

DESIGN AND DEVELOPMENT OF NATURAL COMPOSITE BOARD USING BANANA, BAGASSE AND SISAL FIBRE(Green Composite)

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Abstract- Composites are combination of at least two distinctly different materials, which combined together and provide an engineering performance that far exceeds those of the individual component. It is the quality of the interface between the components that determine the mechanical and chemical performance of the composites. There is an increasing awareness among scientists and engineers who are dedicated to minimizing the environmental impact of polymer composite production. Life cycle assessment is of paramount importance at every stage of a product's life, from the initial synthesis to disposal and a sustainable society needs environmentally safe materials and processing methods. Environment-friendly composites made using the eco materials that are decomposed by micro-organisms and hence can act as an alternative for several products such as wood, and plastic. In this work, low cost green composites using indigenously available natural fibers/waste and resins was produced and tested for mechanical properties. Test results of the green composites produced shows it is suitable for use in the field of agriculture, geo textiles etc., Test results of the newly produced composite are compared with the existing materials and it is found that the test results are comparable. Especially strength of this natural composite is comparatively superior even without any finishing treatment. This is mainly due to the higher tensile strength of Banana & Sisal fibers. It is needless to say that green composites are an essential guide for agricultural crop producers, government departments, agricultural companies, composite producers and material scientists all dedicated to the promotion and practice of eco-friendly materials and production methods.

Stone Age). The 300 ft high ziggurat or temple tower built in the city center of Babylon was made with clay mixed with finely chopped straw is a perfect example of an ancient composite usage. A composite (or composite material) is defined as a material that consists of at least two constituents (distinct phases or combinations of phases) which are bonded together along the interface in the composite, each of which originates from a separate ingredient material which pre-exists.

Interface: The portion of the composite microstructure that lies between its constituents i.e., matrix and reinforcement. The interface may be a simple row of atomic bonds but may also be included in the matrix/reinforcement reaction products (e.g., aluminium carbide between aluminium and carbon fibers) or reinforcement coatings. It is the quality of the interface between the components that determines the mechanical and chemical performance of the composites.

Matrix: The percolating material forming one primary constituent of a Composite in which the other constituents are embedded. The other constituent embedded in this matrix usually serves as reinforcement.

I. INTRODUCTION

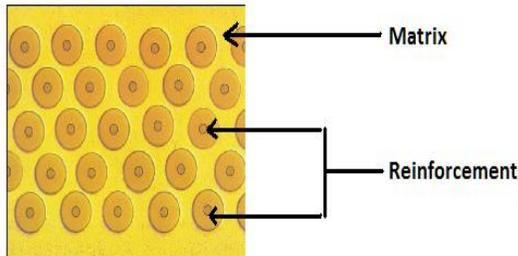
1.1 COMPOSITES

Composite materials were known to mankind in the Paleolithic age (also known as Old

Fig 1.1- The primary constituents of a Composite material

1.2 NATURAL COMPOSITES

The world is now focusing on biodegradable products. Green composites made of eco friendly and



biodegradable fibrous material have replaced the conventional materials like wood, metals and asbestos. Today there is a serious problem of safe disposal of industrial and agricultural wastes. One of the greatest technological challenges of the present time is to utilize the large amount of these wastes. A green composite is the answer for these problems. Domestic waste, Biodegradable wastes and natural fibers can be used to produce Green Composites.

Fig 1.2- Formation of "Green" Composites

II. LITERATURE REVIEW

Many researcher have already reported about composites.[1] Clark [1955] stated that urea furfural resins were prepared, combined with bagasse and cured in the presence of various acid catalysts to yield particle board with excellent rupture modulus and low water absorption and thickness swelling .[2] Dalen [1980] describes the use of bagasse in the production of particleboard and compared the costs for wood and bagasse fibres

[3] Huang [1974] has made a study of the effect of urea-formaldehyde resin content and resin extender on the quality of bagasse particleboard and found that resin spraying conditions had no effect on board quality but reducing the resin content to less than 6 percent resulted in an abrupt decrease in board strength [4] Laurle [1978] has given the Tilby separation process removed the rind from the split sugarcane stalk by milling away the soft pithy interior and then machining off the epidermal layer and wax on the outside of the rind. The rind, which is 18 to 20 percent of the weight of the cane stalk, contained some 46 percent bagasse fibres on a wet basis. The fibres are substantially free of pith and may be washed free of hot-water soluble and used in the production of corrugating medium and particleboard.[5] Mahanta [1970] stated that, bagasse was powdered to a specific size with predetermined moisture content and blended with a suitable dehydrating agent. Boards were prepared on the laboratory scale using a hot press.. The effects of particle size, temperature of the hot press, applied pressure and time of pressing on board properties were studied.

[6] Maku [1972] has noted that the composites building panels were evaluated for thermal conductivity, warping as a function of moisture content, bending strength, modulus of elasticity, and flame resistance. Materials used as laminate plies included decorative veneer, plywood, wood fibre insulation board, wood particleboard, bagasse particleboard, paper honeycomb, and various mineral boards. Results are shown in tables and graphs.[7] Maldas [1990] stated that the mechanical properties of particleboards prepared from ground sugarcane bagasse, polyvinyl chloride (PVC), and polymethylene polyphenylene isocyanate and the effects of different parameters-such as mixing temperature, molding conditions, particle size of the bagasse, concentration of PVC and polymethylene polyphenylene isocyanate, A mixing temperature of 79.4°C and moulding conditions (platen temperature, 87.8°C; time, 10 min; and pressure, 3.8 MPa) were optimal conditions for producing particleboards. [8] Nagaty [1970] has noted that the properties of lignocellulose-poly methacrylate graft copolymer composites, prepared by grafting methacrylate onto bagasse ground to different mesh sizes in the

presence of NaHSO₃ and soda lime glass system, depended on the polymer load and mesh size of the ground bagasse. Grafting without soda lime glass was also successful, although the properties of the composites produced from these samples differed greatly from those containing glass.

[9] *Pizzi [1989]* has proved that the development and application of low-cost adhesives for interior-grade particleboard and for exterior grade structural gleam derived from soda bagasse lignin are very advanced. Laboratory results and optimum conditions of application of these adhesives for particleboard manufacture were evaluated in this study. The results satisfy the requirements of the relevant standard specifications.[10] *Prasad [1985]* has stated that the addition of 8 percent phenol formaldehyde copolymer on the basis of dry fibre weight to bagasse fibres and pressing at 60°C to 62.8°C gave particleboard that met the requirement of Indian Standards for mechanical properties. [11] *Shukla [1985]* has experimented that the chips of bagasse and/or plywood residue were bonded with urea formaldehyde or polyvinyl acetate/ polyurethane adhesives Property evaluations indicate that partially de-pithed bagasse, by itself, could serve for internal-use particleboards and that urea-formaldehyde resin was more compatible as a binder for bagasse than was polyvinyl acetate/polyurethane. [12] *Turreda [1985]* has noted that, in the manufacture of particleboard from bagasse and wood, the resin binder type had a significant effect on the properties of the board. Cornstarch adhesive containing Millionate MR 100 was more compatible with bagasse than with wood particles.

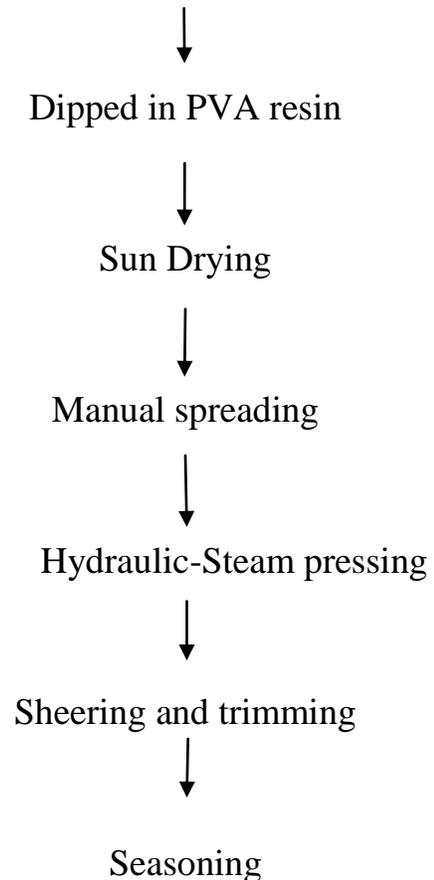
III. MATERIALS & METHODS

3.1 MATERIALS

1. Bagasse 11%
2. Banana 11%
3. Sisal 11%
4. Poly vinyl alcohol (pvoh) resin- 67%

3.2 METHOD OF FORMATION OF BAGASSE-BANANA - SISAL COMPOSITE BOARD

Bagasse, Banana & Sisal fiber



3.3 SOAKING IN PVA RESIN

Banana & Sisal fibres were immersed in the PVA resin for few minutes until the poly vinyl alcohol resin is absorbed by the fibre. The same procedure mentioned above was done for bagasse fibre.also

3.4 SUN DRYING

The moisture content of particles is critical during hot pressing operations. Thus, it is essential to carefully carryout the drying process. The moisture content of the material depends on whether resin is to be added dry or in the form of a solution or emulsion.

3.5 MANUAL SPREADING

After the particles have been prepared, they must be laid into an even and consistent mat to be pressed into a panel. This can be accomplished in

a batch mode or by continuous formation.. After formation, the mat is usually pre-pressed prior to hot-pressing.

- At first the BOPP paper is laid on a plain board.
- Then the dried banana fibres are arranged on the paper in a uniform manner.
- On the banana fibre a paper is laid and the PVA resin is sprayed.
- After that the spreading of bagasse is carried in an orderly way.
- Again the ordinary paper is laid on it and the resin is sprayed.
- Finally the sisalfibers are laid uniformly

3.6 HYDRAULIC PRESSING

After the spreading process is completed the layers are assembled in between aluminium caul plates on either sides and then processed onto the press. After pre-pressing, the mats are hot-pressed into panels. Hot press temperatures are usually in the range of 100–140°C. PVA resins are usually

cured between 75 and 85°C. Pressure depends on a number of factors, but is usually in the range of 40 to 100 kg/cm².

Pressing time – 30 minutes

Pressure - 60 kg/m²

3.7 SEASONING

Generally seasoning is done to improve the strength of the board. The board is immersed into water which is about 13 to 15% of the weight of the board,

IV. RESULTS & DISCUSSIONS

4.1 Mechanical Tests

The mechanical property tests discussed in this section refer to ASTM D 1037 standards /ASTM, 1994a

Mechanical properties namely bending rigidity and Shear Strength were tested in both the axis. i.e., parallel to the fiber axis & perpendicular to the fiber axis.

Table :1 Mechanical Test results of green composite

Test Parameters	Material Direction	Sample Size	No of Samples	Test 1	Test 2	Test 3	Test 4	Avg N/mm ²
Bending Strength	Parallel to Fiber Axis	30 x 5 x 10	4	43.6	40.0	42.2	41.4	41.8
	Perpendicular to Fiber Axis	30 x 5 x 10	4	40.02	34.13	37.08	39.1	37.6
Shear Strength	Parallel to Fiber Axis	500 mm	4	11.5	11.6	12.4	11.6	11.8
	Perpendicular to Fiber Axis	500 mm	4	12.9	15.3	13.5	14.1	13.9

4.2 Water Absorbancy Test

Table:2 Test Results of Water Absorbancy

Sl.No	Sample Size	No of Samples	Test 1	Test 2	Test 3	Test 4	Avg. Water Absorbancy
1	500 mm	4	132.2(%)	107.1(%)	118.7(%)	115.4(%)	118.3(%)

4.3. Thickness

Before seasoning – 10.5mm
 After seasoning –11.2 mm

V. CONCLUSION

As already highlighted, this work confirms that manufacturing of composite as a commercial product by using Banana, Bagasse, and Sisal fibres is possible

Manufactured Green composites has undergone for testing of Bending rigidity, Shear, & Absorbency. Test results of the green composites produced shows it is suitable for use in agriculture and other fields

Strength of this natural composite is comparatively superior even without any finishing treatment. This is mainly due to the higher tensile strength of Banana & Sisal fibers.

Using this composite in the field of agriculture, construction industry will save the cost to a greater extent and preserve environment also. Total cost/square feet of the board works out to Rs.34.-

Since manufacturing / processing / disposing of this composite will not create any negative impact to the user and environment, it is a right thought to name it as a “NATURAL GREEN COMPOSITE”

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