Utilization of Secondary Fibres for Speciality Paper Boards

Saikia, D.C, Ghosh, S.K. and Saikia C.N.

ABSTRACT

The paper highlights the laboratory scale investigations carried out at Regional Research Laboratory, Jorhat, Assam on utilization of secondary fibres like assorted waste paper and gunny waste for producing speciality paper boards like cellulosic insole board for footwear industry and solid toughened board for packaging industry. The cellulosic insol board with apparent density of 0.97 g/cc, tensile strength (dry) 253 kg/cm^2 along and 236kg./cm^2 across, tensile strength (wet) 101 kg/cm^2 along and 89 kg/cm^2 across, stitch tear 55.6 kg/cm thickness along and 30 kg/cm thickness across. Linear shrinkage is 3.3% at 170^0 C for 1h and flexing index 3.06 along and 2.95 across per 10g of flexing cycles. The solid toughened board of 2.5mm thickness showed breaking load of 120 kg in 30 cm span and 65 kg in 40cm span, water absorbancy 11.62% on 24h wetting. Water percolation and delamination tests showed nil. For comparative study imported as well as renowned indigenous brands were collected and tested. The products made in laboratory as in well as pilot plant exhibit characteristic properties of these types of paper boards.

INTRODUCTION

Owing to the shortage of fibrous raw materials for the pulp and paper industry, there remains no alternative other than to go for utilization of secondary fibres mainly in the form of waste papers for producing paper and paper boards for various uses. It is reported that secondary fibre is the second largest source of fibre for the paper and board industry in the United States of America[1]. The use of secondary fibre is greater in Europe and Japan than it is in the United States. India is lagging behind in secondary fibre utilization. Waste paper accounts for 15% of paper and board produced in the country compared to an estimated average of 45% in 1997 in developed countries[2].

The waste paper consumption in India is about 10 lakh tonnes out of which about 4-5 lakh tonnes is available indigenously and the balance quantity is imported predominantly from USA (upto 60-65%) and Middle East (25-40%).

The utilization of waste paper in the Indian pulp and paper industry is about 5-10% in the stock preparation to produce conventional boards like mill board, file cover, file board, various cards like greetings, invitation etc. But with the advancement and modernisation of small sector paper industries, the use of waste papers and paperboards has picked up to a great extent. In some cases waste paper is considered as the principal raw material for paper board making. It may be expected that the utilization

Regional Research Laboratory, Jorhat, 785 006 (Assam)

of waste paper and paperboards as source of secondary fibres will increase at twice the rate in the coming years.

The advantages of using the secondary fibres are well known to the paper makers. Some of them are as follows:

i. Low cost substitute where cheaper grade pulp is not available.

ii. Lower energy requirements for processing of waste paper.

iii. Reduction in waste disposal cost.

iv. Environmental friendly.

Worldwide emphasis has been given for utilization of secondary fibres for development of different types of speciality products. Attempts have been made to utilize secondary fibres for producing paperboards with characteristic properties for use in textile, printing and packaging industries. Eventhough in the field of packaging, corrugated fibre boards and some solid fibre boards are conventionally used, but for export packaging and deep freezing products, special type of high impact resistant, waterproof, moth and termite resistant boards with high compression strength are required.

The current market for export packaging is around Rs. 2000 crores, which has a potential to touch Rs. 6500 crore by the dawn of the 21st century. Our country loses foreign exchange worth over Rs. 500 crores every year due to rejections, spoilage and breakage arising from poor packaging. Engineering products are the worst sufferers for poor packaging accounting for a loss of Rs. 194 crores. Garment packaging comes next with a loss of Rs. 108 crores followed by marine products, which account for Rs. 72 crores.

It is felt that if a toughened solid fibre board is developed from cellulosic raw materials like waste paper, gunny waste etc. at a considerable economic cost, this type of board may find use in packaging industry especially for export and marine packaging. However, this type of boards can also be used for roofing purposes[4,5].

Other speciality paperboards such as Jacquard and also paperboards for casting metal stereoplates have been developed from suitable pulp furnish made from waste papers in combination with pulp prepared from other cellulosic materials [6,7,8].

Cellulosic insole boards is a special type of paperboard used extensively in bags, suitcases, footwear and allied industries. A substantial quantity of this speciality board under the trade name "Bontex", "Shank" are primarily imported.

The main characteristic of these boards are that they should possess high tensile and bursting strength, good water repellancy, smooth and easy punchability, good stiffness, high flexing index, high resistance to abrasion and dimensional stability.

So also, for making solid toughened board which are used in heavy duty packaging, export and marine packaging, secondary fibres like press cuttings, gunny wastes and rags are employed. As these boards are used by converting into cartons, necessary foldability with high tensile and burst, high resistance to puncture, high compression strength etc. are the characteristic properties needed.

An investigation was carried out at Regional Research Laboratory, Jorhat, Assam to develop a process for the manufacture of water resistant heavy duty toughened packaging boards by using conventional raw materials and chemicals to impart high strength and at the same time foldability without delamination along with good compression strength.

Solid fibre boards have certain advantages over conventional corrugated fibre boards which are summarised below:

Moisture resistance: Solid boards perform better than corrugated boards under wet or humid conditions. It is, generally more suitable over corrugated boxes for exporting goods to countries with humid climates or where storage on dock is involved or where the cases are likely to come into contact with water, oil, grease etc.

Puncture resistance: Solid boards have a greater resistance to puncture than the corrugated ones. Solid board is therefore generally more suitable for heavy articles that could damage the container on careless handling due to puncture from external objects.

High density: Corrugated boards crush more easily than solid boards. So solid boards are more suitable for use where a high resistance to indentation is needed.

External treatment: A variety of effective

barriers and treatments can be offered with solid fibre board.

Hygiene: The fluting of corrugated boards provide a nice abode for insects, dirt and undesirables whereas solid board is not so accomodating and should be preferred where prolonged storage or re-use is involved.

Freezing: The contents of a solid case generally freeze quicker than if these are packed in an equivalent corrugated case. Moisture changes during freezing lead to a much more rapid delamination in performance of corrugated than solid case.

Fire risks: The heavier grades of solid fibre boards do not ignite as easily as corrugated board.

EXPERIMENTAL

Raw material

The cellulosic raw materials required are waste papers of suitable grade. Waste tailor cuttings or rags and discarded gunny bags were selected as blending materials. Generally, white press cuttings, envelope trimmings, business machine cards, waste kraft paper or paper boards are used. The materials must be free from coated paper, synthetic fibres, plastic, wood and rubber pieces and other contaminants.

Commercial grade chemicals and synthetic polymers are used in various stages of manufacture of the above boards.

Pulping of Waste Paper

The waste paper and paperboards of selected grades are softened by soaking in water for 2-3 h and then put into the hydropulper to disintegrate into homogeneous pulp slurry at 5-8% consistency. From the hydropulper, the pulp is fed to a hollander beater where the necessary chemicals are also added. The stock from the beater is transferred to the stock chest by passing through a disc refiner.

Processing of gunny bags

The discarded gunny bags are cleaned and fed to a rag chopper and cut to desired sizes. The dusts are separated by passing through a dedusting machine. The cut pieces (approx. 2x2.5 cm) are digested in a rotary digester by adopting soda process under definite cooking conditions.

Processing of waste Tailors cuttings

For making pulp the waste tailors' cuttings are cleaned and chopped in a rag chopper. The chopped rags are put in a vomitting type of digester and cooked for about 1 h with mild alkali. The boiled rags are then washed with fresh water and fed to a Hollander beater. Beating is continued for 3-5 h at 1.5% consistency to obtain desired freeness.

CELLULOSIC INSOLE BOARDS

Stock Preparation

To impart strength and obtain characteristic properties of a cellulosic insole board, suitable fibre blendings of waste paper, gunny waste and rags are taken in a beater and necessary sizing chemicals are added to the stock.

Refining

The above pulp stock is passed through a disc refiner to get a homogeneous slurry.

Board making

Multilayered boards of specified grammage and thickness are made in a single cylinder mould board making machine by conventional method with each layer having 60-80 g/m^2 (o.d. weight).

Pressing and Drying

The multilayered boards with high moisture content are initially passed through a secondary smooth press and then a pile of boards are pressed in the hydraulic press to squeeze out excess water from the boards. In the hydraulic press, the application of pressure to the wet boards is maintained in such a way that the pressure is increased gradually in three stages at definite pressure for definite period. After pressing in the hydraulic press, the boards are dried in the sun or in a hot air circulatory oven. Care should be taken so that the dried boards remain flat without curling. The dried boards are kept flat under some weight and conditioned in the room for 3-4 days.

Calendering and coating:

The above conditioned boards are calendered in a standard 2 roll calendering machine. The edges of the calendered boards are then trimmed for applying

a coating solution to impart certain characteristic properties of the boards.

Testing

The physical properties of the board made in laboratory as well as in pilot plant are given in Table 1. The physical properties of imported boards are also evaluated and shown in the table.

SOLID TOUGHENED BOARD

Stock Preparation

The pulp made by digesting gunny bags is put in a hollander beater and beaten at a consistency of

Table 1

Physical properties of cellulosic insole board

	Samples	RRL Samples (Pilot Plant)				Available Brands in the market		
		A	B	C	D	Shank Board	Bontex 1.5	Bontex 2.25
1.	Apparent Density, (g/cc)	1.08	0.87	0.99	0.97	1.0	0.77	0.74
2.	Tensile strength, (kg/cm^2)							
	a. Dry along	64	179	77	253	404	227	192
	across	48	79	74	236	368	212	153
	b. Wet along	25	70	57	101	161	90	74
	across	23	67	38	89	135	76	56
3.	Elongation of Break %							
	a. Dry along	17	25	29	24	32	110	50
	across	15	17	17	19	23	105	68
	b. Wet along	16.5	23	21	14	20	39	31
	across	12.5	16	15	12.5	16	76	22
4.	Stitch tear strength (kg/cm thickness)							
	a. along	22.5	77	72.5	55.6	4.83	8.7	14.22
	across	52.8	74	62.5	30	4.44	8.02	8.07
5.	Water absorption (% by mass)							
	a. 30 min.	11	47	23	0	41	57	31
	b. 2 hrs.	21	57	55	0	44	66	33
	c. 8 hrs.	35	95	74	9	73	68	42
	d. 24 hrs.	57	118	140	54	101	74	54
6.	Linear shrinkage % at 170°C for 1 h	57	30	2.9	3.3	7	2.8	2.8
7.	Area shrinkage % at 100°C for 1 h	4.9	2.8	2.4	2.6	8	1.2	1.1
8.	Flexing index (10 g of flexing cycles)							
	along	E	2.98	3.06	1.85	1	4.2	4.5
	across	E	2.94	2.95	2.18	1	4.09	3.9

3-4% for 1 h and waste paper pulp from the beater chest is then added to it in the required proportion and the beating of the blended pulp is continued further till desired freeness is obtained.

At the early stages of beating operation, chemicals imparting stiffness and such other desirable properties to the dried boards are added to the pulp stock. The pulp stock is then beaten to the required freeness and at that stage, certain polymeric substances are added to the beater and the beating is further continued for another 15-20 minutes for thorough mixing of the chemicals. Afterwards other sizing chemicals, fillers and additives are added in the beater.

Refining

From the stock chest, the pulp is fed to a disc refiner, wherefrom refined pulp is transferred to the refiner chest.

Board making

Multilayered boards are made maintaining a specified basis weight and thickness. The boards are then pressed in a secondary smooth press. The final boards coming out from the secondary smooth press contain about 40% moisture.

The boards are initially dried in the sun and then dried in a temperature controlled room.

The dried boards are then treated further with surface treatment agents in order to make the finished boards highly water repellant as well as smooth surfaced.

Testing

The laboratory test results show that the boards made from the blends of waste paper, jute fibre and rags pulps, with specific chemical treatments are suitable for use as a speciality packaging board. The boards so prepared possess adequate physical strength properties and other characteristics needed for such a product. The results of the physical and other properties are summarised in Table 2.

RESULTS AND DISCUSSION

The board samples made in the laboratory as well as in the pilot plant, are tested for different properties adopting TAPPI & ASTM standard methods and the results are shown in Table 1 & 2. In case of cellulosic insole board, it has been found that laboratory made samples have shown higher strength and water resistance properties compared to the imported product. However, in all other properties, both the samples are comparable. In case of solid toughended boards, the properties of the samples made in pilot plant are within the limits specified for such boards.

Table 2

Physical properties of toughened boards

	Thickness (mm)		
Properties	**2.5**	**4.0**	**5.0**
Water absorption (%) (24 h)	11.62	11.65	11.8
Water percolation test	NIL	NIL	NIL
Weight of sheet (kg) 1x1.5 m sheet	3.685	3.870	4.050
Breaking load (kg)			
i. 30 cm span	120	125	135
ii. 60 cm span	65	65	70
Fire resistance	Satisfactory	Satisfactory	Satisfactory
Delamination	Nil	Nil	Nil

CONCLUSION

It may be concluded that one of the best utilities for secondary fibres is to develop speciality paper boards, having high market potential, as the ones mentioned in this paper. Based on the recent development of indigenous technology, small scale industries may come up, utilizing secondary fibres, as the products mentioned here, have already occupied their place in the market.

ACKNOWLEDGEMENT

The authors wish to thank the Director, Regional Research Laboratory, (CSIR) Jorhat for his kind permission to publish this paper.

REFERENCES

1. Franklin, W E and Franklin, W A; Waste paper Recycling : its present & future status. Pulp & Paper, Sept. 1979.

2. Ghosh S R, Saikia D C, Ghosh S K, Saikia C. N. IPPTA Vol. 8 (2) June'96. Development of speciality paper boards for secondary fibres.

3. Horn, R. A., The Effects of Recycling on Fibre and Paper properties. Paper Trade Journal Feb. 1975.

4. Aslam N.; Satya R. C., Khazanchi, A., Chaliha B. P. and Rao VSB. Improved Asphaltic Roofing Sheet. Research & Industry, Vol. 24, June 1987.

5. Ganpati R Bhat, John A Heitman and Thomas W Joyee TAPPI Sept. 1991 Vol. 74 (9) Novel techniques for enhancing the strength of secondary fibres.

6. Ghosh S. K., Saikia D. C. Rural technology for paperboard, leatherboard and slate. Four P News. Vol. 4 (5), 1992.

7. Ghosh S. K., Saikia D C. Solid toughened board as an alternative. Four P News, Vol. 4 (2), 1991.