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The study of wood fiber-based filter for absorptive capacity of PM 2.5
Chunmei Yang, Rui Liu, Minghui Guo, Nam-Hun Kim, Seung-Hwan Lee, and Yan Ma
1College of Mechanical and Electrical Engineering, Northeast Forestry University.
2Department of Forest Biomaterials Engineering, College of Forest and Environmental Sciences,
Kangwon National University

Properties of Oriented Strand Board Prepared from Modified Steam Treated Bamboo Strands
Sena Maulana, Fauzi Febrianto, Deded Sarip Nawawi, I Nyoman J Wistara, Rita Kartikasari,
Adesna Fatrawana, Wahyu Hidayat, Nam Hun Kim
1Department of Forest Products, Faculty of Forestry, Bogor Agricultural University, Indonesia
2Department of Forestry, College of Agriculture, University of Lampung, Indonesia
3College of Forest and Environmental Sciences, Kangwon National University

Effect of Particle Immersing in Acetic Acid Solution on the Properties of Particleboard
Apri Heri Iswanto, Tito Sucipto, Samuel Hermanto
Faculty of Forestry, University of Sumatera Utara, Jl. Tridharma Ujung No. 1 Medan, Indonesia

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Tito Sucipto, Apri Heri Iswanto
Faculty of Forestry, University of Sumatera Utara, Medan, Indonesia
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Sena Maulana¹, Fauzi Febrianto¹, Deded Sarip Nawawi¹, I Nyoman J Wistara¹, Rita Kartikasari¹, Adesna Fatrawana¹, Wahyu Hidayat²,³, Nam Hun Kim³

¹Department of Forest Products, Faculty of Forestry, Bogor Agricultural University, Indonesia
²Department of Forestry, College of Agriculture, University of Lampung, Indonesia
³College of Forest and Environmental Sciences, Kangwon National University

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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 steam 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 the strands 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 75 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 NaOH 1% solution after steam 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 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/cm³) | WA (%) | TS (%) | MOR || (kg/cm²) | MOR ⊥ (kg/cm²) | MOE || (kg/cm³) | MOE ⊥ (kg/cm³) | IB (kg/cm³) |
|----------------------|-----------|--------|----------------|--------|--------|------|------------|------------|------|------------|------------|-----------|
| Control              | 10.11±0.08 | 0.71±0.01 | 45.05±1.24 | 11.45±0.49 | 401±18 | 138±8 | 684±32 | 10.03±8 | 3.46±0.08 |
| Steam               | 9.34±0.08 | 0.71±0.01 | 38.72±3.65 | 7.88±0.57 | 510±24 | 142±11 | 875±69 | 1.50±44 | 4.20±0.53 |
| Steam + Water       | 9.86±1.36 | 0.71±0.02 | 35.78±5.75 | 6.34±0.29 | 507±23 | 133±7 | 979±40 | 12.07±113 | 4.6±0.34 |
| Steam + NaOH 1%     | 10.5±1.35 | 0.73±0.02 | 30.22±1.55 | 6.28±0.15 | 580±8 | 161±4 | 523±37 | 12.00±15 | 4.8±0.56 |

Table 2. Effect of steam treatment on the bamboo extractives

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Extractives (%)</th>
<th>Cold water</th>
<th>Hot water</th>
<th>NaOH1%</th>
<th>Ethanol-benzene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>5.63</td>
<td>2.74</td>
<td>19.43</td>
<td>9.09</td>
<td></td>
</tr>
<tr>
<td>Steam</td>
<td>4.62</td>
<td>6.45</td>
<td>18.23</td>
<td>8.89</td>
<td></td>
</tr>
<tr>
<td>Steam + Water</td>
<td>4.17</td>
<td>6.59</td>
<td>16.22</td>
<td>12.36</td>
<td></td>
</tr>
<tr>
<td>Steam + NaOH 1%</td>
<td>3.5</td>
<td>4.36</td>
<td>13.32</td>
<td>4.78</td>
<td></td>
</tr>
</tbody>
</table>

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.

References