Short Communication

Suitability of Acacia hybrid for making hardboard

Nazma Khatun , M. Misbahuddin, U. Roy and Daisy Biswas
Bangladesh Forest Research Institute,
P.O.Box 273, Chittagong-4000, Bangladesh

Keywords: *Acacia hybrid,* hardboard, steamed chips, chemically treated.

The Acacia hybrid, a cross between Acacia mangium and Acacia auriculiformis, grows in Indonesia, Malaysia, Thailand, Vietnam, and China (Kha 2000; Kijkar 1992; Rufelds 1987, 1988). At present forest department and local people of Bangladesh have been planting thousands of hectares of these species. Acacia hybrid is a fast growing medium sized leguminous tree. The species is more productive than either of the parent species. The wood density is slightly higher than A. mangium, and moreover the shape of the log is almost completely round, which renders Acacia hybrid as a valuable and excellent source of timber (Jusoh et.al 2014). In Bangladesh it has very limited use. Due to this Bangladesh Forest Research Institute has been conducting research to determine its end use for efficient utilization. Scientists found that the species is fine grained and may be used for making furniture, small hand tools, cabinet door frame, window frame and pulp and paper (Rokeya et.al 2010). It peels easily and produces the best quality veneer which can be used for decorative purpose, plywood for general use and particleboard (Rahaman et.al 2012). To this end, hardboard making study is undertaken for knowing the suitability of the species.

Acacia hybrid logs were procured from Banshkhali, Chattogram. The freshly cut Acacia hybrid logs were debarked and sawn to 10 cm X 10 cm X 100 cm size. Then these were chipped in the laboratory model Murray chipper machine and screened to remove oversized and pin chips. In addition, the knots, barks and decayed wood chips were removed. The defect free chips were then air dried. The Acacia hybrid chips were cooked by steaming and different chemical pretreatment process. By the steaming process, chips were cooked in laboratory model stainless steel rotary digesters where the digester pressure was 7.03 and 10.55 kg/cm^2. The digesting time was 30, 60 and 90 minutes for each pressure. In the chemical pretreatment process, chips were soaked in 1% NaOH, 2% NaOH, 3% NaOH, 3% Na2SO3 and mixture of 3% (NaOH and Na2SO3) solution under atmospheric pressure for 24 hours soaking time. The chips (steamed and chemically treated) were then refined in a single rotating disk attrition mill at different plate clearances. Three pulps of different freeness were made from each cook. For the preparation of hardboard, at first 10 litre volume of slurry was made from 128 g oven dry pulp in water. Pulp freeness was recorded in the freeness tester each time. Mat was formed after dewatering of water from the freeness tester. The mat was then pressed in cold press to reduce the thickness and remove excess water. At last the cold- pressed mat was compressed between the cauls of a hydraulic hot press at about 190°C. The pressing time was six minutes where first two minutes pressure at 35 kg/cm2 then one minute breathing at 7 kg/cm2 and last three minutes again pressed at 35 kg/cm2. Thus S-1-S (smooth in

one side) hardboards were made. At least five boards of each pulp were prepared for sampling in size 12.7 cm x 5.08 cm. Three samples were obtained from each board. Test samples were conditioned at 50 ± 2 % relative humidity and 23 ± 1°C temperature in a humidity control room. Strength properties (MOR) of the boards were determined by static bending process and water absorptions were measured according to ASTM standards (Anon 1954). Five boards of each pulp were tested. The average values against pulp freeness are shown in Table 1 and 2.

Table 1. Strength and water resistant properties of steamed hardboard made from Acacia hybrid wood chips.

Species	Cooking condition		Freeness in seconds	Modulus of rupture(MOR) kg/cm^2	Water absorption (%)	
	Digester pressure (kg/cm^2)	Steaming time (minute)			Change in weight	Change in thickness
Acacia hybrid	7.03	30	19	38	38	87
			21	45	47	46
			25	45	81	59
		60	21	58	39	29
			22	59	43	30
			23	59	77	50
		90	29	80	17	11
			29	87	16	11
			30	112	13	9
	10.55	30	18	31	123	78
			21	35	109	74
			35	80	12	13
		60	23	53	60	43
			24	48	77	57
			25	61	58	43
		90	20	54	38	28
			20	46	31	27
			21	64	56	39
[1]Sundri		60	35	175	60	16

[1]Khan and Shafi 1988

It may be mentioned that pulp freeness is an important consideration in the manufacturing process, and a freeness value exceeding 40 seconds (defibrator freeness) is ordinarily unacceptable for industrial purpose (Lyall 1969). From Table 1 it is seen that the boards were not strong. But the boards made from the pulps under 7.03 kg/cm2 digester pressure and 90 minute steaming time was moderately strong. Pre-treatments with NaOH and that with mixtures of NaOH and Na2SO3 produced boards with better strength property shown in Table 2. It is also seen that strength properties (MOR) were increased with increasing the chemical concentration. But the boards obtained from pre-treatment with Na2SO3 alone were very weak.

Water resistance is another important property expressed in terms of the amount of water absorbed by the samples and their thickness swelling. These values were very poor of pre- treatment boards compared to those made by steam- softening of the chips. The hardboard made from the pulps under 7.03 kg/cm2 digester pressure and 90 minute steaming time was fairly water resistant.

Table 2. Strength and water resistant properties of hardboard made from chemically treated Acacia hybrid wood chips.

Species	Chemicals	Freeness in seconds	Modulus of rupture(MOR) kg/cm^2	Water absorption (%)	
				Change in weight	Change in thickness
Acacia hybrid	1% NaOH	31	92	126	93
		34	153	117	86
		40	183	107	79
	2% NaOH	30	137	128	95
		30	170	120	90
		32	180	127	94
	3% NaOH	28	129	136	105
		30	179	130	96
		31	185	122	74
	3% Na_2SO_3	23	35	131	94
		32	42	121	91
		42	54	100	81
	3% Mixture NaOH+Na_2SO_3	39	198	117	85
		40	199	125	90
		41	206	125	93
[1]Sundri	3% NaOH	35	395	143	112

[1]Khan and Shafi 1988

As compared to sundri , which was used in Khulna Hardboard Mills, hardboards made with Acacia hybrid are found to be inferior. The strength MOR is comparatively poor at the same freeness level of good stock. Hence it can be inferred that boards made from Acacia hybrid is less suitable compared to sundri. However, there is scope to improve properties by using additives, sizing materials and heat treatment etc.

References

Le Dinh Kha (2000). Studies on natural hybrids of Acacia *mangium* and A. *auriculiformis* in Vietnam. *Journal of Tropical Forest Science.* Vol. 12, No. 4, pp. 794-803

Kijkar S. (1992): Handbook: Vegetative Propagation of *Acacia mangium* × *Acacia auriculiformis* ASEAN-Canada Forest Tree Seed Centre: 19.

Rufelds, C.W.1987.Quantitative Comparison of *Acacia mangium* Willd. Versus Hybrid A. *auriculiformis.* Forest Research Centre Publication 40.Sabah, Malaysia.22 pp.

Rufelds, C. W. 1988. *Acacia mangium* and A. *auriculiformis* and Hybrid A. auriculiformis Seedling Morphology Study. Forest Research Centre Publication 41.Sabah, Malaysia. 109 pp.

Anon. 1954. Evaluating properties of building boards D- 1036-52T, ASTM

Lyall, J.D. 1969. Structural board, Pulp and Paper Manufacture, Vol.II (2nd Edition). Ed. Ronald G. Medonald. P. 422

Khan, M.S. and Shafi, M., 1988. Effect of chemical pre-treatment of sundri wood chips in making hardboard. *Bano Biggyan Patrika* 17 (1 & 2) : 1-7

Ismail Jusoh; Farawahida Abu Zaharin and Nur Syazni Adam 2014. Wood quality of *Acacia* hybrid and second generation *Acacia mangium. BioResources* 9(1) : 150-160.

Rokeya, U.K.; Akter Hossain, M.; Rowson Ali, M. and Paul, S.P. 2010. Physical and mechanical properties of (*Acacia auriculiformis* x *A. mangium*) hybrid *Acacia. Journal of Bangladesh Academy of Science.* Vol.34.(2) : 181-187.

Rahaman, M.M.; Akhter,K.; Biswas, D and Sheikh, M.W.2012 .Suitability of hybrid Acacia wood for manufacturing plywood and particleboard. *Journal of Bangladesh Academy of Science.* Vol.36 (2) 171-176.