Chemical Recovery From Bagasse Pulp Black Liquor Shree Vindhya Paper Mills-A Success Story

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INTRODUCTION

Shree Vindhya Paper Mills, situated at Bhusaval in Jalgaon District of Maharashtra, is a manufacturer of writing and printing papers for the last 18 years, with bagasse as the main raw material. The mill, which earlier was producing 50-60 TPD paper based on soda cooking process, subsequently decided to increase its capacity to 100 TPD and switched over to sulfate cooking.

The unique feature of SVPM, which has bagged many National Productivity Awards, was their decision to install a Chemical Recovery System in their expansion program, to improve their economic viability and also to meet the pollution control requirements. The decision was all the more commendable, because having a small full- fledged Recovery System for 100 % bagasse black liquor, at that time, posed challenges not encountered earlier.

However M/s SVPM & Enmas took up the challenge and emerged with very successful results.

SPECIAL FEATURES OF BAGASSE BLACK LIQUOR

The viscosity of 60 % T.S. bagasse liquor, which can vary from 250-1000 cp, at temperatures from 130°C to 90°C, is the single most important criterion which requires special measures and design features to handle the liquor. Besides, bagasse pulping generates substantial quantities of fiber fines, which, if permitted to enter the evaporation system, can drastically reduce heat transfer. Also, bagasse liquor from soda cooking exhibits different characteristics compared to liquor from Kraft process, and is more difficult to process in recovery system.

DESCRIPTION OF SVPM RECOVERY BOILER AND ITS SPECIAL FEATURES

Prior to installation of the Chemical Recovery System, the dilute black liquor from the washers of the pulp mill were stored in lagoons and disposed off into the Tapi river during periods of high water flow in the river.

It was decided that the Recovery Boiler would be of gas tight membrane wall construction, with suspesion firing and decanting hearth design. Keeping in view the higher viscosity of bagasse liquor, a cascade evaporator was a necessity, whereby the liquor would be brought to firing concentration (> 60% T.S.) utilising heat from furnace flue gas. Concentrations upto 45 % T.S. could easily be achieved in long tube vertical evaporators and forced circulation finisher using low pressure steam from turbine extraction.

To get the maximum benefit energy-wise, the boiler was designed for steam generation at 42 Kg/cm^2 and 420°C, conforming to the mills H.P. steam pressure and temperature parameters. Although the boiler capacity is small (110 TPD solids) the latest features of Ahlstrom State of Art Technology were incorporated, as stated below.

Air System

A 3 level air system was adopted for combustion air delivery. Preheated air (160-180°C) is introduced at two levels below the liquor guns, with 30-35% of total air being admitted through closely spaced primary air ports located on all four walls, and 50-55% of air being delivered through secondary airports on two opposing walls, at a slightly higher elevation.

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Some analysis figures of M/s SVPM Bagasse Liquor are reproduced below:						
			100% Bagasse Black Liquor		15-16% hardwood pulp liquor and balance Bagasse pulp black liquor	
			WBL	SCBL	WBL	SCBL
1.	Total solids	%	9-10	45	12-13	45-47
2.	Suspended solids	gpl	0.4	--	--	--
3.	Free alkalies NaOH	gpl	7.0-8.0	--	8-9	--
4.	Total alkalies Na_2O	% w/w	--	26.1	--	25-26
5.	Silica as SiO_2	% w/w	1.9	2.0	2.2	2.4
6.	Sulphated ash as NaOH	% w/w	31.9	32.0	--	--
7.	Organic % w/w by difference		68.1	68.0	58	55
8.	Smelting Temperature	°C	--	786		
9.	Swelling volume M1/Gr	--	--	10-12	--	--
10.	GCV	Kcal/kg	--	2980	--	3000

This sort of arrangement ensures that combustion is confined to the lower part of the furnace, thereby improving combusion and maintaining good reduction. The balance 10-15% of the total air is admitted at ambient temperature through tertiary air ports, located on opposing walls and elevation above the liquor guns. This tertiary air is introduced at high velocity in an interlaced pattern. Such an arrangement ensures through mixing of flue gases to eliminate gas channeling, burns off any combustible matter still remaining and helps in reducing the carryover of particles to upper furnace regions. To maintain the required velocity of air through the air ports at different load conditions of the boiler all air ports are provided with independent dampers to control port opening.

Boiler Design

The boiler is of a fully welded single drum design in which the steam drum is loated outside the flue gas path. With the panel type axial flow bank and economiser arrangement, wider spacing is provided and fouling of gas passeges is reduced substantially. Membrane type water wall construction gives a gas tight furnace.

Spout

The smelt spout is positioned at the rear wall of the furnace. With this arrangement spout blockages are minimised as the nose arch prevents solid stuff from upper furnace falling directly on to spout.

EXPERIENCE DURING START UP, COMMISSIONING AND STABILIZATION

After completing the pre-commissioning activities like trial runs of various auxiliary equipments, alkali boil out and steam blowing of superheater, the boiler was fired with bagasse black liquor on 03.08.94 for the first time with the help of oil support.

In the beginning the boiler used to run for about 6-7 days and had to be stopped for want of

black liquor. Howerver, after commissioning of pulp mill expansion, the boiler operation on a continuous basis at 75-80% MCR had been possible. Present operating level is about 90% MCR.

During the first three months we faced quite a few problems in handling the liquor due to high viscosity of the black liquor which could only be controlled by having higher R.A.A. from digester. The twin screw pumps with mechanical seals were selected for pumping liquor from SCMT to furnace thro' cone type spray nozzles. The swelling characteristic of black liquor was also found to be very low and the burning characteristics were not satisfactory. We were not able to remove oil support for about 1 month (i.e.) 3-4 start and stop sequences. Also the short running periods due to black liquor non- availability was a handicap, whereby any meaningful trials/observations could not be done. Decayed bagasse raw material due to long storage period in offseason time also contributed to higher viscosity and poor burning characteristics of black liquor.

Because of joint efforts put in by SVPM and Enmas commissioning team, with analytical support from CPPRI, the Recovery system operation was observed and operating parameters were tuned.

One of the suggestions which was implemented was to increase residual alkali from digester, After increasing the chemical charge to the digesters and rationalizing the cooking parameters, a remarkable change was observed in black liquor characteristics and Recovery Boiler operation became smooth. SCBL concentration from Multiple Effect Evaporators improved and Oil support was very much reduced and the boiler started running even at 70% MCR load without oil.

Since November '94, the Recovery Boiler operation has stabilized and is meeting the requirement of the mill production.

Apart from the recovery of cooking chemicals, the boiler is producing about 10-12 tons of steam at 42 Kg/ cm^2 pressure and 400^{0}C temperature, thus contributing to the captive power generation of the mill.

Annexure I shows the recent data on SVPM Recovery Boiler Operation.

SUMMARY AND CONCLUSIONS

After installation of Chemical Recovery unit, it became necessary to maintain a free alkali level of around 8 gpl as NaOH in weak black liquor to improve the flow/viscosity characteristics of the black liquor and to increase the concentration of WBL from wash plant to about 9% TS to reduce the water evaporation duty on Evaporator unit and to produce recycled chemicals on an economic scale.

The commissioning and operation of the recovery boiler came exactly at the need of the hour (i.e.) during the period the caustic prices went as high as Rs. 20,000/ton. SVPM started getting a return on investment from the first day of its commissioning.

Maintaining the residual active alkali in WBL is a must for smoother operation of Evaporators and Boilers and the recommended range is 7-8 gpl as NaOH in WBL. Any amount of caustic addition in cascade will not reduce the viscosity characteristics of the Black Liquor, if the free alkali level in weak black liquor is not adequate.

For other agricultural raw materials like rice and wheat straws, the silica content in black liquor poses additional problem in combustion and in fouling of flue gas paths. Desilication prior to black liquor process becomes a must.

Most of the bagasse based mills in India are having wet depithing systems and the black liquor from the wet depithed bagasse is less viscous and easy to handle than dry depithed bagasse black liquor.

With the experience of 100% of bagasse liquor, that too with dry depithing system at SVPM, today the small to medium capacity bagasse based paper industry can be doubly sure of an economical recovery operation and the SUCCESS IS DEFINITE.

ANNEXURE 1

RECENT DATA ON RECOVERY BOILER OPERATING PARAMETERS

1. Average MCR load : 88%
2. Dry solid firing rate : 96.8 MT/day
3. Average dry solid contents : 1.1 to 1.2 MT/BDT pulp
4. CBL firing solid content: 58-64%
5. Average calorific value : 2900 to 3000 Kcal.KG
6. Furnace oil support : 80 Lits/Mt Caustic recovered
7. HP steam generation : 280 MT/day
8. Steam pressure : 40-42 Kg/cm^2
9. Steam temperature : 400-420°C
10. Chemical over all efficiency : 90±1%

PEAK PERFORMANCES

1. Maximum BL solids fired : 120 MT/day against the capacity of 110 MT/day
2. Maximum steam generated : 338 MT/day

ANNEXURE II

Sample calculation for economic viability of installing Chemical Recovery System

Basis: 1. 100 TPD unbleached bagasse pulp.

2. Operating days = 330 days/year.

A) Mill with Soda Process no, chemical recovery

Pulp yield : 45%

Alkali Charge : 10% as NaOH

Alkali required : 22.2 TPD @ 16,000/- per M.T. cost incurred as NaOH per day: =22.2 x 330 x 16,000= Rs 1,172 lakhs/yr.

B) Mills having Kraft process and Chemical Recovery.

Alkali charge : 13% as NaOH (R.A.A. in WBL=7-8 gpl)

Active Alkali required as NaOH : 29 TPD

Make up alkali required : 29 x 0.1=2.9 TPD (90% recovery efficiency)

Taking 70% Na_2So_4 make-up and 30% as NaOH make-up Salt cake required (Na_2So_4) : 2.9 x 0.7 x 71/40=3.6 TPD

Caustic Soda (NaOH) required : 2.9 x 3=0.87 TPD

Cost incurred for salt cake : 3.6 x 330 x Rss. 6750= Rs. 80 lakhs/yr

Cost incurred for caustic soda : 0.87 x 330 x Rs. 16000= Rs. 46 lakhs/year

Steam Costs

B.L. solids : 100 x 1.1=110 TPD

Steam required for Evaporation from 9% to 45% T.S. @ steam economy of 4.0 : (110/0.9-110/0.45) / 4 = 245 TPD

Steam required for : 80 TPD

Boiler and causticiser

Total Steam required : 325 TPD

Steam generated from : 110 x 2.8=308 TPD

Recovery Boiler at 2.8

T steam per ton B.L.

solids

Net steam consumption: 325 = 308 = 17 TPD

from mill steam grid

@ Rs. 500/- per : 17 x 330 x 500

M.T. steam costs : = Rs. 28 lakhs/yr.

Lime Costs

Lime requirement : 1.1 T/T active alkali

: 29 x 1.1 = 32 TPD

@ Rs. 2200/- per : 32 x 330 x 2200

M.T. Lime Cost : = Rs. 232 lakhs

Furnace Oil Costs

@ 2 kl/day and Rs. : 2 x 330 x 8000

8000/- per Kl : = Rs. 53 lakhs

Power Calculation

Power consumption @ : 400 x (29/24)

400 Kwhr/Mt alkali : =483 Kwhr

produced

Power generation : Approx. 1000 Kwhr

from H.P. steam

of recovery bioler

Net power supplied : 517 Kwhr

to mill power grid

Assuming differential : 517 x 24 x 330 x 1.5

cost between captive : = Rs. 61 lakhs

power and state grid

at Rs. 1.5 per Kwhr.

Less cost of power

Total variable cost : 80+46+28+232+53-61

= Rs. 378 lakhs

As fixed costs, interest on capital and depreciation will vary from mill to mill, on approximation, for an investment of Rs. 1800/-lakhs would be about Rs. 450 lakhs/year.

Thus the overall cost would work out to Rs. 828/- lakhs/year, giving a return of approximate Rs. 344/- lakhs/year or a pay back period of 5 - 5 $^{1}/_{2}$ years.