

TECHNOLOGICAL ADVANCEMENT IN BULK AND STIFFNESS IMPROVEMENT FOR DUPLEX BOARD MAKING INDUSTRIES IN INDIA



M.Vadivel



S.Sathiakeerthi



K.Rajaiah

Abstract :

Increasing demand for packaging grades of paper continues to grow in double digit in recent years and this segment holds bright future. Due to the shortage of paper making raw materials the usage of agro, recycled and other raw materials are inevitable. All over the world for duplex board making mills by using a recycled waste paper have a bright future due to heavy demand raised by on line shopping. The demand for writing and printing paper is either flat or its growth is misagre due to digital life style. In duplex board all customers needs stiffness and bulk rather than coating related properties such as gloss, brightness. To achieve better stiffness and bulk in the duplex board, the mill might expand its operational issues from raw material feeding to finishing. The use of recycled paper like ONP, corrugated, coated boards severely affect the drainage and other functional properties of board. In this case studies the plant trials were taken in a board making mill having a cylinder mould operation, with various furnishes and alter the process parameters to get improved board stiffness and bulk with respect to customer's feedback.

Key words: Old News Paper, Tamil ONP, Indian Mixed waste, Kraft, Magazines Notebooks, white record, retention, Drainage.

1.1.0 INTRODUCTION

The primary functions of board making process is the processing of waste paper to clean stock of paper making involves number of cleaning to remove contaminants such as plastic bottles , plastic covers, iron clips, latex , wax , inks , etc. Also one of the major technological issues are presence of high level of contaminants in imported waste paper, which requires appropriate process configuration with state-of-art process technologies to produce clean stock.

The raw materials are transported from the waste paper end to mill by lorry or mini vehicle. It is unloaded manually. Each and every gunny bags were opened and inspected by lab person and unloaded in a specific area to avoid the random dumping. Many mills have a good flooring area for top layer as well as bottom, filler layer. Especially for top layer the sorting was carried out very carefully to avoid process contaminations. Some mills in India have a deinking system which

allows some low grade raw materials into the system. The mill does not have the deinking system only should allow

the high bright raw material for top layer. High cost top layer material which is used for board making is given in table No: 1.

Table No: 1, Top Layer Raw materials

Sl No	Top Layer Raw materials
1	Coated Book stock – Imported
2	Sorted Office waste - Imported
3	Printed Office Cut – POC
4	Note Books
5	No : 1 White cuttings
6	Printed Bleached pulp - Imported
7	White Record
8	White Book , cheque book , legder



Fig No: 1, Imported Waste Paper

Low cost filler and bottom layer material which are used for board making is given in table

Table No: 2, Filler and Bottom Layer Raw materials

SI No	Filler and Bottom Layer Raw materials
1	Box Board cuttings – Imported
2	Old News Paper (ONP), Tamil , English , Malayalam
3	Unsorted SOP –Imported
4	Newsprint – Imported
5	Indian Mixed waste
6	Box kraft
7	Duplex board cuttings
8	Mill broke
9	Cheque Book , Ledgers

Filler Layer Raw material



Bottom Layer Raw material



Fig No: 2, Filler and Bottom Layer Raw materials

Table: 3, The customer complaints details for the year April 2016 to March 2017

2017 SI No	Nature of the complaints	CUSTOMER'S CODE									
		A	B	C	D	E	F	G	H	I	J
1	Blanket Damage	7	2	0	4	0	2	0	0	0	0
2	Blade lines	0	0	1	0	0	0	0	0	0	0
3	Board Bend	2	0	7	0	0	0	0	0	0	0
4	Bundle Shortage	0	1	0	0	0	1	0	0	0	0
5	Board smell	0	0	0	0	0	0	0	0	0	0
6	Cut sheets in reels / Bundles	0	0	0	2	0	0	0	0	0	0
7	Cross Cutting	0	0	0	0	0	0	0	0	0	0
8	Creasing	0	3	1	6	0	2	0	0	0	0
9	Counting variation	0	0	0	2	0	0	0	0	0	0
10	Dots After Lamintaion	0	0	0	2	0	0	0	0	0	0
11	Feeding Problem	0	0	0	4	0	0	0	0	0	0
12	Gsm Variation	9	6	5	3	0	0	0	1	0	0
13	High Cobb	0	1	0	0	0	0	0	0	0	0
14	Lumps	1	0	3	0	0	0	0	0	0	0
15	Low Gsm Mixup	0	0	2	2	0	0	0	0	0	0
16	Moisture	1	0	1	1	0	0	0	0	0	1
17	More Specks	0	2	0	0	0	1	1	0	0	0
18	Poor coating	2	14	5	8	1	0	0	0	0	0
19	Poor Bulk & Stiffness	0	4	0	20	0	0	2	0	1	0
20	Printing Problem	0	0	0	5	0	0	0	0	0	0
21	Pasting Problem	0	0	0	0	0	0	0	0	0	0
22	Roughness	0	1	0	1	0	0	0	0	0	0
23	Rough cutting	0	0	0	1	0	0	0	0	0	0
24	Size Variation	2	0	0	3	0	1	0	0	0	0
25	Shade variation	0	0	0	1	0	0	0	0	0	0
26	Speck & Block dots	0	1	0	2	0	0	0	0	0	0
27	Top layer peel off	0	2	0	12	0	2	3	0	0	0
28	Top curling	0	0	0	0	0	0	0	0	0	0
29	Uncoated mix up	1	0	0	4	0	0	0	0	0	1
30	Weight Shortage	0	0	0	2	0	0	0	0	0	0
31	Wrinkles	0	1	1	7	0	0	0	0	1	0
32	Waviness	7	0	6	10	0	0	0	0	0	0

1.1.1 CUSTOMER COMPLAINTS REVIEW

The customer complaints report from 20 customers were reviewed by the technical team in laboratory and discussed with the process team. The parameters which had been maintained during that complaint period were seriously analyzed and divided as like, Fig no:3 .The customer complaint details for the year 2016 April to 2017 March is given in Table : 3 ,Table : 4 .

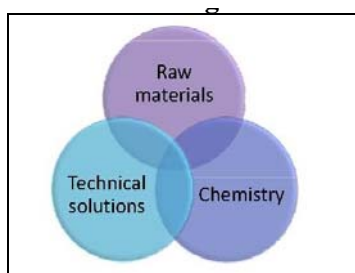


Fig No: 3, Tools for solving customer complaints

Table: 4, The customer complaints details for the year April 2016 to March 2017

SI No	Nature of the complaints	CUSTOMER'S CODE									
		K	L	M	N	O	P	Q	R	S	T
1	Blanket Damage	0	0	0	0	0	0	1	0	0	1
2	Blade lines	0	0	0	0	0	0	0	0	0	0
3	Board Bend	0	0	0	0	0	0	0	0	0	0
4	Bundle Shortage	0	0	0	0	0	0	0	0	0	0
5	Board smell	0	0	0	0	0	0	0	0	0	0
6	Cut sheets in reels / Bundles	0	0	0	0	0	1	1	0	0	0
7	Cross Cutting	0	0	0	0	1	0	0	0	0	0
8	Creasing	0	0	0	0	0	0	4	0	0	0
9	Counting variation	0	0	0	0	0	0	0	0	0	0
10	Dots After Lamintaion	0	0	0	0	0	0	0	0	0	0
11	Feeding Problem	0	0	0	0	0	0	0	0	0	0
12	Gsm Variation	0	0	0	0	0	0	0	0	0	1
13	High Cobb	0	0	0	0	0	0	0	0	0	0
14	Lumps	0	0	0	0	0	0	0	0	0	0
15	Low Gsm Mixup	0	0	0	0	0	0	0	0	0	0
16	Moisture	0	0	0	0	0	0	0	0	0	0
17	More Specks	0	0	0	0	0	1	2	0	0	1
18	Poor coating	1	0	0	0	0	2	0	0	0	0
19	Poor Bulk & Stiffness	1	0	2	0	0	0	0	0	0	0
20	Printing Problem	0	0	0	0	0	0	0	0	0	0
21	Pasting Problem	0	0	0	0	0	0	1	0	0	0
22	Roughness	0	0	0	0	0	0	0	0	0	0
23	Rough cutting	0	0	0	0	0	0	0	0	0	0
24	Size Variation	0	0	0	0	0	0	0	0	0	0
25	Shade variation	0	0	2	0	0	0	0	0	0	1
26	Speck & Block dots	0	0	0	0	0	0	0	0	1	0
27	Top layer peel off	0	0	0	0	0	0	0	0	0	0
28	Top curling	0	0	0	0	0	0	1	0	0	1
29	Uncoated mix up	0	0	1	0	0	0	0	1	0	0
30	Weight Shortage	0	0	0	1	0	0	0	0	0	0
31	Wrinkles	0	0	0	0	0	0	2	0	1	1
32	Waviness	0	0	0	1	0	2	2	0	0	0

From the above tables, the complaints were separated as major complaints and minor complaints. All the complaints were raised by the customer has been visited by the technical team and the defective sheets / reams were found as very low in quantity ie gsm variation, in 10 MT of materials 300 gsm duplex board only 1 ream (144sheets) was found in the range of 285 to 300 . It was concluded that the ream is to be segregated while finishing even though the roll

card marked as gsm variation while quality change, mistaken by finishers. The major complaints were tabulated and given in Table no: 5

The coating related complaints were studied and eliminated by modifying the coating additives and its parts. Gsm variation complaints were inspected and found within the range of + 3.0%. Waviness complaints were not found in the Sivakasi and Madras regions due to its humidity nature. The board used in cold regions causes waviness due to improper storing and conditioning of board before using. Many printers store the board in an open area. Packing methods were modified as per the customer recommendations.

It was found that even though, poor coverage, gsm variation, slight waviness, all customers said that the stiffness and bulk is to be maintained as high as possible to get trouble free printing operation and uniform packaging. Uneven bulk cause packaging issue and low stiffness board yields bend during stacking and handling , which gives adverse effect during transportation.

1.1.2. Laboratory sheet forming vs. paper machine

Laboratory sheet formers will give isotropic sheets while paper made on a paper machine, the fibers align themselves in the machine direction and this paper will be anisotropic. There is also a difference in formation between machine made paper and laboratory sheets (handsheets). In the laboratory sheets the fibres will be evenly distributed and the formation will be almost ideal. On the paper machine, the fibres will catch on to each other and this leads to flocculation. Due to the fact that formation affects the strength properties of the paper, it can be misleading to give judgment on paper strength based on laboratory sheets.

Laboratory sheets of softwood fibers will be much flocculate higher compared to laboratory sheets made from hardwood. But the tendency of softwood fibers to flocculate on the machine will decrease the differences in strength between hardwood and softwood. The closed system on a paper machine will give a good retention of fines, compared to an open system as in the laboratory, where the fines are lost to a certain degree.

In a paper machine the pressing section differs a lot from the one used in the laboratory. The laboratory

Table no: 5 Major customer complaints for the year April 2016 to March 2017

SI No	Nature of the complaints	CUSTOMER'S CODE									
		A	B	C	D	E	K	P	Q	S	Total
1	Coating related	2	14	5	8	1	1	2	0	0	33
2	Gsm Variation	9	6	5	3	1	0	2	1	0	27
3	Poor Bulk & stiffness	0	4	0	20	0	1	0	0	0	25
4	Waviness	7	0	6	10	0	0	0	1	0	24

wet pressing is accomplished by pressing the sheets in a flat plate pressing machine in one or two quite long steps. In a paper machine the press section consists of two to three sets of pressing rolls which will press the paper web for only a short time each but at much higher load.

The development of the drying stress, in fully restrained drying, depends on the drying process itself. If the temperature is high or the rate is low, drying stress becomes low. If the stress is varied during the drying process, as on a paper machine, the final properties of the paper depend on the increasing drying stress vs. solid content. Stresses applied in the beginning of the drying process, before 60 % dryness, have the largest effect on the elastic modulus. Because of the fact that hand sheets are dried slower compared to machine-made paper, the properties will be different between the two kinds of paper (1, 2). Laboratory hand sheet provides only guidance about the strength of the furnish / ratio of pulp.

1.1.3. PLANT TRIAL

With the existing raw material and operating conditions plant trials were taken in a Cylinder mould machine. The trial conditions like furnish ratio, machine speed, gsm and other operation parameters was considered / optimized to conclude the effectiveness of this trial programme. Fig no: 4 give the dimensions of paper making components. Existing furnish is 30 % Note books , 70 % White records for top layer

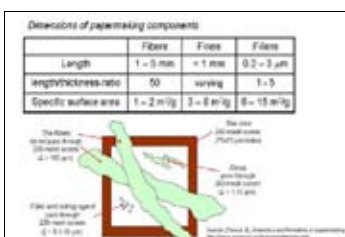


Fig No: 4, Dimensions of paper making components

deinked system , 50 % Indian mixed waste , 30 % Mixed ONP , 20 % Kraft for filler layer and 50% mixed ONP, 35% Indian mixed waste, 15 % broke.

1.1.4. RESULTS AND DISCUSSION

Initially the back water conductivity of the system was measured as 15000- 20000 μS/ cm. Bulk and % ash of various filler and bottom materials were analyzed and tabulated as given below in Table no : 6 and Table no : 7.

Table No: 6, % Ash content of Tamil ONP and Tamil Magazines

SI No	Name of the Raw materials	Caliper μ	gsm	Bulk	% Ash	Age of the material
1	Tamil ONP A	68	52	1.30	9.8	50 days
2	Tamil ONP B	64	49	1.31	8.1	65 days
3	Tamil ONP C	68	52	1.31	7.8	65 days
4	Tamil ONP D	69	52	1.33	6.9	75 days
5	Tamil ONP E	60	44	1.36	5.8	43 days
6	Tamil ONP E	62	46	1.34	5.4	45 days
Tamil Magazines						
1	Tamil Magazines A	71	52	1.36	8.5	65 days
2	Tamil Magazines B (coated)	57	46	1.24	14.5	120 days
3	Tamil Magazines C	76	59	1.28	11.2	75 days
4	Tamil Magazines D	72	54	1.33	10.1	66 days
5	Tamil Question paper E	76	55	1.38	5.4	25 days
6	Tamil Magazines F	64	52	1.23	14.6	135 days
7	Tamil Magazines G	66	54	1.22	14.1	120days

Table No: 7, % Ash content of Malayalam ONP and Malayalam Magazines

SI No	Name of the Raw materials	Caliper μ	gsm	Bulk	% Ash	Age of the material
1	Malayalam ONP A	61	43	1.42	5.6	50 days
2	Malayalam ONP B	62	44	1.41	5.2	65 days
3	Malayalam ONP C	64	45	1.42	5.5	65 days
4	Malayalam ONP D	60	44	1.36	5.1	75 days
5	Malayalam ONP E	61	42	1.45	5.3	43 days
6	Malayalam ONP F	60	42	1.43	5.5	45 days
Tamil Magazines						
1	Malayalam Magazines A	82	72	0.88	23.0	65 days
2	Malayalam Magazines B	80	71	1.13	20.5	120 days
3	Malayalam Magazines C	78	68	1.15	19.6	75 days
4	Malayalam Magazines D	79	69	1.14	19.8	66 days
5	Malayalam Magazines E	80	70	1.14	20.1	25 days
6	Malayalam Magazines F	78	67	1.16	18.6	135 days
7	Malayalam Magazines G	79	68	1.16	18.8	120days

Table No: 8, % Ash content of English ONP and English Magazines

SI No	Name of the Raw materials	Caliper μ	gsm	Bulk	% Ash	Age of the material
1	English ONP A	68	44	1.54	6.4	50 days
2	English ONP B	67	45	1.49	6.2	65 days
3	English ONP C	69	46	1.50	6.4	65 days
4	English ONP D	68	44	1.54	5.8	75 days
5	English ONP E	66	43	1.53	5.4	43 days
6	English ONP F	69	45	1.53	5.5	45 days
English Magazines						
1	English Magazines A	85	71	1.19	22.0	65 days
2	English Magazines B	82	68	1.21	16.8	120 days
3	English Magazines C	80	69	1.16	18.6	75 days
4	English Magazines D	78	67	1.16	19.2	66 days
5	English Magazines E	79	69	1.14	18.2	25 days
6	English Magazines F	80	70	1.14	18.6	135 days
7	English Magazines G	78	68	1.17	18.0	120days

Table no: 6, 7, 8 shows the bulk and % ash content of Tamil, Malayalam and English ONP, magazines. Due to deinking plant, the raw material has been selected to reduce ETP load and deinking process cost. The result has been reviewed and the plant trial had been taken out. Its results were tabulated below.

Table No: 9, Stiffness and Bulk testing report Feb 2017

Stiffness & Bulk Testing Report Feb – 2017, coat weight 16-18 gm									
Process control Parameters : Average draw maintained : 6.0 t/hr									
Date	Avg Gsm	Caliper μ	Bulk cc/gm	Stiffness MD/CD Taber	I Press load Kg/cm ² F/S&B/S	II Press load Kg/cm ² F/S&B/S	III Press load Kg/cm ² F/S&B/S	Hard nip calender –nip counts	Furnish details
01.02.17	250	305	1.22	80/35	10	20	28	3	Top layer
02.02.17	250	308	1.23	75/30	12	18	24	3	30% White record 70% Note Book
03.02.17	400	492	1.23	240/100	8	22	25	2	
04.02.17	320	387	1.21	125/55	11	20	26	2	
05.02.17	300	363	1.21	110/40	11	15	18	2	
06.02.17	300	369	1.23	110/40	12	18	22	3	
07.02.17	250	310	1.24	75/35	13	17	19	3	
08.02.17	260	315	1.21	80/40	13	18	20	2	
09.02.17	285	351	1.23	105/45	15	20	24	2	
10.02.17	300	366	1.22	105/45	12	19	22	3	
11.02.17	320	394	1.23	130/60	12	20	27	2	
12.02.17	265	326	1.23	80/45	11	18	21	3	50% Indian mixed waste
13.02.17	285	353	1.24	100/45	12	20	22	2	
14.02.17	320	384	1.20	130/55	14	19	23	3	30% Mixed ONP
15.02.17	260	315	1.21	80/35	12	18	21	2	20% kraft
16.02.17	300	369	1.23	110/45	14	20	24	2	Bottom layer
17.02.17	350	427	1.22	145/65	12	22	26	2	
18.02.17	320	394	1.23	125/55	13	20	25	2	35% Indian mixed waste
19.02.17	310	378	1.22	115/50	12	19	22	3	
20.02.17	300	369	1.23	110/55	13	19	22	3	
21.02.17	320	390	1.22	125/55	14	21	24	3	
22.02.17	300	360	1.20	115/55	14	20	24	2	50% mixed ONP'
23.02.17	320	387	1.21	130/50	12	21	24	2	
24.02.17	300	366	1.22	110/50	13	20	23	2	15% kraft
25.02.17	250	307	1.23	75/35	12	16	18	3	
26.02.17	300	363	1.21	110/45	11	20	25	3	
27.02.17	310	381	1.23	120/55	11	19	23	2	

During this month the bulk and stiffness was found as low as to the existing norms. Various factors had been taken into accounts to get better bulk & stiffness. First the furnish ratio was found not suitable for the cylinder mould operation. Second thing was found that the press load variation and frequent changes had been done by press crew due to improper shower cleaning and its total solids (200- 450 ppm). Both these parameters are kept under controlled conditions. Finally the furnish ratio was fixed in the month of March 17.

Table No:9, Stiffness and Bulk testing report March - 2017

Stiffness & Bulk Analysis March – 2017, coat weight 16-18 gm									
Process control Parameters : Average draw maintained : 6.0 t/hr									
Date	Avg Gsm	Avg Caliper μ	Avg Bulk cc/gm	Stiffness MD/CD Taber	I Press load Kg/cm ²	II Press load Kg/cm ²	III Press load Kg/cm ²	Hard nip calender –nip counts	Furnish details
01.03.17	250	325	1.30	85/40	10	18	26	3	Top layer
02.03.17	250	328	1.31	85/40	11	16	21	3	50% White record 50% Note book
03.03.17	400	528	1.32	250/105	8	18	20	3	
04.03.17	320	422	1.32	135/65	10	18	22	3	
05.03.17	300	390	1.30	120/50	10	14	16	3	
06.03.17	300	396	1.32	120/50	11	16	18	3	
07.03.17	250	333	1.33	80/40	12	14	18	3	
08.03.17	260	341	1.31	90/45	11	16	19	3	
09.03.17	285	376	1.32	115/55	12	18	22	3	
10.03.17	300	396	1.32	115/55	11	16	20	3	
11.03.17	320	419	1.31	140/70	10	18	25	3	
12.03.17	265	350	1.32	85/55	10	16	19	3	
13.03.17	285	376	1.32	105/55	11	18	20	3	45% Tamil ONP
14.03.17	320	422	1.32	140/65	12	16	19	3	
15.03.17	260	341	1.31	85/45	10	16	19	3	10% kraft
16.03.17	300	396	1.32	120/55	12	18	21	3	
17.03.17	350	459	1.31	155/75	11	18	21	3	Bottom layer
18.03.17	320	416	1.30	135/65	12	16	21	3	50% Malayalam ONP 50% Tamil ONP
19.03.17	310	403	1.30	125/55	11	16	20	3	
20.03.17	300	393	1.31	120/65	12	18	21	3	
21.03.17	320	416	1.30	135/65	12	18	21	3	
22.03.17	300	393	1.31	125/65	11	17	19	3	
23.03.17	320	422	1.32	140/55	11	18	21	3	
24.03.17	300	396	1.32	120/60	12	16	21	3	
25.03.17	250	328	1.31	85/45	11	14	15	3	
26.03.17	300	390	1.30	120/55	10	16	20	3	
27.03.17	310	406	1.31	130/60	10	15	21	3	
28.03.17	350	462	1.32	150/70	11	20	22	3	
29.03.17	310	406	1.31	130/65	12	21	22	3	
30.03.17	300	390	1.30	125/60	12	20	22	3	

During the March -17, month the bulk and stiffness was improved to the existing norms. Hard nip calender has been run under ideal load with 3nips constantly. Table no: 10 shows the better result interms of bulk and stiffness.

Table No:10, Stiffness and Bulk testing report April - 2017

Stiffness & Bulk Analysis April – 2017, coat weight 16-18 gm									
Process control Parameters : Average draw maintained : 6.0 t/hr									Furnish details
Date	Avg Gsm	Avg Caliper μ	Avg Bulk cc/gm	Stiffness MD/CD Taber	I Press load Kg/cm ²	II Press load Kg/cm ²	III Press load Kg/cm ²	Hard nip calender – nip counts	
01.04.17	250	325	1.30	85/40	10	18	26	3	Top layer
02.04.17	250	328	1.31	85/40	11	16	21	3	50% White record 50% Note book
03.04.17	400	528	1.32	250/105	8	18	20	3	
04.04.17	320	422	1.32	135/65	10	18	22	3	
05.04.17	300	390	1.30	120/50	10	14	16	3	
06.04.17	300	396	1.32	120/50	11	16	18	3	
07.04.17	250	333	1.33	80/40	12	14	18	3	
08.04.17	260	341	1.31	90/45	11	16	19	3	
09.04.17	285	376	1.32	115/55	12	18	22	3	
10.04.17	300	396	1.32	115/55	11	16	20	3	60% Indian mixed waste
11.04.17	320	419	1.31	140/70	10	18	25	3	
12.04.17	265	350	1.32	85/55	10	16	19	3	30% Tamil ONP
13.04.17	285	376	1.32	105/55	11	18	20	3	
14.04.17	320	422	1.32	140/65	12	16	19	3	10% kraft
15.04.17	260	341	1.31	85/45	10	16	19	3	
16.04.17	300	396	1.32	120/55	12	18	21	3	Bottom layer
17.04.17	350	459	1.31	155/75	11	18	21	3	
18.04.17	320	416	1.30	135/65	12	16	21	3	40%Malayalam ONP 60% Tamil ONP
19.04.17	310	403	1.30	125/55	11	16	20	3	
20.04.17	300	393	1.31	120/65	12	18	21	3	
21.04.17	320	416	1.30	135/65	12	18	21	3	
22.04.17	300	393	1.31	125/65	11	17	19	3	
23.04.17	320	422	1.32	140/55	11	18	21	3	
24.04.17	300	396	1.32	120/60	12	16	21	3	
25.04.17	250	328	1.31	85/45	11	14	15	3	
26.04.17	300	390	1.30	120/55	10	16	20	3	
27.04.17	310	406	1.31	130/60	10	15	21	3	
28.04.17	350	462	1.32	150/70	11	20	22	3	

During the month of April - 17, Press loads and hard nip calender nips were kept with very negligible load variation which is nearly equal to constant. In filler layer high cost Tamil ONP ratio was reduced and low cost Indian mixed ratio increased. Kraft percentage was kept as 10% . No bulk and stiffness variation was found. Good rattling sound was found in this furnish combinations. 10-15% furnish variation does not affect the bulk and stiffness value. Again plant trial was continued to the bulk 1.35 + and 15-20 % stiffness and these were tabulated in Table no: 11, as given below.

Table No: 10, Stiffness and Bulk testing report May – 2017

Stiffness & Bulk Analysis May – 2017 , coat weight 16-18 gm									
Process control Parameters : Average draw maintained : 6.0 t/hr									Furnish details
Date	Avg Gsm	Avg Caliper μ	Avg Bulk cc/gm	Stiffness MD/CD Taber	I Press load Kg/cm ²	II Press load Kg/cm ²	III Press load Kg/cm ²	Hard nip calender – nip counts	
01.05.17	200	270	1.35	75/35	5	10	12	3	Top layer
02.05.17	230	308	1.34	85/55	6	11	13	3	50% white record 50% Note book
03.05.17	250	338	1.35	100/50	6	12	14	3	Filler layer
04.05.17	300	405	1.35	138/70	8	12	16	3	
05.05.17	320	426	1.33	155/ 75	9	11	14	3	30% Indian mixed waste 50% Tamil ONP 10% kraft
06.05.17	350	473	1.35	180/90	10	14	16	3	10% mill broke
07.05.17	380	513	1.35	220/110	12	12	15	3	Bottom layer 70%Malayalam ONP 30% Tamil ONP
08.05.17	400	536	1.34	248/124	10	14	16	3	
09.05.17	450	603	1.34	300/150	14	16	19	3	

During the month of May - 17, Press loads and hard nip calender nips were kept with very negligible load variation which is nearly equal to constant. In filler layer high cost Tamil ONP ratio was reduced and mill broke introduced .kraft percentage was kept as 10% .In bottom layer Indian mixed waste, mixed ONP and

kraft was eliminated. To get better bulk and stiffness in bottom layer 70% Malayalam ONP and 30 Tamil ONP was introduced. No drainage problem was faced. Only problem that was faced during this trial the PAC consumption was increased from 20 kg / ton of board to 30 kg due to system conductivity (high anionic traces from ink particles) that was managed by anionic retention aid dosing rate as 250 -300 gm / t of board .The percentage of stiffness improvement is given below , Table no :11

Table No: 11 , Percentage of Stiffness Improvement

Percentage of Stiffness improvements & Bulk									
Process control Parameters : Average draw maintained : 6.0 t/hr									Furnish details
Date	Avg Gsm	Avg Bulk cc/gm	Norms Bulk cc/gm	Stiffness MD/CD Taber	Norms	% Increase	Rattling sound	Hard nip	
01.05.17	200	1.35	Min 1.25	78 / 35	65/30	15.0	Customer satisfied & High sound producing board	3	Top layer 50% white record 50% Note book
02.05.17	230	1.34		87 / 41	75/35	16.0		3	
03.05.17	250	1.35		100 / 48	85/40	16.0		3	Filler layer 30% Indian mixed waste 50% Tamil ONP 10% kraft 10% mill broke
04.05.17	300	1.35		139 / 70	120/60	17.0		3	
05.05.17	320	1.33		159 / 76	135/65	17.5		3	
06.05.17	350	1.35		178 / 90	150/75	18.7		3	Bottom layer 70%Malayalam ONP 30% Tamil ONP
07.05.17	380	1.35		228 / 128	195/95	16.9		3	
08.05.17	400	1.34		252 / 126	210/105	20.0		3	
09.05.17	450	1.34		300 / 150	250/125	19.2		3	

From the above table it was found that the stiffness value touches the 15 – 20 % high and improved bulk. The bursting strength / factor also improved from 4.5 BS to 6.0 and Bursting strength from 16 to 19.

1.1.5. HORNIFICATION

Hornification is the term used to describe the irreversible changes that a fiber undergoes as it is dried and rewet. Hornification is the permanent loss of swellability in cellulose fibers, leading to a loss of fiber flexibility (3). For board making base paper porosity (4) which is mainly depending up on the furnish and it is critical parameter which causes the poor coverage on coated surface .In recycling mechanical fibers are not prone to hornification. To some extent, they even gain in flexibility probably due to internal fibrillation caused by repeated drying and calendaring.

The apparent density and relative bonded area of a fibre network

grow when the thickness of fibers decreases due to flattening. The increasing proportion of recycling chemical fibers affects the sheet density more strongly than any change in mechanical fibers because they are flat and their flexibility value in wet state is more. Despite hornification, the flexibility of chemical fibers will increase by outer damage (twisting and kinking). Stiffness is related to thickness and basically from the origin and fully related to fiber physical character.

1.1.6. BENEFITS OF THESE TRIALS

Cationic starch is commonly used in the papermaking process to increase inter-fiber bonding and to obtain paper strength properties .Due to high conductivity the cationic starch was consumed by anionic trashes which is not cost effective. The cationic starch loses its binding activity on cellulose if the alum or PAC dosage is more than 2 % and also the back water conductivity (4) is more than

5000 µS/ cm. The adsorption of cationic starch is shown in graph as given below.Cationic starch was stopped.

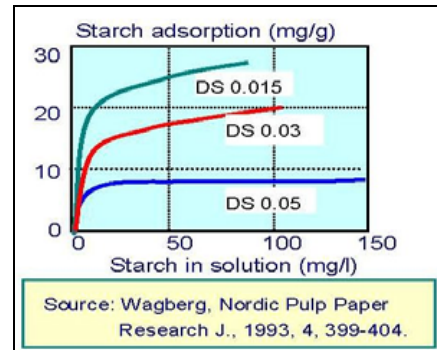


Fig No: 5, Cationic starch adsorption graph

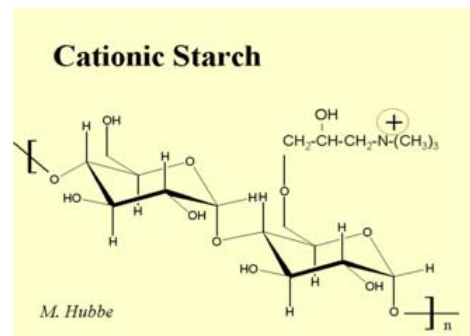


Fig No: 6, Cationic starch

1.1.7. POINTS TO BE CONSIDERED

The following points are to be considered as most imperative for getting better stiffness and bulk in duplex boards are

1. Mould Inlet consistency should be maintained as 0.5 to 0.8 % or recommended by mould Supplier
2. Proper / uniform furnish ratio & selectivity of Anionic retention aids for PAC / alum sizing.
3. Cleaning of mould by Booster pump with minimum 20 kg / cm²
4. Application performance proven chemical application only
4. Felt condition / press shower performance
5. Fine Tuning of press loads

6. No compromise in quality from top management to bottom level

7. Finally, Faith in lab works / result & sufficient equipments / qualified lab persons.

8. Updating the latest technological development in process optimization & lab equipments.

9. Sufficient fund allocation for lab / R&D activities. Many “A” Grade mills have R&D for tax exemption purpose only,

CONCLUSION:

The weak fiber raw material should be bonded chemically to get a better strength as well as machine runnability. The stiffness and bulk is directly related to the fiber diameter, length and its rigidity. Chemicals do not give a bulk and stiffness, because all the wet end

chemicals help for paper making by the way of swelling, bonding. Weaker, shorter fiber gives only a low bulk and stiffness. Proper selection of raw material for board making is very important as well as uniform furnish maintain. Proper web formation and pressing is to be monitored for recycling papers and boards

ACKNOWLEDGEMENT

The author thanks to co –author for their valuable suggestions and also the Executive Directors and Directors of M/s. Saraswati Udyog India Limited , Velur for granting the permission valuable suggestions to submit this plant trial report for IPPTA Zonal seminar-2017, 4th and 5th August at Aurangabad.

REFERENCES

1. Htun, M., de Ruvo, A., 1978 .,“The implication of the fines fraction for the properties of bleached kraft sheet” Svensk Papperstid. 81:507-510.
2. Htun, M. and de Ruvo, A., 1983., “The Role of Fundamental Resarch in Paper Making” J. Brander, Ed. Mech. Eng. Publ., London, vol .1, pp. 385-398.
3. A.D.Bawden.,and R.P. Kibblewhite.,1995., “Effects of multiple drying treatments on kraft fibre walls”., 3rd Research Forum on Recycling CPPA, Vancouver., pp. 171–177.
4. Y.V.Sood., Sanjay Tyagi., etal.,2010.,“Effect of base paper characteristics on coated Board quality”, Indian Journal of chemical Technology.,vol.17.,pp.309-316.
5. Dr.M.Vadivel.,etal.,2016.,“Technological advancement in stiffness improvement for duplex board making industries in India”, IPPTA J , Vol .28.,No:3, pp.147-159.
6. Dr.M.Vadivel.,etal.,2016.,“Technological development in wet end sizing for packaging grades of board industries in India”, IPPTA J , Vol .28.,No:4, pp.95-108.