PROPERTIES AND UTILIZATION OF LOCALLY GROWN CHINAR (*PLATANUS ORIENTALIS LINN.)* WOOD

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Abstract

Chinar (*Platanus orientalis*) wood grown in Khyber Pakhtunkhwa was tested for its physico-mechanical properties and pulping characteristics to find out its better utilization. Results revealed that the comparatively high value of cleavage made it better for carving and cutting works. A comparison of physico-mechanical properties of Chinar (*Platanus Orientalis*) wood with that of Shisham (*Dalbergia sissoo*) wood properties also showed that the wood could be used as a substitute for Shisham (*Dalbergia sissoo*) wood for manufacturing of medium strength requiring furniture articles, cabinet work, etc. Moreover, results of the pulping characteristics showed that, small sized timber, like tree branches, wood shavings, sawdust, etc., of the species could also be used as raw material for pulp and paper manufacture.

Introduction

Pakistan has meager forest resources. Presently about 5% of the country's land is under forest cover which is very low when compared with other Asian countries. Owing to growing utilization pressure on few indigenous commercial species, it is the need of time in the country to explore more species for wood and wood based utilization. Taking into consideration the above mentioned problem, Chinar (*Platanus orientalis)* wood had been tested for its wood properties and was analyzed for its utilization in various wood products. Small sized timber branch wood was also tested for its suitability for the production of pulp and paper owing to the ever increasing demand in paper and paperboard products as "the paper and paperboard industry has shown substantial growth of (8.38 %) during the first nine months of the year 2011-12." (Economic Survey of Pakistan 2011-12).

Chinar (*Platanus orientalis*) is a large, deciduous tree known for its longevity and spreading crown. The tree is native to South Western Asia. (Wikipedia, 2007). It has an average girth of 4 meters; the bark is thin, smooth and light or dark grey. It is cultivated in Balochistan, Malakand and Hazara Divisions of Khyber Pakhtunkhwa and Azad Kashmir up to 2500 meters elevation. The heartwood is indistinct from sapwood. The wood is medium to straight grained, medium fine and uneven textured (Siddique, 1996). The tree grows best on moist deep well-drained soil. (Troup, 1921). It is tolerant tree that grows on sandy, acidic soils, on wet sites and along stream banks. It prefers an arid, cool temperate climate at elevations up to 3000 meters. (Sheikh, 1993).

Materials and Method

In order to study the physico-mechanical properties, the butt end Chinar (*Platanus orientalis)* logs were taken and converted into planks. Half of the material

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was stacked in seasoning shed to attain equilibrium moisture content. However, the freshly sawn material was further converted into strips of 2cm x 2cm cross section to prepare clear wood specimens for testing of various physical and mechanical properties. The samples of the following sizes were prepared according to standards (ISO Standards).

S.No	Property	Size of sample
1	Shrinkage	3cm x 2cm x 2cm
2	Density	6cmx2cmx2cm
3	Static bending	30cmx2cmx2cm
4	Impact bending	30cmx2cmx2cm
5	Compression parallel to grain	6cmx2cmx2cm
6	Tensile strength Perpendicular to grain	7cmx2cmx2cm
7	Cleavage	4.5cmx2cmx2cm
8	Hardness	10cmx2cmx2cm

The values of the properties tested for air dry condition were adjusted at 12 % moisture content using the formula given in ISO Standards. The samples were tested on Amsler Universal Wood Testing machine with a total loading capacity of 4000kg and an accuracy of 1% of its total loading capacity.

For the determination of pulping characteristics of Chinar (*Platanus orientalis)* wood small sized logs were taken and debarked .Chips were prepared using Staffi chipper. Chips size distribution is very important factor in chipping operation. For this purpose N-3 fraction (1 inch in length and 3.2 mm in thickness) was used for pulping through laboratory chips screener. The Moisture content was determined and the chips were cooked with 15 % active alkali and 25 % sulphidity. After cooking, pulp was washed thoroughly. `The washed pulp was then disintegrated in order to get a uniform pulp. Cooking yield was determined. This disintegrated pulp was beaten in a beater to find out consistency through SR (Schopper Reigler). These sheets were then pressed in Semi-Automatic-Press and dried to get fine sheets. In order to find quality of paper, various tests were carried out to estimate paper properties like grammage, density, bulk, breaking length, tensile index etc. (TAPPI Test Methods).

Results and Discussion

Physical Properties of the wood

Chinar *(Platanus orientalis)* wood is grayish brown in color. It has medium to straight grain. Based upon its specific gravity which was calculated 0.680 and its basic density 0.66, it was classified as moderately heavy wood. Volumetric shrinkage in the wood was calculated as 11.49 % from green to air dry condition. This indicates that the wood is liable to shrink both in radial as well as in tangential direction as shown in table 1.

Table 1. Physical properties of Chinar (*Platanus orientalis*) wood

S.No	Property	Average value
1	Specific gravity	0.68
2	Basic density	0.66
3	Moisture content % Air dry	10.0
4	Moisture content % green	76.2
5	Longitudinal shrinkage From green to air dry % From green to oven dry %	 1.09 1.21
6	Radial shrinkage From green to air dry % From green to oven dry %	 4.2 5.45
7	Tangential shrinkage From green to air dry % From green to oven dry %	 6.20 6.85

Mechanical Properties of the wood

Chinar *(Platanus orientalis)* wood has been tested to determine its various mechanical properties both in green as well as in air dry conditions. Values of MOE and MOR were 53036kg/cm² and 674kg/cm² respectively which are considered as low. The value of impact bending in the wood was also low (3.2 m-kg). However, the cleavage value was observed fairly well (34 kg/cm) that makes the wood suitable for making the wooden articles in which medium strength is required. Further, higher cleavage value makes it better timber for carving, boring and cutting etc. Details of the results of mechanical properties in green condition and Air dry conditions are shown in Table 2 and 3 respectively.

Table 2. Strength Properties of Chinar (*P. orientalis)* wood in green condition

S.No	Property	Average value	Standard deviation	Coefficient of variation%
1	Modulus of rupture (kg/cm²)	518	60.3	13.1
2	Modulus of elasticity (kg/cm²)	30210	2437	9.1
3	Maximum compression parallel to grain (kg/cm²)	225	11.0	6.2
4	Cleavage (kg/cm)	33	3.2	10.1
5	Tensile strength perpendicular to grain (kg/cm²)	31	5.2	17.2
6	Impact bending (m-kg /4 cm²)	5.5	0.3	4.3
7	Hardness (kg) Side End	 432 523	 41 62	 9.33 11.75

Table 3. Strength Properties of Chinar (*P. orientalis*) wood in Air dry condition

S.No	Property	Average value	Standard deviation	Coefficient of variation%
1	Modulus of rupture (kg/cm²)	674	86	12.8
2	Modulus of elasticity (kg/cm²)	53036	4498	8.7
3	Maximum compression parallel to grain (kg/cm²)	439	34	8.3
4	Cleavage (kg/cm)	34	6.1	16.2
5	Tensile strength perpendicular to grain(kg/cm²)	41	6.2	13.1
6	Impact bending (m-kg/4 cm²)	3.2	1.0	18.1
7	Hardness (kg) Side End	 634 689	 109 139	 18 21

Comparison with Shisham wood

On comparison of values of various strength properties of Chinar (*Platanus orientalis*) wood with those of shisham *(Dalbergia sissoo)* wood as shown in Table 4. It was found that most of the strength properties of chinar (*Platanus orientalis)* wood were not comparable to those of Shisham *(Dalbergia sissoo)* wood properties however, the Cleavage and Impact bending values are fairly higher than those of Shisham *(Dalbergia sissoo)* wood and enable the former to be utilized in wood works where medium strength is required.

Table 4. Comparison of strength properties of Chinar (*P. orientalis)* wood with that of Shisham *(Dalbergia sissoo)* wood

S.No	Property	Chinar wood	Shisham wood
1.	Density (kg/m³)	640	801
2.	Modulus of rupture (kg/cm²)	674	1120
3.	Modulus of elasticity (kg/cm²)	53036	85790
4.	Maximum Compression parallel to grain (kg/cm²)	439	560
5.	Cleavage (kg/cm)	34	22
6.	Impact bending (m-kg/4cm²)	3.2	1.79
7.	Hardness (kg) Side End	 634 689	 650 800

Suitability for pulp and paper

Results given in table 5 indicated that Chinar (*Platanus orientalis)* wood is suitable for pulp and paper manufacture. Higher grammage value (56.5g) showed great suitability of Chinar (*Platanus orientalis)* wood for paper industry. Higher value of bulk (0.77) showed that paper made from Chinar (*Platanus orientalis)* wood was good for printing purposes. Moreover, wood strength properties could be further enhanced due to higher wood density.

Table 5. Pulping Characteristics of Chinar (*Platanus orientalis*) wood

S.No	Property	Value
1	Active Alkali (%)	15
2	Sulphidity (%)	25
3	Cooking Time (hours)	3
4	Cooking Temperature (ºC)	170
5	Wood : Liquid	1:5
6	Cooking Yield (%)	43
7	Kappa No.	17.3
8	SR	65
9	Grammage (g)	56.5
10	Density (g/cm^3)	1.28
11	Bulk (cm^3/g)	0.77
12	Breaking length (km)	5214.8
13	Tensile Index (Nm/g)	51.1
14	Runkel Ratio	0.59

Conclusion

Based on the results it was concluded that Chinar (*Platanus orientalis)* wood was suitable for making small wooden articles. It was a better wood for carving, boring and cutting work for the reason the wood was suitable for making decorative articles. It can also be used for making the furniture items in which medium strength was required. Furthermore, the small branches and wood waste could also be used as a raw material for pulp and paper manufacture.

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