SUITABILITY OF VILLAGE TREE SPECIES OF BANGLADESH FOR HARDBOARD MANUFACTURE

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ABSTRACT

Nine tree species growing in the villages of Bangladesh were studied to determine their suitability for making hardboard. Hardboards were made on defiberizing the pre-steamed chips mechanically. Strength and water-resistance properties of the boards were determined. It was found that none of the species could make hardboards good enough to meet the requirements of Class-1 hardboard of the US Hardboard Association Specifications. Nevertheless, all the species except neem, produced good, or even better, hardboards compared with sundri used in Khulna Hardboard Mills.

সারসংক্ষেপ

হার্ডবোর্ড তৈরীর যোগ্যতা নিরূপণের জন্য বাংলাদেশের নয়টি গ্রামীণ বৃক্ষপ্রজাতির গুণাগুণ পরীক্ষা করা হয়েছে। এ সকল বৃক্ষপ্রজাতির বাষ্পসিদ্ধ কুঁচি হতে যান্ত্রিক পদ্ধতিতে মণ্ড প্রস্তুত করে হার্ডবোর্ড তৈয়ার করা হয়েছে। পরীক্ষা করে দেখা যায়, হার্ডবোর্ডগুলি প্রথম শ্রেণীর মান সম্পন্ন নয়। তবে একমাত্র 'নিম' ব্যতীত অন্য সকল প্রজাতি হতে খুলনা হার্ডবোর্ড মিলস-এ উৎপাদিত সুন্দরী বৃক্ষের হার্ডবোর্ড এর সমান মান সম্পন্ন বা উৎকৃষ্ট হার্ডবোর্ড তৈয়ার করা সম্ভব।

Keywords : Bangladesh, hardboard, village trees

INTRODUCTION

A large number of tree species growing in the villages of Bangladesh substantially contribute to the country's need. The village tree species constitute a potential source of fuelwood and timber. In fact, village supply of fuelwood and timber far exceeds that of our small forest cover. There occur more than 150 village tree species in Bangladesh (Das 1991), of which only a few are being traditionally used in saw-milling and other woodworking industries. The rest are mainly used as fuelwood or under-utilised by being often put to wrong uses because of their less known characteristics. But an ever-increasing demand of wood coupled with scanty forest supply calls for both maximum

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output and more profitable use of these secondary village species.

Wood is the most important fibrous raw material source for paper, board and rayon industries. There exists an acute worldwide shortage of wood posing a serious threat to these industries. This is more true for Bangladesh. Pulp and paper mills, and specially the only hardboard mill, of Bangladesh have been facing problems due to shortage of pulpwood over the past few years. In the circumstances, the village grown wood species hold a good prospect of being more profitably utilised in these industries. The present work, therefore, aims at investigating the qualities of nine village tree species for hardboard manufacture.

MATERIALS AND METHOD

Pulping

Logs of mango (*Mangifera indica*), jackfruit (*Artocarpus heterophyllus*), neem (*Azadirachta indica*), raintree (*Samanea saman*), babla (*Acacia nilotica*), shisham (*Dalbergia sissoo*), pannya mandar (*Erythrina fusca*), mandar (*Erythrina orientalis*) and tentul (*Tamarindus indica*) were swan and chipped in a Murray chipper. The chips were air dried and cooked in steam for one hour in laboratory model rotary digesters at 10kg/cm^2 pressure. The steamed chips were then defiberized in a single rotating disc attrition mill using a stream-of water at room temperature. Attempts were made to obtain pulps at three different freenesses from each species by varying the plate clearance of the attrition mill.

Hardboard making

Mats were formed in a matformer-cum-freeness tester from 10 litre volume of pulp slurries, each containing 128 g oven dry pulp in water, and the pulp freeness was noted everytime. The consistency of the pulp slurry was such that the mat would ultimately make a hardboard disc of about 21.6 cm diameter, 3.175 mm nominal thickness and nearly 1040 kg/m^3 density.

The mats were cold pressed to remove excess water prior to hot pressing. The prepressed mats were finally consolidated between the cauls of a hydraulic hotpress at about 190^{0}C temperature and 35kg/cm^2 pressure. Hot pressing was done for 6 minutes including a one minute breathing time at a low pressure of 7 kg/cm^2 after the first 2 minutes to allow the entrapped steam to escape from inside the mat. Also a 20 mesh wire net was placed underneath the mat to ease water removal during pressing. Thus wet-felted smooth one side (S-1-S) hardboard discs were made with all the species.

Board Testing

At least 15 boards, taking 5 boards from each of the three pulps made with a species were tested. Test samples of 12.7 cm X 5.08 cm size were prepared and conditioned for 72 hours at 50 $\pm$ 1% R. H. and 23 $\pm$ 2^{0}C temperature in a humidity control room. Modulus of rupture (MOR) was determined by static bending process and water absorption tests were done with the samples according to ASTM procedures (Anon. 1954).

RESULTS AND DISCUSSION

Two important properties, i. e., strength and water-resistance, of the hardboards were evaluated by determining MOR, water intake and thickness swelling. The results are given in Table 1. These properties have been compared with that of US Hardboard Association Specifications for Class-1 hardboard. Properties of sundri hardboards (Khan and Shafi 1988) made by the same process have also been referred to for comparing the

species with sundri wood, the latter being the chief raw material for locally manufactured hardboards in the Khulna Hardboard Mills. It may be metioned that pulp freeness is an important consideration in the manufacturing process and a freeness value exceeding 40 seconds (defibrator freeness) would ordinarily make a pulp unsuitable for industrial purpose (Lyall 1969). Hardboards made only from the pulps having freeness values within the acceptable limit have, therefore, been considered for comparison.

It is seen from Table 1 that none of the species under study could produce hardboards good enough to meet the requirements of Class-1 hardboard specified by the US Hardboard Association. They all fell short of both strength and water-resistance properties. The only exception is the thickness swelling of the boards of raintree, neem, shisham, pannya mandar and tentul which compares favourably with the above specification. All the species except neem were, however, found to make better boards than sundri wood. Neem produced too weak boards. Tentul pulps were too slow-draining but the hardboards made from them were strong and water resistant.

It needs to be mentioned that besides the characteristics of the tree species, pulping process and other manufacturing variables affect the properties of hardboards. By applying a pulping process and variables other than the ones followed in this experiment, it may be possible to make stronger hardboards with these species. Since the objective of this study was confined to an investigation of the inherent properties of the species only, attempts were not made to select a process that would give the best boards. Hence the results of this work will not suffice to conclude that the species under study are not suitable to make class-1 hardboards. On the other hand, it can safely be stated that they possess the necessary properties for making hardboards as good as, or even better than, sundri. Thus the species, except neem, are suitable for hardboard making in the context of Bangladesh.

The following is a short description of the characteristics of the individual species with special reference to sundri.

Mango	:	The pulps tend to be somewhat slow draining. Hardboards are strong and fairly water resistant.
Jackfruit	:	The pulps are fairly free. Strong boards can be made only from fine grade pulps which are a bit slow-draining. The boards are fairly water resistant.
Mandar	:	The species being a light hardwood, it produces fluffy mass of quite free pulps. The boards are bright coloured and strong but not water resistant.
Neem	:	The pulps are fairly free and dark producing hardboards of almost no strength.
Raintree	:	The pulps are slow draining capable of making fairly strong and water resistant hardboards from less free finer grade pulps.
Babla	:	The pulps are fairly free. The hardboards are sufficiently strong and fairly water resistant.
Shisham	:	The pulps are free and make strong hardboards with good water resistance properties.
Pannya mandar	:	The pulps are quite free giving strong and fairly water resistant hardboards.
Tentul	:	The pulps are too slow draining. The hardboards are, however, strong and water resistant.

Table 1. Strength and water resistance properties of hardboards made from village tree species.

Species	Pulp freeness (seconds)	Modulus of rupture (MOR) kg/cm^2	Water absorption	
			Change in weight (%)	Change in thickness (%)
Mango	54	308.0	48	24
	36	283.0	47	23
	26	216.0	50	28
Jackfruit	40	258.0	47	21
	28	209.0	46	22
	25	168.0	45	20
Mander	33	267.0	64	35
	31	264.0	59	39
	19	251.0	59	42
Neem	43	142.0	34	15
	31	46.0	35	13
	22	23.0	34	15
Raintree	57	261.0	41	17
	36	189.0	41	16
	34	172.0	40	15
Babla	44	385.0	47	27
	27	284.0	50	28
	24	244.0	51	30
Shisham	33	292.0	35	18
	30	259.0	33	17
	28	232.0	35	19
Pannya mander	23	305.0	43	18
	18	265.0	44	18
	15	217.0	40	17
Tentul	75	276.0	35	19
	60	217.0	33	17
	42	179.0	32	16
Sundri	35	175.0	60	27
US Hardboard Association Specification for Class-1 hardboard	-	352.0	20	16

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