Print : ISSN 0970-7662

Journal of Tree Sciences
online available at www.ists.in

Volume 34 No.2 December, 2015

Suitability of Combination Plywood from *Melia composita* and *Populus deltoides* and Effect of Curing Pressure on Their Glue Shear Strength

Ismita Nautiyal and Shilpa Gautam*

Forest Products Division, Forest Research Institute, P.O. New Forest, Dehradun-248006.

** Biodiversity and Climate Change Division, Indian Council of Forestry Research and Education, P.O. New Forest, Dehradun-248006.*

Key words:

Combination Plywood, Glue shear strength, Poplar, Melia

ABSTRACT

Melia composita, a promising agro-forestry species is considered to be a money spinning tree of short rotation. The species has recently been identified as one of the best raw material for the manufacture of plywood as both face and core veneer. The study was carried out on preparation of plywood with different combinations of *Populus deltoides* (P) and *Melia composita* (M). Effect of two pressure levels viz. 14. 0 kg/cm^2 and 17.5 kg/cm^2 and four combinations (PMP, MPM, PMPMP and MPMPM) on the laboratory manufactured plywood were studied. The dry and wet glue shear strength at all combinations passed Indian standard IS: 303 except the wet glue shear strength for MPMPM combination. In general no pressure effect could be observed for the glue shear strength of the combinations.

INTRODUCTION

Melia composita Willd. (*Melia dubia* Cav.) commonly known as white cedar or Malabar neem wood, belonging to family Meliaceae, is a fast growing, light demanding deciduous tree having a strong potential for reforestation and agroforestry purposes. It is a handsome tree used as a shade tree in avenue plantations. It is also used for afforestation purposes due to its fast growth. The trees can be planted as single crop or as an agroforestry tree on bunds or with inter-cropping among coconut trees, ground nut, black gram and green gram. It performs well as a bund plant for Casuarinas, Banana, drumstick and sugarcane plantations and mango orchards. The tree supports cultivation of tomato and turmeric underneath. It is also grown as a shade tree in coffee and tea plantation. Apart from environmental benefit, it fetches handsome market price, assured buyback with minimal maintenance expenditure. (www.thehindu.com) *Melia composita* an important multipurpose fast growing tree species is a boon to wood industries and agroforestry practitioner's. This species is suitable for production of veneers, plywood and matches.

Plywood industry in India is facing severe shortage of timber due to existing forest management policies and total ban on felling of trees in the natural forests. Non-availability of

conventional timbers had diverted the attention of plywood industries towards the utilization of plantation timbers and other lesser known timbers for making plywood. In India, plywood is manufactured mainly from plantation timbers like poplar and eucalyptus. Their large scale plantations are being raised in different parts of country. However, these species have certain limitations. It has, therefore, become essential to look for other fast growing tree species and explore their suitability for plywood.

Melia composita has been identified as an important fast growing secondary species suitable for the manufacture of plywood Uday et al. 2011. Apart from problem of raw material shortage it has been found that plywood made of a single wood species has some drawbacks too. The plywoods of imported species like birch are better looking in appearance but expensive. The plywoods of poplar and eucalyptus are economical but are not so appealing for face and back veneers. To achieve economical and good looking plywood and to effectively utilize the raw material, combi-ply could be made. Combi-ply is plywood which is made up of combination of two or more wood species. Combi-plywood has lot of advantages and can meet requirements for construction, joinery, furniture and transport industries where high strength throughout plywood is not required. Combi-ply using poplar and eucalyptus has already been developed. (khali et al. 2005, 2006)

The present study was carried out to investigate the suitability of *Melia composita* for manufacture plywood in combination with poplar. The suitability of poplar for plywood has already been established. khali et al. 2006a, 2006b). This study will help us to explore suitability of *Melia composita,* with other species to develop new combinations of plywood.

MATERIALS AND METHODS

Logs of *Populus deltoides* (Poplar) and *Melia composita* were peeled and veneers of 2.00 mm thickness were obtained and dried to 8- 10 % moisture content. The dried veneers were utilized for making 3-ply and 5-ply boards, using Phenol Formaldehyde by standard method Anonymous 1989 (IS: 303-1989). The amount of glue applied was about 110 gm/m^2 in single glue spread on solid basis. The experiments were carried out to prepare plywood using combinations Poplar-Melia-Poplar (PMP) and Melia-Poplar-Melia (MPM). Plywood boards of each combination were pressed in hot press at 150° C at two different pressure levels viz. 14.0 kg/cm^2 and 17.5 kg/cm^2. The duration of pressing (11 minutes) was kept constant. The boards were conditioned at room temperature. Standard size test samples were prepared from these boards for glue shear strength test as per IS: 1734 (Anonymous 1983). The glue adhesion test was conducted under two different conditions viz. glue shear strength test in Dry state and water resistance test.

Six samples for each test were taken from each board. The dimensions of all the test samples were in accordance with IS: 1734 (Part-4). In the glue Shear strength test in Dry state (IS: 1734 (Part -4)) the tenacity of the bonding material is estimated. Six samples were conditioned at room temperature (27± 5°C). The maximum load at the time of complete failure of each specimen along with the extent of glue shear failure (percentage) was recorded.

The Water resistance test (IS: 1734 (Part -6)) was also used to determine the water resistance of plywood. For BWR (Boiling Water Resistance) grade, the samples were submerged in boiling water for a period of 8 hours. The wet sample pieces were then subjected to glue shear strength test.

One-way Analysis of variance (ANOVA) was carried out to find out the effect of the two pressure levels used in the study on all combinations.

RESULTS AND DISCUSSION

The study was carried out for Glue shear strength of two combinations of 3-ply (PMP and MPM) and two combinations of 5-ply (PMPMPMP and MPMPMP) in dry and wet state samples. For general purpose plywood (BWR grade), glue shear strength average minimum values for dry test and water resistance test should be 135 kg and 100 kg

respectively as per IS: 303. Density of plywood for all four combinations ranged from 0.5 to 0.57 kg/m$^{3.}$

Glue Shear Strength of dry and wet samples at two pressure levels

It was observed that for PMP combination, average glue shear strength at both pressure levels for both dry samples as well as wet samples met IS: 303 (1989) standard except for wet samples at 14.0 kg/cm^2. For wet samples glue shear strength at 17.5 kg/cm^{2}was 109 kg and at 14.0 kg/cm^{2}it was 95 kg (Table 1). In MPM combination, at both the pressure levels, average glue shear strength for dry and wet samples met IS: 303 (1989) (Table 1). In PMPMP combination, at both the pressure levels (Table 1), average glue shear strength for dry samples and wet samples met average minimum value as per IS: 303 (1989). In MPMPM combination, at both the pressure levels, average glue shear strength for dry samples meet average minimum value as per IS: 303 (1989) . It can also be seen that in water resistance test, average glue shear strength (Table 1), at both the pressure levels did not satisfy IS: 303 (1989).

Table 1. Glue shear strength of wet and dry samples and two pressure levels

S. No	combination	Ply Size Inches	Resin	Pres sure (Kg/cm^2)	Average density	Average glue shear strength	
						Dry condition FL (Kg)	Wet condition FL (Kg)
1.	P-M-P	15x15		14.0	0.50	139	95
2.	P-M-P	15x15		17.5	0.57	139	109
3.	M-P-M			14.0	0.50	135	108
4.	M-P-M			17.5	0.57	158	108
			PF				
5.	P-M-P-M-P			14.0	0.50	150	118
6.	P-M-P-M-P			17.5	0.57	146	108
7.	M-P-M-P-M			14.0	0.50	141	80
8.	M-P-M-P-M			17.5	0.57	146	96

Effect of Pressure levels on dry and wet Glue shear Strength

The two pressures used in the study did not exhibit significant differences in the DGSS and WGSS for all four combinations except for WGSS of PMP combination (Table 2). Thus it may be inferred that pressures of 14.0 kg/cm^2 and 17.5 kg/cm^2 are equally good for DGSS and WGSS in all combinations.

Table 2. Significant values for different combinations

Combination	Source of variation	df	Mean Square	F	Table value
PMP (DGSS)	Pressure levels	1	0.242	0.001	0.970
	Error	18	165.026		
PMP (WGSS)	Pressure levels	1	911.250*	6.463	0.020
	Error	18	140.994		
MPM (DGSS)	Pressure level	1	2622.050	3.375	0.083
	Error	18	776.806		
MPM (WGSS)	Pressure level	1	0.057	0.000	0.994
	Error	15	928.676		
PMPMP (DGSS)	Pressure levels	1	63.375	0.100	0.755
	Error	22	632.511		
PMPMP(WGSS)	Pressure levels	2	365.659	0.860	0.438
	Error	21	425.390		
MPMPM (DGSS)	Pressure levels	1	1566.482	4.520	0.055
	Error	12	346.531		
MPMPM(WGSS)	Pressure levels	1	1568.167	3.999	0.058
	Error	22	392.167		

***significant at level 0.05**

CONCLUSION

Study was carried out to understand the suitability of combination plywood (BWR grade) from *Melia composita* and *Populus deltoids*. It was observed that all four combinations performed equally well and met IS: 303 (1989) except for WGSS for PMP and MPMPM combination. The findings of the study indicate that pressure was not significantly affecting GSS for dry and wet samples in the four combinations.

REFERENCES

Anonymous. 1983. Method of test for plywood, IS:1734 (Part 1 to 20), Bureau of Indian Standards, New Delhi.

Anonymous. 1989. Specification for plywood for general purposes. IS: 303, Bureau of Indian

Standards, New Delhi.

Khali D.P., Anil Negi and Singh J.P. 2005. Combi Plywood for General Purpose (interior grade) of Plantation Species – Eucalyptus hybrid, *Populus deltoides* and *Paulownia fortune*. *Journal of Timber Development Association of India*. 51(1-2): 43-50.

Khali D.P., Anil Negi, Singh J.P. and Jain V. K. 2006, Combi Plywood for General Purpose (exterior grade) of Plantation Species – Eucalyptus hybrid, *Populus deltoides* and *Paulownia fortunei*. *Journal of Timber Development Association of India.* 52(3 & 4):70-78.

Khali D.P., Anil Negi and Singh J.P. 2006b. Treatment of Combi Plywood of Plantation Species – Eucalyptus hybrid, *Populus deltoides* and *Paulownia fortunei* with Water Borne Preservatives. *Journal of Timber Development Association of India*. 52 (3 & 4): 64-69.

Uday D. N., Sujatha D and Pandey C. N. 2011. Suitability of *Melia dubia* (Malabar neem wood) for plywood manufacture. *Journal of the Indian Academy of Wood Science*. Vol 8(2): 207-211.

www.thehindu.com Prabu M. J. *Melia dubia* tree holds promise of good returns for ryots. The Hindu http://www.thehindu.com/sci-tech / agriculture/melia-dubia-tree-holds-promise-of-good-returns-for-ryots/article228515.ece.