ECO-FRIENDLY CORRUGATED BAMBOO-COMPOSITE SHEETS FOR ROOFING APPLICATIONS

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Keywords:

Eco-friendly, BMCS, Bamboo, Phenol formaldehyde, Corrugated bamboo sheets, Hardness, Impermeability, Water absorption

Introduction:

Corrugated Bamboo Roofing Sheets (CBRS) is a very good alternative to corrugated plastic, asbestos or metal roofing sheets. The Corrugated Sheets are made up of bamboo and adhesive resin which are then glued together at high pressure and temperature. They are produced from a sustainable natural resource that can be used to cover storage facilities, animal pens, house roofing and many other permanent or temporary structures. Corrugated bamboo roofing sheets are stronger, eco-friendly, have better sound and thermal isolation and are more durable compared to many other roofing materials used these days. Bamboo finds its extensive use in the construction of houses, mainly the walls, partitions and roofing. The roof protects against extreme weather and provides clear and usable space underneath. It must be strong enough to resist the natural forces and be durable. Bamboo is found ideal as a roofing material as corrugated bamboo-composite sheets. The decline in the availability of timber has encouraged the interest in bamboo-based composites. Asbestos sheets are being replaced with many other alternatives in different countries because of their health hazards.

The production of corrugated bamboo roofing sheets is a commercially viable and socially effective means of utilizing bamboo resources to produce value added items for the benefit of consumers and producers alike.

Applications of Bamboo roofing sheets

- For construction and architecture
- Domestic uses in villages
- For storage animal pens
- And as temporary or permanent structures.

Objectives:

- To study fabrication process of Corrugated Bamboo Roofing Sheets and fabricate eco-friendly and light weight corrugated bamboo sheets that have more durability and less resistance to weathering.
- To study the CBRS material and its properties as per Indian Standards (IS).
- To test the fabricated Corrugated Bamboo Roofing Sheets and determine the mechanical properties by conducting the following tests : Aging, Impermeability, water absorption, Cyclic Test, Resistance to Falling Weight, Hardness, Flame Penetration Test, Compression Test and Impact Test.

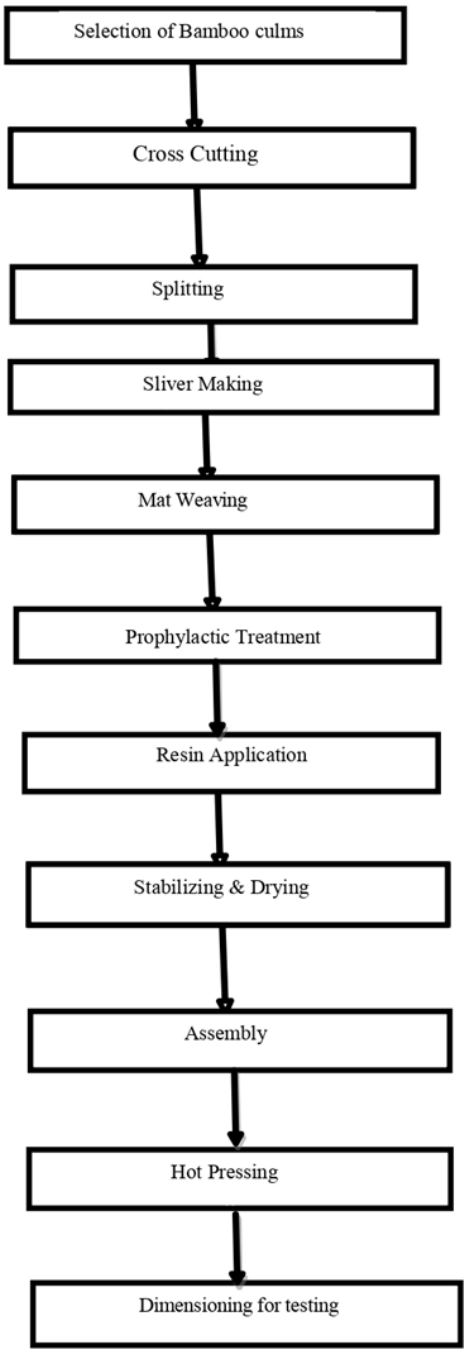
Methodology:

Materials used :
Ochlandra travancorica was used for the manufacture of BMCS.
Phenol formaldehyde resin of 1: 1.6 (wt ratio) manufactured using phenol (98% purity), formalin (37%) and sodium hydroxide as catalyst.

The fabrication process of Corrugated Bamboo Roofing Sheets is done in three stages:
STAGE I – Preparation of Bamboo Mats
This stage includes the fabrication of:
1. Selecting Bamboo- Mature bamboo is selected based on the region and ease of availability of bamboo.
2. Cross cutting of Bamboo- The cross cutting of bamboo includes the cutting of bamboo into required size so that it can fit into splitting machines. This is done due to the varying sizes of bamboo.
3. Splitting of Bamboo- After the cross cutting of bamboo the bamboo culms are divided into a number of equal strips. This process is called splitting of bamboo.
4. Making of Bamboo slivers- After the splitting process of bamboo these strips are further made into thinner strips called Bamboo Slivers. Before the sliver making process, knot removal is done to achieve an even surface and thickness.
5. Mat Weaving- The epidermal layer is removed from the slivers and the Bamboo Slivers are weaved into mats.

STAGE II – Resin Application
1.Prophylactic treatment- Chemical preservation (with or without the help of special equipment) ensures long term protection
2.Resin application- Bamboo strips can be resin coated with brush or roller coaster. But for bamboo mat such coating is not suitable.
3.Stabilizing & Drying- After the resin application the bamboo mats are allowed to stabilize and dry in the drying chamber.
STAGE III – Hot Pressing

1.Assembly of resin applied Bamboo Mats- After the assembly of the bamboo mats accurately on top of each other a hydraulic hot press is used for the pressing process.
2.Hot pressing- After the assembly of the bamboo mats accurately on top of each other a hydraulic hot press is used for the pressing process.
3.Dimensioning of the CBRS for testing- The final dimensions of the CBRS achieved is 6*4 ft. Further finishing is not required on the CBRS. Optionally it can be painted if required. The test specimens are cut from the CBRS required for the tests.



Testing

Fabricated Corrugated Bamboo Roofing Sheets is tested and mechanical properties are determined by conducting the following tests : Aging, Impermeability, water absorption, Cyclic Test, Resistance to Falling Weight, Hardness, Flame Penetration Test, Compression Test and Impact Test.

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30th, May 2022

The Manager
Indian Plywood Industries Research & Training Institute
HMT link road off Tumkur Road
Yeshwanthpur, Bengaluru-560022

Respected Sir/Madam,

Subject: Request to visit Indian Plywood Industries Research & Training Institute

We, the students of Mechanical Engineering from Atria Institute of Technology currently studying in 8th semester would like to visit the institute to get information and to get a better understanding about Bamboo Mat Corrugated Sheets and the different equipments and machineries used for the manufacture of Bamboo Mat Corrugated Sheets with the testing methods on bamboo products.

Thanking you,
Mohamed Ibrahim Junaid (1AT16ME045)
Sumukh S Kashyap (1AT18ME046)

Asst Prof Anjan Kumar D
Project guide

Dr M S Rajendra Kumar
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The students visited our campus & learnt about IPIRTI, Bangalore;

30/5/2022
(RAMKUMAR V R)
Scientist-C
[PAISD]

Conclusion:

- Achieved Light weight corrugated bamboo roofing sheets.
- Impermeability test-The test was conducted on CBRS and the lower surface did not show any traces of water except for traces of moisture.
- Cyclic test-The test was conducted and there was no delamination found in the test specimen.
- Resistance to falling weight-The test was comnducted and the test piece did not break or showany crack or tear.
- Charpy Impact test-The charpy impact test was conducted on the test sample and the specific impact factor of the sample is 1.23J/mm2 .
- Hardness test- The Rockwell hardness test was performed on the sample and the value was found to be 90RHN.
- Water Absorption test- Under progress.
- Flame Penetration test- Under progress.
- Compression test- Under progress.
- Aging - Under progress

Scope for future work:

There is a scope for the development of small CBRS producing enterprises. Corrugated bamboo roofing sheets are particularly in demand in uncivilized, mountainous region due to their inaccessibility. The proximity of natural raw materials and the low cost of the sheets. Given some effective marketing the sheets could easily be popularized in more affluent areas and in affluent countries, where eco-friendly products are very popular. In this case the establishment of a vigorous sales department within the unit, or at a local or community level to pool resources from a number of units and act on their behalf would be beneficial. The development of bamboo roofing sheets enterprises offers considerable income generating opportunities for different categories of resource-poor people.

The technology has strong forward and backward linkages and its implementation will benefit a wide range of rural people involved in all stages of CBRS production. It may be possible to apply for incentives/benefits offered by the government for the establishment of small-scale enterprises.