Deinking, Floatation and Washing Deinking Equipments

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ABSTRACT

In order to meet the growing need of Paper and to conserve resources like material, energy, water, capital, we have to adopt ECO friendly technologies in the process of paper making. Thus the process of utilisation of waste paper has come into play which eventually led to conserve forest wealth to meet ecological balance. For the past few years technology has advanced to a greater extent to use waste paper economically to make quality papers comparable with paper made from virgin fibers.

INTRODUCTION

AMARAVATHI SRI VENKATESA PAPER MILLS (ASVPM) in Coimbatore District, Tamilnadu is the leading manufacturing company in the paper field for the past three decades.

The new concept of WASTE TO HEALTH was perceived in early 70's and continuous development was made after that. In ASVPM group all varieties of Writing and Printing, Kraft, Newsprint and Tissue papers are being manufactured. First unit of ASVPM was commissioned in the year 1965. Continuous improvement in production and quality was done after 1970. At present we are manufacturing 270 tonne per day in five manufacturing units out of 9 machines.

Since our (INDIA) per capita consumption is around 5kgs. per annum against World average of 45 kgs. Waste Paper Generation, Collection & Quality available in INDIA is very limited. Hence 5000 tonne per month of all varieties of waste paper per imported every month from **U.S. European countries, Singapore and Gulf countries.**

MILL PROFILE

Production capacity	= 24000 tonne/Annum
Number of Paper machine	= 3
Substance	= 28 - 110 GSM
Paper manufactured	= Printing, Writing & Newsprint

VIRGIN PULP PROCESS

Bagasse	10 tpd
Waste Cotton	4 tpd
Power Consumption	850-900 kWh/tonne
Water Consumption	60-70 m^3/ton
Bleaching Chemical in use	Calcium Hypo-Chlorite Hydrogen Peroxide Sodium Hydro Sulphite

CHLORINE CONSUMPTION FOR:

Waste paper	= 3 - 4%
Bagasse	= 7 - 8%
Cotton	= 8 - 10%

Since waste cotton process is highly power and water intensive, the use is limited to manifold papers only to impart wet web strength and good runnability of paper machine.

Our other raw material use is of wider range because, different quality papers are being manufactured. The cost and quality of imported and indegenous raw material are widely varying, the use and process of these raw material are manipulated to suit the quality of final product.

WASTE PAPER PROCESS

Total recycled waste paper can be classified into two categories:

1. Unprinted Waste paper

The unprinted raw materials like Hard White Shavings, Soft White Cuttings, Light and Medium colour envelopes, Note books are slushed, screened and bleached according to the final product.

Good quality raw material require only bleaching and washing whereas other raw materials

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require coarse screening, centri cleaning, fine screening etc., to remove the contaminents mixed in generation or at collection (Fig.-1)

2. Printed Waste paper

The printed raw material has to undergo extensive process which are given in the following pages (Fig. - 2)

Problem caused by stickies is the main draw back in any waste paper processing. The problem can be classified in 2 broad headlines.

(1) OPERATIONAL PROBLEM

This include all negative effect of stickies on process / productivity. Most of them takes place in paper machine.

They are:

Web Breaks in wire, press and dryer parts.

Deposits on wires, felts, dryer screens, press rolls and/dryers, blades, scrapers which results in higher down time for cleaning.

Potential sources of stickies are fragments of adhesive taps, lables wax, ink, latex, wet strength resins, other polymers etc.,

Adhesive are the most important groups, both hot melt and pressure sensitive adhesives, as well as waxes used mainly in coating.

(2) PRODUCT QUALITY PROBLEM

Alterations in product quality such as spots, holes, decrease mechanical resistance resulting poor in sizing and printing. The importance of these problems depends on final product characteristics.

In coated board stickies can cause problem in coating & printing.

In multiply board stickies in middle plies can cause discloration problem.

Stickies stuck with calender rolls cause hole formation in paper.

Stickies which are small in size stickes adjacent layer during rewinding which cause web break while printing.

In printing variety of paper sticky spots decrease product quality.

SLUSHING

Raw Materials (waste paper variety) used for Newsprint are:

News & Pamps.

Text Books & White Records.

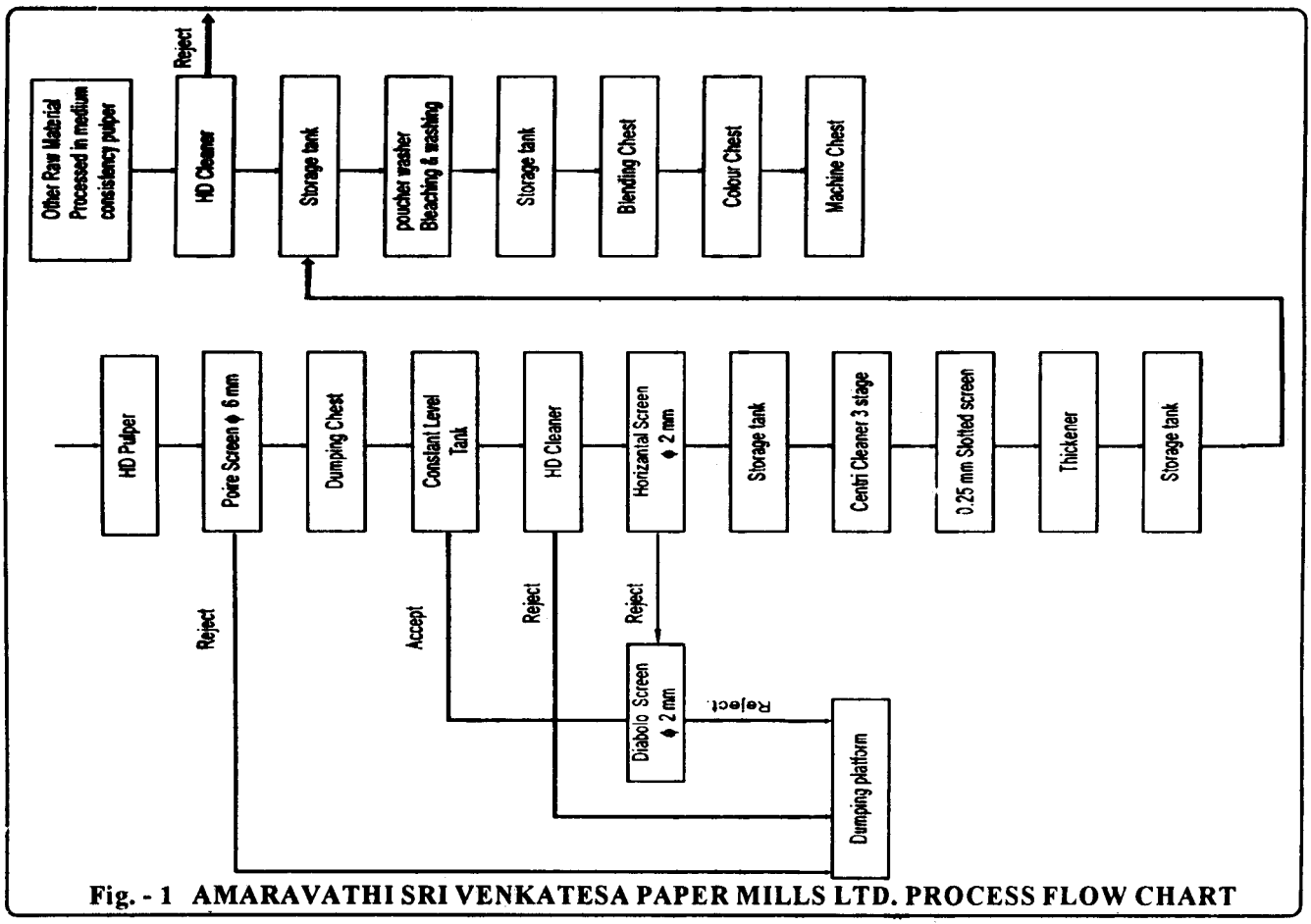

Fig. - 1 AMARAVATHI SRI VENKATESA PAPER MILLS LTD. PROCESS FLOW CHART

Imported Office Waste.
Coated Book Stock.
Over Issue Book.
ONP etc.

All the varieties of waste paper needed for the final product is slushed in the high consistency pulper. All the chemicals used for deinking process are added in the pulper itself.

Pulp Consistency	=	16%
°SR of pulp	=	22 - 24
Power consumption	=	30 - 32 kWh /tonne - (Fig. - 3)
Temperature	=	Around 50°C
Pulp Brightness of HD pulper	=	52 - 54% PV

Chemicals used and its effect on the Waste Paper are given below:

(1) Sodium Hydroxide 0.6 - 0.8% is used

The effect of Sodium Hydroxide on the pulp are:

(i) To Swell the fiber for higher activity.
(ii) Activate hydrogen peroxide.
(iii) Modifies additives & Contaminents.
(iv) Dispersing sizing and coating chemicals quickly.

(2) Hydrogen Peroxide: 0.8 - 1.10% is used

It helps for:

Bleaching the fiber

It helps brightness increase by suppressing the yellowness of alkaline action on groundwood fiber.

(3) Sodium Silicate: 1 - 1.5% is used

The main functions are:

It stabilise hydrogen peroxide
Aids in ink dispersion

(4) Surfectants: Surface Acting Agent:

Its main functions are:

It acts as a detergent.
Used of dispersion & emulsification.
Collection of ink.
Frothing.

Surfectants which are used for deinking will have 2 main components namely hydrophilic & hydrophobic elements.

During floatation hydrophobic group will associate with ink, oil and dirt & hydrophilic will remain in water.

COARSE SCREENING

After slushing pulp is transferred to a dumping chest through a coarse screen called 'POIRE' - supplied by LAMORT.

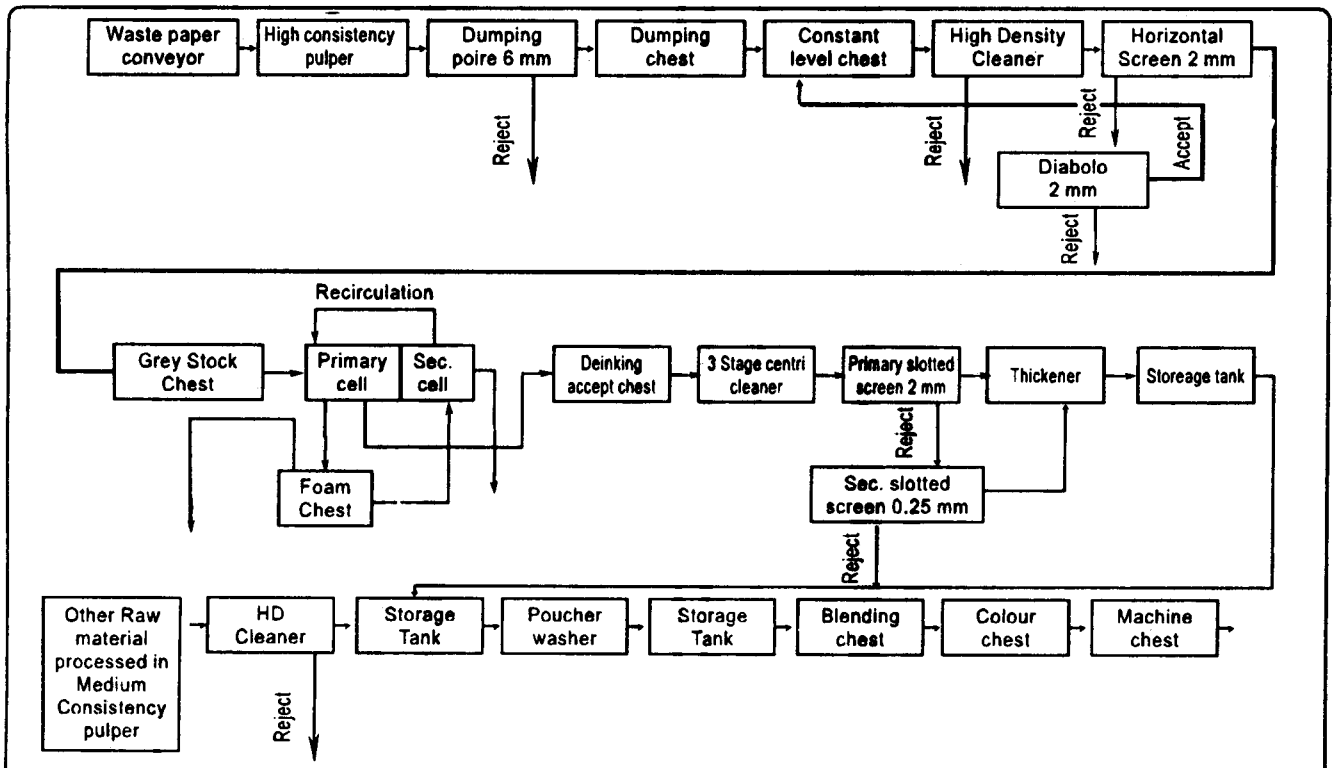

Fig. - 2 - AMARAVATHI SRI VENKATESA PAPER MILLS LTD. DEINKING PLANT : PULP LINE - FLOW CHART

Fig. 3 : DEINKING PLANT PERFORMANCE

1	Pulp Production		40 tonne /day
2	ELECTRICAL ENERGY CONSUMPTION IN EACH OPERATION		
		Kind of operation	kWh/tonne
	a)	Slushing and Preliminary Screening	31 - 32
	b)	Coarse Screening	30 - 31
	c)	Deinking Operation	74 - 75
	d)	Fine Screening	44 - 45
	e)	Thickening and Pulp Transfer	10 -11
	f)	Air Compressor	4 -5
	g)	Back Water pumps for total deinking plant	22 - 23
	h)	Bleach Washing	20 - 22
	i)	Refining	5 - 6
	j)	Paper Making	370 - 375
	k)	Utilities, Fresh Water, Steam Generation, ETP	40 - 45
		Total Electrical Energy Consumption	**650 - 670**

This is a 6 mm perforated plate screen made up of stainless steel.

Rejects removal and cleaning of the equipment is done in Auto Cycle.

TYPE OF REJECTS REMOVED ARE: (Fig. - 4)

Unslushed/ Unfibered Paper, Thermo coal, plastics & Other higher size contaminents.

COARSE SCREENING - II

Pulp from dumping chest is transferred to a constant level chest of 15m³ Volume.

From Constent level tank pulp is delivered to a high Density Cleaner at a pressure of 3 kgs./cm². Accepts from the H.D. Cleaners is directly passed to a CH3 screen. The type of rejects removed are:

a) Grits

b) Bolts, Nuts & Pins

c) Other metal pieces

The rejects are collected in a junk & removed during the cleaning cycle.

In CH3 screen perforated hole of 2.0mm dia is used. This screen primarily removes thin, flat foil - like (or) linear particles. Consistency is maintained around 3%.

Reject from CH3 screen is passed through a secondary screen called 'DIABOLO' supplied by 'LAMORT' for recovery of fiber.

The rejects from Diabolo screen is sent to waste collection system and accept is put back in the original feed.

CH3 accepts is taken to a constant level box and then to the grey stock chest. Then the pulp is subjected to deinking operation in a floatation cell.

DEINKING

The floatation cell was supplied by Larsen & Toubro of ECO design.

Deinking cell is divided into 3 main compartments namely

a) Mixing Cell

b) Primary Cell

c) Secondary Cell

In the mixing cell pulp coming from grey stock tank and fiber collected from secondary cell are mixed together.

The Primary floatation cell is divided into 6 compartments. Each compartment is fitted with a high volume, low head pumps operating at 0.9 bar. For forward transmission of stock from one compartment to the other through diffusor. Counter current flow, through the partition wall provide additional retention time resulting in higher contaminent removal. A common rejects channel is provided for collecting primary foam.

The diffusor fixed inside the cell in the discharge end of each circulation pump, delivery line sucks air and mixes as tiny bubbles with the stock to have a complete mix up of air & pulp stock.

Outlet line is provided at the 6th compartment for collecting the accepts pulp. The inlet and outlet limes are provided with LIC to control flow and recirculation rate.

The primary Cell's common overflow foam with carryover fiber are treated in the secondary cell. It is fitted with 2 compartment & 2 pumps with diffusor.

Out of the 2 pumps fitted in the secondary cell,

Fig. 4 : PERCENTAGE & NATURE OF REJECTS IN EACH STAGE			
	Area of Operation	% Rejects	Nautre of Rejct
(a)	Preliminery coarse of Screening (POIRE)	1%	Polythylene, Plastic Sheets, Thermocoal & Other Oversized debris, pins, thread etc.,
(b)	H.D. Cleaner	1%	Grits, Sand, Pins, Bolt & Nuts etc
(c)	Coarse Screening	0.8%	Cut Pieces of all the materials passed through the Poire screen holes
(d)	Deinking	1-1.5%	Fibre, Filler & Pigment, Printing inks. BOD : 200 - 225 ppm.; COD : 4000 - 5000 ppm. Ash : 50%
(e)	Fine Screening	1%	Small Plastic Pieces, Fine Sand, unslushed materials etc.
(f)	Paper Machine Centri Cleaner	1%	Fine Sand, Fillers & Other contaminents

one pump is meant for recirculating the collected fiber and foam back to the mixing cell. Overflow from the secondary cell is into the drain in the form of foam.

Characteristic of rejects - foam

Volume of foam Collected	= 40-50 m^3 /day
Ash	= 50 - 60%
BOD	= 200 - 220 ppm
COD	= 4000-5000 ppm

DIFFUSOR

The diffusor consists of a nozzle plate with opening for air suction, a step diffusor block, an impact mixer & a distribution diffusor.

In the nozzle plate stock is subjected to high accelaration which leads to self suction of air into the stock.

The orifice (or) nozzle diameter is optimised to provide efficient forced mixing of air and stock. The aeration injector are kept inside the eliptical cell in such a manner that the raising ink bubbles travel a short distance low stock velocity at the end of the diffusor eliminates the possiblilities of bubbles collapse.

Bubbles collected at the top of the secondary cell is wiped - off and mixed in the stream.

Cell levels are monitered in such a way that fibre loss should be as minimum as possible & ink removal should be at the maximum.

CLEANING AND FINE SCREENING

After deinking the pulp is cleaned in the 3 stage centricleaner system. Accepts of primary centricleaner is taken to a 0.2 mm slot screen. The main advantage of using centri cleaners before fine screening is specific heavy contaminents are removed by centrifugal force. This protects the fine screen from wear & damage. The slotted screen is able to eliminate cubical, round & three dimensional parts more successfully.

Accepts of the primary slotted screen is thickened & dumped in the storage tower. The fiber rejected from primary slotted screen is recovered in the secondary screen of 0.25 mm slot. The reject of secondary screen is rejected to common drain to ETP.

The rotor design of the slotted screen is also a variable. The rotor body is designed in different ways either as a closed drum rotor or as an opening ring rotor. The rotor design has a considerable effect on the screening. Regardless of the varying design they must achieve the same objective. Turbulance must be produced i.e. Pulsaton of varying strength. The rotor element produces a shockwave which feeds the screen basket. The rotor element than produces a vacuum which cleans the screen basket (i.e.) if a fiber mat has been formed, it is removed from the screen basket and the opening cleaned.

This prevents blinding over and plugging of the screen basket. The most important influencing factors are the form of the rotor element (Closed drum or Opening rotor), the peripheral speed of the rotor and the space between rotor and screen basket.

To achieve optimum results in stickies removal,

Fig. 5 : PROPERTIES OF ASVPM NEWSPRINT				
S. No.	Particulars	Units	ISI Norms No: II.658/86	ASVPM Newsprint
1	Substance	g./m²	48 - 52	48 + 1
2	Ash	%	-	5 - 6
3	Thickness	microns	80 + 4%	70 - 75
4	Bulk	Cc /gm	-	1.5 - 1.55
5.	Breaking Length MD CD	metre	Min. 3000	3800 - 4200 1800 - 2100
6	Tear Factor MD CD	- -	Min. 45	45 65
7	Burst Index	k.Pam²/g	-	1.3 - 1.4
8.	Smoothness	ml/min.	Max. 300	200 - 250
9	Porasity	ml/min.	Max. 800	500 - 600
10	Brightness - ISO	%	Min. 49	58 - 60
11	Opacity - ISO	%	Min. 90	90 - 91

Fig. 6 : PRODUCTION, POWER & WATER CONSUMPTION IN THE LAST DECADE			
YEAR	PRODUCTION tonnes	POWER CONSUMPTION kWh/tonne	WATER CONSUMPTION m³/tonne
1991 - 92	15, 028	1290	78.6
1993 - 94	17,476	1110	07.7
1995 - 96	20,271	1081	97.6
1997-99	21,379	1058	87.9
1999-00	23,667	986	75.7
2000-01	24,504	916	75.0

the screen basket passing velocity should ideally be 1-2 m/sec. at 1% consistency and rotor peripheral speed should be 10-20 m/sec.

CONCLUSION

As discussed above we can very well produce papers like Printing, Writing and News Print grades comparable to virgin grades by adoption of good screening and deinking systems. The optical properties of paper like invisibility of specks, dots etc may further be improved by using dispersion to make it homogenous.

With the use of recycling of waste paper by rigorous screening, deinking and dispersing we can derive the following benefits in the present industrial scenario.

1. It substitutes forest based raw material requirement (Viz. Wood, Bamboo).
2. The equipment requires less capital investment compared to large integrated mills.
3. It uses less energy, water etc.,
4. Load on ETP system is less and ETP treatment are less expensive.
5. The strength and printing characters are in no way inferior to virgin pulp papers and some of the characters like opacity, bulk are even better. (Fig. 5).

During the past decade ASVPM has achieved a considerable reduction in energy, water utilisation etc by adopting these process to make quality papers Fig. - 6)

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REFERENCE :

IPPTA - DECEMBER 1998:

Paper recycling by M.A BLANCO, C. NEGROL, J. TIJERO

IPPTA - DECEMBER 1999:

Paperex - 99 - 4th international conference on pulp & paper Industry.