

**Technology package**

**on**

**Sap displacement techniques for treating  
small girth timber and bamboo**

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## Abstract

Wood is a versatile material for variety of uses; yet, it is biodegradable and needs protection to enhance serviceability. Conventional method of treating wood material is by subjecting it to pressure treatment or by diffusion treatment, which involves machinery and skilled labour. Since investments on these are expensive, many wood processing industries are reluctant to adopt the technology.

A simple Sap displacement technique which does away with the elaborate plant and skilled man power and which can be carried out at felling sites obviating transportation of poles to a centralized pressure treatment plant has been standardized at our Institute of Wood Science and Technology, Bangalore. Treatment cost (excluding equipment) including manpower is ` . **50 - 60** per pole of 15 ft length and 45cm girth, and for that of bamboo is ` . **25 -30** for 15 ft length and 10-15cm girth. Life of timber and bamboo after treatment enhances by five to ten folds and therefore the actual cost of bamboo and poles works out to be less than the cost of untreated bamboo and poles.

## Introduction

With the rapid progress of development in the country, demand for timbers for various purposes has increased considerably and on the other hand scarcity and high price of conventional timbers has resulted in more attention towards plantation grown species. However, the material from plantation timber is often non-durable and needs preservative treatment.

Bamboo, the poor man's timber has become the potential alternative through its substitution value. Bamboo is extensively used as structural material for building purposes, fence post, poles, pits, props, rafters, scaffolding etc. Although bamboo is one of the strongest structural materials available, it is often vulnerable to destruction by wood deteriorating agents. Natural durability of bamboo is low, varying between 1 and 36 months depending on the species, age and climatic conditions. In the same way poles obtained from secondary timber species like Eucalypts and Casuarinas are used for fencing purpose and for construction. In general wood/bamboo being a biological product is liable for deterioration by wood deteriorating agents like insects, termites, borers, fungi, marine organisms and fire. India being a tropical country, decay and damage of wood by termites is more compared to other agents.

During post-harvested period timber and bamboos are prone to fungal and insect attack during storage period as the moisture contents is very high. It is estimated that an average loss of 25 to 40% occurs due to biodeterioration. To ensure long-term structural performances, wood/bamboo must be protected from its natural predators. Wood preservation is the process by which wood is preserved. Proper preservative treatment will enable to enhance durability of bamboo. Therefore it is very essential to use bamboo after proper preservative treatments.

Conventional method of treating wood material is by subjecting it to pressure treatment or by diffusion treatment, which involves machinery and skilled labour. Since investments on these are expensive, many wood processing industries are reluctant to adopt the technology. Moreover bamboo in dry condition is very refractory to chemical treatment due to its hard impermeable outer surface. This has necessitated treatment of bamboo in green condition by sap displacement method. It is not easy to treat bamboo conventionally as it is very refractory to treatment i.e. it resists the entry of preservatives. This is because of the structure of bamboo. Bamboo culm is resistant to lateral penetration of preservatives because of its hard skin, but has a very high longitudinal permeability in living bamboo. This is because of sap flow activity. This property is taken advantage of to achieve an axial liquid exchange. This technique is commonly referred to as sap displacement technique and is specially suited for treating green bamboo and highly refractory to treat timber species like Eucalyptus and Casuarinas. In this method, basically sap is replaced slowly by preservative solution in the vessels, which offers a continuous flow.

## **Treatment Methods**

Sap displacement is achieved by several varieties working on natural osmotic pressure, hydrostatic pressure or low pneumatic pressures that can be created by even a cycle pump. The methods in vogue are

### **A. Modified Boucherie Process**

This method is an adaptation of the treatment process developed and patented by Dr. Boucherie of France in 1838 for treating green timber.

Modified Boucherie process developed by our institute is commonly used to treat green timber poles/bamboo in large numbers quickly by sap displacement technique. The conventional Boucherie process is modified to treat bamboo quickly. In the modified Boucherie process, a suitable container is used for keeping the treating solution which is of water soluble type. The container is provided (at the bottom) with side tubes fitted with stopcocks and rubber tubes to which are attached green bamboos with branches on. In order to secure leak-proof contact between rubber tubes and bamboos, suitable metallic clamps or other devices should be used. The tank is also fitted with a screw cap to which is attached a motorcar tyre tube valve. The tank is filled with the treating water soluble preservative solution to about two-thirds of the volume and after tightening the cap, air is pumped in through the valve to a pressure of (14 to 18 lb/sq.in.) 1.0 to 1.4 Kg/cm<sup>2</sup> which could be easily measured by using a pen-gauge. Under this pressure, the treating liquid forces the sap out of the walls and septa of the bamboos through the open end and takes its (sap) place in course of time. After a few preliminary experiments, the concentration of the treating solution and the period of treatment can be fixed to obtain requisite absorption of the preservative. Bamboo is taken off on completion of treatment.

The preservative liquid that is flowing out of the bamboos and which has got diluted with the sap could be reused after bringing it up to the required concentration and pH value of 4 to 5.

The principle of the Modified Boucherie Process uses a simple pressure pump (electric or gas-powered) to push a preservative salt mixed with water through the entire length of the bamboo pole, from the bottom to the top. The sweet sap is pushed out and replaced by the preservative chemical so that insects do not like to make their homes in it; and if they do lay their eggs in the treated bamboo, the larvae die, because the chemical affects their digestive system.

For the efficiency of the process

- Timber/Bamboo must be very fresh. Therefore the method of harvesting, transporting and storing is very important.
- Preservative solution must be very clean.
- Equipment should be cleaned with fresh water after each use, including the machine, buckets, the work area and the floor to keep everything dirt free.
- Remove and wash nozzles, rubber sleeves and hoses in fresh clean water.
- Cover the water pump and pressure regulation tank with a big plastic tarp when not in use to keep sun, rain and dirt out.
- To stop corrosion, every month, brush a light lubricant such as motor oil on all metal parts (inside and out).
- Use lubricant on the screw threads of clamps and other metal fittings. Leaks around connector fittings on the water pump and pressure regulation tank can be stopped by applying epoxy glue around the leaking point.

Recently, Institute developed compressor based Boucherie equipment in which pressure is developed by using the compressor. This equipment avoids using manual /cycle pump.

### **Fixation of preservatives**

After the poles/culms have been treated they are allowed to dry in a covered place to avoid direct wetting and exposure to sun rays which may produce leaching of the preservative and subsequently fungi infestation and insect attack.

Drying in a very humid tropical climate takes a lot of time. It is therefore recommended to have enough space between the poles/bamboo pieces and a good distance, from the wet soil (not less than 40 cm) for good ventilation.

### **B. Simple Sap Displacement Technique**

It was originally employed for the preservation of fence posts in India by Tewari et. al (1967). This is an excellent and very simple on site treatment standardized at Institute of Wood Science & Technology, Bangalore, India. Rural people, who cannot afford to follow anyone of the Boucherie methods, can employ the simple sap

displacement technique for treating green poles/bamboos. This is done by keeping the butt end of freshly felled poles/bamboos with the crown and branches intact in a tub containing the preservative solution to a depth of 30 - 45 cm. when, during the course of a week or so, sufficient amount of preservative can be sucked up to a height of 10 to 20 ft (4 to 6 mtrs.) due to the transpiration of moisture from leaves. In this method, seasoning of poles and posts, which is an essential prerequisite for pressure treatment process, can be completely avoided.

In this method, freshly felled bamboos of varying diameter (full as well as half split) are made to stand on their butt ends submerging to a height of 30-40 cm in a suitable tank containing preservative solution (6 to 8% CCA or CCB). After 24 – 48 hrs, depending on the girth and length of the poles/bamboos, are reversed with the top end submerged in the solution. They can be removed after 24 – 48 hrs of reversal. After this operation, all poles/bamboos should be closely stacked for 2-3 weeks before putting into use. After the treatment, penetration of chemical can be checked by cutting sections from treated and untreated bamboos by usual spot test (semi-carbazide) penetration test. This simple technique of treating green bamboos is being popularized in India by demonstration to many user agencies such as NGO's, planters, farmers, fishermen and others in rural places by the Institute of Wood Science & Technology, Bangalore, India.

Green bamboos cut fresh in the farm can be treated by sap displacement methods with in 6 to 15 hours from the time of felling. If there is a delay between felling and treatment the latter can be taken up, by keeping felled green poles/bamboos soaked in fresh water in a tank, stream, channel or trough for a period ranging from 1 to 2 days.

## **Quality control**

It is necessary to follow closely the different steps of treatment processes in order to be sure that material is well treated. In the first step preservative solution has to be prepared. For this, preservative should be correctly weighed and right quantity of water to be mixed carefully for the required concentration. Solution requires constant stirring and should become clear. Use hydrometer, pH meter wherever it is possible. Sludging should be avoided.

After the treatment, poles/bamboos must be stored in a rack under a roof to avoid direct sun light and rain for at least two weeks. The poles/bamboo must be stored in shade. The rack must support poles/bamboo in a horizontal and not in vertical position. If poles/bamboo dries in vertical position the preservative solution may leak out. During these two weeks of slow drying process, the preservative will diffuse from sap to the surrounding tissue of the poles/bamboo and multiple salts like CCA & CCB get fixed.

For successful treatment the following points should be borne in mind:

1. Use green fresh timber poles/bamboo
2. Bamboos of 3 to 4 years age should be selected
3. Cut both ends just before clamping the timber poles bamboo into container

4. Always filter the recycled solution back into the master preservative container before using and reusing to keep the solution as clean as possible
5. Carefully bleed / suck all air out of rubber sleeve before the treatment of bamboo

### **Economic aspects of bamboo preservation by sap displacement**

If untreated, non-durable timber/bamboo is used, the decay is inevitable calling for loss or early replacement of material, sometimes with heavy labour charges. Failure of a piece of timber/bamboo in a building through decay or insect attack may involve expenses enormously greater than the actual cost of the piece of timber/bamboo itself. Therefore, use of untreated timber/bamboo gives rise to maintenance problems and high annual costs.

Average life of an untreated timber/bamboo house thus may be considered not more than 7 years. Treated timber poles/bamboo posts may last about 15 years and treated woven mats for walls about 20 years. Treatment may involve an additional cost of about 20% to 13% respectively. But, this will help increase service life of poles/bamboo and its products by 5 to 10 times. This means the cost of poles/bamboo can be decreased to one fifth to one tenth of original costs through treatment and the benefits are obvious.

### **Environmental Health and Safety points to be taken care of**

In order to prevent or minimize the harmful effects of preservatives/chemicals on the person using the chemical, environment as well as knowledge on proper handling preparation and application of chemicals is important. Hazards from preservative chemicals to human beings depend on their toxicity, form (liquid or solid), methods of packing, storage, dilution and application. Basically there are three ways that preservatives can enter into human body, i.e by inhaling, swallowing or from contact with skin.

#### **Safety precautions in preparation, handling and application of chemical treatment**

1. Wear appropriate protective clothing (made of impervious material) like plastics gloves, safety boots and helmets. Eye protective goggles are needed while mixing preservative solutions.
2. Do not drink, eat or smoke during or after application of treatment.
3. Store preservative in correct manner and follow instructions of manufacturer.
4. Spray along the wind direction.
5. Wash hands, feet or take shower after work. Change work clothes regularly.
6. Place containers out of reach of children. Empty containers can be disposed by burying them under ground.
7. Do not allow sludges to accumulate.
8. Do not remove treated timber poles/bamboo material until dripping is stopped.
9. For material treated with water soluble preservatives like CCA,CCB etc., store the poles/bamboo under cover and use only after drying.

10. Dispose off treating solutions properly.
11. Do not release CCA preservatives in streams and do not burn treated materials as fire wood.
12. Train staff and display precautionary materials and gadgets.

**Pollution:**

Pollution can occur from wood preservatives, preservative process and treated timber / bamboo. In most cases pollution problem originates from preservative chemicals themselves. The extent of pollution differs widely with the type of preservative and the treatment process employed. Disposal of waste from treatment requires much care. CCA preservative solutions are toxic and should never be released into streams or canals. CCA treated timber bamboo should not be burned and especially it should never be used for cooking or in a barbeque.



**Boucherie Equipment**



**Compressor based Boucherie equipment**



**Sap-displacement – Eucalyptus poles**



**Sap-displacement of Bamboo**

## **Technology transfer**

Institute has vast experience and expertise on wood preservatives, preservative analysis and treatment methods. As a policy, Institute of Wood Science and Technology encourage industries/ entrepreneurs /individuals to join hands with the Institute to commercially exploit the technologies developed at the institute.

For detailed terms and conditions and negotiation of cost of technology, he interested parties may contact Marketing Cell of IWST. Email ID: [groupco\\_iwst@icfre.org](mailto:groupco_iwst@icfre.org) phone No.080-23340115. Office Hours- 9.00 A.M to 5.30 P.M.