Improved Waste Paper Cleaning System – A Case Study

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ABSTRACT:-- The paper deals with a case study made to evaluate the performance of screening and cleaning systems in order to select the optimum type of equipments for screening, cleaning system and dimension of plate size, holes or slots, for pulping and cleaning mixed cutting waste for making middle layer of a boxboard.

INTRODUCTION

The projections of Paper & Board demand made at different forums and the future availability of fibrous raw materials indicates the necessity to plan the future projects/ expansions with recycled fibers as major constituents. Recent reports published in Papermaker Asia shows 1780,000 MT/ year capacity being added up by the end of 2000 AD, out of which approximately 548,000 MT per year is based on secondary fibers in India. The quality of paper produced in India from secondary fiber is of a poor quality. The reasons can be any or all of those given below

* ***Inadequate cleanliness***
* ***Low brightness &***
* ***Poor strength***

The main cause for first two are obviously due to less cleaning of recycled pulp, whereas reasons for third point is merely because of inherent lower strength of initial indigenous fiber and subsequently formation of large amount of fines.

Servall has the experience of making kraft and cultural grades of papers from secondary fibers in its three paper mills. With the introduction of Hot dispersion system (KRIMA) the quality of paper has improved and the advantages in strength were evident however the brightness developments were not upto the required level. This is expected, as the dispersion process will reduce the contaminant size making it invisible but will not remove the contaminant. Thus fall in brightness is expected. The systems available were studied for bleaching with Sodium hydrosulphite, Hydrogen peroxide and the Calcium hypochlorite and the improvement were evident depending upon the type of furnishes, however, the necessity of better cleaning systems could not be ruled out.

While deciding the process flow for the new board project under erection for making light weight and normal coated duplex board, the experience of mills came handy to select the best cleaning systems before the hot dispersion. Various process circuits were studied and trial runs with mixed waste (most contaminated waste paper) were taken on the process circuits. Salient features of the trial process circuit are discussed in present paper.

PROCEDURES AND EQUIPMENT

The flow diagram of the whole process is shown in Figure-1. Which can be subdivided in different heads as given below.

Pulping

A batch pulper at 6.5% consistency was run with mixed waste. This Mixed waste as shown in

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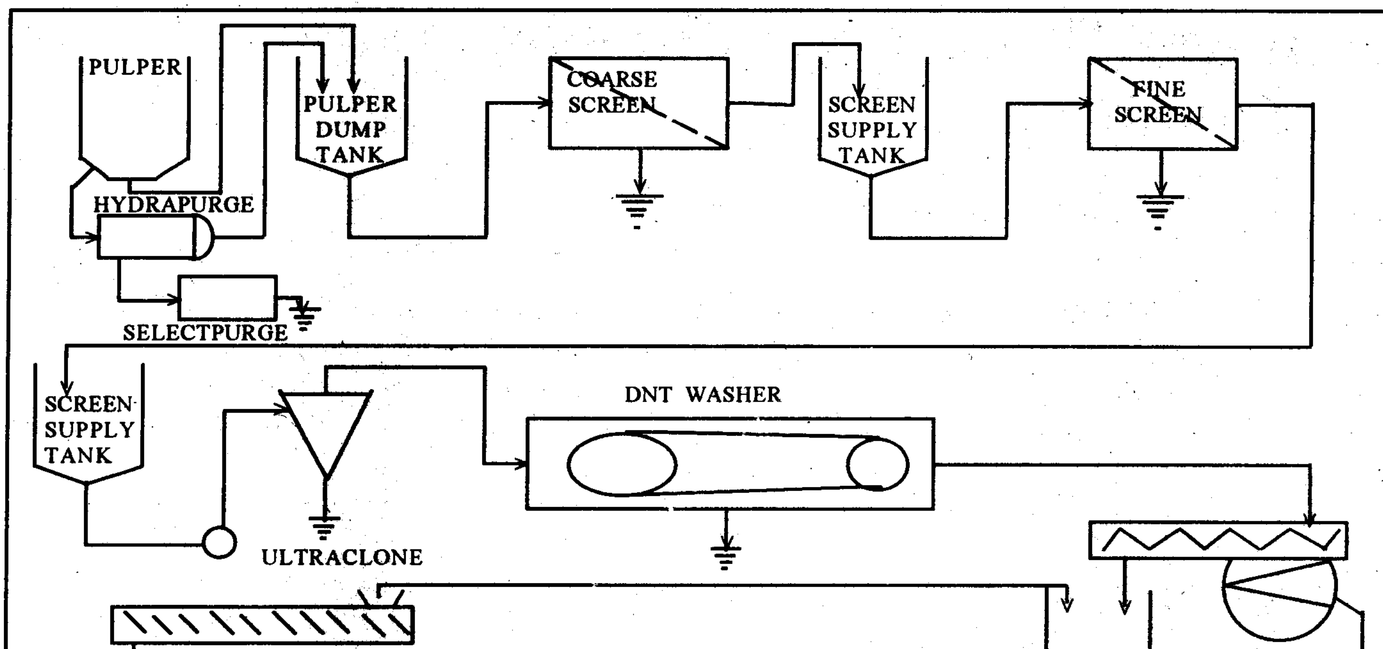


Figure-1: Flow diagram

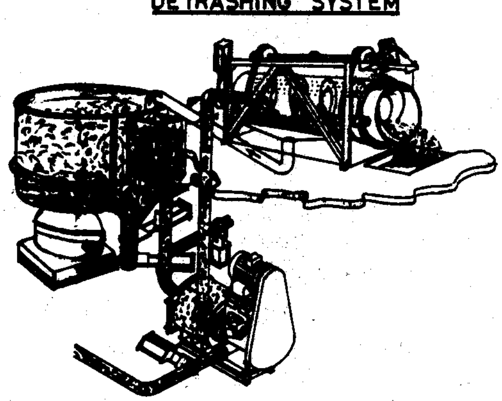
slide no. 1 contained all sorts of contaminants along with pieces of rocks and glass with following characteristics

Type	***- Mixed waste***
Moisture	***- upto 15%***
Sand/Grits	***- 0.1%***
Total out-throw	***- 10%***
Prohibitive Material	***- 2%***

The batch pulper used has vokes rotor and a trash removal system (Fig.-1). This trash removal system throws heavy contaminants centrifugally to trash removal compartment. It has the provision for intermittent removal of heavy junk by a junk separator through top.

The ratio of flows to the process and trash removal could be raised between 80 : 20 to 70 : 30. For the present study 80% of pulper material was extracted through 9.5 mm bed plate holes and remaining 20% was run through Hydrapurge and select purge units before combining with screen supply tank stock. Hydra purge is a pressurised vessel fitted with a horizontally mounted rotor, used for excellent continuous removal of contaminant from the hydrapulper tub, before they break into particle small enough to pass through the extraction plate (slide no. 2 and 3). Contaminants like plastics, styrofoam etc along with heavy debris are rejected from hydrapurge tub through a time controlled valve and passed to a selectpurge. The hydrapurge and selectpurge system are shown in fig.-2.

Fig-2 HYDRAPURGE II CONTINUOUS PULPER DETRASHING SYSTEM



- DECREASES OR ELIMINATE CLEANOUT DOWNTIME
- REMOVES PLASTIC IN LARGE PIECES, WITH LITTLE DEGRADATION
- CONTAMINATES ARE REMOVED AT OPERATING FLOOR LEVEL
- INCREASED PULPER CAPACITY
- PROTECTION AGAINST TRAMP METAL DAMAGE
- EASES BURDEN ON DOWNSTREAM EQIPMENT

Selectpurge is designed to take batches of reject material from hydrapurge and separate the water and fiber from these rejects. The rejects are conveyed by the spiral flights in the drum and are discharged from the end of the drum. This Hydrapurge Detrashing system provides following advantages.

* Decreases or eliminates clean out down time
* Removes plastic in large pieces with little degradation
* Increases pulper capacity
* Protection against tramp metal damage
* Eases burden on down stream equipment

The samples collected from Hydrapurge feed and accepts are shown in slide 4 and 5.

Screening

Coarse screening was done at 3.1% consistency in model 100 ultra v pressure screen with 2.0 mm holes and a rotor. The stock enters this screen through a tangential bottom inlet and is displaced upwards to the screening area inside the perforated screen cylinder. Light weight particles travel to the top reject outlet along with entrained air. Heavy debris is rejected in the junk box, so reduces the possibility of damage to the rotor of screen cylinder.

The screen cylinder has rolled stainless steel plate and has vertical bars welded to inner surface. These vertical bars break the tendency of stock to circulate around the cylinder in the direction of rotation foils thus a high velocity turbulence is created between the bars which keeps cylinder perforations open and offers a very high screening efficiency. The accept of coarse screen was passed through a fine screen with 0.2 mm slot and a 3 foil LP 1 rotor. Accepted material was sent to a tank while reject to sewer.

Cleaning

The pulp cleaning was accomplished using 2-6 inch Ultra Clone heavy duty Cleaners. The cleaners were fed at 37 psi and accept was collected at 17 psi. These ultra clone cleaner is a high efficiency forward centrifugal cleaner. They are very effective in running contaminants of higher specific surface area than fibers.

The tips of ultra clone cleaner are made up to ceramic thus has been wear and long life.

Thickening

The accept from cleaners was sent for thickening at a feed consistency of 0.7% at a rate of 177 GPM and a belt speed of 3450 fpm to produce thick stock at 6.7% consistency. This thick stock was sent directly to double fiber cone press where additional water was pressed out. The press ran at 1500 psi nip pressure to produce thick stock consistency of 46.5%. The DNT Washer is fed by a headbox using synthetic wire as a dewatering media. Stock is fed from headbox in to the first nip formed by a grooved breast roll and the wire resulting in high feed stock capacity and efficient washing.

The second nip is formed by wire and breast roll towards couch, which washes and thickens the consistency to 15%. A doctor blade removes the thickened stock from couch roll into a screw conveyor. The DNT washer has a high ink, clay and other contaminant removal efficiency at a high speed in a compact space.

Dispersion

The thick stock was fed to Disperser MICAR at a rate of 10 tons/day. This supply of stock was mixed with steam inside to produce a pulp temperature of 70°C, The stock was fed through the MICAR three times; the first time at 5 tons per day as a pre-heat stage followed by two runs at 70°C and at 10 ton per day throughput rate. Final accept consistency form dispersion was 36.1%.

Samples were drawn from the feed, accepts and reject material around each piece of equipment, once proper flow were obtained. These samples were used to measure consistencies, freeness, dirt count and observation hand sheets. Results of different equipments are tabulated along with data from Image analysis for dirt count.

The effect of 2 mm dia perforated Coarse screen could be analysed from following data:

Table-1

Performance of Coarse Screen

Contaminant	Feed			Accept		
Size	Count	Area (mm^2)	ppm	Count	Area (mm^2)	ppm
2->5 mm	22	81.756	1165.6	7	20.025	285.5
1-2 mm	26	38.954	555.4	26	36.149	515.4
0.4-1 mm	73	44.557	635.3	90	53.043	756.2
0.25-0.4	74	23.146	330.0	93	28.631	408.3
0.15-0.25	114	22.159	315.9	126	23.875	339.8
0.06-0.15	518	48.403	690.1	501	46.253	659.4
0.04-0.06	472	22.99	327.8	488	23.602	336.5

Coarse screen was effective in removing 75.5 large size contaminants i.e 2->5 mm. The coarse screen has caused deflocculation of dirt component evident from increase in ppm. value of feed and accept.

Table-2

Performance of Fine Screen

Contaminant	Feed			Accept		
Size	Count	Area (mm^2)	ppm	Count	Area (mm^2)	ppm
2->5 mm	7	20.025	285.5	2	4.783	68.2
1-2 mm	26	36.149	515.4	2	2.482	35.4
0.4-1 mm	90	53.043	756.2	20	11.203	159.7
0.25-0.4	93	28.631	408.3	38	11.946	170.3
0.15-0.25	126	23.875	339.8	80	15.169	216.3
0.06-0.15	501	46.253	659.4	324	28.802	410.6
0.04-0.06	488	23.602	336.5	399	19.23	274.2

The performance of fine screen with 0.2 mm slot screen was very effective as evident from Table-2. 78% of dirt removal was there for the contaminant upto 0.4 mm.

Table-3

Performance of Centricleaners

Contaminant	Feed			Accept		
Size	Count	Area (mm^2)	ppm	Count	Area (mm^2)	ppm
2->5 mm	2	4.783	68.5	0	0	0
1-2 mm	2	2.482	35.4	0	0	0
0.4-1 mm	20	11.203	159.7	0	0	0
0.25-0.4	38	11.946	170.3	8	2.466	35.2
0.15-0.25	80	15.169	216.3	15	2.469	37.7
0.06-0.15	324	28.802	410.6	96	8.562	122.1
0.04-0.06	399	19.23	274.2	135	6.581	93.8

The centricleaners were found to be effective on all the dirt sizes. The removal efficiency was 20 to 80% for different sizes of particles. The net dirt removal in terms of area was 78.3% in reducing the dirt area form 93.615 mm^2 to 20.258 mm^2.

The net effect of thickening and Hot dispersion was reduction in dirt area from 20.258 mm^2 to 5.455 mm^2 with the maximum number of particles of 0.06 to 0.04 mm^2. The 243 particles in the feed were of the size of 0.15 to 0.04 mm were reduced to only 72 particles in the out going pulp. The reduced number of contaminant particles by Hot dispersion were due to loss of these particles while increasing consistency from 4% to 30%.

Table-4

Performance of Thickener & Dispersion

Contaminant	Feed to DNT			Thick Stock From DNT			Dispresed Stock		
Size	Count	Area (MM)	ppm	Count	Area (MM)	ppm	Count	Area (MM)	ppm
0.25-0.4	8	2.466	35.2	6	2.109	30.1	1	0.312	4.4
[illegible] 0.25	15	2.469	37.7	14	2.456	35.0	4	0.704	10.1
0.06-0.15	96	8.562	122.1	82	7.191	102.5	34	2.850	40.6
0.04-0.06	135	6.581	93.8	111	5.337	76.1	33	1.589	22.7

CONCLUSION

* The system studied as shown in fig. 1 removed major fraction of dirt and debris from mixed waste producing a very clean and useable fiber (slide 5)

* Performance of Trash removal system is excellent as it removes the contaminant in large size without degradation and eleminates cleansing down time.

* There is significant reduction in dirt count between coarse screen accept and cleaner accept because of good cleaning efficiency of screens and cleaners used.

* Substantial amount of dirt is also removed as a result of floataion effect of ink particles. As the stock became dormant on the top portion of the stand pipe and feed tank ink particles floated to surface and get eliminated.

* A floatation stage in between would have further reduced the debris level.

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