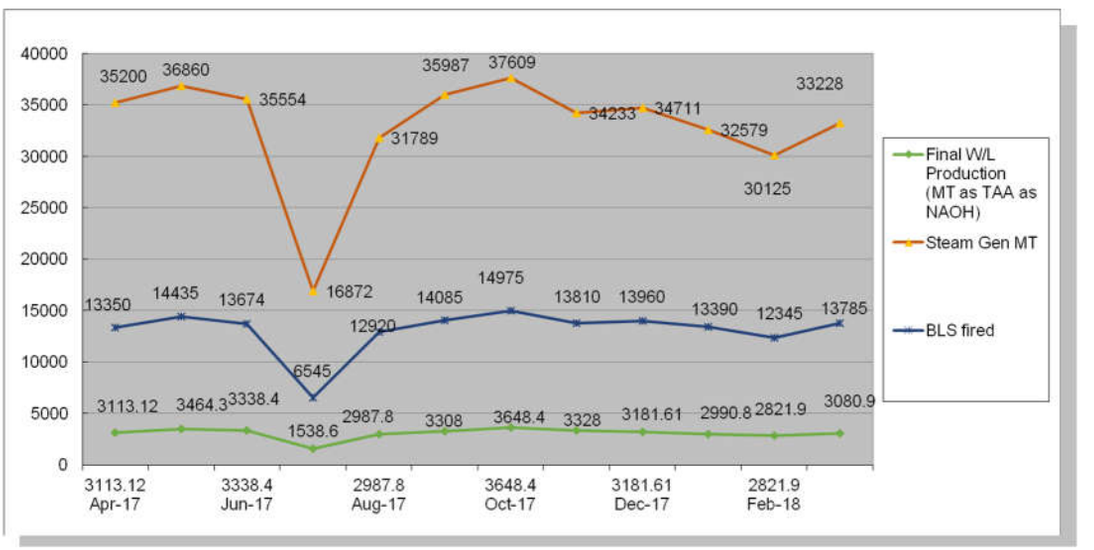
- **Recovery plant is running normal with more than 100 % MCR.**
- **Recovery boiler running more than 3 months between two cold wash.**

Major benefits achieved are given below:

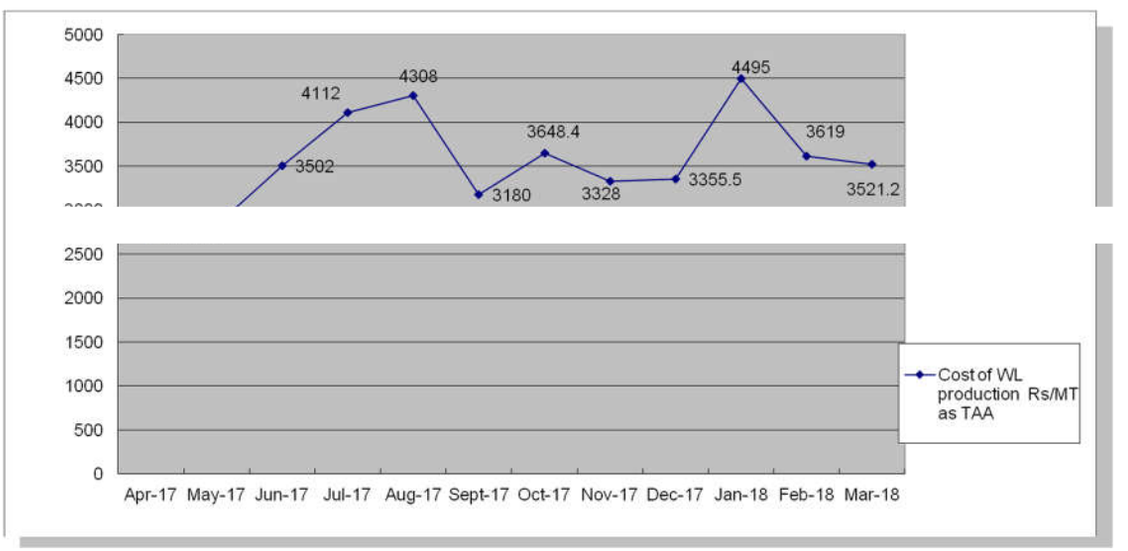
The significant reduction of cost of recovered pulping chemicals to Rs 3,500 /Mt from earlier level of Rs 12,000 achieved with LTI.

- Extra Power generation from heat recovered. New 5MW Turbine Installed.
- Improved overall chemical recovery efficiency from 87 % to 95.5 %.
- Increased output of recovered chemical from 2250 MT per month to 3250 MT per month.
- Achieved lowest steam consumption of 7.425 MT /MT of white liquor produced.
- Achieved steam generation of 10.73 MT/MT of White liquor produced.
- Recovery Plant becomes surplus in Steam generation (Steam generation /Steam consumption Ratio 1.44).
- Improved continuous operation of recovery plant in comparison of irregular running of LTI due to high percentage of chloride in black liquor from Pulp mill.
- Reduced emission of chemicals from stack.

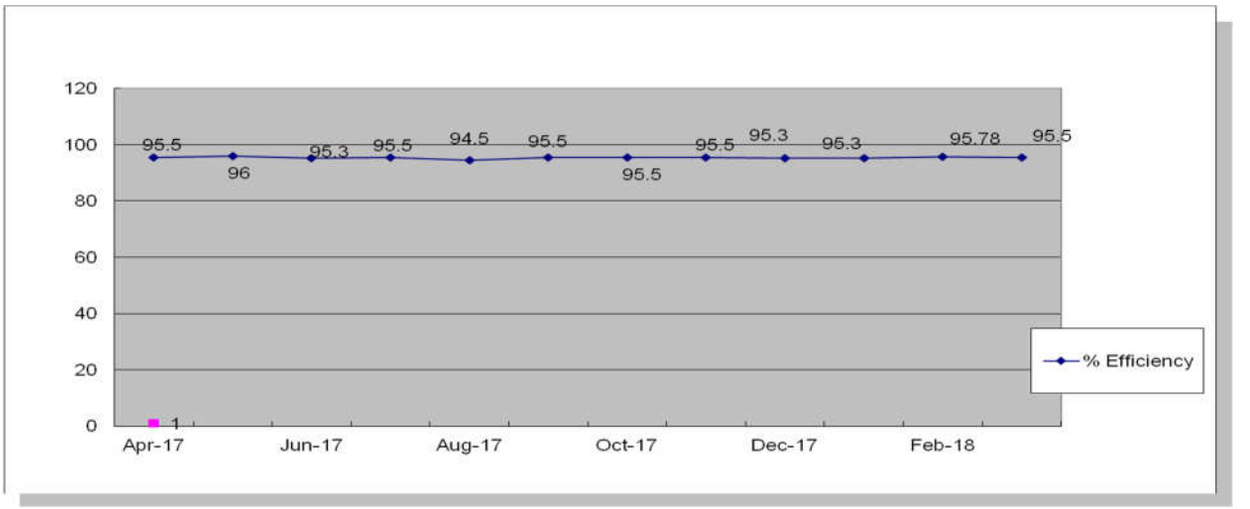
Graph D1-Chemical Recovery Plant Data



Graph D2 - Cost of White Liquor Production



Graph D3 - Chemical Recovery Efficiency



Conclusion

The Various steps taken in optimizing process of Recovery Plant contributed significantly to reduce both water and gaseous emissions has not only given financial leverage but also fulfill our commitment for improved environmental sustainability. BPML will continue strive for further improvements to fulfill the next possible stages of environmental contribution & adopting new practices for further improving the plant operating efficiencies.

Acknowledgement

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Vimal Kishore, An Approach towards sustainability by Adopting New Innovative Concepts At M/S Bindals Papers Mills Limited, *IPPTA: Quarterly Journal of Indian Pulp and Paper Technical Association*, vol. 30, no.1, 2018.