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Development and Testing of Presurrized Bamboo Treatment Unit

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ABSTRACT: *The presence of large amounts of starch makes bamboo highly susceptible to attack by staining fungi and powder-post beetles. Preservation can extend the life of bamboo and can maintain its quality and hence make it suitable for the use as construction material., Pressure treatment plant was developed for treating three varieties of bamboo using Copper Chrome Boron and Cow urine. Mechanical properties of bamboo were determined by using universal testing machine and following conclusion were drawn. After treating three bamboos it was observed that, out of 7 liter of preservative 4.9 liter of Copper Chrome Boron was required for bamboo in 1.5 hrs. Out of 7 liter preservative, 5.36 liter of Cow urine was required for bamboo in 1.5 hrs. In Cashew Nut Shell Liquid test it was observed that during treatment cashew nut shell liquid was not absorbed by bamboo specimens. This may be because of more viscosity of cashew nut shell liquid. It was observed that the tensile strength for bamboo before treatment and after treatment for* Dendrocalamus stocksii *(Mes),* Dendrocalamus ritchy *(Manga),* Dendrocalamus strictus *(Manvel) was 17.35, 14.96 and 15.32 N/mm^2 and 18.01, 15.12 and 16.01N/mm^2 respectively. The compressive strength for bamboo before treatment and after treatment for* Dendrocalamus stocksii *(Mes),* Dendrocalamus ritchy *(Manga),* Dendrocalamus strictus *(Manvel) was 1.10, 0.90 and 0.80 N/mm^2 and 0.91, 0.82 and 0.76 N /mm^2 respectively.*

INTRODUCTION

At least one third of the human race uses bamboo in one way or another. Bamboo is an integral part of the culture in several Asian countries. In India, over one million tones of bamboo are used as a long fiber sources for the manufacture of pulp and paper. Its unique strength properties, coupled with innovative uses by people, have enabled its versatility to be exploited for many industrial and architectural uses. Bamboo is used for housing construction, mats, ladders, floating fenders, furniture, handicraft articles, baskets, etc. Its versatile nature and innumerable uses have earned bamboo the name 'green gold of the forest'. Since bamboo is less expensive than construction materials like steel, cement and even wood, it is considered to be 'poor man's timber', Among the many uses, bamboo is an important construction materials, such as scaffolding, bridges, shelters, towers and for simple and modern engineered structures.

Bamboo consists of 50-70% hemicellulose 30% pentasons, and 20-25% lignin . Ninety percent of the hemicelluloses are xylan with a structure intermediate between hardwood and softwood xylans. The lignin present in bamboos is unique, and undergoes changes during the elongation of the culms Bamboo is known to be rich in silica (0.5 to 4%), but the entire silica is located in the epidermis layers, with hardly any silica in the rest of the wall. Bamboos also have minor amounts of resins, waxes and tannins. None of these, however, have enough toxicity to impart any natural durability. On the other hand, the presence of large amounts of starch makes bamboo highly susceptible to attack by staining fungi and powder-post beetles. Major drawback with bamboo is that it is not durable against wood degrading organisms. Thus most bamboos used for structural purposes in rural and tribal housing deteriorate in a couple of years, putting heavy pressure on the resources, owing to increases demands for frequent replacement. This adversely

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affects the supplies of bamboo, even in bamboo rich regions. Preservation bamboo extends their life, reduces costs in the long run and to improves safety of the structures they are used to form.

MATERIAL AND METHOD

Bamboo treatment plant consists of tank for preservative storage, control valves and pipes. Capacity of storage tank was 10 liter. One main outlet with control valve was provided to the tank. To the main outlet three sub outlets with control valves were provided to control the flow of chemical through the bamboo. Non return valve was provided to supply air by using hand pump. Pressure gauge was attached to measure pressure in the tank. Measuring cylinder of 1 lit capacity was used to measure the water. Weighing balance of 0.1 g to 2000 g capacity was used for measuring weights of the chemical preservatives. Cutting knife was used for harvesting bamboo and cutting branches of bamboo. Knife was also used for preparation of dumbbell shaped sample required for tensile test. The steel rule and metal tape were used for the measurement of the length of sample. Vernier caliper of 0.001 mm least count was used for the measurement of thickness of the bamboo samples, Hot air oven was used to determine moisture content. Universal testing machine of 50KN capacity model number AG-X available at College of Forestry was used to determine the tensile and compressive strength of bamboo sample digitally on computer. Chemical was filled in tank from inlet and the lid was closed tightly. Chemical was pressurized at 1.5 to 2 kg/cm^2 by hand pump. Three bamboo were attached at the end of outlet by rubber casing. When pressure of tank reaches desired value, the main valve at the bottom of tank was opened. To adjust the pressure sub control valves was adjusted. Sap start dipping from end of bamboo after 10-15 min. The treatment is finished when chemical starts dipping from the other or free end of bamboo. Time required for treatment and chemical required were noted. The dumbbell shaped bamboo sample having length 220 mm, width 30 mm and thickness 6 mm used to determine tensile stress and the rectangular cross section shaped bamboo sample having length 100 mm, width 30 mm and thickness 10 mm used to determine compression by using universal testing machine

RESULT AND DISCUSSION

Chemical required

To determine the quantity of preservative required, bamboo was fixed to three sub outlet of the developed pressure treatment plant . After treating bamboo, it was observed that, out of 7 liter of sample, 5.5 liters of Copper Chrome Boron and 6.0 liters of cow urine in 2 hrs was required for treating *Dendrocalamus stocksii* (Mes). Out of 7 liter preservative, 4.7 liters of Copper Chrome Boron and 5.3 liters of cow urine in 1 hrs was required for treating *Dendrocalamus ritchy* (Manga). *Dendrocalamus strictus* (Manvel) required 4.5 liters of Copper Chrome Boron and 4.8 liters of cow urine in 1.5 hrs. Manga required less time than Manvel and Mes variety for treatment. This may be because of varietal difference. Results are shown in Table 1. In Cashew Nut Shell Liquid test it was observed that during treatment cashew nut shell liquid was not absorbed by bamboo specimens after 24 hrs of treatment. This may be because of more viscosity of cashew nut shell liquid.

Table 1
Preservative require and time required for treatment

Sr. No.	*Variety*	*Preservative required (liter)*		*Time for treatment (h)*
		C.C.B.	*Cow Urine*	
1.	*Dendrocalamus stocksii* (Mes)	5.5	6.0	2.0
2.	*Dendrocalamus ritchy* (Manga)	4.7	5.3	1.0
3.	*Dendrocalamus strictus* (Manvel)	4.5	4.8	1.5

VISUAL OBSERVATION

During the preservation study some changes in colour was observed. The changes were noted visually. It was observed that the dark green colour of bamboo changes to brown colour. This may be because of chemical treatment.

PHYSICAL PROPERTIES

Moisture content

Moisture content of treated and untreated bamboo was determine by using Hot air oven. It was observed that moisture content of bamboo increased after treatment. Moisture content of treated and untreated bamboo is given in Table 2

Table 2
Moisture content of treated and untreated bamboo

Sr. No.	*Variety*	*Moisture content of treated bamboo (%)*	*Moisture content of untreated bamboo (%)*
1.	*Dendrocalamus stocksii* (Mes)	19.08	14.80
2.	*Dendrocalamus ritchy* (Manga)	18.97	15.48
3.	*Dendrocalamus strictus* (Manvel)	14.6	10.88

WEIGHT OF BAMBOO

Weight of bamboo was determined by using weighing machine. Weight of bamboo increased after treatment. Weight of treated and untreated bamboo is given in Table 3

Table 3
Weight of treated and untreated bamboo

Sr. No.	*Variety*	*Weight of bamboo after treatment (Kg)*	*Weight of bamboo before treatment (Kg)*
1.	*Dendrocalamus stocksii* (Mes)	4.2	3.76
2.	*Dendrocalamus ritchy* (Manga)	3.6	3.3
3.	*Dendrocalamus strictus* (Manvel)	4.16	4.0

MECHANICAL PROPERTIES

Tensile strength

Tensile strength of treated bamboo was determined. Tensile strength of *Dendrocalamus stocksii* (Mes), *Dendrocalamus ritchy* (Manga), *Dendrocalamus strictus* (Manvel) after treatment was 18.01 N/mm^2, 15.12 N/mm^2 and 16.01 N/mm^2 respectively and for untreated bamboo Tensile strength was 17.35 N/mm^2, 14.96 N/mm^2 and 15.32 N/mm^2 respectively. Table 4 shows the tensile strength of treated and untreated bamboo respectively. No significant difference was observed in tensile strength

Table 4
Tensile strength of treated and untreated bamboo sample

Sr. No.	*Variety*	*After treatment (N/mm^2)*	*Before treatment (N/mm^2)*
1.	*Dendrocalamus stocksii* (Mes)	18.01	17.35
2.	*Dendrocalamus ritchy* (Manga)	15.12	14.96
3.	*Dendrocalamus strictus* (Manvel)	16.01	15.32

COMPRESSIVE STRENGTH

Compressive strength of treated and untreated bamboo was determined. Compressive strength of *Dendrocalamus stocksii* (Mes), *Dendrocalamus ritchy* (Manga), *Dendrocalamus strictus* (Manvel) after treatment was 0.91N/mm^2, 0.82 N/mm^2 and 0.76 N/mm^2 respectively and for untreated bamboo Compressive strength was 1.10 N/mm^2, 0.90 N/mm^2 and 0.80 N/mm^2 respectively. Table 5 shows the Compressive strength of treated and untreated bamboo respectively. No significant difference was observed in Compressive strength.

Table 5
Compressive strength of treated and untreated bamboo sample.

Sr. No.	*Variety*	*After treatment (N/mm^2)*	*Before treatment (N/mm^2)*
1.	*Dendrocalamus stocksii* (Mes)	0.91	1.10
2.	*Dendrocalamus ritchy* (Manga)	0.82	0.90
3.	*Dendrocalamus strictus* (Manvel)	0.76	0.80

CONCLUSIONS

1. *Dendrocalamus ritchy* (Manga), *Dendrocalmus strictus* (Manvel), *Dendrocalamus stocksii (Mes)* variety of bamboo can be treated by developed pressure treatment plant
2. Bamboo can be treated by using Copper Crome boron (CCB) and cow urine within 1-2 hrs.
3. CSNL is not suitable to treat bamboo within 24 hrs by using developed treatment plant.

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