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Technical Papers

An Efficient agro based integrated Chemical Recovery Plant at M/s Bindals Papers Mills Ltd.

Abstract: *Bindals Papers Mills, established in 2009 at Muzaffarnagar, U.P., India 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 to 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 and 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 2013 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 BL solids handling capacity with Electrostatic Precipitator.

Chemical Recovery plant was commissioned in Jan' 2015 & since then it is running with more than 100% capacity and 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 50000 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 best practices & efficiencies.

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Key Words: *Efficient operations, Energy conservation, Water recycling, chemical cost reduction, improved environment norms*

Introduction

The chemical recovery process is a very important operation in pulp and paper making cycle. The process employs treatment of the residual liquor generate after pulping of cellulosic raw material, efficient generation of steam and electrical power from the fuel value of black liquor ,and effective conversion into fresh cooking liquor and 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 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 and in recovery boilers in recovery plant.

As part of achieving its environmental sustainability goals and reducing production cost Bindal Paper Mill situated in Muzaffarnagar in UP took a crucial step to install an integrated Chemical Recovery plant in 2013 commissioning it in Jan -2015 without any delay & achieving the reduction in recovered chemical cost along with other benefits .The Black liquor 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 faced in designing various equipments and subsequently optimizing the operations with respect for controlling air emissions as per norms, reducing fresh water consumption and developing efficient process control for improved energy recovery & utilization and producing cooking chemical at reduced cost.

The main Design features of the various sections of Recovery plant are:

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% TS to 55% TS.
- 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 * 4.24 M width
- Boiler Pressure -67 Bar
- Steam Temperature -460^{0}C
- Steam Flow - 39 MT /hr
- Boiler is having 2 no's of cascade to concentrate Black Liquor from 55 % Total Solids to 74 % Total Solids
- 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 installed in rural area in Muzaffarnagar surrounded by green fields and the houses belonging to mainly farmers.

The main concerns have historically been particulate matters, TRS, SO_2 and recently NO_2 emissions.

The particulate emissions are mainly from recovery boiler, smelt dissolving tank. Hence BPML decided to keep these emissions at a minimum level by installing an Electrostatic Precipitator and wet scrubbers in dissolver vent.

Installation of highly efficient ESP system supplies by Clyde Bergmann and later on it was modified to reduce emission and for further 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 always visible due to presence of maximum amount of water vapours also the heat contained in the vapour was going waste.

To overcome this, mill took step and installed Heat & chemical Recovery system to recover both heat & chemical from the vapour also reducing the emission of condensable gases to reduce the quantity of visible vapour from vent.

This system as shown in fig -A consists of collecting & drawing vapour from dissolver vent by a fan passing the vapour from a cyclone to reduce /separate the condensate. Than these vapour were passed through a tube & shell heat exchanger where in the heat of these hot vapour were passed on to the condensate being sent to pulp mill. The temperature could be raised by 12 degree C. Condensed vapour in the form is collected in the form of condensate having alkali recovered from these vapours. This condensate is re-cycled back to dissolver tank.

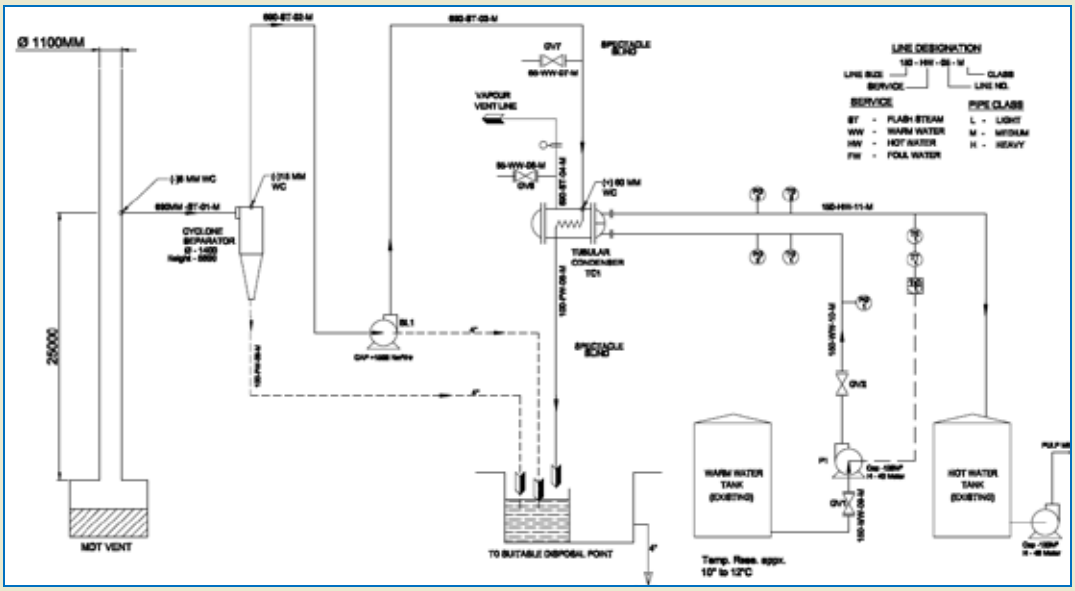
A Variable speed drive is installed to control the speed of fan to according to loading of boiler (Black liquor firing).

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

Figure A -- Scheme & P& I of the system



The benefits achieved from this system

- Heat recovery in the form of raising temperature of condensate being supplied to pulp Mill by about 11-12 degree
- Recovery of chemical of about 4.5 MT per month from this system, and the recovered chemical is added back to dissolver in the form of condensate
- Total annual saving of Rs 19 Lakhs /year

HEAT RECOVERY IN MDT VENT SYSTEM
OF RECOVERY BOILER

Table B – 1

Distribution of Chemical loss per month in Recovery Plant	
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 or 54 MT/Annum (Rs 35000 /MT Caustic)
Total Saving	18.9 Lakhs /Year

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 to 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 conservation	
1	Causticizing plants 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 vent 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

Achieved a saving of about 22m^3 /hr in water consumption

Figure C1

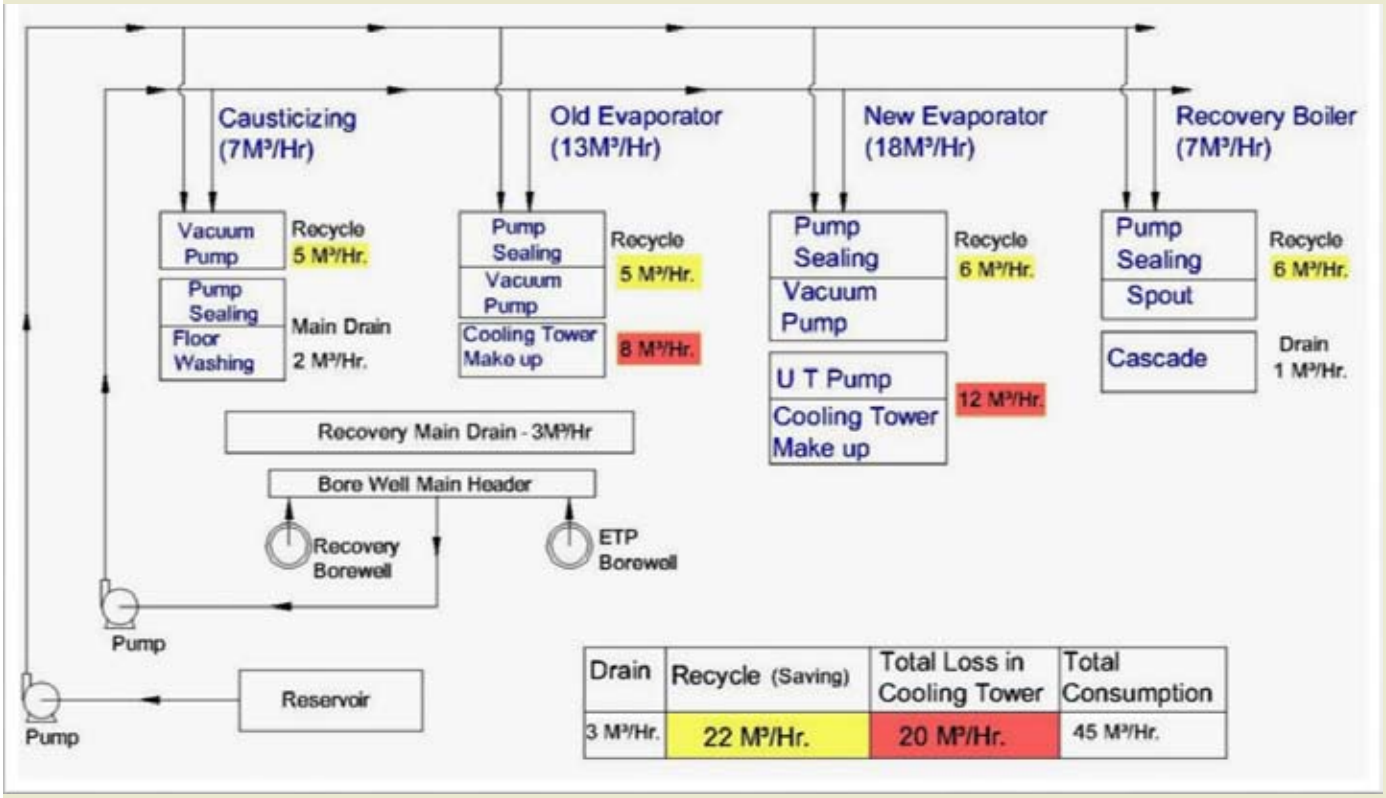
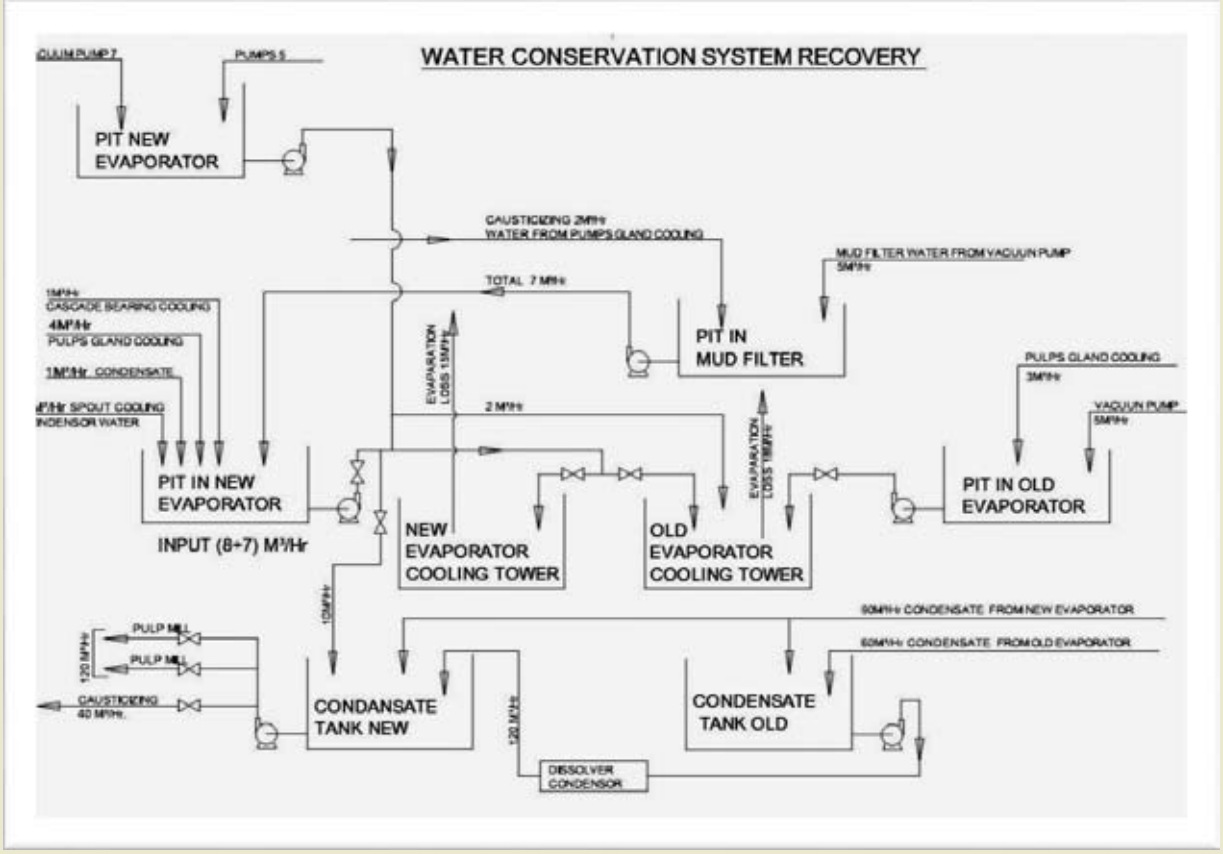


Figure C2



Plant Performance Data

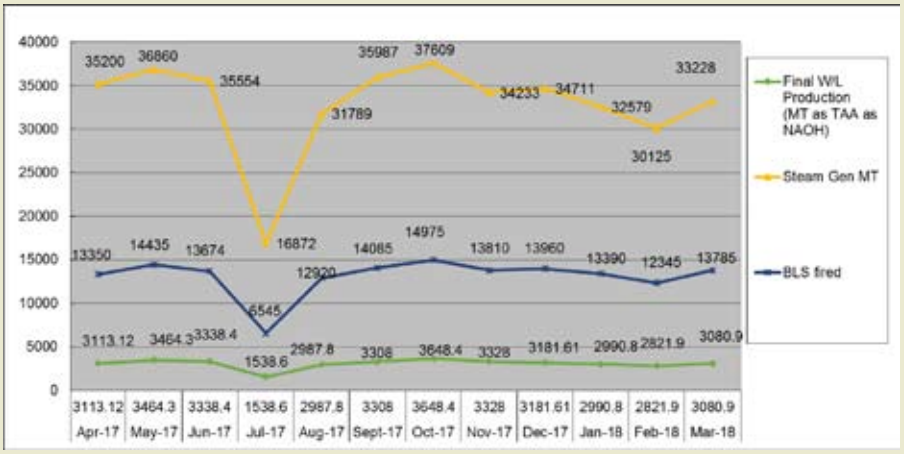
Recovery plant is running normal with almost at above 100 % MCR.

Recovery boiler running more than 3 months between cold wash

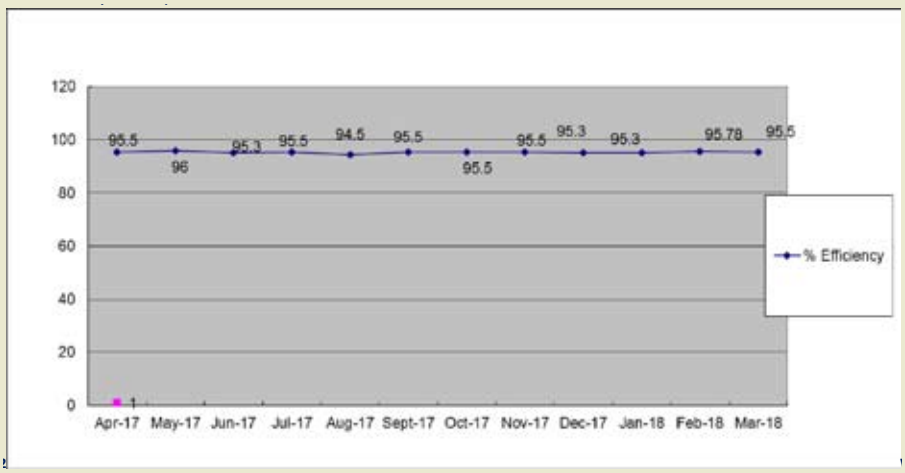
Major benefits achieved are given below

- The significant reduction of cost of recovered pulping chemicals to Rs.3500/- / Mt from earlier level of Rs.12000/- 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 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 % of chloride in black liquor from Pulp mill.
- Reduced emission of chemicals from stack.

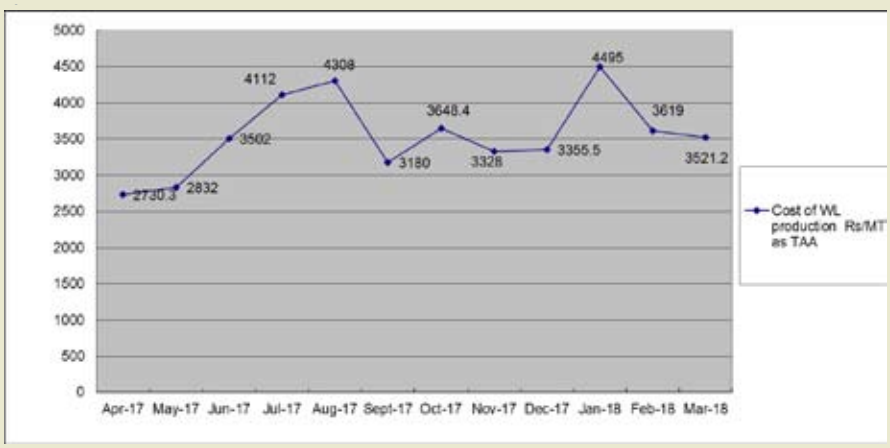
Plant Data Graph D1



Chemical Recovery Data Graph D2



Cost of White Liquor Production Graph D3



Conclusion

The Various steps taken in optimizing process of Recovery Plant contributed significantly to reduce both water and gas emissions has not only given financial leverage but 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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