

“Wheat Straw”—‘A Potential Non-Wood Fibre Source’ For Writing and Printing Grade of Papers

*Semwal J P., *Choudhary A.B.

ABSTRACT

Time is constantly snatching away the easy options of processing and technology, binds us to search for economical and viable solution, using unconventional Raw material suitable for Paper Making.

Medium and Small Scale Paper Mills have to depend on agricultural residue and they have to develop the technology to stand in the competitive market for their survival. This is also important due to the growing demand of paper and depleting forest resources, problems associated with importing of raw material etc.

This Paper describes the utilization of Wheat Straw, giving satisfactory results to meet the challenge of raw material crises.

A complete pulping process of Wheat Straw is given and suitable cooking and bleaching parameters have been standardised to manufacture quality Writing & Printing Papers

Introduction

Environmental preservation and stiff resistance from Government against de-forestation forces us to look for alternate source of raw material. On the other hand, severe restrictions on imports of Waste Paper and Wood Pulp forces the Small and Medium scale Paper Mills to utilise on agricultural residues, hence the continuous search of alternative agricultural residues in the industry is going on.

A Predominantly agricultural country like India where agricultural residues like Bagasse and straws are abundant, the immediate answer should be the utilisation of these as fibre source. In the recent years Bagasse availability has become limited and its price has also gone up. So Wheat Straw appears to be an important fibrous source for Pulps. Even with conservative estimates more than 40 Million tonnes of this material can be obtained. Assuming that 50% of it is used as cattle fodder, a sizable quantity which is normally used as fuel can be made available for Paper Industry.

Our Government is also encouraging the use of these unconventional raw materials by giving exemption on Excise Duty if 75% (By weight) or more of these pulps is used for Paper Production.

Taking above points into consideration, “SIMPLEX PAPER MILL”, has started Wheat Straw pulping along with Bagasse and Rice Straw. Large quantity of Wheat Straw is available to us from surrounding 150 K M area.

Wheat Straw As A Fibre Source

Morphological structure of Wheat Straw differs the other agricultural residues in many respects. Table No. 1 illustrates these differences.

Table 1 indicates that Wheat Straw has less Leaf Sheaths, Leaf blades, Nodes, foreign material

*The Simplex Mills Co. Ltd.

(Paper Division),

Village : Chagera, P. O. Box No. 50,

Gondia-441 601 (Maharashtra)

and fines. On the other hand more stems and grains but the ratio of its fibre length and dia is an average

number, therefore we need to avoid drastic mechanical or chemical treatment.

TABLE—1
Morphological Comparison of Wheat Straw with other Agricultural Residues.

SNo.	Particulars	Raw Materials		
		Wheat Straw	Rice Straw	Bagasse
1	Stems or Culms	% 68.5	32.4	
2	Leaf Sheaths	% 20.3	33.1	
3	Leaf Blades	% 5.5	16.4	
4	Nodes etc.	% 4.2	11.9	
5	Grains	% 1.0	0.7	
6	Foreign Material	% 0.2	0.7	
7	Fines	% 0.3	4.8	
8	Av. Fibre length (MM)	1.1 to 1.5	0.5 to 2.5	0.3 to 3.4
9	Av. Fibre width (Micron)	9 to 13	4 to 15	9 to 45
10	Fibre length : dia	1:0	1:0	85

TABLE—2
Chemical Composition of Wheat Straw as compared to other Raw Materials

SNo.	Particulars	Raw Materials		
		Wheat Straw	Rice Straw	Bagasse
1	Ash	% 7 to 8	16 to 22	1.7 to 3.0
2	Lignin	% 16 to 18	12 to 14	18 to 22
	(Ash Corrected)			
3	Pentosans	% 26 to 30	19 to 20	28 to 32
4	Hot Water Solubles	% 10 to 15	13 to 14	3.9
5	Alcohol Benzene Solubles	% 3 to 4	5 to 6	4.2
6	Cold Water Solubles	% 5.8	10 to 12	—
7	1% NaOH Solubles	% 41 to 45	43 to 44	37.6
8	Hollo Cellulose (Ash Corrected)	% 67 to 70	55 to 57	—
9	Alpha Cellulose	% 39 to 40	35 to 36	—
10	Cross & Bevan Cellulose	% 52 to 54	46 to 50	46 to 55
11	Silica	% 5	10	1

Chemical Composition of Wheat Straw

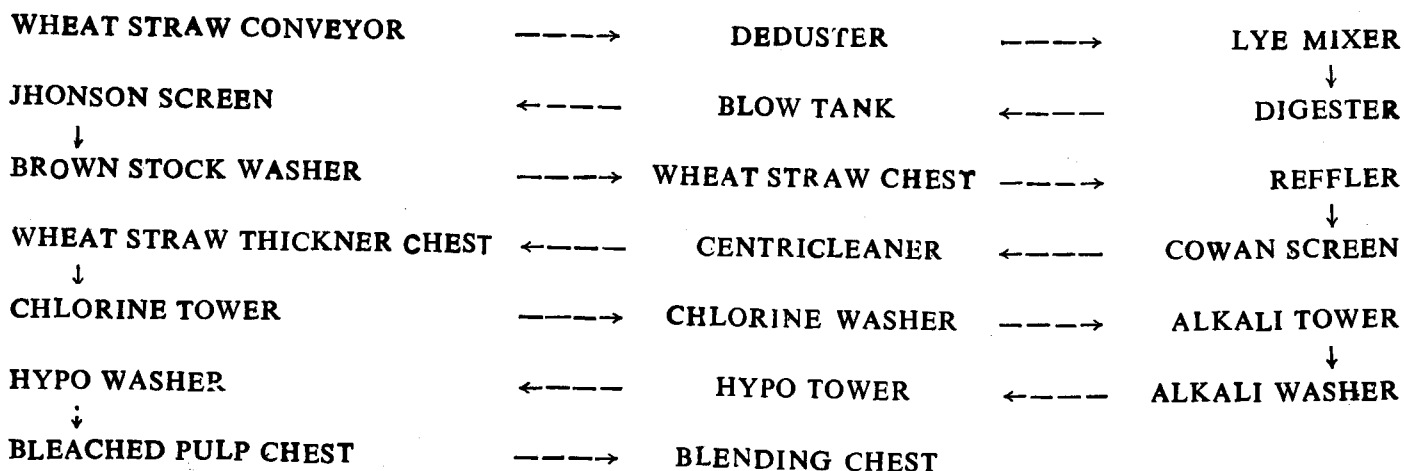
A Comparative study of Chemical Composition, given in 'Table 2' shows that Wheat Straw has more Ash, Silica, hot water solubility and 1% NaOH solubility as compared with bagasse, and less ash, more

Pentosans, less solubility in Cold Water, hot water and alcohol benzene, more hollo cellulose and less silica in comparison with Rice Straw. Hence the chemical characteristics of Wheat Straw are closer to that of Bagasse.

It has been observed that Pulp strength characteristics and drainage properties improve as more and more percentage of "DUST" is removed from Wheat Straw.

Processing of Wheat Straw

Wheat Straw is taken in Lye Mixer to ensure uniform Wetting through deduster having 5 MM Screen which removes most of the dust, fines and shives resulting better Pulping.



In case of more shredded quality of Wheat Straw, deduster removes 10 to 12% fines and dust, otherwise this figure stands at 7 to 8%.

Pulping. 6 M. T. Bone Dry Wheat Straw is fed in each digester, maintaining bath ratio of 1 : 2, we took 3 trials of Cooking with different amount of cooking chemical and cooking time and found that the results of 3rd trial were the best giving lower permanganate number and better quality Pulp.

Cooking of Wheat Straw :

We use 4 digesters (40 M³ each) for Wheat Straw

TABLE-3
Cooking Results with three different Cooking conditions.

SNo.	Particulars		1st Trial of Cooking	2nd Trial of Cooking	3rd Trial of Cooking
1	Alkali Used as NaOH,	%	12.5	14.0	15.0
2	Steaming time ,	Hrs	2 00	2.00	2.00
3	Cooking time ,	Hrs	1.00	1 00	1.00
4	Temperature	°C	160	160-165	160-165
5	Pressure ,	Kg/Cm ²	7	7	7
6	Temp. at which air is released.	°C	100-105	100-105	100-105
7	Permanganate Number from digester.		14-16	13-15	13 to 14
8	Free Alkali ,	gpl	Nil-1.0	1.5 to 2.5	3 0 to 3 5%
9	Unbleached Pulp Yield,	%	42 to 44	45 to 46	46 to 47%

We also observed that the use of Anthraquinone is useful for better results.

Screening and Cleaning System

Pulp from blow tank is pumped to knotter having 5MM perforations. In case of 1st & 2nd trial (Table 3) reject comes around 3 to 4% but in the 3rd trial it

reduces to 0.5 to 1% with K No. 11 to 13. Black liquor is of 7 to 8° TW at 50° C temp with free alkali (as NaOH) 3.0 to 3.5 gpl. This black liquor is used in Digesters, Blow Tank and Jhonson Screen for dilution. After 2nd Brown Stock Washer, pulp is collected in a chest and then it is pumped to 'Cowan Screen' and after that Centricleaning is done.

TABLE-4
Rejects from Knotter and Cowan Screen in 3 Trials

SNo	Particulars (%)	1st Trial of Cooking	2nd Trial of Cooking	3rd Trial of Cooking
1	Caustic	12.5	14.0	15.0
2	Rejects from B.S.W Knotter with 5 MM Perforations.	3 to 4%	2 to 3%	1 to 2%
3	Rejects from Cowan Screen with 2MM Perforations	4 to 5%	2 to 3%	0.5 to 1%

TABLE-5
Bleaching Conditions and Results of Three Cooking Trials

SNo.	Particulars	1st Trial of Cooking	2nd Trial of Cooking	3rd Trial of Cooking
1	Parmanganate number before bleaching.	13-15	12-14	11-13
2	Chlorination			
(a)	Chlorine added, %	10-11	8-9	6-7
(b)	Final pH	1.7-1.9	1.5-1.7	1.5-1.7
(c)	Retention Time	1.00	1.00	1.00
3	Alkali Extraction			
(a)	NaOH added, %	1.8-2.0	1.6-1.8	1.5-1.6
(b)	Hypo added, %	2-2.5	2.5-3.0	1.5-1.8
(c)	Final pH	9.5-10.5	9.5-10	9.5-10
(d)	Retention time, Hrs	2-2.5	2-2.5	2-2.5
4	Hypo Stage			
(a)	Hypo added, %	3-3.5	2-3	1.7-2.0
(b)	Buffer as NaOH, 100 Gpl	Drop by Drop	Drop by Drop	Drop by Drop
(c)	Final pH	8.5-9.0	8.5-9.0	8.5-9.0
(d)	Retention time, Hrs	3.5-4.0	3.5-4.0	3.5-4.0
5	Free Chlorine, ppm	Upto 200 Max.	80 to 150	70 to 100
6	Brightness, (Elrepho), %	76 to 78	78 to 80	80 to 82
7	Pulp Sheet	Slight Shives Seen	Clean	Clean
8	Bleached Pulp Yield %	37.2 to 37.5	39.5 to 40	40 to 41

Bleaching :

In our 3 stage bleaching CEH sequence is adopted. Hypo Solution is added along with Caustic in Chlorine washed Pulp.

Bleaching conditions and results in the above 3 cooking trials are given in Table-5.

From table, 5 we concluded that bleaching of 3rd Cook is the best because it consumes less chemicals and gives more brightness along with other properties.

Results Obtained From Wheat Straw Pulp

1. In comparison to Bagasse, Wheat Straw—
 - (a) reduces fluff problem on Paper Machine
 - (b) improves machine runnability
2. With 15 to 20% of Soft Wood, Wheat Straw Pulp gives good quality, speckless paper Table 6 indicates the properties of Papermade from this furnish.

TABLE—6
PAPER PROPERTIES

S.No.	Particulars	Unit	Simplex Copier 75 Gsm	Simplex Bond 58 Gsm	S. S. Maplitho 70 Gsm	S. S. Maplitho 80 Gsm	Simplex Ledger 65 Gsm
1	Thickness	Micron	104	78	96	106	90
2	Bulk	C.C./Gm	1.38	1.34	1.37	1.33	1.38
3	Bursting Strength	Kg/Cm ²	1.5	1.1	1.4	1.4	1.1
4	Burst Factor		20.0	18.9	16.4	16.9	17.7
5	Tensile MD	Kg.	5.0	3.3	4.7	5.4	3.9
	Strength CD	Kg.	2.7	1.9	2.2	3.0	2.1
6	Breaking MD	Meter	4440	3790	4420	4500	4000
	Length MD	Meter	2350	2180	2100	2540	2000
7	Double MD	No	14	11	11	11	19
	Fold CD	No	10	6	8	6	6
8	Smoothness (Gvrley)	Sec/50ml	33	49	44	42	36
9	Ash	%	4.40	11.80	16.5	10.0	12.70
10	Sizing	Sec	—	—	15	25	—
11	Brightness	%EI	81.1	79.3	77.1	77.5	—
12	Cobb 60	Gm/m ²	18.0	19.3	—	—	17
13	Tear Factor MD		73.0	56.4	55.0	62.1	52.2
	CD		75.9	63.8	60.2	67.2	58.1

Problems Faced During Processing of Wheat Straw :

- 1) Because of its bulky nature it needs more space for storage.
- 2) Its quality varies from place to place, some material contains more knots.
- 3) Ground and handling losses are more.

Remedial Measures :

A suitable storage and handling system is being adopted.

Conclusions :

- 1) Taking all factors into consideration, we have started using Wheat Straw as a raw material for Quality Papers.

- 2) Through numbers of trials, optimum cooking and bleaching conditions are standardized for implementation.
- 3) It is observed that pulping of Wheat Straw is better than that of Bagasse and Rice Straw in many respects.
- 4) 80% of Wheat Straw Pulp along with 20% Soft Wood Pulp gives paper of very good physical and optical properties.

Acknowledgement :

The author expresses his sincere gratitude to Shri N. S. Damani, Chairman & Managing Director, "The Simplex Mills Co. Ltd. (Paper Division) Gondia" for his keen interest, valuable guidance and permission to publish this paper.

References :

1. S. N. Pandey, No. 3, Vol-17. IPPTA SEP' 1989.
2. Chivate S. G., Mangonkar N. D. & Kulkarni A. Y. 'Appropriate Technology for improving productivity in Small Paper Mills' Page 24, IPPTA Convention issue-1986.
3. Common Wealth Bureau of Pasture and field Crops abstracts Vol 34, No. 7, July 1981.
4. IPPTA, Vo-21, No. 2, June 1984, Annexure 7 (Table 4).
5. Singh S. V., Sharma Y. K., Bhola P. P., Rai A. K. IPPTA 1987, Vol 24, No. 2
6. Ashok Kumar, Jindal A. K., Rao N. J. 'Utilization of Bagasse for Paper Making—A Review', IPPTA Vol 23, No. 4, December, 1986.
7. Trivedi M. K., Dissertation, I. I. T. Bombay, Wheat Straw as a source of Cellulose Pulp IPPTA Vol XII No 4 December, 1975.