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RESEARCH ARTICLE

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Exploratory studies on utilization of lops and tops of poplar for development of fibre board

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ABSTRACT : This work was initiated to explore the utility of lops and tops for composites. Medium density fibre board (MDF) was prepared using lops and tops of poplar. Boards were prepared at two pressure levels 17.5kg/cm^2 and 21.0 kg/cm^2 and at two pressing times (15 and 20 minutes). Phenol formaldehyde was used as binder at 8% and 10% loading levels. The main use of lops and tops of the poplar at industry level is as fuel for boilers. Physical properties except thickness swelling could not meet the standard 12406 (2003). Screw withdrawal could meet the standard for 8% and 10% resin loading.

KEY WORDS : Fibre board, Phenol formaldehyde, Physical properties, Mechanical properties, Wax

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INTRODUCTION

Fibreboard structural and decorative is a fibrous-felted, homogeneous panel made from ligncellulosic fibres, combined with a synthetic resin or other suitable bonding system, and then bonded together under heat and pressure (Philip *et al.*, 2007). MDF are the newest members of the all fibre boards process (specific gravity 0.6-0.9). It has good properties for furniture, as fibres provide better bending strength and stiffness than shavings and particles. It has tight edges with no porosity. It is becoming an environmentally friendly product. It is isotropic (no grain), so no tendency to split. Consistent in strength and size. It is flexible, can be used for curved walls or surfaces MDF shapes well.

MDF is being developed from species like Eucalyptus, Casuarinas, Mango wood and other lignocelluloses materials like cotton stalk. Suitability of various lignocelluloses wastes has been evaluated for making fibre board. For fibre board, suitability of lops and tops from plantation species *viz.*, Eucalyptus hybrid (Shukla *et al.*, 1987), *Leucaenaleucocephala* (Subabul) (Shukla *et al.*, 1985) and poplar (Shukla, 1987) with and without bark have also been evaluated for making fibreboard. Many of these raw materials were found suitable for making fibre board. Suitability of lops and tops from poplar with and without bark and bark alone,

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for particleboard, have been evaluated (Singh *et al.,* 1995). Suitability of lops and tops *Prosodies juliflora* and *Ailanthus excelsa* for particle board have also been evaluated recently (Singh *et al.,* 1996). Suitability of lops and tops of *Populous deltoids* with and without bark manufacture was evaluated. The data indicated that populous deltoids wood alone and with bark (about 19 %) is suitable for making particleboard (Singh *et al.*, 1995). But very meager work on medium density fibre board was carried out in FRI. MDF produced with eucalyptus fibre and castor-oil-based polyurethane resin presents results very satisfactory (CristianeInácio *et al.*, 2004). Dix *et al.* (1999) reported that results of the investigations regarding the use of poplar short and midi rotation wood in medium density fibreboards (MDF) show that the properties of MDF depend on the age of the wood and on the disintegration conditions. Further the strength properties of MDF from poplar wood are somewhat higher and the thickness swelling lower in comparison to MDF from Eucalyptus wood. Hiziroglu *et al.,* 2007, reported that Bamboo and rice straw based medium density fibre board gave satisfactory results.The common feature of all these products is that particle is small and thus opened the opportunity for wood and other cellulosic waste to be utilized. India being predominantly a solid wood user country needs added efforts to utilize wood waste to reduce the gap between demand and supply.

Efforts to reduce dependency on solid wood and plywood can be achieved through R and D efforts to tape underutilized resources in the products like MDF. Poplar is being used for manufacturing plywood. In which mostly lops and tops of poplar are being use for fuel. Therefore lops and tops of poplar may be used for development of Medium density fibre board.

EXPERIMENTAL METHODS

Poplar lops and tops were procured from range office Forest Research Institute. Phenol Formaldehyde resin was prepared in the laboratory from Phenol and Formalin. 500 g of white crystalline pure solid Phenol charged into a flask. This was followed by 500ml of formalin and 600 ml of distilled water. 32 g of sodium hydroxide is added to the above solution. Then the flask is placed into water bath at 100^0 C. Once the reaction inside the flask has started the mixture is allowed to stand for 40 minutes. The prepared resin was allowed to stand for 24 hours and then analyzed for various properties like solid content, viscosity, pH, and flow time. This analysis was repeated for every new resin charge prepared.

Lops and tops of the poplar were chipped manually by sickle. These chips were then converted into particles through Condux mill. Coarse particles were then passed through grinding stone of lab disc refiner to extract fibres. Fibres were dried to moisture content of 6% to 8%. Dried fibres were blended with phenol formaldehyde resin with the help of spray gun. The resin-blended fibres were uniformly laid to form mat in wooden frameof size 24" x 24" inches placed over preheated and wax applied caul plates. This was then manually pre-pressed and after pre-pressing for 5 minutes, wooden frame was taken out. Another caul plate on which wax has been applied was then placed over the mat. The mat in between two cauls plates was then kept in the press. Mat was pressed with temperature 150^0 C, at two specific pressures, 17.5 kg/cm^2 and 21.0 kg/cm^2 for 15 minutes and 20 minutes at both the pressures. Boards were then conditioned at room temperature (27 ± 3^0C). Test boards were cut into samples as per IS:2380 (1981). For each test carried out 6 samples for tested (Table A).

Table A : Specification of boards

Sr. No.	Specifications for board	Size and units
1.	Size of board	24x 24 inches
2.	Raw material for board	3.5 kg
3.	Duration of pressing	15 Minutes
4.	Temperature	150°C
5.	Specific pressure	17.5 and 21.0 kg/cm^2

EXPERIMENTAL RESULTS AND ANALYSIS

Physical and mechanical properties of flat pressed single layered medium density fibre board's made from lop and tops of the poplar were studied. Testing was carried out as per IS: 2380 (1981). Minimum requirements for properties tested were compared as per IS: 12406 (2003).

Effect of pressure and pressing time on properties of boards with 8% loading:

Average readings for water absorption and general absorption could not meet the permissible limits of IS: 12406 (2003) (Table 1). Average values for surface

absorption, for 15 minutes of pressing time ranging from 2.93% (17.0kg/cm^2) to 0.75% (21.0 kg/cm^2) was within permissible limits of the standard. Similar results were observed for 20 minutes of pressing time and both the pressures. It can be observed from the table that with higher pressure, thickness swelling has shown decline Screw withdrawal (SW) strength for face and edge were 3160.5 N and 3074.7 N, respectively at 17.5 kg/cm^2 and 2229.5 N and 1494.5 N, respectively at pressure 21.0 kg/cm^{2}for 15 minutes of pressing time (Table 2).This falls within the permissible values of the IS: 12406 (2003). Similar results for screw withdrawal were observed for 20 minutes of pressing time. Tensile strength at the pressure 17.5 kg/cm^2 and 21.0 kg/cm^{2}for 15 and 20 minutes pressing time did not falls with the permissible limit of IS: 12406 (2003). It can be observed from the Table 2 that internal bond is higher for 20 minutes pressing time and 21.0 kg/cm^2.

Effect of pressure and pressing time on properties of boards with 8% loading and 1% wax:

Water absorption and general swelling did not show any improvement after addition of wax at 1% loading. Surface absorption was observed to be within the permissible limits of IS. Screw withdrawal for face and edge also has not depicted and noticeable improvement with addition of wax into boards but the values are with the IS limits. Internal bond strength also did not meets the values of standards.

Effect of pressure and pressing time on properties of boards with 10% loading with and without wax:

It can be observed from Table 2 that water absorption, general swelling, did not meet the minimum requirement of IS: 12406 (2003).Similar results were observed for tensile strength. But surface absorption values did fall within the IS: 12406(2003). Noticeable improvement was reported for screw withdrawal when compared with 8% resin loading level. Screw withdrawal values met the requirements of IS: 12406 (2003). Tensile strength was reported higher at higher pressure and longer pressing timebut failed to meet the requirement of the standard. 1% wax as additive did not much improve the properties of the boards.

Table 1:Physical and mechanical properties of medium density fibre board with 8% resin content

Sr. No.	Pressure (kg/cm^2)	Pressing time (Min)	Wax (%)	MC (%)	Water absorption (%) 2hrs and 24hrs		General swelling (%)	Surface absorption (%)	Screw withdrawal face/edge (N)		Tensile strength (N/mm^2)
A8	17.5	15	0%	6.90	15.33	34.93	21.91	2.92	3160.5	3074.7	0.11
A8	21.0	15	0%	7.13	59.77	80.40	19.99	0.75	2229.5	1494.5	0.11
A8	17.5	20	0%	6.93	12.90	30.23	27.84	1.31	2768.5	3650.5	0.15
A8	21.0	20	0%	6.20	41.76	57.76	28.60	1.20	2854.2	2780.7	0.23
A8	17.5	15	1%	8.50	87.09	101.31	35.43	1.95	1715	1384.25	0.23
A8	21.0	15	1%	8.23	75.53	89.98	41.76	3.24	1882.25	1508.75	0.19
A8	17.5	20	1%	7.02	97.9	113.52	37.73	2.50	1961.75	1165.75	0.20
A8	21.0	20	1%	8.87	83.38	98.0	35.43	1.98	2033.5	1849.75	0.22

Table 2 : Physical and mechanical properties of medium density fibre board with 10% resin content

Sr. No.	Pressure (kg/cm^2)	Pressing time (Min)	Wax (%)	MC (%)	Water absorption (%) 2hrs and 24 hrs		General swelling (%)	Surface absorption (%)	Screw withdrawal face/edge (N)		Tensile strength (N/mm^2)
A10	17.5	15	0%	7.59	63.65	75.87	31.35	5.01	3638.25	2719.50	0.41
A10	21.0	15	0%	6.90	47.04	59.02	30.06	3.90	3417.75	1984.50	0.40
A10	17.5	20	0%	8.29	43.34	53.42	28.29	4.54	4177.25	4005.75	0.34
A10	21.0	20	0%	8.63	19.28	34.94	27.10	5.32	4508	3503.50	0.38
A10	17.5	15	1%	5.73	82.43	100.7	29.40	1.99	3087	/2572.25	0.30
A10	21.0	15	1%	5.43	60.71	74.34	27.72	2.15	3822	2756.25	0.19
A10	17.5	20	1%	6.78	48.44	68.92	27.95	1.22	3895.5	2609.25	0.26
A10	17.5	20	1%	4.19	34.76	48.49	20.34	1.69	4054.75	3074.75	0.24

Conclusion :

Medium density fibre boards did not meet the minimum requirements of IS: 12406 (2003) for physical properties. This is clear from the fact that while converting chips into fibres more dust was formed than fibres. Screw withdrawal has shown improvement. This also indicates that boards from lops and tops of poplar can be utilized for places where only mechanical properties plays a part. But this requires further investigation.

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