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국민대학교 산림과학연구소 KOOKMIN UNIVERSITY INSTITUTE OF FOREST SCIENCE

후원 목재산업단체총연합회

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P-51 **Properties of Oriented Strand Board Prepared from Modified Steam Treated Bamboo Strands**

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P-52 **Effect of Particle Immersing in Acetic Acid Solution on the Properties of Particleboard**

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P-53 **Physical and Mechanical Properties of Particle Board Made From Passion Fruit Shell with UF Resin**

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<전시-P-51>

Properties of Oriented Strand Board Prepared from Modified Steam Treated Bamboo Strands

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1. Introduction

Steam treatment is commonly used to facilitate the bending of bamboo into desired shapes. It can also improve bamboo resistance against insect attack (Liese 1987). During steam treatment free sugars in woody materials can be converted into furan intermediates, which can be further converted into furan resins (Rowell *et al* 2002). In order to complete the previous results (Febrianto *et al* 2015), in this study we modified the steam process by washing the bamboo strands with water and NaOH 1% solution after the steam process to remove extractives and to facilitate better contact between strands and resin during OSB manufacturing. The effect of modified steamed process of bamboo strands and adhesive content on the properties of OSB prepared from betung bamboo (*Dendrocalamus asper*) were reported.

2. Material and methods

For the present study, 25 bolts of 3~4 years-old of betung bamboo were collected from the Sukabumi district, West Java, Indonesia. The strands were manually produced using a sharp-knife. The target length, width, and thickness of the strands were 70, 20, and 0.80 mm, respectively. Phenol formaldehyde (PF) adhesive was used as adhesive with concentration of 6, 7 and 8%. The strands were steamed at 126 °C for 1 h at a pressure of 0.14 MPa. One-third of stands were washed with distilled water and one-third strands were washed with NaOH 1% solution. The strands were then air-dried for 1 week and oven-dried at 75- 80 °C for 3 days to achieve a moisture content (MC) of 7%. A rotary drum blender was used for mixing the strands and the adhesive. Paraffin at a concentration of 1% was added to strands and adhesive mixture prior to mat formation. The mat-form was hot-pressed at 160 °C for 6 min at a pressure of 3.5 MPa to fabricate OSBs. The board was then conditioned for two weeks in a room adjusted to a temperature of 25- 30 °C and 60- 65% RH. Three boards were prepared for each treatment.

3. Results and Discussion

Density and MC of OSB showed similar amongst treatments indicated that the board was produced homogenously. Steam treatment improved significantly the dimensional stabilization i.e. water absorption (WA) and thickness swelling (TS) and mechanical properties i.e. modulus of elasticity (MOE), modulus of rupture (MOR) both parallel and perpendicular to the grain direction and internal bond (IB) of board. Washing the strands with NaOH1% solution after steamed treatment resulted in better improvement of WA, TS, MOE, MOR and IB parameters than washing with distilled water (Table 1). The higher the adhesive content added resulted in the better WA, TS, MOE, MOR and IB parameters. Board prepared from modified steamed strands by washing with NaOH 1% solution bonded with 8% PF adhesive showed the best performance in term of all physical and mechanical properties based on CSA 0437.0 (Grade O-1) standard

adopted in this experiment. During steam treatment, free sugars in woody materials can be converted into furan intermediates, which can be further converted into furan resins (Rowell et al 2002). This resins improved the bonding quality amongst bamboo strands. Steam treatment also removed part of extractives (Table 2). Extractives can prevent the adhesive to penetrate into the bamboo substrates. Washing bamboo strands with NaOH1% after steam treatment beside removed part of bamboo extractives, it also increased the pH of bamboo strands resulted in optimum condition of bonding process using PF resin can be achieved.

Table 1. Physical and mechanical properties of OSB prepared from modified steam treated bamboo strands under various adhesive content

Adhesive content (%)	Treatment	MC (%)	Density (g/cm^3)	WA (%)	TS (%)	MOR ∥ (kg/cm^2)	MOR ⊥ (kg/cm^2)	MOE ∥ (kg/cm^2)	MOE ⊥ (kg/cm^2)	IB (kg/cm^2)
6	Control	10.11±0.98	0.71±0.01	48.05±1.24	11.45±0.49	401±18	139±8	68455±2346	10038±363	3.46±0.08
	Steam	9.34±0.88	0.71±0.01	39.72±3.65	7.86±0.57	510±24	142±11	87599±15827	10891±1447	4.20±0.53
	Steam + Water	9.86±1.36	0.71±0.02	35.78±3.73	6.34±0.29	567±25	153±7	97936±10799	12097±1113	4.46±0.34
	Steam + NaOH 1%	10.95±1.35	0.73±0.02	30.22±1.55	6.28±0.15	560±8	165±4	91263±3757	12600±1536	4.98±0.56
7	Control	10.41±0.51	0.71±0.01	47.31±2.23	9.43±0.43	439±14	144±15	74014±1015	10434±366	3.79±0.05
	Steam	9.31±1.24	0.72±0.01	37.57±1.20	6.85±0.45	589±9	174±21	90165±4012	10757±547	4.47±0.24
	Steam + Water	10.37±1.17	0.72±0.01	33.49±1.96	5.77±0.78	608±52	195±18	101675±1482	12459±1235	4.52±0.61
	Steam + NaOH 1%	9.61±0.82	0.72±0.02	31.99±2.11	5.81±0.06	677±16	222±24	99050±7043	12801±1716	4.95±0.02
8	Control	10.33±0.57	0.71±0.02	43.56±2.26	7.50±0.27	524±91	157±3	81830±3907	11030±1057	3.89±0.13
	Steam	9.37±0.70	0.72±0.01	38.18±2.43	5.91±0.18	707±81	184±6	115610±7152	11625±217	4.73±0.38
	Steam + Water	9.60±0.91	0.71±0.02	31.81±1.25	5.72±0.32	763±105	226±25	123023±7475	14046±332	4.89±0.41
	Steam + NaOH 1%	8.99±0.25	0.71±0.01	26.13±1.39	4.12±0.24	847±34	242±16	129743±8791	14887±775	5.38±0.56
Standard*		na	na	na	15	234	96	45000	13000	3.45

* CSA 0437.0 (Grade O-1) Standard. Na: not available

Table 2. Effect of steam treatment on the bamboo extractives

Treatment	Extractives (%)			
	Cold water	Hot water	NaOH1%	Ethanol-benzene
Control	5.63	7.64	19.43	9.09
Steam	4.62	6.45	18.51	8.89
Steam+ Water	4.17	5.59	16.22	12.38
Steam+ NaOH 1%	3.5	4.36	13.32	4.78

4. Conclusions

- The physical and mechanical properties of OSB prepared from bamboo strands were much influenced by steam treatment and adhesive content.
- Steam treatment removed some of bamboo extractives.
- Steam treatment of bamboo strands followed by washing with NaOH 1% solution bonded with 8% PF adhesive resulted in the best physical and mechanical properties.

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