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Environmentally Friendly Particle Board

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Abstract : This article explores the use of the sugarcane waste as a replacement for the wood dust in the making of fiberboard since the dust can affect our environment and health. The waste of sugarcane dumped from the machine that make the juice might cause environmental pollution and also make the surroundings feel uncomfortable. Nowadays, particle board or medium density fiberboard (MDF) is one of the building materials that can be used for slab of structural buildings. MDF is largely composed of resin and wood particles that have been pressure steamed and fried to produce a fine, unified product free of wood grain patterns.Deforestation is one of the problems that happen when it comes to create the MDF or particle board because in the creation of the material, it needs so much sawdust to make single board. Too much deforestation can affect our environment such as flood occurrences and landslide. The main objective of this project is to produce a fiberboard by mixing the sugarcane waste with different amount of adhesive material by applying technology of compressing.To analyse the result,density test and water absorption test conducted on the samples.Sugarcane waste is highly recommended to be used as a study for future.This is because there are various benefits that we can get through sugarcane waste as soon as it can help in recycling sugarcane that has been used.

Keywords: Sugarcane Waste, Environment, Particle Board, Medium Density Fiber (MDF), Deforestation

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1. Introduction

In recent years, there has been an increasing trend towards more efficient utilization of agro-industrial residues [1]. In Uttar Pradesh, North India, large amount of solid wastes is produced by agriculture-based industries, mainly bagasse form distilleries and sugar industries. Heat is used in the production of particle board. To create the substance in question, wood shavings, sawdust, resin, chips, and other fibers are heat-pressed together. In addition, adhesives and releasing agents are mixed into the substance. It is able to develop resistant characteristics as a result of this.

The aim of this study is to produce a particle board that environmentally friendly by replacing the main material of the particle board which is sawdust with sugarcane waste. These days, one of the building materials that can be utilised for the slab of structural buildings is particle board or medium density fiberboard (MDF). In order to create a smooth, uniform product devoid of wood grain patterns, MDF is primarily made of resin and wood particles that have been pressure steam- and fried-steamed. One of the issues with manufacturing MDF or particle board is deforestation because the material requires a lot of sawdust to produce just one board [2]. Besides, the test is conducted to this particular material to make sure that the material is suitable with compatible ratio of adhesive material. The novelty of this product is the production of less dust and can reduce environmental pollution in the manufacturing process.

2. Materials and Methods

The materials and methods section, otherwise known as methodology, describes all the necessary information that is required to obtain the results of this study.

2.1 Materials

The raw materials used in this study are sugarcane waste and epoxy resins.

- Sugarcane Waste
  Sugarcane waste is the dry pulpy fibrous material that remains after crushing sugarcane or sorghum stalks to extract their juice [3]. It is used as a biofuel for the production of heat, energy, electricity and manufacture building materials [4].

- Epoxy Resin
  Epoxy is two parts of adhesive that forms when the epoxy resin and hardener. The two substances are stored in different containers and mixed together when ready for gluing [5].

2.2 Methods

Firstly, the sugarcane waste is cut into a small piece (5 cm - 10 cm) and being weighted for obtaining 200 g. Then the sugarcane waste is dried to remove water content using the oven for 30 minutes at 100 °C. Dried sugarcane waste then being mix with the epoxy resin and hardener using 2:1 ratio which is 100 g of epoxy resin and 50 g hardener and mixed thoroughly [6].

The mixture then being put into a 35 cm x 35 cm x1 cm mould and lining it with baking paper. By using hot press machine, press the mixture on 100 °C for 30 minutes. After 30 minutes, take it out from the machine and let the sample rest for 24 hours. The process is repeated for the different ratio of adhesive which is 3:1 (150 g of epoxy resin and 50 g of hardener). The mix design sample in this study as in **Table 1.**

Table 1: Mix Design of Sample

Sample	Material	Type of Adhesive	
	Sugarcane Waste (kg)	Epoxy Resin (kg)	Hardener (kg)
A	0.2	0.1	0.05
B	0.2	0.15	0.05

2.3 Testing

Two tests were conducted in this study which are density test and water absorption test.

- Density Test

The density of the sample is calculated by measuring the length, width, height and mass of the sample and being recorded. Then the volume of sample is calculated by multiplying the value of length, width and height of the sample. Lastly the density is calculated using the **Eq.1.**

$$\rho = m/v. \quad \textbf{Eq.1}$$

- Water Absorption Test

Water absorption test is poised towards investigating the amount of moisture or water that the particle boards with varying composition of adhesive towards absorption within a specified period of time. The particle board specimen was immersed in water for 2 hours and 24 hours at a temperature of 23 °C. After 2 hours of immersion in water the specimen was observed to determine the least value for water absorption and the highest value of water absorption.Water absorption can be calculate using the **Eq.2.**

$$\text{Water absorption (\%)} = (W_f - W_i) / W_i \times 100. \quad \textbf{Eq.2}$$

3. Results and Discussion

Density test and water absorption test have been done to obtain the data for calculation and discussion. The product of this experiment is as in **Figure 1**.

Figure 1: Product of the experiment

3.1 Result of Density Test

Table 2 shows result of sample density test.

Table 2: Result of Density Test

Name of Sample	Length (m)	Width (m)	Height (m)	Mass (kg)	Volume (m^3)	Density (kg/m^3)
Sample A	0.35	0.35	0.01	0.318	0.001225	259.98
Sample B	0.35	0.35	0.01	0.377	0.001225	308.37

From the **Table 2**, it clearly shows that the density of sample B is higher than sampel A. The mass of sample A is lower than the mass of sample B due to the difference in the ratio of epoxy resin mixture and also hardener. Sample A used a ratio of 2:1 with a value of 0.1 kg epoxy resin and 0.05 kg hardener while sample B used 3:1 ratio with a value of 0.15 kg of epoxy resin and 0.05 kg of hardener.

The mass of each sample is affected by the ratio used. Sample B uses a larger ratio than sample A, this causes the compression of sample B to be higher than sample A due to less space between the materials that allows water diffusion to occur. The measurements for both samples were same because both used the same mould.

3.2 Water Absorption Test

For the water absorption test, mass before samples A and B were immersed in water were recorded as shown in **Table 3**. Then, both samples were immersed in water for 2 hours and left to dry at room temperature for 24 hours. After that, the mass for both samples are recorded as the data. Then, percentage of water absorption calculated using formula.

Table 3: Result of Water Absorption Test

Name of Sample	Mass Before Immersion (kg)	Mass After Immersion (kg)	Water Absorption (%)
Sample A	0.098	0.181	48.23
Sample B	0.118	0.141	16.75

The masses of samples A and B before immersion in water were 0.098 kg and 0.118 kg while the masses of samples A and B after immersion and left at room temperature were 0.181 kg and 0.141 kg. The percentage water absorption for sample A was higher than sample B with values 48.23% while the value of total water absorption for sample B is 16.75%. Both samples were left for 24 hours at room temperature for the purpose of drying process. In this test, there were several errors occurred which is compression difference. Sample B is more compact than the sample A.

This happens because during the process of inserting the material into the mould, the material is inserted unevenly, and this causes there to be voids on the sample. This causes the process of water permeation to occur faster and larger on the sample A. Furthermore, during the making of sample B, the sugarcane residue dusts were mixed together during the process of mixing the sugarcane residue with epoxy resin and hardener. As a result, the compression of sample B is higher than that of sample as soon as it is shown that the water permeability value for sample B is lower than that of sample A.

4. Conclusion

The subsequent common findings are based on the laboratory tests reported in this paper. It is interesting to know that from the density test, we can conclude that the amount of density influenced by mass and volume. Sample B has more mass than mass A due to difference in ratio of the mixture of the epoxy resin and hardener used. The data results found that the density test result for sample B is higher than sample A. We can conclude that the higher the mass of the sample, the higher the total density. Generally, the amount of water permeability is affected by the compression of the sample. The total water permeability rate for sample B is lower than sample A. This is because, sample B is more compact than sample A. In addition, there are some errors during the sample making process that cause water permeation rate for samples A and B have large distances. The percentage of water absorption is influenced by the compression of the sample. Sugarcane waste is highly recommended to be used as a study for future due to various benefits that we can get through sugarcane waste as soon as it can help in recycling sugarcane waste.

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