Preparation and Characteristics Study of Particle Board Made From Babul Tree

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Abstract- *The demand for manufactured panels for construction, furniture and other applications place strains on the forestry industry leading to deforestation. Similarly, one component of the very large waste stream from construction and renovation is post-consumer carpet. The post-consumer carpet waste and widely available waste biomass streams can be used to produce panels sustainably.This project is to use babul tree waste, plant waste and saw dust collected from various sources to make particle boards with each individual item as well as a combination of these in various ratios. Since most of the previous studies done are by making use of fibers, the present work focuses on finding the properties of the board without the use of fibers. The physical and mechanical properties of these boards are then determined by using a series of tests like moisture content test, water absorption properties, thickness swelling, compressive test and flexural strength. The results are then compared and most of the samples are found to comply with the IS standards.*

Keywords- Particle Board, Resin, Babul tree.

I. INTRODUCTION

In recent years, recycling and reusing techniques of different kinds of bio-degradable wastes have become an important part of the sustainable utilization of resources. These alternative raw materials can play a growing tendency and major role in Particle Board industry. Using of residues of various products in the production of Particle Boards is very profitable in economic and environmental terms. The activities of forestry industry generate a significant volume of waste which can be reused or recycled.

The recycling of waste from this sector presents a viable alternative to prevent this valuable raw material to have an inappropriate final disposal in landfills, which can cause negative environmental consequences. Due to the growing scarcity of wood and the increasing consumption of wood products, some authors comment that the replacement of solid wood particles for other kind of raw materials for production of particleboard, MDF and plywood is inevitable. The lignocellulose fibers, such as shell, rice straw, and bagasse from sugar cane and babul tree wastes, derived from agriculture can be easily transformed into particles which resemble the particles of wood fibers and may be used as raw material. Particle Board is a product manufactured under pressure from different kinds of wastes, wood or other materials and an adhesive. Particle Boards are produced from municipal solid waste, agro-waste materials such as coconut coir, rice husk, jute sticks, waste wood, sugarcane wastes and kitchen waste. Particle Board can also be produced from watermelon peels, kelempayan, waste paper treated with maleic anhydride, Peachnut Shell with impregnated with glass powder as an alternative to wood based boards. Particleboard is commonly used for cabinetry, tabletops, shelving, Wall and floor panels, partition walls, doors, furniture, and other non-structural architectural applications.

The present study is done to assess the physical and mechanical properties of the particle boards manufactured from babul tree waste and saw dust in different combinations. These properties play an important role in manufacturing the particle boards when compared with the standards.

This study aimed to produce and evaluate the physical characters and mechanical characters properties of varies types of particleboards produced with babul tree waste residues and using adhesive isophthalic resin and a castor oil based adhesive in the proportions of 6%, 8%, 10% and 12% based on the dry weight, in order to compare the performance and applicability of these adhesives and babul tree residues.

II. MATERIALS AND METHODS

2.1Materials

2.1.1 Babul Tree

Babul tree binomial name is commonly Vachellia nilotica. Babul tree known as gum Arabic tree, thorn mimosa, Egyptian acacia or thorny acacia. Is a tree in the family Fabaceae. It is native to Africa, the Middle East and the Indian subcontinent. It is also a Weed of National Significance and is an invasive species of significant concern

in Australia.Babul trees woods are cuts, dry in sun light from few days and reduce the wet property. And make a wood chips using saw miller machine. And collet to dry in sun light. To check the dimension of the babul tree wood chips.

Figure-1 Babul tree

2.1.2 Sawdust

Sawdust is the main component of particleboard. Wood dust is a form of particulate matter, or particulates. Research on wood dust health hazards comes within the field of occupational health science, and study of wood dust control comes within the field of indoor air quality engineering.

Figure-2 Saw dust

2.1.3 Binding Resin

To use Isophthalic resin was a binding material of our project. It is an organic compound with the formula $C_6H_4(CO_2H)_2$. This colorless solid is an isomer of phthalic acid and terephthalic acid. The main industrial uses of purified isophthalic acid are for the production of polyethylene terephthalate (PET) resin and for the production of unsaturated polyester resin (UPR) and other types of coating resins.Isophthalic acid is produced on the billion kilogram per year scale by oxidizing meta-xyleneusing oxygen. The process employs a cobalt-manganese catalyst. The world's largest producer of isophthalic acid is Lotte Chemical Corporation. High-performance polymer polybenzimidazole is produced from isophthalic acid. Also, the acid is used as an important input to produceinsulation materials. Isophthalic resin chemical structure is give the figure.

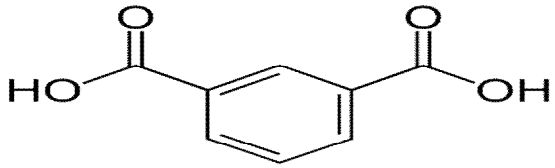

Figure-3 Isophthalic Resin

2.2 Particle Boards Manufacturing

Particleboard is defined as a panel product manufactured from lignocellulose 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 particles used in this study were measure various properties of a particle board. Those wood particles were collected from a nearest location and saw mill house. Adhesive used was Isophthalic resin (polyester) with correct content in board preparation. A blending box was used to mix the particles and resin adhesive. The mixed adhesive-wood particles were placed in a forming box die to a specific square size. Then the particular thickness adhesive-wood chips mixture was hand-pressed with a certain temperature, pressure 3MPa and pressing time 5 min. The target density was 0.72 g/cm^3 with board size of 150mm x 150mm x 20 mm. Three particleboard panels were prepared for each experimental variable, therefore no of pieces are dry in sun light.

The following flowchart shows the schematic process involved in the production of babul tree particleboard.

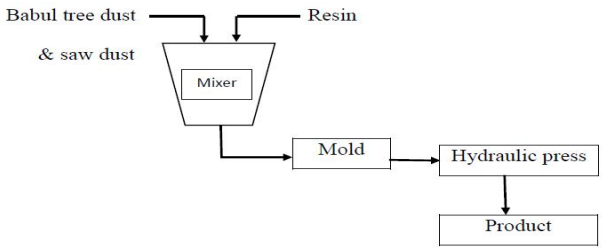

Figure-4 Process flow chart

2.3 EXPERIMENTAL SETUP

In our project die made up of wood, It has two side frame, two top frame and on top pressing plate. When the dimension of our die is side frames length is 150mm, Top frames length is also 150mm but it is enlarged in some length to couple the side frame and the top plate is square in size

150mm×150mm.And to use small size testing particle board making die it has rectangle in size dimension is 110mm length and 60mm breathe when the thickness is based on particular dimensions of standard value.

Figure-5 Experimental setup

III. RESULT AND DISCUSSION

3.1 Density

The boards were cut into size of 280 x 280 mm, and then the density was measured (ρ) by measuring its weight (w) and volume (v). Density value comparison is show in table 1 and graphical comparison is shown in figure 6. Board's density was calculated as follow

$$Density(\rho) = \frac{w}{v} \ (g/m^3)$$

Table 1 Density comparison

S.NO	Sample type	Density (kg/m^3)
1	Pure babul tree chips	6.6×10^{-4}
2	Pure normal sawdust chips	6.8×10^{-4}
3	Babul tree with saw dust	7.1×10^{-4}

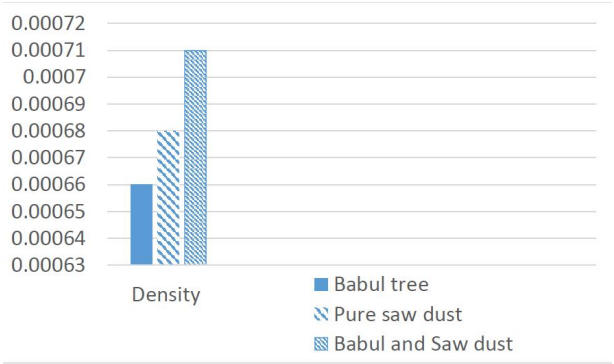

Figure-6 Density comparison

3.2 Water Absorption

The water absorption test for each particle board is done as per IS3087. The board is soaked for two hours at room temperature and then measuring the weight of each and then soaking them again and repeated the procedure till a constant weight is obtained.W1 – initial weight, W2 – final weight. And each board had taken approximate 2 hours to attain a constant weight. The final weight of each is measured and the water absorption value is reported. And our specimen size is 50×50×16mm. To weight our specimen to use Mettler balance. Water absorptionvalue comparison is show in table 2 and graphical comparison is shown in figure 7. Water absorption calculated as follows:

$$MC\,(\%) = \frac{W2 - W1}{W1} \times 100$$

Table 2 Water absorption comparison

S.No	Sample type	Water absorption (%)
1	Pure babul tree chips	37.5
2	Pure normal sawdust chips	33.3
3	Babul tree with saw dust	41.7

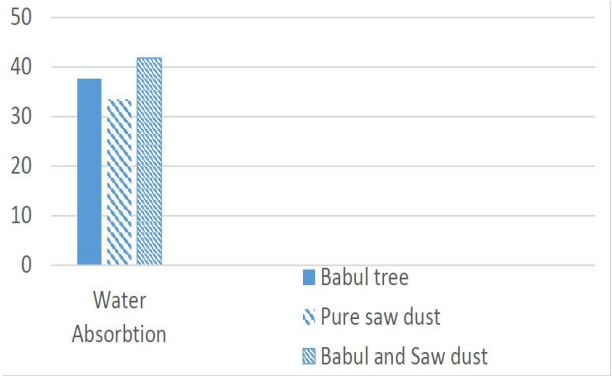

Figure-7 Water absorption comparison

5.3 Thickness Swelling

The thickness swelling test, the thickness of each original sample is first measured and recorded. Then the samples are soaked in water for a period of 2 hours. The thickness of the soaked samples are then measured and the percentage of thickness swelling is calculated. T1 = initial thickness and T2= final thickness. The values obtained are as shown in Table. The standard value of thickness swelling percentage is 12%. From the values obtained from the present work, it can be seen that the thickness swelling values are much less than the maximum value. Thickness value

comparison is show in table 3 and graphical comparison is shown in figure 8.

$$TS\,(\%) = \frac{T2 - T1}{T1} \times 100$$

Table 3 Thickness Swelling comparison

S.No	Sample type	Thickness swelling (%)
1	Pure babul tree chips	10
2	Pure normal sawdust chips	3.3
3	Babul tree with saw dust	6.6

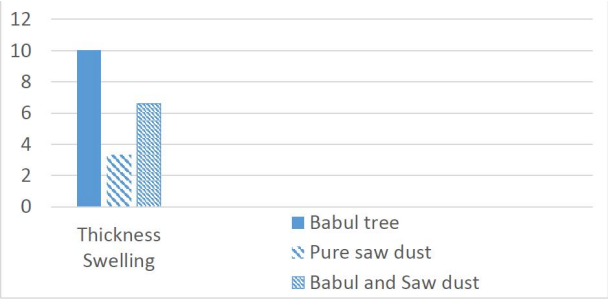

Figure-8 Thickness Swelling comparison

5.4 Moisture Content

The moisture content of the Particle Boards was tested as per the relation, W1- Initial weight, W2- Oven dried weight of the particle board. The moisture content for the board sections is found out by taking each sample, weighing it in the air and then drying it in an oven at 50 degrees and then finding out the difference between the values are as shown in the Table 5.4 and graphical comparison show in figure 5.4. As per IS3087standard, the moisture content in a particle board should be in the range of 5 to 15 %. Any value less or more than the range mentioned has an impact on the linear dimension and thickness of the board. Moisture content value comparison is show in table 4 and graphical comparison is shown in figure 9.Moisture content was calculated as follow:

$$MC\,(\%) = \frac{W1 - W2}{W2} \times 100$$

Table 4 Moisture content comparison

S.No	Sample type	Moisture content (%)
1	Pure babul tree chips	8.3
2	Pure normal sawdust chips	4
3	Babul tree with saw dust	9

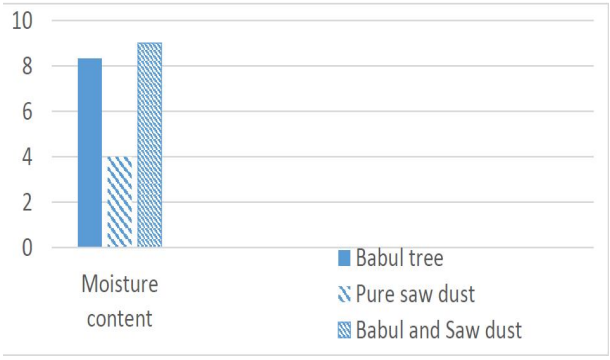

Figure-9 Moisture Content

5.5 Compressive Strength

Compressive strength is a maximum stress that a material can sustain under crush loading. It is nothing but the maximum amount of compressive load a material can withstand before fracturing. The sample piece is compressed between the platens of a compression testing machine by a gradually applied load. Compressive tests were carried out using Instron model 8801 Universal testing machine. Compression strength value comparison is show in table 5 and graphical comparison is shown in figure 10.

Table 5 Compressive strength comparison

S.No	Sample type	Max Comp-load (kN)	Comp-stress (N/mm^2)
1	Pure babul tree chips	30	12
2	Pure normal sawdust chips	27	10.8
3	Babul tree with saw dust	32	12.8

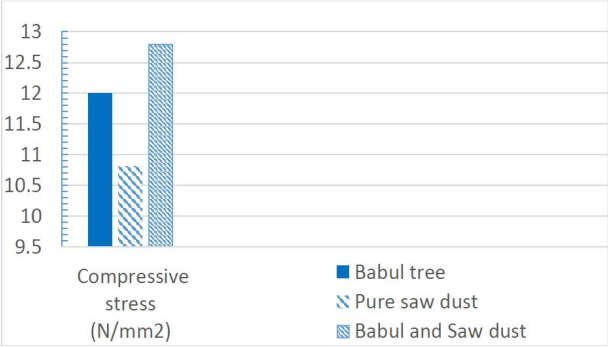

Figure-10 Compressive strength comparison

5.6 Flexural Strength

Modulus of rupture is an important property determining the application of the product for structural components. This property results will depend according to the board density. A concentrated bending load was applied at the center with a span of 15 times the thickness of the Specimen. Flexural tests were carried out using Instron model 8801 Universal testing machine. Flexural strength value comparison is show in table 6 and graphical comparison is shown in figure 11. To use as Formula to find flexural strength.

$$\text{Flexural strength} = \frac{3Fl}{2bd^2}$$

Table 6 Flexural strength comparison

S.No	Sample type	Flexural strength (N/mm^2)
1	Pure babul tree chips	6.75
2	Pure normal sawdust chips	8.44
3	Babul tree with saw dust	11.25

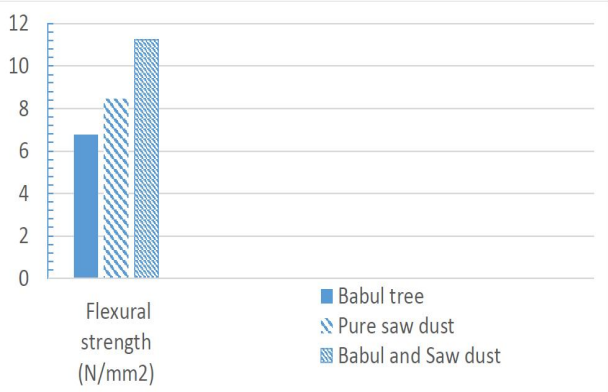

Figure-11Flexural Strength

V. CONCLUSION

The particle board has been made using different base materials which include Babul tree dust, saw dust and also a combination of resin as per standard procedure. An important point to mention here is that all the boards have been prepared without the use of fibers unlike all the previous works did where fiber was one of the key ingredients. The board prepared for this study without the use of fibers have its physical and mechanical properties almost on par with that made using fibers except for its flexural and compressive stress which is lower than the required standards. Water absorption and thickness swelling, which are two of the key qualities compared to commercial usage, has their limits much lower than the standard range and comparable to boards made from other proved materials. The tests conducted on the boards also shows that the board made with saw dust has the best properties among all the others and also meet up with the standards to be used commercially.

VI. FUTURE SCOPE

- To find alternate materials which will improve the flexural and compressive stress.
- Improve the resin property to increase water resistance property.
- Modify the grain structure to improve the strength of particle board.

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