RAJ KOROI (*ALBIZIA RICHARDIANA* KING & PRAIN*)* AS RAW MATERIAL FOR PLYWOOD & PARTICLE BOARD MANUFACTURE

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ABSTRACT

Rajkoroi (*Albizia richardiana*) wood has been studied for assessing it suitability for plywood and particleboard manufacture. It was found that 1.5 mm thick smooth and figured veneer can be peeled and dried easily. Three-ply plywood were made using veneer of this species bonded with liquid urea formaldehyde glue of 50% solid content extended with wheat flour and catalyzed with 2% hardener (ammonium chloride) under the three specific pressures, viz,1.05 N/mm^2, 1.40 N/mm^2, 1.76 N/mm^2 in three replications at 6 minute press time and 120°C press temperature. Dry and wet shear test were conducted on the plywood samples and their shear load at failure per unit area and percentage of wood failure were determined. 1.05 N/mm^2 pressure for the manufacture of ply wood was found to be the best. Particle board was manufactured from the chips of obtained from wasted veneer pieces using 10% UF resin glue (solid content) on the oven dried weight of the chip. The particleboards were tested for determining the strength and dimensional stability. The tensile strength passed the British and German standard specification, bending strength was found nearest to Indian Standard but not met with German and British standard specification.

Key words: Rajkoroi, particleboard, modulus of rupture, internal bond strength, urea formaldehyde, ammonium chloride, hardener.

INTRODUCTION

Wood is one of the earth's most valuable resources and it conforms to the most varied requirements. Bangladesh has only 17% forest areas which are very limited compared to its demand (BSS, 2011). The forest of Bangladesh have nearly 500 hard wood species but only 55 species are at present being used for the manufacture of different composite wood products (Anon, 1984). Wood composites represent one of the most challenging product groups in the world from a marketing point of view because of their number, versatility, end-use variation, dissimilarities of the producer base and resource richness. Today, composite industries can play an important role in earning a lot of foreign exchange by importing world class panel products and in developing socio-economic condition of rural people involved in collecting, processing and manufacturing of composite products. Composite products are stronger than or as strong as the original tree (Williston, 1958). Global production of plywood in 2002 was estimated to 56 million cubic meters (Dinwiddie and Enjily, 2004a). The production of wood-based panels in 2004 was 2, 25,106 m^3 plywood -70,000 m^3

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(Asia-40,000 m^3), particleboard 95,000 m^3 fiberboard -45,000 m^3 (Aderholt and al, 2006, FAOSTAT database 2005). The share of plywood in the European (without Russia) wood based panels production in 2005 reached around 6%, that is , about 3.6 million m^3 (Dory 2006).

Rajkoroi *(Albizia richardiana)* is very fast growing tree with smooth well-shaped stem. It is locally known as rajkoroi, chambole and gagan-shrish(*Khatun,*1987). The wood is light yellow in colour. Sapwood and heartwood are indistinguishable. The species had been planted as roadside tree and also in parks and gardens in Bangladesh (Das, 1990). A good number of Rajkoroi tree species have become matured for harvesting both in private and public land (Z. Islam et al, 2012). This is an exotic tree species from Madagascar (Africa) and largely available in Bagerhat, Barisal, Jhalakathi, Madaripur, Pirojpur district and in small patches in other district of Bangladesh. It is used for cheap furniture and boat making (Das and Alam, 2001). The wood of rajkoroi may be an alternative new source of raw material for plywood and Particleboard industries to increase its economic value and reduce pressure on other species.

MATERIALS AND METHODS

Log peeling

Logs of rajkoroi (*Albizia richardiana*) were collected from Barisal. The logs were straight and cylindrical and free from natural defects. The bolts were peeled to 1.5 mm target thickness in a Coe-Veneer Lathe machine with knife angle at 91°-15''. Recovery of veneer was calculated. Veneer thickness, veneer quality, grain pattern, colors; smoothness, etc was observed carefully.

Shrinkage of veneer

The moisture of the green veneers was found out by moisture determination balance. The green veneers were dried in the industrial batch oven at temperature of 100°C and after drying the moisture content of veneer was 8%. The randomized sheets of size 500 mm x 500 mm veneers were used to determine the percentage shrinkage in three directions, viz; longitudinal, tangential and radial. The dried veneers were used for gluing studies.

Plywood making and testing

The veneer was clipped to 600mm x 600mm size. Liquid urea formaldehyde glue of 50% solid content, catalyzed with 2% ammonium chloride and extended with 20% wheat flour was used to prepare 3-ply plywood. The plywood panels were manufactured at three specific pressures viz., 1.05 N/mm^2, 1.40 N/mm^2 and 1.76 N/mm^2, applying 6 minutes press time for each specific

pressure and a constant temperature of 120°C. These were conditioned at 65±5% relative humidity and 20±2°C temperature. The dry shear tests of the plywood were measured. The wet shear tests of samples were measured by 24 hours soaking in water at room temperature. The shear load at failure and the percentage of wood failure were determined.

Particle board making and testing

The wastage of dry veneers was hammer milled to chips and seived through mesh screen (No.20) to remove dust and fines. The chips were dried to 4 to 5% moisture content. Five-single layer particleboard of size 500 mm × 500 mm × 12 mm having a target density of 750 kg/m^3 were made in the laboratory hot press. The temperature of the platens of the hot press was maintained at 140°C. Ten percent solid content of liquid urea formaldehyde glue based on oven dry chips was used in the particleboard manufacture. The liquid urea formaldehyde was catalyzed with 2% ammonium chloride. The mats of the board were formed manually in wooden fabricated bordered frame. Then the mats were pressed initially at 3.56 N/mm^2 for 6 minutes. The pressure was then lowered in two steps, firstly 1.05 N/mm^2 for 4 minutes and then 0.35 N/mm^2 for 2 minutes. The boards were then conditioned at 65±5% relative humidity and 20±2°C temperature before they were put to tests. The particleboards were cut into tests specimens. The static bending tests (modulus of rupture in bending) was carried out according to Indian specification of IS: 2380 (Anon 1977) with a constant loading speed of the testing machine at 12 mm/minutes. The tensile strength perpendicular to the surface was also carried out according to the Indian specification of IS: 2380 (Anon 1977) with the exception that wooden blocks of 75 mm× 25 mm were glued in cold press with the test specimens. Three specimens of size 100 mm × 100 mm were taken from each board to determine thickness swelling and water absorption. The thickness of the specimens was measured with the platform type thickness gauge with an accuracy of 0.01 mm. The test specimens were immersed in 25 mm depth of cold water at room temperature. At the end of 2 hours and 24 hours the test specimens were withdrawn from water at room temperature, wiped with a damp cloth, reweighed and re-measured the thickness as before. The percentage of water absorption and thickness swelling were then calculated.

RESULTS AND DISCUSSION

The results of peeling studies of *A. richardiana* including veneer characteristics and relative suitability of veneer are given Table 1. The bolts were almost cylindrical with no natural defects. The bolts were peeled smoothly and easily. The surface of the veneer sheet was smooth and no raising of grains were seen. The result of drying and shrinkage of veneer are given in Table 2. Veneers were dried easily but when sun dried, warping of veneer occurred. The load at

failure of dry and wet shear test and the percentage of wood failure at three specific pressures, viz, 1.05 N/mm^2**,** 1.40 N/mm^2 and 1.76 N/mm^2 are given in Table 3. Maximum wood failure found in dry shear test was 45% at 1.05 N/mm^2 specific pressures indicating strong bonds but after 24 hour soaking in cold water (ambient condition) the sample gave maximum wood failure (32%).

Different physical and mechanical properties of particleboard made with the chips of *A. richardiana* and the different standards are illustrated in Table 4. Medium density particle board has the highest bending strength nearest to the Indian IS 3087 (Anon, 1985) Standards but does not meet the requirement of German Din: 68761 (Verkor and Ledune 1975) and British BS: 5669 (Anon, 1979) Standard. The tensile strength is higher than the minimum standard requirement of German and British Standards but does not meet the requirement of Indian Standard. The tensile strength indicates stronger bonding property. Thickness swelling and water absorption of *A. richardiana* particle board requirements to meet the Indian Standard. On the other hand, the thickness swelling values after two hours immersion did not confirm to the German Standard.

Table 1. Result of peeling study of *Albizia richardiana*

Pre treatment	Ease of cutting	Veneer characteristics	Veneer recovery (%)	Relative suitability		
				Commercial	Decorative	Inner ply
Log were peeled at cold condition	Peeled easily	Sapwood and heartwood light yellow in colored and indistinguishable. No fuzziness of veneers were occurred.	65-70	*	-	*

* Well suited for those products.

Table 2. Shrinkage properties of dried veneer at 8% target moisture content.

Average green moisture content (%)	Shrinkage (%)			Remarks
	Tangential	Radial	Longitudinal	
48	5.55	4.83	0.38	Veneers were dried easily but when sun dried, warping of veneer occurred.

Table 3. Results of gluing studies of *Albizia richardiana*

Test	Specific pressure of plywood manufacture					
	1.05 N/mm^2	SD	1.40 N/mm^2	SD	1.76N/mm^2	SD
Average load at failure of dry shear test (N/mm^2)	2.48	0.30	2.18	0.38	1.69	0.27
Percentage of wood failure of dry shear test (%)	45	-	42	-	40	-
Average load at failure of wet shear test (N/mm^2)	1.25	0.22	1.12	0.25	1.02	0.20
Percentage of wood failure of wet shear test (%)	32	-	28	-	23	-

Table 4. Strength properties of particleboard made from *Albizia richardiana*

Standards compared with	Thickness of particle board (mm)	Density of particle board (kg/m^3)	Static bending strength (N/mm^2) (MOR)	Tensile Strength (N/mm^2)	Thickness Swelling (%)		Water Absorption (%)	
					2hr	24hr	2hr	24hr
	14.85	Avg. 750 SD. 15.00	Avg.10.8 SD. 1.31	Avg.0.56 SD. 0.22	Avg. 10 SD.1.68	Avg.32 SD.5.45	Avg.25 SD.3.57	Avg.48 SD.7.72
IS Specification 3087(Anon.1985b)	6-40	500-900	11.2	0.80	10	-	25	50
German standard Din 68761 (Verkor1975)	13-20	600-750	18.0	0.35	Max 6	-	-	-
BS Specification 5669 (Anon.1797)	6-19		14.0	0.34	12 (for 1hr soaking)	-	-	-

CONCLUSIONS

Rajkoroi woods peels easily and produces the quality veneer, which can be used to manufacture commercial plywood for general use. Particle board made of chips from wastage of dried veneer of the same species Rajkoroi can also be used conventionally.

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