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Studies on preservation of bamboo

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Abstract **:** Bamboo was treated by steeping method using boric acid borax, copper chrome boron and cashew nut shell liquid treatment for 14 day. After treatment, quality evaluation of bamboo was done by cutting bamboo in sample size of 61 cm (2') and exposing them to environmental condition. Mechanical properties of 61 cm (2') bamboo (30.5 cm (1') buried in soil and 30.5 cm (1') above soil were determined by using universal testing machine. Preservation of *Dedrocalmus ritchy* (manga) variety of bamboo can be done by using boric acid borax and copper chrome boron. Cashew nut shell liquid is not suitable for steeping method. Tensile stress and compressive stress treated with boric acid borax was maximum. Tensile stress of bamboo goes on increasing from bottom to middle height and decrease from middle to top.

Key words **:** Bamboo, Treatment, Mechanical properties

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Bamboos play a dominant role as woody raw material for a variety of products in the tropical regions. Bamboos are, however, more abundant in the tropics, with over 75 genera and 1250 species, ranging from small grasses to giants of over 40 m in height and 0.3 m in diameter. It has been reported that about 50 genera and 700 species of bamboo are found all over world. Asia alone accounts for 400 species. Over 136 species in 30 genera occur in India. In Maharashtra bamboo production is 2,47,239 tonnes. The Konkan region contributes 70,000 tonnes of bamboo production. In Konkan region *Dendrocalamus strictus* (Manvel), *Bambusa bambus* (kalak), *Dendrocalamus stocksii* (Mes) *Dendrocalamus ritchy* (Manga) are locally available varieties. Bamboo consists of 50-70s hemicellulose, 30 per cent pentosans, and 20-25 per cent lignin. 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. A 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 resource, owing to increased demands for frequent replacements. This adversely affects the supplies of bamboo, even in bamboo rich regions Low life of bamboo and its susceptibility to various attacking agents is the main cause for its fewer acceptances as construction material but preservation can extend the life of bamboo and can maintain its quality and hence make it suitable for the use as construction material. Different preservation methods are used for this purpose.

The *Dedrocalamus ritchy* (Manga) variety of bamboo was used for the present study. The bamboo samples were collected from Ranevadi village of Dapoli Tahsil, district Ratnagiri. The bamboo of 4 year of age and more than 2 m in length was used.

Containers:

Plastic containers of 20 L capacity was used for keeping and mixing the preservative chemicals and for carrying out the various treatments. The six container were used for preservative treatment.

Weighing balance:

Weighing balance of 0.1 g to 2000 g capacity was used for the measuring the weights of the chemical preservatives.

Cutting machine:

Electrically operated cutting machine was used for cut bamboo in size of 61 cm (2') in length.

Hot air oven:

To determine moisture content of bamboo, hot air oven was used.

Universal testing machine (UTM):

Universal testing machine was used for measurement of tensile and compressive strength during storage period of selected bamboo samples. The capacity of universal testing machine is 50 KN having model number AG-X.

Vernier caliper:

Vernier caliper of 0.001 mm least count was used for the measurement of thickness of the bamboo samples.

Moisture content:

The moisture content was determined by using hot air oven. For this purpose, samples were kept in oven at 105^{0}C for 24 hours. The moisture content on per cent basis was determined. It was calculated by formula

$$\text{Moisture content} = W_2/W_1 * 100$$

W_2 = weight of water removed, g

W_1 = initial weight of sample, g

Boric acid borax treatment:

To prepare boric acid borax preservative, in 2:2:0.5 ratio boric acid (400 g), borax powder (400 g) and sodium dichromate (100 g) was mixed in 20 lit of water. The bamboo specimens were kept in the boric acid borax solution for 14 days.

Copper chrome boron treatment:

For preparing copper chrome boron preservative in 1.5:3:4 ratio copper sulphate (600 g), boric acid (300 g) and sodium dichromate (800 g) was mixed in 20 L of water. The bamboo specimens were kept in the copper chrome boron solution for 14 days.

Cashew nut shell liquid treatment:

Cashew nut shell liquid was processed from metafile industry. For the treatment 20 L of cashew nut shell liquid taken in a container. The bamboo specimens were kept in the cashew nut shell liquid chemical for 14 days.

Steeping method:

This method was aimed at increasing storage life of well treated bamboo, reduce the vulnerability to mechanical attack and to retain the mechanical properties (Tensile and compressive). To carry out this test, bamboos of more than 915 cm (15') length along with their leaves were used. These bamboos were dipped in preservative and kept for 14 days. The three bamboo samples were kept in a single container.

Periodic quality evaluation:

To carry out periodic quality evaluation of bamboo, leaves of bamboo were removed. Bamboo was cut into size of 61 cm (2') size and was exposed to the environmental condition. Out of 61 cm (2') height, 30.5 cm (1') was kept under soil and 30.5 cm (1') above soil.

Study was carried out on preservative of bamboo (*Dedrocalamus ritchy*) by using boric acid borax, copper chrome boron and cashew nut shell liquid was used for preservation. Bamboo was treated by using steeping method. For periodic qualitative evaluation bamboo was cut into a size of 61 cm (2') and buried in soil to expose to climatic condition. Tensile stress and compression during storage period of 15, 30 and 45 days was determined by using universal testing machine.

Chemical absorption

To determine the absorption of preservative, the bamboo with leaves was dipped in the 20 L containers. After preservation time of 14 days it was observed, out of 20 lit of sample, 10 L boric acid borax liquid, 5 L of copper chrome boron liquid was absorbed by bamboo.

In cashew nut shell liquid test it was observed that during 15 days of treatment cashew nut shell liquid was not absorbed by bamboo specimens. It may be because of more viscosity of cashew nut shell liquid.

Moisture content:

A small piece of treated bamboo was taken and its moisture content was determined by using hot air oven. Moisture content of bamboo treated with boric acid borax, copper chrome boron and cashew nut shell liquid was 11.4 per cent.

Visual observation during storage:

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 and atmospheric condition.

Mechanical properties:

Treated and untreated bamboo strips after exposure to environmental conditions were used for testing for their mechanical properties on universal testing machine. They were tested for tensile and compressive strength.

Tensile stress during storage:

The dumbbells shaped bamboo strip was prepared for testing. The bamboo treated with boric acid borax treatment has the highest tensile strength. The results also showed that bamboo treated with copper chrome boron treatment had

tensile strength less than that treated with boric acid borax treatment. The cashew nut shell liquid and untreated bamboo treatment bamboo had less tensile strength as during storage period their quality detoriateed.

Compression during storage period

Compressive stress was determined by preparing square shape strip of bamboo sample. The results obtained from universal testing machine shows that bamboo treated with boric acid borax treatment had the highest compressive strength. The results also showed that bamboo treated with copper chrome boron treatment had compressive strength less than that treated with boric acid borax treatment. The untreated bamboo and cashew nut shell liquid treatment bamboo had less compressive strength. Mechanical properties of Calcutta bamboo and chemical composition of ten species of bamboo were also studied by Ahad (2003) and Chen *et al.* (1985), respectively

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