Particleboard from Ethiopian Lowland Bamboo
(Oxytenanthera Abyssinica)

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ABSTRACT

This paper evaluates the utilization of Ethiopian lowland bamboo or Oxytenanthera abyssinica to manufacture a particleboard. Two boards were tested; one of the boards was fully manufactured from bamboo and the other one was taken from market, which is mostly utilized by those household factories and other wood product manufacturers who use particleboard, fully manufactured from Eucalyptus tree. The particles were bonded using 10% urea formaldehyde. Compression tests were conducted for the two types of particleboards as per Japanese Industrial standard (JIS A 5908) both under wet and dry conditions. A total number of four samples were taken from each type and tested along the width and length on HUALONG universal testing machine with a loading rate of 10mm/min. During the test the upper surfaces of the specimens were under compression and the lower sides were under tension. The results from both tests have shown that the lowland bamboo can be a good candidate for particleboard manufacturing.

Keywords: Bamboo, Particleboard, Oxytenanthera Abyssinica, Bending Strength Test.

1. INTRODUCTION

The demand for particleboard in Ethiopia is related to the expansion and growth of the building and construction sector. According to development association, it is revealed that the yearly requirement of residential building units is estimated to be 20,000 for the capital city (Addis Ababa) and 121,000 for the other urban towns. Now a day’s the construction of houses is tremendously increasing all over the country which needs more particleboard more than any other time.

The other sector which utilizes the particleboard is the furniture industries, which are engaged with manufacturing of cup boards, tables, shelves and etc. It is assumed that the furniture industry consumes about 30% of the particleboard production for manufacturing the above mentioned and other related items [1]. There are three factories which are engaged with the manufacturing of particleboard in the country. All the factories are using eucalyptus tree as a raw material for the production of particleboard, but according to different researchers, Even if the tree is abundant all over the country it has its own negative impact on the ground water and the surrounding air and vegetation’s. [2]

Researches by different scholars and writers indicates that eucalyptus has the following disadvantages:
There is relatively high reduction of soil nutrients by Eucalyptus trees which is caused by high removal rates of nutrients in harvested tree products due to rapid growth. Besides that, teff grows very bad on soils that have been previously used for eucalyptus cultivation; this could cause severe problems with respect to food production.

In dry areas eucalypts impede the growth and germination of surrounding vegetation by competition for water and release of allelopathic extracts. This can cause reduced yield of nearby crops and increased erosion risk in plantations. In humid areas eucalypts are suitable as fostering trees for undergrowth because of their weak competition for light and low litter production.

According to environmental bamboo foundation, bamboo has the following advantages over the other woody plants:

- It has a potential to survive through hardship times.
- It grows with strength and speed, with a tensile strength superior to mild steel, it can with stand up to 52,000 pounds of pressure Psi, and a weight – to- strength ratio exceeds to that of graphite.
  ✓ It is the strongest growing woody plant on earth with a widest range of habits
  ✓ It is the fastest growing, clocked shooting skyward 2 inches per hour
  ✓ It is a preferred material for various applications owing to its straightness, high strength, and light weight, easiness of working with it, suitable fiber for pulp production and absence of bark [3].

According to Ensermu and his friends the total Ethiopian natural bamboo forest is estimated to cover around 1 million hectare, which is about 7% of the total the world and 67% of the African bamboo population [4]. The total population of the bamboo holds two species, *Oxytenanthera abyssinica* and *yushanina alpine* [5]. The lowland species (*Oxytenanthera abyssinica*) covers 85% of the total population bamboo in the country.

The species of the bamboo, which is the lowland bamboo, was collected from Benishagul Gumuz region of Ethiopia. The typical lowland bamboo has an average length, diameter and wall thickness of 15m, 16cm and 4cm respectively. In rural areas and some urban areas the bamboo is limited for the use of building chairs, fences and other traditional units.

2. **MATERIALS AND METHODS**

2.1. **Particle Preparation**

The bamboo culms were stored under a room temperature of 22°C. All the culms were brown in color, which is the indication of bamboo at its fully grown age. Then the culms were cut into slice of 50cm long and processed on the planner machine. The particles were screened using two sieves of 3mm and 1mm. The particle which passes through is used for the outer surface of the particleboard. It was set at 8% of moisture content.
2.2. **Particleboard Manufacturing and Testing**

The prepared particles from bamboo (≈ 800g) were blended with urea formaldehyde using mechanical blender. The amount of the resin (urea formaldehyde) was 12% which is similar to that of the blending ratio of the resin to particles from eucalyptus tree particles in the factories which engaged with the production of particleboard in the country. The homogenized mixture was hand formed into mats of 30mm × 30mm and hot pressed at 140°C for 15 minutes using nominal pressure of 3.5N/mm². Using this method four different samples were produced and conditioned at room temperature like the other types which are out there for commercial use.

Each board was cut in specimen according to JIS A 5908 standard. Property of static bending was evaluated. The value of the result was compared to those minimum requirements according to JIS A 5908.

2.3. **Bending Strength Test under Dry Condition**

Four samples from both the particleboard of the eucalyptus tree and the bamboo are tested for bending strength for both length and width wise test according to JIS A 5908 using Hualong universal testing machine. The sample dimensions in bending strength test under dry condition are maintained approximately at 50mm × 200mm × 13mm. Samples are compressed at a loading rate of 10mm/min. Load and the compressive yield strength values are recorded for each of the samples in the test. From the load recorded the bending strength is calculated.

2.4. **Bending Strength Standard and Specimen Size under Wet Condition Type A**

Four samples from both the particleboard of the eucalyptus tree and the bamboo are tested for bending strength for both length and width wise test according to JIS A 5908 using HUALONG universal testing machine. The sample dimensions in bending strength test under dry condition are maintained approximately 50mm × 200mm × 13mm. All the samples were immersed in warm water of 70 ± 3°C for 2 hours and in water at ordinary temperature for 1 hour. Samples are compressed at a loading rate of Load and the compressive yield strength values are recorded for each of the samples in the test. From the load recorded the bending strength is calculated.

![Figure 1. Two Dimensional Drawing Representation of the Bending Strength Test](image-url)
3. RESULT AND DISCUSSION

3.1. Bending Strength Test under Dry Condition

After the samples both from the bamboo particleboard and eucalyptus particle were prepared the following results were generated from HUALONG universal testing machine.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Test 1</th>
<th>Test 2</th>
<th>Test 3</th>
<th>Test 4</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bamboo</td>
<td>76.5</td>
<td>67.4</td>
<td>64.3</td>
<td>70.4</td>
<td>69.6</td>
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<tr>
<td>Eucalyptus</td>
<td>55.1</td>
<td>55.9</td>
<td>42.8</td>
<td>61.2</td>
<td>51.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample</th>
<th>Test 1</th>
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<th>Test 3</th>
<th>Test 4</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bamboo</td>
<td>21.4</td>
<td>24.5</td>
<td>18.4</td>
<td>21.4</td>
<td>21.4</td>
</tr>
<tr>
<td>Eucalyptus</td>
<td>15.3</td>
<td>18.4</td>
<td>21.4</td>
<td>18.4</td>
<td>18.4</td>
</tr>
</tbody>
</table>

3.2. Bending Strength Test under Wet condition Type A

From the above Table s we can see that, the bending strength of the particleboard from the Ethiopian lowland bamboo is 86% and 73.7% of to that the particleboard from Maychew particleboard factory along the width and length wise test results, respectively. Which shows the Ethiopian lowland bamboo can be a good candidate for particleboard manufacturing. If there will be a chance to produce the particleboard from the lowland bamboo under controlled condition there will be a chance of getting particleboard with better mechanical property than that of the eucalyptus tree particleboard.

According to the Japanese industrial standards both the particleboards are classified under the same category, base particleboard, which means the particleboard from the Ethiopian lowland bamboo, can be a substitute for the particleboard which is manufactured from the eucalyptus tree if those manufacturing gaps which are indicated in the respective methods in the paper can be controlled.
4. CONCLUSION

From the experiment and analysis for the bending strength the following conclusions can be drawn from this paper:

- The lowland bamboo is a good candidate for the production of particleboard;

- The strength of the particleboard from the lowland bamboo falls under the same category with that of the particleboard from the eucalyptus tree which implies that the particleboard can be applied on those areas of applications that the particleboard from the eucalyptus tree is applied;

- If the manufacturing conditions can be controlled well the Ethiopian lowland bamboo can be a substitute for the eucalyptus tree in the manufacturing of particleboard;

- If we can use the bamboo in the manufacturing of particleboard, we can get a particleboard with an equivalent strength and keep our globe from the negative side effects of the eucalyptus tree which is the great concern of the world now a day’s.

REFERENCE


