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RESEARCH ARTICLE

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Study on the suitability of *Lantana camara* and *Dendrocalamus strictus* for the manufacturing of cement bonded particle board

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ABSTRACT : Cement bonded wood composites have unique features due to their acceptability among industries. However the compatibility of cement with the wood species is always a major concern due to presence of wood extractive, which might have inhibitory effect on the bonding properties. In the proposed work cement particle boards were prepared using *Lantana camara* and Bamboo spp. (*Dendrocalamus strictus*) at three different ratios *i.e.* 2:1, 2.5:1 and 3:1. The soluble sugar and tannin content present in these species was estimated and their effect on the MOR of cement-lantana bonded boards and cement-bamboo bondedboards was studied. The modulus of rupture was less in case of bamboo boards with high soluble sugar content. Lantana boards performed better strength wise than bamboo boards.

KEY WORDS : Cement bonded particle boards, MOR, Tannin, Soluble sugar

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INTRODUCTION

Cement Particle boards are bio-composites prepared by lignocellulosic material and cement. The compatibility of cement with wood particle play crucial role in strength properties of board, since wood particles have inhibitory effects on boards (Pehanich *et al.,* 2004).One of the major problems of wood that inhibit the development of wood cement bonding is the presence of wood extractives that maydelay cement stiffness, hardening and curing (Wei *et al*., 2003 and Schubert *et al.,* 1990).Various laboratory tests on wood indicated that all woody species are not suitable for making cement bonded composites (Shukla *et al.,* 1982). Liu and Moslemi (1986) concluded that cement has completely loosed its strength on adding simple sugars and some other carbohydrates. Tannins also produced a similar effect (Miller, 1987). Hachemi and Moslemi (1989) studied the correlation between wood cement compatibility and wood extractives using nine

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hardwood and softwood species. The authors indicated that different woods may have the same extractive content but they have different compatibility with cement.Therefore, it is essential to estimate the soluble sugar and tannin present in lignocellulosic materials before preparing cement bonded particle boardsto ensure its suitability. *Lantana camara* is available in many parts of India, which has been recognized as a future threat to ecosystems due to its easy adaptability in different ecosystems and weedy nature (Kohli *et al.,* 2006 and Dogra *et al.,* 2009). However its proper utilization in furniture,toys and articles of household utilityindustries can give a replacement of canefurniture and flourish the wood industries (Kannan *et al.,* 2008). Similarly bamboo has been successfully demonstrated as futuristic raw materials to augment panel product supplies for MDF and Particle boards.It is a need of hour to look some value added products from these easy available species. The study in scientific line can give a new dynamics to the researchers as well as industries. Therefore, the present study of soluble sugar and tannin content in lantana (*Lantana camara*) and bamboo (*Dendrocalamus strictus*) was estimated and its effecton mechanical strength properties was evaluated through testing of Modulus of Rupture.

EXPERIMENTAL METHODS

Board preparation:

Lignocellulosic material *i.e. Lantana camara* and *Dendrocalamus strictus* were collected from Forest Research Institute Campus, Dehradun and further cut into small parts. The material was passed through condux mill to convert them into particles.Particles of both the species were then sieved through 60 meshto get coarse particles and 40 mesh to get fineuniform size particles. The coarse and fineparticles were separated into 2:1 ratios for both the species. Particles were oven dried at 80°C temperaturefor preparing boards. Coarse particles were used in core and the fine particles in the face and back of cement bonded particle board (CBPB).The dried particles were soaked in water for 48hrs before board's preparation. Portland cement (Type IV) was used as a sizing agent.Different proportion of cement: particle ratios 2.0:1.0 (2.34 kg cement and 1.17 kg particles), 2.5:1.0 (2.51kg cement and 1kg particles) and 3.0:1.0 (2.61kg cement and 0.90kg particles) were used to make 21 x 21 inch^2 board. Sodium Silicateat 2% by weight of cement and 2% Aluminum Sulphate were added to reduce heat of hydration and to accelerate the setting of cement. The boards were cold pressed at 28 kg/cm^2 for 6 hours. After pressing, the boards were cured for 6 hours in oven at 50^{0}C temperature. After curing boards were removed and wrapped with cellophane and kept in room temperature (27±2^0 C) for 7 days.

Simultaneously particles of Lantana and bamboo were tested for soluble sugar and tannin.Total soluble sugar present in lantana and bamboo was estimatedby titrimetric method using ferricyanideas per Sharma and Varshney (2012).This method is based on reduction of the residual potassium ferricyanide by potassium iodide.Tannin contents of lantana and bamboo were measured by spectrophotometric method using Folin-Denis as chromogen (Schanderi, 1970).

Total soluble sugar content in lantana and bamboo:

The amount of total soluble sugar present in lantana and bamboo was calculated by the following formula:

Total sugar in 5ml of sample extract (mg) = μ (X + 0.05)

where,

μ = 0.0338

X = Volume of $Na_2S_2O_3$used in blank – Volume used in sample

Table A : Tannic acid concentrations in different absorbance

Concentration (µg)	10	20	30	40	50	60	70	80	90	100
Absorbance (µg/ml)	0.085	0.124	0.166	0.201	0.267	0.308	0.371	0.398	0.447	0.496

Table B : Sample absorbance

Sample	*Lantana camara*	*Dendrocalamus strictus*
S_1	0.059	0.068
S_2	0.069	0.071
S_3	0.074	0.061

Tannin content in lantana and bamboo:

Standard graph (Fig. A) was produced by using 0-100µg tannic acid (Table A). A blank was prepared with water instead of sample.According to standard graph the tannin content was estimated in lantana and bamboo samples (Table B).

Tannic acid equation formed after standard graph plotted

$y = 0.0046x + 0.0304$

where,

y = Sample absorbance

x = Tannin content (µg/ml)

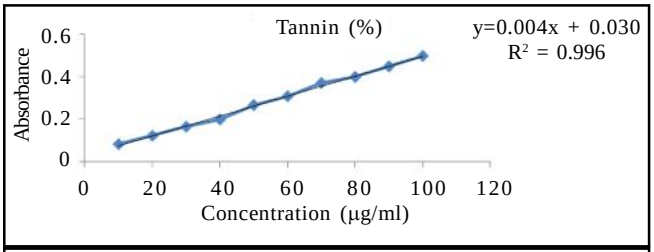

Fig. A : Standard graph for Tannic acid

EXPERIMENTAL RESULTS AND ANALYSIS

A standard graph for different tannic acid concentrations (Table A) at different absorbance was prepared in Fig. A. Based onthis line graph equation tannin content for lantana and bamboo was estimated and presented in Table 1. Results revealed 0.147% mean total soluble sugar present in lantana, whereas in case of bamboo, it was 0.703%. The soluble sugar content present in bamboo particles is nearly four times higher than lantanaparticles. It was observed that mean tannin content in lantana and bamboo was 0.028% and 0.026%, respectively. Both the test species showed approximately similar tannin content.

Mean MOR of cement bonded lantana board and cement bonded bamboo board prepared at three different cement/wood ratios (2.0:1.0, 2.5:1.0 and 3.0:1.0) is presented in Fig. 1.The mean MOR for cement bonded bamboo board was found 6.01, 8.20 and 9.70N/mm^2 at 2.0:1.0, 2.5:1.0 and 3.0:1.0 ratio respectively. The cement bonded lantana board revealed means MOR ranged from 10.01 to 12.47N/mm^{2}at test cement/wood ratio. Results indicated that cement bonded lantana board performed better than cement bonded bamboo board in all three different cement/wood ratios. It is assumed that quantity of total soluble sugar may play an important role to decide compatibility of wood with cement in cement bonded particle boards. Chew *et al.* (1992) reported that bamboo contained more than 0.6 % total sugar and produced cement bonded particle board of low mechanical properties. Liu and Moslemi (1986) work also revealed that almost all simple sugars examined and some other carbohydrates bring about a complete loss in strength of the cement. Since in this study bamboo recorded high soluble sugar content, this may be a reason for low values for MOR. It is interesting to note that the MOR of board increased with increasing the amount of cement in board. Lee (1984) reported that wood excelsior could not receive adequate cement coating on using lower cement/wood ratio and resulted poor bonding. Similar results were reported by Alhedy *et al.* (2006). Therefore, the higher

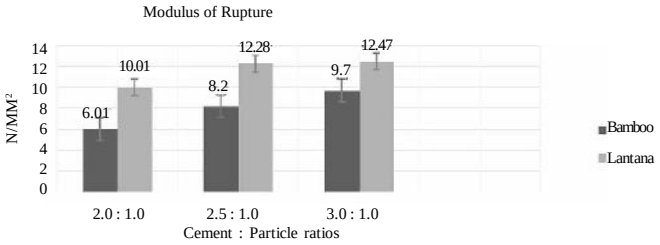

Fig. 1 : Mean value MOR in different cement: particle ratios

Table 1 : Mean soluble sugar and tannin content percentage in Lantana and Bamboo

Species	Total soluble sugar (%)		Tannin (%)	
Lantana camara	Sample 1	0.146	Sample 1	0.022
	Sample 2	0.139	Sample 2	0.026
	Sample 3	0.156	Sample 3	0.036
	Mean	0.147	Mean	0.028
Dendrocalamus strictus	Sample 1	0.730	Sample 1	0.023
	Sample 2	0.687	Sample 2	0.036
	Sample 3	0.692	Sample 3	0.019
	Mean	0.703	Mean	0.026

amount of cement can be suggested for particle board manufacturing where the strength is prime concern.

Conclusion :

The highest mean value of MOR was observed in lantana and bamboo boards of 3.0:1.0 cement/wood ratios and lowest in 2.0:1.0 cement/wood ratios. Bamboo showed less strength compared to lantana, which may be due to presence of high quantity of soluble sugar in bamboo boards. It can be inferred that lantana is suitable for preparing cement bonded particle board but wood extractives such as soluble sugar and tannin content may play major role in cement setting. This requires further investigation.

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