STUDIES ON THE MANUFACTURE OF HARDBOARD FROM BARUNA WOOD

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Hardboards were made from Baruna by steaming and cold soda processes. Modulus of rupture, water absorption and thickness swelling of the boards were determined by standard procedures. It is found that the boards made by both the processes are only moderately strong and poorly water-resistant. Cold soda pulps were found to be very slow draining.

INTRODUCTION

Baruna (*Crataeva religiosa,* Forst) is a fast growing tropical hardwood species found to grow sporadically in Bangladesh near river banks and in swampy lands. The wood is softer than many other indigenous species with a yellowish-white to brown colour. The wood has been reported to be a good timber for turnery works and, as such, used for making toys, cups, saucers and many other small articles (Chowdhury and Ghosh 1958). But uptil now it is not utilised as an industrial raw material in the country except for fuel wood. A fast growing species as it is, raising of Baruna plantations in swamp forests as well as its possible uses in wood-based industries of the country was discussed in more than one meeting of the 'Research Consultative Committee' held in the Forest Research Institute, Chittagong. In this context, the present research works have been conducted in the Institute to study its suitability for the manufacture of hardboard.

MATERIALS AND METHODS

Material : Several Baruna logs were procured from a nearby village. The logs were sawn to 10 cm x 10 cm x 100 cm size and chipped in the laboratory model Murray chipper machine producing approximately 2.5 cm x 1.3 cm x 0.3 cm chips.

Pulping : The chips were pulped by both steaming and cold soda processes. In the steaming process, the chips were cooked by direct steaming under pressure in stainless steel rotary digesters of 0.022 cubic metre capacity. Six cooks were made by steaming the chips at 7.0 and 10.0 kg/cm² digester pressures for ½ hour, 1 hour and 1½ hours in both the cases. The chips from each cook were then refined in a single-rotating disk attrition mill to two different freenesses by varying the plate clearance. In all 12 pulps were thus obtained by this process.

In the cold soda process, chips were soaked in 10, 20 and 30 gram per litre caustic soda solution under atmospheric condition using 1-hour, 3-hour and 5-hour soaking times in each case, giving 9 cooks thereby. Chips from each of them were refined in the attrition mill as before to two different pulp freenesses so as to produce 18 pulps in all.

BOARD MAKING

Stock freeness : A defibrator freeness tester-cum-mat – former was used for determining the stock freeness. A slurry was first made of a pre-determined quantity of pulp (about 128 gm O. D.) in water, stirred well and poured into the freeness tester to which was added more water to make a 10 litre sample of fibre suspension. No sizing materials or additives were used in the slurry. The water was then allowed to drain out through the screen plate of the mat former by suddenly opening a valve at its bottom. The freeness obtained with this apparatus was the drainage time, in seconds, required for the water to pass through the screen plate and for 10 litres of air through the pulp mat formed on the screen.

Mat preparation : After dewatering of the fibre suspension in the freeness tester, the fibres settled down on the screenplate to form a thick mat. It was then cold pressed to reduce the thickness and to bring the moisture content down to 60 percent.

Pressing : The cold-pressed mat was placed on a caul plate with a wire-screen in between and transferred to a single daylight hydraulic hotpress. The pressing was carried out for an initial 2-minute period at 35 kg/cm^2 followed by 1 minute's breathing time at 7 kg/cm^2 for the escape of entrapped steam and finally for another 3 minutes at 35 kg/cm^2 platen pressure, maintaining the temperature at 190°C althrough. Nominal 0.3 cm thick and 21.6 cm diameter screen-back hardboard discs were thus made.

Test methods : Five boards were made from each pulp and tested for evaluating strength and water absorption properties. From each board 3 test specimens of 12.7 cm x 5 cm size were cut and their edges trimmed. One specimen was used for modulus of rupture test by static bending process. The test was done in a standard testing machine using a span of 3 inches to meet the length-thickness ratio requirement of 24 to 1 of ASTM standard D1037–52T. Water absorption tests were done on another specimen by immersing it flat 2.54 cm deep under water for 24 hours. Amount of water absorbed by the specimen and the consequential change in its thickness were recorded.

It needs to be mentioned that before going to evaluate the board properties, the test specimens are to be conditioned and kept in an environment maintained at 22± 2°C temperature and 50±2% relative humidity for at least 72 hours. But as the humidity control room of the Institute was not in working condition, these requirements could not be met. For the same reason, it was not possible to carry out the water absorption tests under specified condition of maintaining the temperature of water at 20° ± 3°C.

RESULTS AND DISCUSSION

The objective of the present investigation was to assess the suitability of Baruna for making hardboards. Data for MOR,

Table 1. Pulping conditions of Baruna wood by steaming process and the board properties

Pulp No.	Cooking Condition		Freeness (seconds)	MOR (kg/cm²)	Water Absorption	
	Digester pressure (kg/cm²)	Steaming time (hours)			Change in weight %	Change in thickness %
B1/1	10.0	1	86	311	45.0	23.2
B1/2	10.0	1	48	278	40.8	20.3
B2/1	7.0	1	90	258	61.6	33.6
B2/2	7.0	1	55	266	61.5	30.0
B3/1	10.0	½	235	283	43.3	22.6
B3/2	10.0	½	108	294	43.1	26.0
B4/1	7.0	½	75	282	67.5	36.1
B4/2	7.0	½	167	307	65.9	34.8
B5/1	10.0	1½	132	336	46.0	22.0
B5/2	10.0	1½	60	308	53.3	25.0
B6/1	7.0	1½	57	336	58.6	37.8
B6/2	7.0	1½	50	282	67.8	40.7

Table 2. Pulping conditions of Baruna wood by cold soda process and the board properties

Pulp No.	Cooking Condition		Freeness (seconds)	MOR (kg/cm²)	Water Absorption		Remarks
	Soaking time (hours)	NaOH (g. p. l.)			Change in weight %	Change in thickness %	
BC1	1	10	80	317	71.2	39.6	
BC2	1	10	50	320	67.3	41.3	
BC3	3	10	75	291	69.3	44.5	
BC4	3	10	42	265	76.2	49.2	
BC5	5	10	Above 5 minutes	—	—	—	Pulp rejected
BC6	5	10	50	329	80.0	51.5	
BC7	1	20	36	245	75.9	47.3	
BC8	1	20	100	317	67.8	42.1	
BC9	3	20	75	324	88.4	42.6	
BC10	3	20	—	—	—	—	
BC11	5	20	46	266	74.8	38.8	
BC12	5	20	57	258	81.1	50.0	
BC13	1	30	70	311	68.7	42.3	
BC14	1	30	82	314	65.9	44.4	
BC15	3	30	70	319	67.5	44.8	
BC16	3	30	72	306	70.4	43.4	
BC17	5	30	50	256	71.1	42.8	
BC18	5	30	55	285	69.1	44.0	

weight percent of water absorbed and percent increase in thickness of the boards together with the cooking conditions and board freeness have been summerised in Table 1 and Table 2 for steam cooking and cold Soda processes respectively. The figures for freeness, MOR and the water absorption values entered in the tables are the average of 5 boards tested from each pulp.

Referring to Table 1, it is noticed that cook nos. B 5/1 and B 6/1 produced the strongest boards having the same MOR value of 336 kg/cm². From cook no. B 5/1 made by 1½ hours' steaming under 10.0 kg/cm² digester pressure, better water-resisting boards with very slow draining pulp were obtained. Comparing the freeness values of the two cooks (132 seconds for B 5/1 and 57 seconds for B 6/1), it will not be unreasonable to expect better results from cook no. B 6/1 at a higher drainage time. In case of other pulps made by this process, it can be observed that the boards obtained from them are not satisfactory in strength and/or in water absorption. The higher cooking pressure has produced stronger boards with better water resistance property than those made under 7 kg/cm² pressure except in cooks no. B 5/2 and B 6/1. The average MOR is maximum at 1½ hours cooking time but the boards are least water-resistant as indicated by higher water-absorption and thickness swelling values. There is, however, no proper information as to make out a pattern of changes of board properties with the cooking time at any given freeness level.

From Table 2, it would appear that the cold soda boards are of almost equal strength to those made by steaming process but definitely much inferior in water resistance properties. cook no. BC_6 produced the strongest board (MOR 329 kg/cm²) with very high water absorption and thickness swelling values.

CONCLUSIONS

Baruna boards are moderately strong. Cold soda boards are more hygroscopic than the boards made by steaming process. Both kinds of boards fall short of the physical property requirements for untreated class I (type 1) 0.3 cm S–1–S hardboard which are as follows : MOR (minimum) 387 kg/cm², water absorption (maximum) 20% and thickness swelling (maximum) 16% (Anon. 1955). Freeness of both kinds of pulps is beyond the commercially acceptable range.

It is, however, not unlikely that quality boards can be made from Baruna by using sizing materials and additives. Also higher temperature pressing schedule may greatly improve both strength and water resistance properties of the boards (Schwartz and Baird 1950). Further studies based on proper experimental design and under proper experimental conditions are needed for the purpose.

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