Quality parameters of Bamboo (Dendrocalamus strictus)

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Abstract: Bamboos are a valuable and precious gift of nature to man. Bamboo plays a dominant role as woody raw material for a variety of products in the tropical regions. Bamboo is the fastest growing plant in the world having growth up to 60 cm or more in a day. Bamboo has social, economic and cultural significance and is used extensively for building materials along with thousands of uses. It is highly versatile raw material for different works. The bamboo is light weight, flexible, tough, high tensile, cheap material than the other building material like steel. Bamboo structures are flexible, earthquake resistant, light weight and cheap. There are various species of bamboo found all over the world. Dendrocalamus strictus is the predominant specie found in India. Male bamboo or Dendrocalamus strictus or Lathi bans occupies total 53 percent of total bamboo area in India. Various quality parameters are conducted by the author on the specie. This paper investigates the various quality parameters of Dendrocalamus strictus.

Index Terms- Bamboo, quality parameters, male bamboo, Dendrocalamus strictus or Lathi bans.

I] INTRODUCTION-

Bamboo are a valuable gift of nature to man. They have age-old connections with the material needs of the people and are fascinating to the artist, the poet, the craftsman and to the scientist. Aptly called the Poor man's timber they have a significant place in rural economy. They are sufficiently cheap and can meet the varied needs of the human population from the cradle to the bier. They can be easily split and made into useful articles with ordinary hand-tools. In fact, there is no limit to the varieties and qualities of articles that can be made out of this natural plant resource.

Bamboos play a dominant role as woody raw material for a variety of products in the tropical regions. Almost all continents, except Europe, have indigenous bamboo species. Bamboo 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 (Tiwari,1993).

The number of ways bamboo enter into the diverse phases of human life are too well known. They are used for a variety of purposes, such as toothpicks, baskets, mats, flutes, agricultural implements, spears, bows and arrows, walking sticks, bridges and houses and are good foe afforestation, soil conservation and social forestry. Being closely interwoven with the life of the people in several ways, bamboos occupy a place of pride in our country.

Unfortunately, like most lignocellulosic materials, bamboo has very low resistance to biological degrading agents. Several techniques to enhance its durability have, quality have, therefore, been developed. This paper on bamboo quality parameter has been compiled to consolidate all useful information and to provide helpful guidelines to users.

II] PROPERTIES OF BAMBOO-

Anatomically, bamboo is quite different from wood coming from gynosperms and dicotyledonous angiosperms (Ghosh and Negi, 1959). All the growth in bamboo occurs longitudinally and there is no lateral or radial growth as in trees. Characteristically, bamboo has a hollow stem, or culm (solid in some species only), which is closed at frequent intervals called nodes. The bamboo culm comprises about 50% parenchyma, 40% fibres and 10% vessels and sieve tubes (Liese 1987). Fibre percentage is higher in the outer one- third of the wall and in the upper part of the culm, contributing to its superior slenderness (Grosser and Liese, 1971). Most fibres have a thick polylamellate secondary wall (Parameswaran and Liese, 1976). The typical tertiary wall present in most woody cells of gymnosperms and angiosperms is not present. Similarly, bamboos do not develop reaction wood, which is most common in tree species due to aging.

Fibres in bamboos are grouped in bundles and sheaths around the vessels. The epiderma1 walls consist of an outer and inner layer; the latter is highly lignified. The outer layer contains cellulose and pectin with a wax coating. Silica particles also exist in the peripheral parts of the culm. These anatomical features are responsible for the poor penetration of preservatives into round culms during treatment. Although vessel elements in bamboo are easily permeable, lateral flow is restricted because of the absence of ray cells.(Satish kumar *et* al 1994).

III]MATERIALS AND METHOD-

This paper deals with the study of one of the three available species of bamboo that is found in the Balaghat region, namely, Dendrocalamus Strictus. The assessment of various standard quality parameters of the species was done such as;

- **Physical and mechanical properties**
- **Durability**
- **Drying of green bamboo**
- **Treatment of green bamboo**
- **Working qualities**

IV] RESULT-

4.1). Physical and mechanical properties-

4.1. (a) Physical properties:-

Depending upon the soil, locality and the species, there is considerable variation in the diameter of culm and the extent of cavity in bamboo, both amongst the species and within the species**.**

The moisture content of immature culms is higher than that of mature culms. The moisture content in different parts of a culm is almost the same in the case of immature bamboo, but in case of mature bamboos, the moisture content decreases with the height of the culm.

Because of the difference in anatomical nature and distribution pattern of different cells, variation in specific gravity has been observed along the wall thickness of bamboo.

There is significant variation in tangential shrinkage among different tangential layers in the wall thickness of bamboo. The shrinkage of the whole wall is controlled by the outer most portion of the wall which has the highest shrinkage (15 percent). Unlike wood, bamboo starts shrinking both in the wall thickness as well as diameter from the very beginning of drying. The trend of the shrinkage-moisture content in bamboo is particular as excessive shrinkage takes place well above fiber saturation point. This shrinkage lies between 4-16 percent approximately in the wall thickness and between 3-12 percent in diameters. Below 15 percent moisture content in the shrinkage, moisture curves follow a proportional curve similar to wood.

Figure 1. Dendrocalamus strictus (Lathi Bans) Balaghat District(M.P.)

Figure 2. Dendrocalamus strictus.

4.1(b). Mechanical properties:-

The strength of bamboo depends upon the species, climatic conditions, age and moisture content. The strength of the culm increases upto 3 to 4 years of age, the strength also increases with the decrease in the moisture content. The tensile strength and hardness are greater in the outer surface than in inside of the culm. The bending and tensile strength of outer layer of bamboo are about twice of those of the inner layer. The strength property of Dendrocalamus strictus is summarized below;

Table 1 - Strength of Dendrocalamus strictus.

Species	Moisture content (%)	Modulus of Rupture (kg/sq. cm)	Modulus of elasticity (kg/sq cm.)	Maximum crushing stress (kg/sq cm)
Dendocalamus Strictus	58	958.183	156409.21	422.728

4.2). Durability-

In general bamboos are easily susceptible to attack by insects and fungi. In tropical countries the deterioration due to these agencies is very severe. Investigation carried out at the FRI-Dehradun have indicated that bamboos are generally destroyed in about 1 - 2 years time when use in the open and in contact with the ground while a service life of 2 – 5 years can be obtained from bamboos when used under cover and out of contact with the ground.

It is now well established that service life of bamboo can be increased many times by impregnating it with wood preservatives. Such treatments give adequate protection against bio degrading agencies and economic service life (at least fifteen years), is obtained.

Table 2- Natural durability of Dendrocalamus strictus (graveryard test data).

Bamboo spp.	Maximum life (months)	Minimum life (months)	Average life (months)	Remarks
Dendrocalamus strictus	30	18	19.3	Unpublished data FRI, Dehradun

Satish *et* al., 1994.

4.3).Drying of green bamboo-

As already mentioned, green bamboos may contain 100 – 150 percent moisture content, depending on the species, area of growth and felling season. In addition, bamboo possess hygroscopic materials in the parenchyma and therefore, take a longer time to dry compared to wood of similar density (Sekhar and Rawat, 1964; Laxmana, 1985). The liability to biological degradation and to deformation owing to excessive shrinkage (which occurs even above the fiber saturation point) necessitates quick drying of bamboo.

4.3.(a). Air Drying:-

Airs drying takes 6 – 12 weeks, depending on the initial moisture content and wall thickness. Collapse may be a major problem in some species, owing to excessive and non-uniform shrinkage of the culm. However, problems are mostly seen in drying of immature culms. It is recommended that only mature culms are used (Sharma, 1988)

Split bamboos do not pose any problem in air drying and can be dried even in the open sun. Split bamboos standing upright dry faster than horizontal stacking. Round bamboos can also be dried standing upright or in stacks, using bamboo crossers of appropriate diameter.

Figure 3 - Stack of bamboos for drying.

4.4). Treatment of green bamboo-

The best and simplest process for the treatment of green, round or split bamboo is by the diffusion process, wherein the material in green condition is submerged in the preservative solution for sufficiently long time to obtain adequate absorption of the preservative in quantity and depth. It takes about five to six weeks, or more to treat the bamboo by this method.

Table 3 -Treatment of green Dendrocalamus strictus by Diffusion method (Singh and Tewari,1979 ;1981).

Specimen type	Method	Preservative	Duration	Absorption Kg/m3*
Round	Diffusion	Boricacid Borox 6%	10 Days	7.73
Half-split	Diffusion	Boric acid Borox 6%	10 Days	11.32
Round	Diffusion	Boric acid Borax 6%	20 Days	10.86
Half-split	Diffusion	Boric acid Borax 6%	20 Days	20.16

*Ascertained by chemical analysis

If the structural requirement needs round bamboos and also doesn't allow rupturing of intermodal portion wall, the Boucherie process is the only possible commercial process. Only freshly felled bamboo can be treated by this process and higher the moisture content in the bamboo, the better will be the absorption of the preservatives Preservative is forced under pressure of 1.0 to 1.4 kg/sq cm.

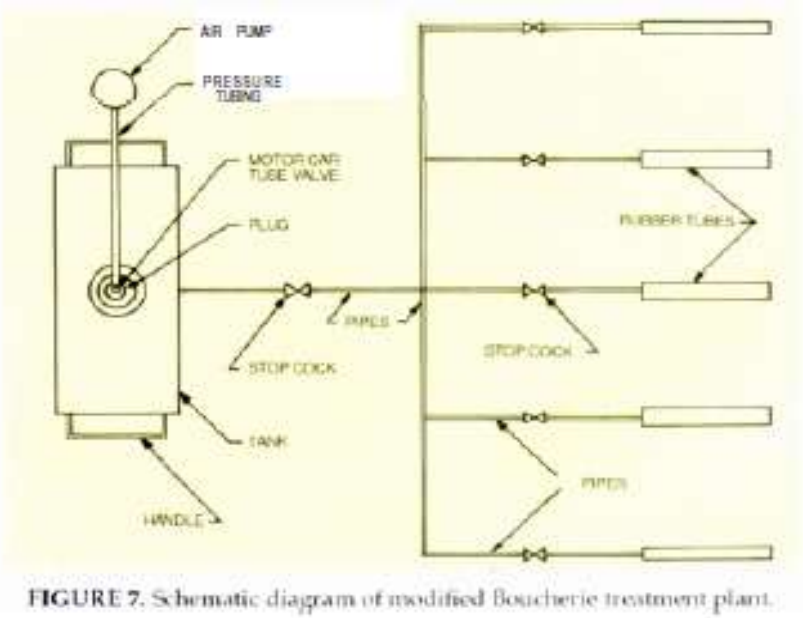

FIGURE 7. Schematic diagram of modified Boucherie treatment plant.

Figure 4- Schematic diagram of modified Boucherie treatment plant. (Satish kumar *et* all. 1994).

Detailed information regarding different wood preservatives desired absorptions, treatment processes for different end uses of bamboos can be obtained from FRI - Dehra Dun.

4.5). Working qualities

Bamboo can be cut and split easily with hand-saw. Strips of any length and size can be made with pen-knife. Immature bamboos are soft, liable and can be modules to desired shapes. It takes polish and paint well.

V] CONCLUSION-

From the foregoing discussion it is inferred that bamboo culms are good source of building materials, household and decorative items. Amongst all the varieties Dendrocalamus strictus which is grown abundantly in the region was found best in terms of quality parameters. These culms can be exploited for the development of various value added products to add new dimension in the market.

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