

# **A Case Study of Evaporation of Black Liquor from a Furnish containing High Percentage of Hardwood**

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## **SUMMARY**

This paper is a case study of Seshasayee Paper and Boards where the black liquor from a mixture of 40% bamboo and 60% hardwoods has created considerable problems in the evaporation plant. The problem is going to be aggravated further when the mill will be compelled to use 30% bamboo, 45% eucalyptus and 25% miscellaneous hardwoods in the future.

## **INTRODUCTION**

With the depletion of bamboo forests, Indian Paper Mills have to resort to use of more hardwoods for pulping for their survival. Black liquor from higher percentage of hardwoods poses serious

problems in the multiple effect evaporators due to high scaling and viscous nature of the black liquor. Cooking of hardwoods leaves considerable quantity of fines in the black liquor, further aggravating the scaling property. Hardwoods cover a wide spectrum of wood with different densities and different morphological characteristics and to cook each of these species separately is virtually impossible.

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## DESIGN PARAMETERS

The mill started its operation in 1962-63 as 66t/day mill, and multiple effect evaporators for the recovery boiler had the following design characteristics:

Black liquor solids	90 t per day from a production of 66 t of pulp per day.
Weak Black Liquor inlet concentration:	13%
Outlet concentration of evaporators	: 46%
Water evaporated	: 28 t per hour
Number of bodies	: 5
Steam economy	: 4.2 t of water evaporated per tonne of steam

I and I-A effects made of stainless steel tubes  
Area of I Effect : 2200 sq ft

The operating characteristics for the evaporator in the initial starting-up days were as below:

Raw material used for cooking:

Bamboo	: 75%
Bagasse	: 25%

The operation of the evaporator was satisfactory and the cycle of water boiling was as below:

Strong liquor effect	: 45 days
Second and third effect	: 65 days
IV and V effects	: Once a year

The scales collected during the cleaning operation had the following analysis:

Loss on ignition	: 12-14%
Acid insolubles	: 55%
R <sub>2</sub> O <sub>3</sub>	: 7%
Calcium as CaO	: 15.2%

## OPERATIONAL DETAILS

The mill went for an expansion in 1968 with 100 t/day from its original 66 t per day. No additional equipment for the evaporators were provided. The additional water evaporation was taken care of by the Venturi Scrubber evaporator installed in the recovery boiler as part of the expansion. The evaporator outlet was maintained at 40% solids. The alkali consumption per tonne of pulp was reduced to 365 kg per tonne with a sulphidity of 18-20% in the white liquor. The reduction of chemicals to the digester could be brought down as a result of installing

stationary digesters while the mill originally had only Pandia Continuous Digester. By the reduction in cooking chemicals, the total solids in black liquor came down to 1400 kg from its original 1550 kg per tonne. As bagasse availability became poor the mill started using hardwoods to supplement the raw material for pulping. The raw materials consisted of 70% bamboo, 25% eucalyptus and 5% miscellaneous hardwoods. As a result of pulping wood the black liquor became highly scaling. Because of the scaling nature of black liquor, the evaporator had to be stopped for frequent water boiling. Because the evaporators had to be frequently stopped for water boiling and cleaning the effects, it was decided to keep one more effect as a standby, running the evaporator as a IV effect one. This has of course increased the steam consumption, but the mill was able to handle all the black liquor from a production of 105 t of paper per day with one street of evaporator.

In 1976 the capacity of the mill was further increased to 165 t/day. In the recovery section one additional street of evaporators and one new recovery boiler to handle 135 t of black liquor solids per day with an inlet feed of 42% solids to the cascade and with an outlet of 59-60% solids, were added. The cascade had capacity to evaporate 3.6 t of water per hour. The proportion of raw material after the second expansion so far is 40% bamboo, 40% eucalyptus and 20% miscellaneous hardwoods. The two streets of evaporators are combinedly run to cater to the needs of the two recovery boilers. The old street of evaporators run for two shifts to feed the old furnace at 40% solids and one shift to feed to new furnace at 42% solids. The new street of evaporators run at 42% solids to feed the new recovery furnace. If both streets of evaporators are run at a concentration slightly higher than 40%, they run only for 20 days, by which time they have to be stopped for cleaning. It runs to a rated capacity for the first three days after initial boiling. When the body is drained, lot of scales and fines are observed.

The unit then has to be given alternate day water boiling for about 3 hours, which gives service to the full capacity for a week's time and later the capacity goes down to 60% irrespective of any amount of water boiling. Scales collected from the tubes gave the following analysis :

Loss on ignition	: 25.2%
Acid insolubles	: 45.3%
Calcium as CaO	: 17.6%
R <sub>2</sub> O <sub>3</sub>	: 3.7%

Though the calcium carbonate scale has slightly increased, the suspended solids in white liquor is never above 0.5 gpl.

Since the Ist effect has two passes the velocity in the 2nd pass was increased by an additional pump. Though this has increased the capacity in a marginal way, the evaporator could not handle all the black liquor from pulp mill.

The black liquor that is coming to the recovery section is produced by cooking a mixture of bamboo and hardwoods. Separate cooking and washing is not done in the mill.

It has been the experience that the evaporators can run satisfactorily for a longer time, if the outlet concentration is brought down to 38-39% solids and if the outlet concentration is increased above 40%, the rate of scaling is fast and evaporators had to be taken out of service for cleaning or water boiling.

As it will not be possible for the mill to reduce the consumption of hardwoods, a finisher effect is contemplated to bring up the outlet solids from 35% to 42% which is expected to give better runnability for the evaporators.

### EXPERIENCE AND VIEWS

It is felt that Seshasayee Paper and Boards should share their experience and exchange ideas with other paper mills who are faced with similar problem of raw material and are forced to use higher percentage of hardwoods. The following points are open for discussion for exchange of ideas which may be beneficial to the industry as a whole.

- a) Whether Indian mills which are using hardwoods more than 50% have faced similar problems with their multiple effect evaporators?
- b) Does any mill which is obliged to use hardwoods 50% and above for pulping, have separate stream for cooking, washing and evaporation of liquor from bamboo and wood? What is their experience?

- c) If mixed cooking is followed, have any mills decided the maximum percentage of hardwoods in pulping which will not upset their evaporators?
- d) Has double-stage cooking or impregnation cooking when using high percentage of wood, produced any difference in black liquor characteristics with regard to its effects on evaporators?
- e) Whether stainless steel tubes in evaporators will help in avoiding fast scaling when using higher percentage of hardwoods. What are the experiences of other mills in this regard?
- f) Will a finishing effect for the evaporator be a solution? What is the experience of other mills in this regard?
- g) Are mills which use high percentage of hardwoods and who have installed chip washing system, experiencing similar problems in evaporators?
- h) What are the possibilities to design an evaporator suitable to handle viscous, gelatinous, colloidal black liquor?
- i) Experience of mills regarding acid cleaning of evaporators to improve runnability of the evaporator unit.

These are some of the problems which Seshasayee Paper and Boards have faced in the evaporators as a result of increasing percentage of hardwood in their pulping, and it is genuinely felt that discussion on the problems may be beneficial to other mills which may also be forced to use higher percentage of hardwood in pulping.