# Modernization of Brown Stock Washing and Screening Plant- A Case Study

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*ABSTRACT*

*In new scenario of high competitiveness in Pulp and Paper Industry, there is no option but to replace old, lesser efficient and high power consuming washing and screening plants with high efficient and energy saving new system with state-of-the art technology. APPM has selected hot stock screening and chemiwasher system as the system is more energy efficient and environment friendly. This paper deals with the description of the system and APPM's experience in absorption of this modern screening and washing technology.*

## INTRODUCTION

APPM Brown Stock Washing system consists of 2 streets of washing plants of each 100 TPD and 150 TPD capacity and one screening plant. Washing plants are of 4 stage counter-current drum type vacuum washers. Screening plant consists of centrifugal screens arranged in 3 stages followed by 3 stage centri-cleaning and three thickeners. To meet the pulp requirement of the Mills the washing and screening had to be run with overloading compromising the chemical losses and TS of WBL. In addition to this, the system itself is poor energy efficient and consuming more power i.e. around 168 kWh/tonne of pulp.

### Selection of new screening and washing system

Offers were obtained from different reputed suppliers and were evaluated judiciously to the parameters like dilution factor, TS% of weak black liquor, chemical losses and power consumption etc. The projected parameters given by different vendors are given in Table 1. As the system offered by Vendor-C meets the requirement of APPM, hot stock screening and horizontal belt type chemi-washer was selected.

## RESULTS AND DISCUSSION

### Knotting and screening

The hot stock screening system consists of

- Hy - Tec knotter,
- Secondary knotter (Hydra screen)
- Ultra V Pressure screen
- Secondary and tertiary mini pressure screen
- Liquid cyclone with automatic rejects discharge
- Quarternary screen (Hydra screen)

Block diagram of screening Plant is given in Fig. 1.

### Operation

The pulp from blow tanks is pumped to knotter feed tank at consistency of 4.5%.

### Knotter

Primary knotter is vertical centripetal screen having screen basket of 8 mm dia perforations, the knotter operates at feed consistency of 4.0% and inlet pressure of 2.8 Kg/cm$^2$, the accepts are pumped to primary screen and rejects are fed to secondary screen, hydra screen. The accepts from hydra screen are fed to blow tanks and knotter feed tank. The rejects from hydra screen are sent back to digesters along with chips.

### Screening

The accepts from primary knotter is fed to primary screen at feed consistency of 3.0% by means of pump. The accepts from primary screen at 2.9% consistency is fed to chemi-washer head box. Primary screen is also vertical type pressure screen having slotted screen basket of 0.2 mm slots and is operated at inlet pressure of 2.0 kg/cm$^2$. The rejects from primary screen are fed to secondary screen at feed consistency of 2.2% by means of pump. The secondary screen is horizontal type pressure screen having slotted screen basket of 0.2

mm slots. The accepts are circulated back to the feed of primary screen feed, while the rejects are fed to liquid cyclone at consistency of 1.3%.

### Liquid cyclone

Liquid cyclone is installed prior to tertiary screen and is operated at differential pressure of about 1.8 Kg/cm$^2$. This is intended to remove the foreign materials like sand and small metal pieces from stock.

### Tertiary screen

The accepts from liquid cyclone is fed to tertiary screen at feed consistency of 1.2%. It is also horizontal type mini pressure screen having slotted screen basket of 0.2 mm slots. The accepts from tertiary screen are taken back to secondary screen feed. The rejects are fed to quartenary screen, hydra screen. The accepts from quartenary are taken back to feed of tertiary screen while rejects are sent to digesters along with chips.

### Operation control strategy

The plant is operated from DCS. For efficient operation of the primary knotter and pressure screens control strategy is of paramount importance. Whenever pressure difference between feed and accepts pressure is more than 0.5 Kg/cm$^2$, the accepts control valve gets closed completely, keeping the rejects control valve remained at the same opening or gets completely full open. As differential pressure reduces less than 0.2, the accepts valve gets open slowly to its normal position and reject valve also reaches the normal position. This strategy is helpful to clear off the blinding, that takes place in the screens during operation without interference of the operator. The operation of unplugging activity will continue till the screen is completely free from plugging for one minute. If de-plugging is not completed within one minute, emergency shut of the screening unit activates and trips to enable it to clear the plugging manually.

### Chemi-Washer

Chemi-washer is horizontal belt type washer of 5 stage counter current washing. It is completely closed with hood. It uses pin seamed polyamide wire for quick wire chages. Pulp is pumped to head box at 2.9% consistency and spreads uniformly on the wire at formation zone and the mat is counter currently washed in 5 stages and finally discharged at 12% consistency on couch roll. This is also completely operated from DCS.

The required vacuum for chemi-washer is generated by vacuum fan. A level controller maintains vapour phase within each suction box as well as controlling the flow to the shower of the preceeding stage. The pressure differential between the hood and the vapour phase of the suction boxes, provided by the fan is the driving force for the liquor to pass from the stock to suction box. The chemiwasher design provides large surface areas within the suction box zones. This helps in prevention of foam generation, thereby intermediate feed tanks are not necessary. Further, the gases separated into zones and exhausted by the blower, are recycled back into the hood. The re-circulated gases into the hood establishes very quickly the atmosphere of high relative humidity. As the hood maintains a seal between atmosphere and suction boxes it renders plant and its surroundings, odourless. This helps to eliminate conventional odour problem and make it environmentally friendly. The hood also prevents cooling of the pulp and shower liquor which aids the drainage characteristics of the pulp and permits a relative equilibrium between vapours and

Table 1 The projected parameters

| Description | A | B | C | D | E |
|---|---|---|---|---|---|
| System | Knotting, washing, screening and thickening | Knotting, screening and washing | Knotting, screening and washing | Knotting, washing screening, thickening | Knotting, washing and screening |
| Type of washing | DD washer | Belt washer | Blet washer | Press | Drum washer |
| Conc. WBL % TS | 17.5 | 18.5 | 19.0 | 15.0 | 15.0 |
| Total Chemical Losses, Kg/Tonne | 13 | 18 | 12.5 | 13. | 15 |
| Power consumption kWh/Tonne | 66 | 42 | 30.7 | 98 | 81.8 |

Table 2 Problems and Remedial actions taken

| Problem | Effect | Remedial action taken |
|---|---|---|
| Consistency variation: This is much more prevalent at blow tank pump discharge end and primary knotter feed. | High consistency causes the plugging of knotter and screens. Low consistency effects the runnability of chemi-washer. | Rotary type consistency transmitters are installed at blow tank area and primary knotter feed pump delivery. Performance of consistency transmitter at knotter feed is satisfacory. |
| DP activation on primary knotter and pressure screens. | Tripping of the plant effecting the production. | Control strategy of the primary knotter and screens is modified. |
| High knotter reject content | Plugging of the knotters and screens. Production loss. | Kappa of Unbleached pulp was reduced to 16-17 from 20-21 |
| Secondary knotter Jamming | Down time of the equipment for clearing the jamming production loss | Replaced with open type vibrating screen. |
| Feed variation to primary knotter | causing plugging of the knotter and effects the performance of chemi-washer. | Pump impeller was changed to open type vortex impeller. |
| Aeration of stock in primary knotter feed tank | entering of air with the pulp causing the generation of foam | All inlet lines to the primary knotter feed tank is extended to the bottom of the tank to avoid air entering. |
| Plugging of primary knotter and primary screen | Down time of the units for clearing the jamming. Production loss. | Speeds of the primary knotter and primary screen increased. |
| Chemi-washer wire guide zero speed | It trips the washer and screening. Production loss. | New air compressor was installed to meet the requirement of air for the operation of stretcher roll air motor. |
| Immature failure of wire fabirc | Seam of the wire fails production loss | Wire tension reduced after installation of compressor. Under study. |
| Wire clogging | Effects the drainage characteristics of the wire. Load on hydraulic drive increases. Conductivity of the 5th stage filtrate also increases. Production rate effects. | De-foamer is being used and occasional cleaning of the wire with 5% phosphoric acid followed by jet cleaning. |

gases in suction boxes and in the hood.

As there is no interstage dilution and dilution factor is less, total solids of weak black liqour from chemi-washer are to be on higher side i.e. on 19.0%.

## Advantages

The advantages of Chemi-washer are:

- Low dilution factor
- High spent liquor concentration
- High washing efficiency
- Excellent turndown ratio at sustained high efficiency
- Small space requirement
- Building height is less
- No intermediate filtrate tanks

## Process control

Alghough system provides better operational controls, the efficiency depends on the actual process control maintained during operation. Some of the critical parameters are-

• Consistency at blow tank pump discharge and knotter feed tank pump discharge.

• Consistency at primary screen feed

• Knotter reject content in the pulp

• Stock flow variations

• Temperature of wash water

### Performance Guarantees

The plant is expected to perform with the following guarantees:

• Production: 320 TPD of screened & washed pulp

• Washable losses: 7.5 kg of $Na_2SO_4$/T

• Concentration of Weak black Liquor to Evaporators: 19% (W/W)

• Power consumption (for supplier scope of equipment): 30.7 kWh/T

### Problems and Remedial Actions

During commissioning and stabilization of the plant, some serious and teething problems were encountered. With zeal and dedicated team work and constant encouragement from the Management, the problems could be surmounted and could be able to run the plant continuously by improving production steadily to the level of 75-80% efficiency. Some of the problems and remedial actions evolved/taken are given in Table 2.

### Achievements

### Production

After implementing successfully all the above modifications, the performance of the plant has been improved. Production has been improving steadily and gradually touched to 250-260 TPD on several days and for few days it reached to 280-290 TPD. There was set back for a while due to wear out of screen baskets. After new set of baskets were fixed recently the performance of the plant picked up.

### Chemical Losses

Currently washable chemical loss is about 10 Kg/tonne of pulp. Still improvement is warranted in this aspect as the guaranteed Figure is 7.5 Kg/T.

### Power Consumption

Installed power for the plant is 1420 kW. The esitmated power consumption per tonne of pulp in the plant is 88 kWh/Tonne. There is power saving of 80 kWh/Tonne of pulp when compared to the power consumption of 168 kWh/Tonne for old washing and screening system. Power consumption on the day the production of 280 TPD was achieved, is 88 kWh/Tonne. If we calculate power consumption for the vendors scope of supply on 280 TPD, it is 28 kWh/Tonne which is less than guaranteed Fig. of 30.7 kWh/Tonne. There is scope still for further reduction in power consumption, once the target production is achieved.

### Concentration of WBL

Concentration of WBL so far we could achieve is about 17%. We envisage further improvement in this regard.

## CONCLUSION

In spite of many hurdles encountered during stabilization of New hot stock screening and washing system, the energy efficient and environmental friendly, give fillip to overcome the hurdles by innovative remedial actions and constant follow up.


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