

Determination of Optimum Preservative Treatment Time for Green Bamboo using Boucherie Apparatus: Jagriti

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Abstract: The Boucherie Process is one of the processes for preservative treatment of bamboo to enhance its durability. Various authors have reported a treatment time of 3 - 7 hours for 12' long bamboo and 30-60 min to treat short length bamboos using pressures of up to 2 kg/cm² without mentioning the completion of treatment process. Further literature survey did not reveal any procedure for preservative treatment of bamboos and completion of the treatment process. In the present study the preservative treatment protocol was developed and tested using Boucherie apparatus (Jagriti) on *Bambusa pallida* using the pressure between 1 to 1.5 kg/cm². The completion of treatment process was estimated by comparing the Specific gravity of the treating solution and the effluents at an interval of five minutes using the specific gravity bottles. It was found that freshly harvested bamboo of a meter length required only 15-20 minutes for completion of the process at 1 to 1.5 kg/cm². Longer treatment time was observed due to the presence of particulate matters in the treating solution or on cut surface of bamboo. Post harvest delay also contributed to longer treatment time. There was a significant difference in the treatment time required among the different portions of bamboo and also when the treatment was given 1-2 days after harvest.

Keywords: Durability, Modified Boucherie process, Preservative treatment time.

1. Introduction

Bamboo finds multifarious uses but its natural durability is very low due to damage caused by insects and fungi (Beeson, 1941; Kumar *et al.*, 1994). Various methods are employed to enhance its durability by age old traditional methods and by using modern scientific methods which employ chemical preservatives. These preservative chemical are instilled into the bamboos by various process like steeping, soaking, Boucherie process etc. To enhance the durability of bamboo different techniques are employed viz. traditional and chemical. The traditional methods employ curing, water submergence, smoking, drying and lime/tar coating. In chemical preservation of bamboo various methods and chemicals are used to enhance its durability like Boucherie process, Vacuum process, Fell-cell process, Empty cell process etc. In terms of penetration, distribution and retention of preservatives Boucherie method is considered one of the best methods (Liese, 1980; Gnanaharan, 2000). Initially the Boucherie process was used to treat green timber with the help of motor tyre tubes or a container connected to such tube, containing the chemical preservative is referred to as the "Boucherie Process (Purushotham *et al.*, 1953, Shukla and Dev, 2000). This system of preservative treatment is basically a sap replacement process, which is still practised by placing a tank high enough to create sufficient hydrostatic pressure for preservative treatment (Liese & Kumar, 2003).

The "Modified Boucherie Process" differs from the earlier version is the use of cycle pump to increase pneumatic pressure on the preservative (Purushotham *et al.*, 1953). The Modified Boucherie process can be utilized for preservative treatment of freshly harvested green bamboo with or without branches and leaves. The use of simple hand or foot pump to generate suitable pressure reduces the period of treatment time significantly. The penetration and absorption of the preservative depends upon several factors such as concentration of solution, treatment time, nature of

chemicals used, dimensions of the bamboo, its age and moisture content. It was reported to takes 30-60 min to treat short bamboo lengths using pressures up to 2 kg/cm² (Singh, 1968; Kumar *et al.*, 1994). In order to obtain uniform distribution of preservative from bottom to top, it is recommended to initially use a concentrated solution (6%) until the solution drips out of the apical end. This should be followed by pumping in a solution of a lower concentration (2%) for the same period of time. But further literature survey did not reveal the exact procedure for preservative treatment of bamboo; the time it is supposed to be completed and the time taken for completion of the preservative treatment. Treatment time for 6 m long bamboo is 3 hrs for interior use and 6 hrs for exterior use (Anon, 2006).

2. Material and Method

Commonly available bamboo namely *Bambusa pallida* Munro (Bijuli bah) of 3 - 4 years of age was harvested on a daily on requirement basis, cut and sized to 1 m length and separated into top (R1), mid (R2) and bottom (R3) portions. The chemical preservative used was Copper Chrome Boron (CCB), procured from ASCU Arch Timber Protection Limited, 3524 D-Hide Road Extension Kolkata 700088. India. The weight of 10 ml of the filtered water to be used for preparation of preservative solution was recorded using the 10 ml capacity specific gravity bottle and electronic balance (Model: Sartorius). Similarly the weight of the treating preservative solution of CCB in the concentrations of 8%, 10% and 12% were also recorded up to four decimal points as and when it was prepared. The bamboo samples of 1m length were treated by locally designed and fabricated Boucherie apparatus - Jagriti (Fig:1) (Patent No: 231745 Dated 09.03.2009) with the selected preservative under pneumatic pressures of 1 to 1.5 kg/cm² generated by foot pump.



Figure 1: Jagriti: the Boucherie apparatus

With the initiation of treatment process, effluents' emerging from the distal end of bamboo was collected at an interval of every 5 minutes and the weight of 10 ml of the effluent collected was recorded. The specific gravity of the effluent was compared with that of the treating solution to determine the completion of the treatment process (Table 1). The bamboo samples which could not be given preservative treatment on the day of harvest were kept submerged in water which was given the preservative treatment within the next two days. A thin slice of bamboo was cut to reveal the fresh tissues, washed with clean water before they were attached to the Boucherie apparatus for preservative treatment process. The preservative treatment process was deemed complete when the specific gravity of the effluent became equal that of the treating solution to four decimal points. The preservative treatment process was continued for sometime even after the completion of the treatment to see if any changes takes place in specific gravity of the effluents with time. Since only fresh bamboo samples were used in the study their moisture content was not recorded. The data on preservative treatment time required to complete the process were analyzed with ANOVA at CD (Critical Difference) 5% (Gomez & Gomez. 1984).

Table 1: Protocol for determination of completion of treatment process

Wt of effluent (10 ml)	Time (min)	Specific gravity of effluent	Specific gravity of treating solution
29.829	5	1.0094	1.0205
30.046	10	1.0168	1.0205
30.070	15	1.0176	1.0205
30.073	20	1.0177	1.0205
30.110	25	1.0190	1.0205
30.133	30	1.0197	1.0205
30.142	35	1.0200	1.0205
30.145	40	1.0201	1.0205
30.150	45	1.0203	1.0205
30.153	50	1.0204	1.0205
30.156	55	1.0205	1.0205
Weight of water (10 ml)=29.55			
Weight of treating solution (10 ml)=30.156			

3. Results and Discussion

The preservative treatment time required for different portions of *Bambusa pallida*, irrespective of post harvest treatment given, is presented in Table 3. The average preservative treatment time required (Table:2) in *Bambusa pallida* were 51.50, 46.67 and 54.33 minutes for apical, mid and basal portions respectively, which indicate that lesser average preservative treatment time for the mid portion of the bamboo and higher for the apical and basal portions. Statistical analysis (ANOVA) of the data (Table 3) of the data show that there is a significant difference among the preservative treatments at 5% level of probability.

To see the effect of post harvest delay on the completion of preservative treatment, the data (Table 2) were segregated into three categories viz. preservative treatment given to bamboo on the day of harvest, delay of one day and two days and presented as graph 1. It was found that in case of those bamboo samples which were given preservative treatment on the day of harvest, the average treatment time needed for completion of preservative treatment was 49.44, 35.36 and 44.36 minutes for apical, mid and basal portions of *B. pallida* respectively. When the preservative treatment was given after a delay of one day after harvest the treatment process was completed in 55.00, 39.00 and 52.86 minutes for apical, mid and basal portions respectively and after a delay of two days of harvest the preservative treatments were completed in 56.67, 85.83 and 86 minutes for apical, mid and basal portions respectively (Graph: 1).

Table 2: Preservative treatment time (minutes) required for completion of the process using Jagriti: the Boucherie apparatus in *B. pallida*

S. No	Apical	Mid	Basal
1	50	50	60
2	40	75	65
3	35	45	60
4	45	45	45
5	45	35	35
6	35	50	30
7	35	30	55
8	50	25	60
9	20	45	75
10	50	25	85
11	65	145	105
12	95	35	95
13	55	40	60
14	60	50	105
15	55	60	60
16	25	20	30
17	25	15	15
18	80	25	40
19	70	30	40
20	50	25	45
21	25	40	35
22	25	50	25
23	25	20	60
24	15	20	30
25	40	35	65
23	90	90	40
27	85	70	25
28	70	95	65
29	70	70	15
30	115	40	105
Mean	51.50	46.67	54.33

The study indicate that when the bamboo samples of 1 m length were treated on the day it is harvested, apical portion needed the longest time averaging 49.44 minutes for completion of the preservative treatment process. It was followed by basal portion where the preservative treatment process was completed in an average of 44.38 minutes. The middle portion of the bamboo required the least time of 35.36 minutes (average) to complete the treatment process. When the preservative treatment was carried out after one day after harvest, the average time needed to complete the process were 55.00, 39.00 and 52.86 minutes respectively for apical, mid and basal portions respectively. But when the preservative treatment was given after two days of harvest, the time needed to complete the process was 56.67, 85.83 and 86.00 minutes respectively which are different from the trends seen in the case of treatments given on the day of harvest and after one day of harvest.

In case of preservative treatment of apical portion of *B. pallida*, there is an increase in completion of treatment process from 48.44 (mean) minutes treated on the day of harvest to 55.00 (mean) minutes after storage of one day which further increased to 56.67 (mean) minutes after storage of two days. The preservative treatment time required in mid portion of *B. pallida* was 35.36 (mean)

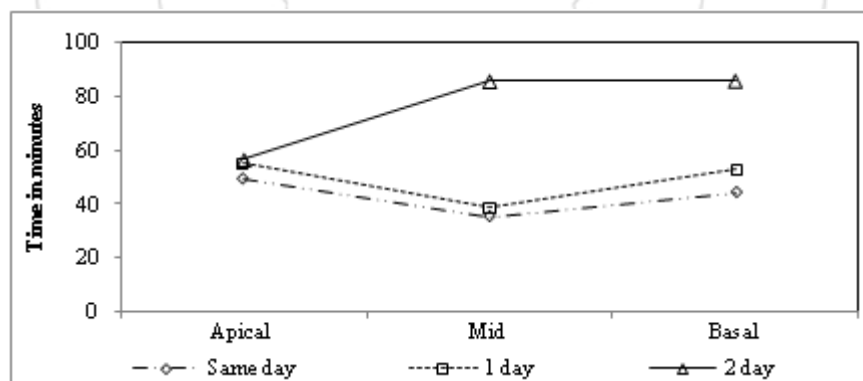
minutes when it was given preservative treatment on the day of harvest which increased to 39.00 (mean) minutes and 85.83 (mean) minutes (~1 hr 26 minutes) after storage of one and two days respectively. In case of basal portion of *B. pallida* the preservative treatment time needed was 44.38 minutes (mean) when it was given preservative treatment on the day of harvest, it increased to 52.86 (mean) minutes and 86.00 (mean) minutes (~1 hr. 26 minutes) after the storage period of one and two days respectively. This increase in longer treatment time required for completion of the treatment process may be attributed to gradual post harvest anatomical changes in bamboo, which occur by way of the precipitation of the sap in the vessels and clogging of the flow pathways to the adjacent tissues (Kumar *et al.* 1994).

The precautions to be adhered to during the preservative treatment of bamboos using Boucherie apparatus is that the preservative solution should not contain any particulate matters in it and also there should not be any debris adhering to the cut surface of bamboo attached to the apparatus. The bamboos should be harvested on day to day requirement basis, as storage of bamboo for longer duration cause anatomical changes in bamboo resulting in longer duration to complete the treatment process.

Table 3: Analysis (ANOVA) of preservative time required for treatment of *B. pallida*

Source of variation	Degree of freedom	Sum of squares	Mean squares	F calculated	Tabular F 5%	Significance
Replications	29	32329.2	1115	2.41	1.65	Sig
Portion of bamboo	2	902	451	0.97	3.15	NS
Error	58	26832	463			

SED : 27.26 CD 45.55



Graph 1: Effect of post harvest delay on completion of preservative treatment using Boucherie Apparatus - Jagriti

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