



RESEARCH NOTE

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Physical and mechanical properties of particle board made from lops and tops of *Populus deltoides* and *Broussonetia papyifera*

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ABSTRACT : The present study was carried out with an objective to evaluate the density, moisture content, water absorption, general swelling, surface absorption, modulus of rupture, internal bonding and screw withdrawal strength of experimental Particle Board prepared from admixture (50:50) of *Populus deltoides* and *Broussonetia papyifera*. The Particle Boards were made with 8 per cent, 10 per cent and 12 per cent Phenol Formaldehyde resin and hot pressed at 21 kg/cm² for 12 minute. The physical and mechanical properties of resulted Particle Board meet the requirement of Indian Standard specification IS: 3087 (1985). The swelling of board is slightly higher than the require Indian Standard specification (3087) which can be controlled by suitable treatment.

KEY WORDS : *Populus deltoides*, *Broussonetia papyifera*, Particleboard, Phenol formaldehyde, Specific pressure

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The demand for wood composite from waste wood has been increasing as timber resources in natural forests decline. The use of renewable biomass as raw material in composite production was one approach and use of renewable biomass. Particle board is a panel product manufactured from lignocellulosic materials, primarily in the form of discrete particles, combined with a synthetic resin or other suitable binder and bonded together under

heat and pressure. The particleboard has been widely used throughout the world for manufacture of furniture and house construction, including flooring system. The demand of particleboard has continued to increase for housing construction and furniture manufacturing. Particleboard is a reconstituted constructional panel particularly developed as a suitable for naturally constructional wood and is made from low-grade waste wood or from certain agricultural ligneous waste. Particleboard offer a mean to utilize as much as the forest and industrial wood waste as possible because it is so tolerant of wood quality and a wide variety of species, both soft wood and hard wood can be used. There is no

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doubt that the particleboard is going to stay for a long time due to plenty of raw materials, manufacturing properties and product properties. The major types of particles used to manufacture particleboard include wood shavings, flakes, wafers, chips, sawdust, strands, slivers, and lops and tops of wood.

Populus deltoides is widely distributed in India. Its plantation is in the plains of North-West India *i.e.* Western Uttar Pradesh, Punjab and Haryana and to some extent in the plains and valleys of Uttarakhand and Himachal Pradesh. After eucalypts, poplar is the major source of woody raw material from plantations for various utilisations (Kothiyal, 2012).

Broussonetia is a small tree or shrub, which grows naturally in Asian and Pacific countries such as India, Korea, Myanmar, Thailand and China. The wood is light-coloured, soft, greyish-white, even and straight grained. It is light, with a basic density of 506 kg/m³. The timber from *B. papyrifera*, being soft and brittle, is used mainly in the manufacture of cheap furniture, match sticks, light packing cases etc. (Orwa *et al.*, 2009). The research was carried out to explore their potential as sources of composite wood for future use. In the present study to evaluate the suitability of *Populus deltoides* and *Broussonetia papyrifera* for particleboard using 8 per cent, 10 per cent and 12 per cent phenol formaldehyde resin content at 21kg/cm² specific pressure.

Lops and tops of *Populus deltoides* and *Broussonetia papyrifera* were collected from Forest Research Institute, Dehradun (latitude: 30°19'N and longitude: 78°04' E). The lops and tops of both the species were converted into chips or particle. The accepted particles were dried in an oven at 50-60°C to achieve

moisture content 6 to 8 per cent. Boards were made using ratio (50:50) of species composition. The particle board were made according to IS: 3087 (1985). The details of which given below:

Species: *Populus deltoides* and *Broussonetia papyrifera* (50:50)

Binding agent: Phenol formaldehyde resin (35% solid content).

Resin content: 8%, 10% and 12%

Specific Pressure: 21kg/cm²

Press condition: Hot press (140-150°C)

Pressing Time: 12 min

Replicates: Six in each test

After hot-pressing, these particleboards were conditioned for 24 hrs at ambient room temperature and humidity prior to properties evaluation. The physical and mechanical properties of the particleboard were determined in accordance with IS: 2380 (1977).

The mean value of physical and mechanical Properties of *Populus deltoides* and *Broussonetia papyrifera* (L.) particleboard prepared by different resin content were shown in Table 1. It is observed that the density of the particleboard varies from 0.61 to 0.77, which is medium density particle board. The modulus of rupture increases from 31.8 to 49.8 (N/mm²) with increase in resin content per cent from 8 per cent to 12 per cent. The initial bond strength also increases from 0.7 to 1.25 (N/mm²) with increase of resin per cent from 8 per cent to 12 per cent. The water absorption, thickness swelling (surface absorption and General swelling) decrease with increase of resin content per cent from 8 per cent to 12 per cent, the furthermore improvement in these properties can be achieved by adding sizing material such as paraffin

Table 1 : The mean value of physical and mechanical properties of *Populus deltoides* and *Broussonetia papyrifera* (L.) particle board prepared by different resin content

Sr. No.	Parameters	Resin content		
		8 %	10 %	12 %
1.	Density	0.608	0.714	0.771
2.	Moisture content	6.08	5.92	5.71
3.	Water absorption (%)	2 hrs	24.77	20.21
		24 hrs	44.95	37.70
4.	General swelling (%)	24 hrs	16.91	13.76
5.	Surface absorption (%)	2 hrs	16.85	8
6.	Internal bond (N/mm ²)		0.701	1.155
7.	MOR (N/mm ²)		31.81	44.24
8.	Screw withdrawal strength (N)	Face	1930.6	2474.5
		Edge	1793.4	2254

wax. Thus, it is observed that the most of the properties meet as per the IS specification 3087: 1985. Therefore, lops and tops of *Populus deltoides* and *Broussonetia papyrifera* (L.) may be used for the development of particle boards.

The similar work for suitability of various woods for particleboard were carried out, such as suitability of lops and tops from poplar with and without bark and bark alone have been evaluated by Singh *et al.* (1995). Suitability of lops and tops of *Prosopis juliflora* and *Ailanthus excelsa* for particleboard have been also evaluated by Singh *et al.* (2002). The particle boards can be produced from inferior variety of wood (Singh and Negi, 2001 and Singh *et al.*, 1995), which have no commercial utility or from wood wastes from sawmills, plywood plants, other wood based industries (Singh and Rawat, 1990). So it may be considered as one of the best methods to minimize the waste and proper utilisation of these raw materials for manufacture of particle board.

Conclusion :

The present work was carried out to evaluate the suitability of *Populus deltoides* and *Broussonetia papyrifera* admixture (50:50) for manufacture of particle board. The results revealed that the physical and mechanical properties of particle board meet IS: 3087 (1985) requirement. So it can recommended that the species composition *i.e.* *Populus deltoides* and *Broussonetia papyrifera* (50:50) is suitable for

manufacturing of the particle board at pilot scale.

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