SUITABILITY OF (A*ILANTHUS ALTISSIMA*) WOOD FOR MANUFACTURING OF PARTICLEBOARD

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Abstract

Suitability of *Ailanthus altissima* wood was determined for the manufacture of medium density particleboard. The panels of particleboard were manufactured from the flakes of ailanthus wood at compression ratio 1.1 and 1.2 with board density 733 and 784kg/m^3. Physico-mechanical properties of the boards indicated that a quality particleboard can be manufactured from ailanthus wood. At compression ratio 1.1, strength properties i.e. MOR 446kg/cm^2, MOE (48348kg/cm^2, SWR 155 kg exceeded the minimum standard values by 163%, 71% and 51% respectively. The properties were improved by increasing the CR from 1.1 to 1.2 with parallel increase in board density.

Introduction

Rapid-growing tree (*Ailanthus altissima*) in the family Simaroubaceae, is native to China and Japan and widely naturalized in Pakistan and can be found almost anywhere from 0 to 1700m elevation (Sheikh,1993). It is also known as tree of heaven. Because of its resistance to pollution, freedom from insect predation and disease, and ability to grow in almost any soil is planted as a yard and street tree in urban centers. It grows upto 60 ft (18 m) or more in height. Estimated to range from Subtropical Dry to Wet through Cool Temperate Dry to Wet Forest Life Zones, tree-of-heaven is estimated to tolerate annual precipitation of 3 to 25 dm (tolerating a dry season up to 8 months), annual temperature of 10° to 20°C, and pH of 5.5 to 8.0. Growing on the smallest of city plots and rubbish heaps, this species obviously can tolerate a wide array of soils, from acid to alkaline, sand to light clay, well-drained to swampy, poor to rich. It is said to do poorly on chalky soils or compact clay (Little, 1983). Besides ornamental uses of the living tree (shade, screen, erosion control), its wood is though little used, except in poor countries, (http://www.ibiblio.org/pfaf/cgi-bin/arr_html?Ailanthus+altissima).

The wood is easy to work with tools and glues well. It is locally used for firewood. The heartwood is pale green to yellow with dark streaks, while the sapwood is wide and creamy colour. It is ring-porous wood with wide rays superficially resembling to ash. (http://www2.fpl.fs.fed.us/techsheets/HardwoodNA/htmlDocs/ailaeng.html). The density of wood in dry condition has been reported as 530 kg/m^3. (http://www.hort.purdue.edu/newcrop/duke_energy/Ailanthus_altissima.html#Uses).

In Pakistan, Ailanthus wood is commonly used as fuelwood and does not have any other commercial utilization. In order to create its demand in the local wood industry, suitability of Ailanthus wood was determined for the manufacture of particleboard at Forest Products Research Division of Pakistan Forest Institute, Peshawar

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Material and Method

Logs of smaller diameter (3-4inch) of Ailanthus tree were procured locally. The logs were converted into blocks of size 6"×3"×3" for manufacturing of flakes with the help of disc flaker. The Flakes were air dried in the sun to reduce their moisture content up to 7-8% and sprayed with urea formaldehyde resin glue. Calculations of glue and particles for the desired board were made according to board density and size. Blended particles were pressed into mat by manual pressing and finally pressed in hot press. Press temperature (140^0C) and press time (15min) was kept constant for each board. Particleboards were manufactured both at 1.1 and 1.2 compression ratio (CR); the ratio of board density to wood density.

After manufacturing, the boards were kept under load for 24 hours to prevent them from warping and to equalize the temperature gradient. Then test specimens were made according to ASTM standard 1037-78 for different physico-mechanical tests i.e. modulus of rupture (MOR), modulus of elasticity (MOE), screw withdrawal resistance (SWR) and nail withdrawal resistance (NWR), thickness swelling (TS), and water absorption (WA). The tests were performed according to the standard procedure outlined in ASTM 1037-78. For MOR and MOE tests, Universal Testing Machine was used. Percentage thickness swelling and water absorption were determined after soaking in water for 2 hours and 24 hours at room temperature. After testing all the results were compiled and shown in table 1.

Table1. Physico-mechanical Properties of Particleboard from *Ailanthus altissima* wood

Properties	Compression Ratio		Standard Req.
	CR 1.1	CR 1.2	
WD g/cm^2	0.642	0.642	-
BD g/cm^2	0.733	0.784	600-800
MOR kg/cm^2	446	498	169
MOE kg/cm^2	48348	52188	28124
SWR kg	155	171	102
NWR kg	77	83	-
TS %			
After 2 Hours	5	4	-
After 24 Hours	10	8	-
WA^8 %			-
After 2 Hours	11	10	-
After 24 Hours	32	27	-

WD Wood Density, **BD** Board Density

Results and Discussion

From the results shown in Table 1, it is evident that a good quality particleboard may be manufactured from Ailanthus wood, which is merely used as fuelwood in North West Frontier Province and Azad Jammu Kashmir areas. Strength properties are even better than standard strength properties. MOR value is twice the standard value. Similarly, MOE of particleboard from Ailanthus is greater than the requisite standard value. Strength properties improve with the increase in the CR value. Since the board density 733 kg/m^3 at CR 1.1 was commercially acceptable therefore it was found to be most suited for the manufacturing of particleboard

Table 2. Comparison of Physico-mechanical properties of Particleboard from *Ailanthus altissima* and Poplar (*Populus euphratica*) wood

Properties	Wood species	
	Ailanthus altissima	Poplar (*P.euphratica*)
WD (kg/m^3)	642	449
BD (kg/m^3)	733	700
MOR (kg/cm^2)	446	385
MOE (kg/cm^2)	48348	31000
SWR (kg)	155	137
NWR (kg)	77	64

In Table 2, the physico-mechanical properties of particleboard from Aialnthus and poplar (*Populus euphratica*) wood have been compared (Yasin, 1983). From the results, it can be inferred that particleboard manufactured from Ailanthus is superior to those manufactured from poplar wood, which is a major raw material for particlboard industry after mango wood. Both species i.e. mango and poplar are in short supply because of

higher demand in other segments of forest products industry. At present 60 percent mango wood and 30 percent poplar wood is used in the manufacture of particleboard (FAO, 2002). Both species are in short supply because of increasing demand. It is estimated that 55-60 thousand cubic meter of wood is utilized by the particleboard industry in Pakistan. Ailanthus wood may easily extend the base of raw material for particleboard industry. Ailanthus tree needs lesser water compared to the poplar trees. Furthermore ailanthus is a preferred species as soil binder in the hilly areas to stop the land slides. Sheikh (1993) has reported the specific gravity of Ailanthus wood as 0.40 which is lower than the ailanthus wood used in the current study. However, Alden (1995) has reported specific gravity (0.531 at 12 percent moisture) and oven dry wood density (537-617 kg/m^3) of Ailanthus wood grown in USA. This variability in the density may be due to difference in age of the trees. Lower age trees of ailanthus may easily substitute the poplar wood in the manufacture of particleboard.

Because Ailanthus is a fast growing hardwood species, short rotation plantations may be raised in future to meet the challenge of industrial wood supply for forest products industries. Similarly, Schreiner (1970) recommended the Ailanthus along with other hardwood and softwood species for mini-rotation forestry in North east America to meet the future demand of industrial wood in the region.

References

Alden, Harry A., 1995. Hardwoods of North America . General Technical Report FPL-GTR-83 USDA Forest Service 136 p.

FAO, 2002**.** An Overview of Forest Products Statistics in South and Southeast Asia. FAO, Bangkok Thailand. p.108**.**

Little, E. L. Jr., 1983. Common fuelwood crops: a handbook for their identification. McClain Printing Co., Parsons, WV.

Sheikh, M. I., 1993. Trees of Pakistan, Winrock International Institute for Agricultural Development, GOP-USAID Forestry Planning and Development Project. Pictorial Printers (Pvt) Ltd., Islamabad, Pakistan p.30.

Schreiner, E. J., 1970. Mini Rotation Forestry U.S.D.A Forest Service Research Paper NE-174. pp. 3-35.

Yasin, S. M., 1983. Utilization of poor quality woods growing in Pakistan in the manufacture of panel products, PL-480 Programme of USA, Project No. PK-FS-47 Pakistan Forest Institute, Peshawar.