National Mission on Himalayan Studies

Standard Operating Procedure (SOP)
Fabrication of Low-Cost and User Friendly VPI Bamboo Treatment Plant

NMHS Project: Capacity building on bamboo treatment techniques for promotion of Earthquake Resilient Housings and Structures in Hill regions of Tripura.

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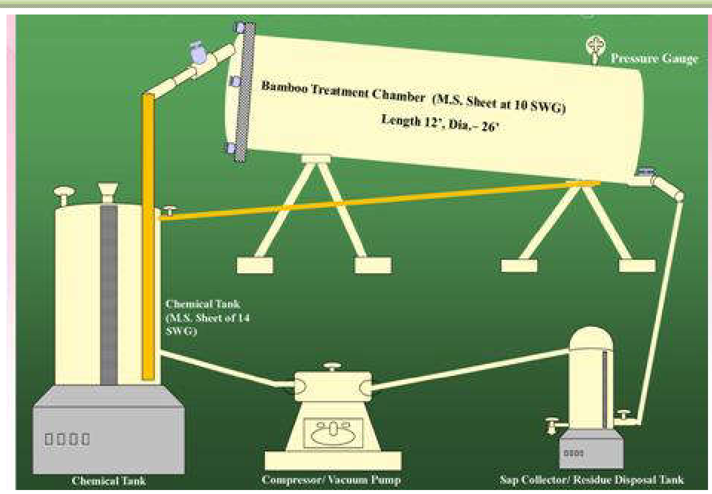
Life in rural Tripura has an intimate relationship with Bamboo. A divine idea of developing Bamboo preservation based community micro-enterprise in the tribal clusters of Tripura for economic self-sufficiency was the brainchild of FRC-LE and the project was supported by the National Mission on Himalayan Studies. Design development and promotion of low cost earthquake resilient Bamboo houses and establishing community micro-enterprise equipped with VPI (Vacuum Pressure Impregnation) machine for increasing the durability of Bamboo for producing Bamboo handicrafts were the main gears of this visionary idea.

Step 1: VPI machine and its components

- Cylinder for bamboo chamber with one side lid mount on 06 legs (length-11.5', Diameter - 20" made up with 5 mm Ms Sheet)
- Chemical Tank mount on 3 legs (5 mm MS Sheet 20" dia x 3 ft)
- Sap Collector mount on 3 legs (3 mm MS Sheet, 6" dia x 1.5ft)
- Vacuum pump (0.25 HP)
- Compressor (1.5 HP)
  Including Connecting GI pipes (1" and 1.5"), 3 Union Joints, Valves 8 Nos., pressure gauge 2 Nos.
  And installation at site within Tripura (Carrying charges extra depending on distance etc.)

Step 2: Design developed by FRC-LE, Agartala

The improved version with a total cost of Rs. 1.27 lakh has been recently installed at FRCLE. It was modified by upgrading the capacity of Compressor (form 0.5 HP to 1.5 HP) and Vacuum Pump (from 0.25 HP to 0.5 HP) besides some minor changes.



Step 3: Chemical Methods of Bamboo Preservation

Chemical treatment is more effective than traditional treatments. Typical chemical treatment methods uses water soluble preservatives like Gamma BHC 0.5%, Formalin 0.5% , Phenol+ 1 Copper sulphate (1: 2), sodium pentachlorophenate 0.5% and Borax 1.5%. The chemicals are dissolved in water. Bamboo or bamboo mats are either sprayed with the solution or dipped in the solution for 10 minutes. After treatment the bamboo mats are stored in shade till they are processed further. Bamboo is non-durable in its natural state. Durability can be greatly increased by preservation with safe, environment-friendly chemicals, such as boron. Several simple and cost-effective treatment methods are available.

3.1. Treatment of Fresh Bamboo

- Butt end treatment / Steeping: Freshly cut culms arc immediately placed upright in containers of concentrated solutions of water-borne preservatives (5-10%). The basal end should be kept immersed in the preservative solution up to the level of 25 – 40 cm. Generally, drops of preservative solutions are observed at the nodes. The treatment takes between 7 and 14 days, depending on the length of the culm. Losses in preservative solution in the container are made up to maintain the initial level of solution. Bamboos can be satisfactorily treated by this method without any equipment and technical skill.
- Sap displacement: Round or split fresh bamboos are immersed vertically up to 25 cm, in water-borne preservatives like copper-chrome-boron (CCB) in suitable containers. The preservative solution rises by wick action as the sap is sucked up. Solution level is maintained by adding fresh quantity at intervals. A meter long bamboo can be treated in just six days. Longer pieces can be treated over a slightly longer period.
- Diffusion process: In this process, freshly felled culms or bamboos with high moisture content is kept submerged in solution of water-borne preservatives for a period of about 10 to 20 days. In round bamboos boring holes near the nodes results in better penetration and higher loading. Preservatives that fix slowly, or have high diffusion coefficients like boron-based preservatives, penetrate better.
- Boucherie process: This is widely recognized process. It is suitable for freshly felled bamboos with or without branches and leaves. In this process, one end of the bamboo is connected to the reservoir containing the chemical preservative through a coupling unit. The gravitational or hydraulic pressure pushes the preservative through the bamboo.

3.2 Treatment of Dry Bamboo

- **Soaking**: Air-dried bamboos have only to be submerged in the preservative solution (oil or solvent type) for a period depending upon the species, age, thickness and end use. It requires little equipment and technical knowledge, provided the schedule of treatment is known. Soaking treatments with solvent like pentachlorophenol, copper/zinc naphthenate/ abietate, work better than steeping in water-soluble preservatives. Such treatments may, however; be more expensive in some countries because of the cost of the solvents.
- **Brushing / Painting**: Decorative items may be brushed or painted with preservative chemical for protection against biodegrading agents.
- **Spraying**: Bamboo stacks are sprayed with chemical preservative with suitable quantity and concentration of preservative, at various stages of stack preparation so that preservative distribution is uniform. It is then covered with suitable cover like plastic sheet / tarpaulin so that the preservative chemical is properly soaked into the bamboo. This method is suitable for large-scale preservative treatment, both in green and dry, during bamboo storage.
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Species-wise Economics involved in a single rotation of treatment (Chemical @ 8% concentration)			
Species	**Treatment Chamber Capacity (Average)**	**Invest (Rs)**	**Net Profit (Rs)** (@local market rates)
Muli (Melocanna baccifera)	70 culms (10')	1300/-	600/-
Kanak kaich	60 culms (10')	1580/-	520/-
Mirtinga (Bambusa tulda)	35 culms (10')	1375/-	375/-
Barak Bamboo (Bambusa balcooa)	25 culms (10')	3000/-	1500/-
Betu/Bom (Bambusa cacharensis)	30 culms (10')	2300/-	700/-
Treatment up to maximum length of culms: 11 feet Capacity: One rotation within three hours.			

Step 4: Advantages of FRC-LE developed VPI machine:

- User friendly, easy to install and low cost as compared to conventional VPI machines.
- Can be operated through single phase electric connection.
- Pressure can be created and reserved in the chemical tank for long which can be transferred to treatment chamber without the need of electricity in case of frequent and long interval of power failure.
- Automatic recovery of the chemical into Chemical Tank after completion of one cycle.
- Vacuum created into the Treatment Chamber before releasing chemical ensures effective absorption of chemicals in the Bamboo Cells.