Manufacturing Particle Board from Rice Husk

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ABSTRACT

Alternative methods are the key to a sustainable future. The furniture industry is entirely reliant on wood as its core element and thereby contributes to large scale deforestation. The experiment here provides a feasible and practical solution to this problem, and presents 'Rice Husk' as a potential substitute for wood-based board materials and it serve the environment on two fronts: waste management and replacing non- renewable/rapidly depleting resources.

Although research has been undertaken in this field earlier, the proposed combination of husk and a biodegradable adhesive has not been addressed so far. The use of easily accessible and inexpensive adhesives (cornstarch, vinegar and soy sauce) to bind the naturally spongy rice husk particles is the thrust of this research. It also highlights the economic feasibility of the product.

The rice husk is first ground, followed by mixing with the binder. The slurry is poured in the mould and compressed till the composite becomes hard. Water absorption tests are carried out. The tests conclude that the rice husk and adhesive combination is a possible way of reinforcement in the production of particle boards that can be used as pseudo ceilings, partitioning, paneling, etc.

Keywords: *Rice husk, Biodegradable adhesive, Particle board, Potential substitute, Waste management, cost effective.*

I. INTRODUCTION

India being an agricultural country, produces tones of rice husk as a by-product every year. This is generally discarded or used as cattle feed. However rice husk ash poses severe health hazards if allowed to lie around without proper disposal. Also, it has the potential to contribute in a large way towards air pollution. Synthetic adhesives are easily accessible and give immediate and satisfactory results when used to stick together rice husk particles. But these synthetic adhesives further add on to pollution and hence are hazardous for the environment so, the need of the hour is different. This hour demands biodegradable adhesives. Hence this project focuses on

synthesizing biodegradable and easily bendable adhesives that possess the ability to bind together light rice husk particles

The bulk density of rice husk is 90-150 kg per m^3 and its external surface contains high concentrations of amorphous silica which in turn helps in executing cementing properties which increases the strength of the product made. Rice husk is taken as a waste product from rice mills and its properties are determined and checked according to the requirements of the particle board. Then the rice husk is finely ground in local flour mills. Using easily available inexpensive biodegradable ingredients, a proper biodegradable adhesive is prepared and added to rice husk. The mixture is then poured in a mould and using suitable compression techniques it is compressed at a certain temperature after which it is kept for air drying.

To reduce the pressure on forest resources for furniture and other essentials and to put the hazardous rice husk to a better use, this paper directs a substantially feasible method to manufacture particle boards which have the potential to substitute wood. This can be taken down to other uses also based on the method of compression and type of mould used. It can be made into packaging papers, pseudo ceilings, water resistive boards etc. But here this paper very specifically focuses on making a thick and strong particle board that can be used as a potential substitute for wood.

Literature Review

A. Asha [1] discussed that polyester adhesives offer easy handling, low cost, dimensional stability, and good mechanical, chemical-resistance and electrical properties. Polyester resins are the less expensive resin options, providing an economical way to incorporate resin, filler and reinforcement. Paul A.P et.al [2] showed a comparative study of the phenol formaldehyde and urea formaldehyde particle boards from wood waste, which concludes that the property of the particle boards is a function of the percentage composition of the binder (resin) and the filler (sawdust). Onyemachi [3] discussed that rice husk has some organic substance which makes it difficult to bind effectively with cement.

II. EXPERIMENTAL WORK

The method of fabrication involves the following steps:

2.1 Grinding

The rice husk is first grinded using ball milling machine. The ground rice husk is then sifted using a fine sieve to get rid of any insects or unwanted matter that may be present. Thus it is finely grinded till its particles are light enough to mix purely with adhesives.

2.2 Adhesive preparation [4]

25g of corn starch (C27H48O20) is mixed in 170 ml of distilled water. It is stirred continuously till a white, paste-like colloidal suspension is formed. 15 ml of vinegar (CH3COOH) is added to the paste and it is heated on a mild flame accompanied by constant stirring. This is done to avoid the formation of lumps. 50 ml of dark soy sauce is added to the mixture. Along with this 20 ml of Soy milk is also added to the mixture. (Soya bean protein has excellent binding properties. Heating enhances the binding properties of the adhesive thereby making it strong). The hence formed adhesive should not contain any lumps.

The key ingredients are shown in Fig. 1.

Corn starch

Distilled water

Soy sauce

Vinegar

Soy milk

Fig. 1. Key Ingredients for adhesive

2.3 Mould and compressor preparation

A wooden mould of the following dimensions was made: 13mmx13mmx1.2mm (Fig. 2). A wooden compressor was made as shown in Fig. 3, in order to compress the slurry into the particle board. The mould and compressor act as key elements of the project. After the construction of mould and compressor, they are tested to minimize the risk of generating errors and loopholes.

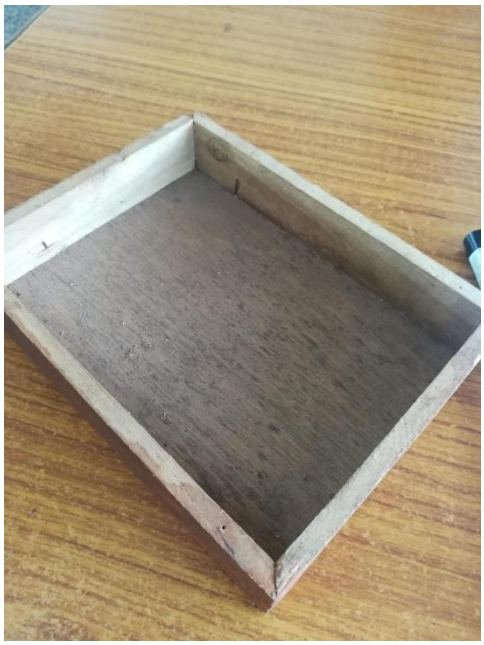

Fig. 2. Wooden Mould

Fig. 3. Compressor

2.4 Mixing, compressing and drying

The heating source is turned off and the finely ground rice husk is added to the adhesive mixture and it is stirred continuously till the rice husk purely blends with the adhesive. The slurry thus formed is poured into the mould. The mixture is leveled using a flat faced spatula and then compressed with the wooden compressor. Hydraulic compressor can also be used. But the so formed wooden compressor is specially designed for the particle board and hence it helps in compressing the mixture to a very finite level without developing cracks. The compressed composite is now allowed to dry for 24 hours. Heating in a microwave oven can reduce the time duration required for drying. Fig. 4 shows the model in process and Fig 5 shows the Final product.

Fig 4. Before drying

Fig 5. Final Product

III. Tests performed

After preparation of the particle board, certain tests are carried out to determine and check the properties of the product.

3.1 Water Absorption test

A small sample from the product is taken and weighed. It is then subjected to water absorption test. In this test, using a dripper, water is allowed to fall drop by drop on the sample for 12 hours and then for the next 12 hours the hence-soaked sample is allowed to dry. The percentage of water absorbed is measured and calculated.

Percentage of water absorbed= (final weight- initial weight)/ initial weight *100

Initial weight	Final weight	Percentage water absorbed
24g	24.68g	2.83%

IV. Advantages and Applications

1. The board is extremely cost effective since the principal material (rice husk) is a waste. Also, the paper focuses mainly on using easily available and cheap adhesives and on avoiding the use of synthetic resins which are very expensive.

2. It can be used in pseudo ceilings, partitions, furniture, panels, packaging, etc.

3. It is biodegradable and environment friendly.

4. This is an effective way to moderate the drastic rate at which forest resources are being exploited and is a feasible step towards sustainable development.

5. If the amount of compression and thickness are varied, then it can also be used for making cardboard and paper. That however will require a stronger adhesive which will have even lesser water absorptivity.

6. Since the product is extremely cost effective, it can be easily marketed.

V. Conclusion

A particle board is manufactured from rice husk which can potentially replace wood in furniture. It is biodegradable unlike the materials like thermocol or foam sheets used in pseudo ceilings. The cost of this is less than Rs. 30 per square feet, whereas that of pseudo ceilings is nearly Rs. 250 per square feet. It can also be used in electric panels, distribution boards, etc.

Rice husk is easily available and disposable. Its combination with the home-made adhesives highlights the novelty of the project.

VI. Future Scope

The pared strength of the binder can be increased. Using more advanced soy products, the strength of the product can be increased manifolds. Also, with further research on the same, more practicable results can be obtained and the product can be marketed.

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