FABRICATION OF COMPOSITE MATERIAL USING NATURAL FIBER (COIR) AND TESTING ITS MECHANICAL PROPERTIES

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ABSTRACT:

Today, the world faces unprecedented challenges in social, environmental, and economic dimensions, in which the industrial design has showed an important contribution with solutions that provide positive answers regarding such problems.

In particular, due to the fast-depleting resources, our dependence on trees has increased which is hampering our environment drastically. Our world confronts a moment of crises, and sustainable development of manufacturing industries provides us with challenges as well as opportunities.

In this context, the use of natural fiber composites, produced in developing countries, have presented several social, environmental and economic advantages to design "green" substitutes. Thus, this work demonstrates the possibility to use natural fibers through a case study design which investigates the environmental improvements related to the replacement of wood for natural composite fibers.

Sugarcane bagasse and coconut fibers are thrown away and are seldom recycled. Using these to produce composite fibers can reduce wastage and provide alternatives for wood, saving our most important natural resource, trees.

1. INTRODUCTION.

Natural fiber reinforced composites is an emerging area in polymer science. These natural fibers are low-cost fibers with low density and high specific properties. These are biodegradable and non-abrasive. Natural fibers are of three type Animal fiber, Mineral fiber, and plant fiber.

Natural fibers gained more opportunities due to increase in cost of fossil and non-renewable resources. Many automobiles sector and other industries gets more interested on natural composites and renewable resources as it contributes an ecofriendly property and also it produce low cast material.

These natural fibers are of natural material which does not affect the environment and acts as an Eco-friendly. Natural fibers are gaining more attention due to its properties of nontoxic to environment, renewable property low-cost specific strength and weight ratio etc. Composite material is a process which combines two are more materials to form a material with different possibilities. It's made of three types, they are fiber reinforced, particle reinforced and structural. Using this above material many combinations of composite materials are being made used in many aspects of application like industries, automotive and many other sectors. Sugarcane fiber has a better strength and hardness which can use it as a composite material for, any aspect of application.

Based on these properties' sugarcane fibers got a massive attention in many countries to replace and use it as a composite material. Sugarcane is grown to extract sugar from its stalk. After the juice is extracted, the remaining sugarcane fiber pulp is called bagasse. Internationally, Brazil is a major producer of sugarcane with harvest expected to be 595.13 million tons in 2013.

2.LITERATURE REVIEW.

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3. METHODOLOGY.

- Sugarcane fiber and coconut fiber composites were prepared by hand layup process. This process will help the fibers to have a standard size and shape which reflect a proper accurate value of result at the time of results
- Then coconut coir fiber is spread on the resin equally without any overdeposition n the material which will affect the result values. Now repeating this process for required layers is done with the fiber.
- This process of combining layers of fibers with epoxy resin as adhesive is known as matrix type arrangement.
- This type of arrangement of will increase the strength and will combine together in a proper manner. After the process of making the composite fibers the material is being dried out to make it as samples to test the material.
- The drying processes are done for 6-9 days for the epoxy resin to attached both the material together and get dried. The dried material is being cut into required dimension to test the material and analyze its material properties.

4. COMPOSITE MATERIAL.

Sugarcane fiber:

The sugarcane is being smashed as the juicy inside the sugarcane gets extracted by manual process, otherwise the remaining after the removal of juice will be available in stores. After collecting them the fibers are being dried out for 1 to 2 weeks.

Figure 1.1 Sugarcane fiber

The extraction of bagasse fibers from sugarcane rind is performed in two different steps: mechanical separation and chemical extraction. Several factors are considered such as solutions of sodium hydroxide with different concentrations and time of reaction. The bagasse fiber can be noticeably long, but it should not be shorter than 6 to 12 mm. If the fiber is not of the desired length it might not hold together.

Coconut fibers:

In this experiment the composite product is made of coconut coir fiber and was arranged in randomly discontinuous oriented configuration. In this coconut coir fiber is extracted from coconut fruit. When coming to the experiment first the coir fiber is dried at 70°C-80°C using sunlight To avoid factor of degradation it is necessary for the coir fibers to go through the treatment process.

In this process the coir fiber is soaked in NaOH solution for min 24 Hours later it is abundantly washed with plain water to remove NaOH and the top layer of the coir fiber.

Figure 1.2 Coconut fiber

5. FIBER PREPERATION.

Sugarcane fiber and coconut fiber composites were prepared by hand layup process. This process will help the fibers to have a standard size and shape which reflect a proper accurate value of result at the time of results. When these two materials are ready, the epoxy resin will be used to combine the two type of fibers into single material. For that, sugarcane fiber is spread evenly in a form of sheet then slowly the epoxy resin is being applied over the sugarcane fiber. Then coconut coir fiber is spread on the resin equally without any overdeposition n the material which will affect the result values. Now repeating this process for required layers is done with the fiber. This process of combining layers of fibers with epoxy resin as adhesive is known as matrix type arrangement. This type of arrangement of will increase the strength and will combine together in a proper manner. After the process of making the composite fibers the material is being dried out to make it as samples to test the material. The drying processes are done for 6-9 days for the epoxy resin to attached both the material together and get dried. The dried material is being cut into required dimension to test the material and analyze its material properties. The cross section structure and shape is being tested with microscopic device and analyzed its structure and estimate the strength between the fibers and the epoxy resin. The tensile, stress and strain is being analyzed and plotted as results to compare its data and estimate its property of the composite material.

6. ALKALIZATION.

The alkaline solution used for alkalization of fibers is sodium hydroxide (NaOH).

The process involves immersing the areca and arenga fibers in the solution for 3 days alkalization of composite fibers can be a useful technique for modifying their surface properties and enhancing their performance in various applications, including in the fields of textiles, composites, and biomedical materials.

After 48 hours these fibres were taken out and kept under sunlight for drying.water content should be completely dried out in order to go to alkali

7. ISOPHTHALIC POLYESTER RESIN.

Isophthalic polyester resin is a type of synthetic resin that is commonly used in a variety of applications such as boat building, automotive parts manufacturing, and construction. It is made from a combination of isophthalic acid, diols, and other chemical additives.

This type of resin has excellent mechanical and chemical properties, including good tensile and flexural strength, high resistance to corrosion and chemical attack, and good dimensional stability. It is also highly resistant to water, making it ideal for use in marine environments.

Overall, isophthalic polyester resin is a versatile material that is widely used in various industries due to its excellent properties and ease of use.

8. CATALYST (MEK P).

A Catalyst(MEK P) is a substance that increases the rate of a chemical reaction without being consumed in the reaction itself. In other words, it is a substance that speeds up a reaction without undergoing any permanent chemical change.

Catalyst (MEK P) work by providing an alternative pathway for the reaction that has a lower activation energy, which is the energy required for the reaction to occur. By lowering the activation energy, the Catalyst(MEK P) enables the reaction to proceed more quickly and efficiently.

Catalysts are widely used in many industrial processes, such as in the production of fertilizers, plastics, and fuels. They are also used in the catalytic converters of automobiles to reduce harmful emissions.

9. COBALT ACD 6

In chemistry, a Cobalt ACD 6 is a substance that enhances the activity of a Catalyst(MEK P) or increases the rate of a chemical reaction. Cobalt ACD 6 can be used to improve the efficiency of a Catalyst(MEK P), reduce the amount of Catalyst(MEK P) needed, or enhance selectivity to a particular product.

Cobalt ACD 6 are often used in industrial processes to increase the efficiency and selectivity of Catalyst(MEK P)s. For example, in the production of ammonia by the Haber-Bosch process, iron is used as a Catalyst(MEK P) with small amounts of Cobalt ACD 6 such as potassium oxide or aluminium oxide to increase its activity.

Overall, Cobalt ACD 6 play an important role in catalysis, allowing for more efficient and selective chemical reactions.

10. COMPRESSION MOLDING MACHINE

A compression molding machine is a type of machinery used in the manufacturing industry to produce various plastic or composite products through the process of compression molding.

In this process, a pre-measured amount of raw material, such as thermosetting plastics, is placed into an open mold cavity. The mold is then closed, and high pressure and temperature are applied to the material to compress it and shape it into the desired product. The heat and pressure cause the material to cure and solidify, resulting in a finished product.

11. PREPARATION OF COMPOSITE PLATE.

STEP 1: ARRANGEMENT OF FIBRE

- Note the weight of fibre for the required plate
  and the two fibres are mixed well
- Place the mixed fibre into the frame of the mold cavity

STEP 2: REACTION OF RESIN WITH Catalyst (MEK P) AND PROMOTER

- Take half litre of resin and mix well
- Add the 10 ml of Catalyst (MEK P) with the resin and mix well

- Mix the Catalyst (MEK P) for 5 min
- Add the 5ml of promoter into the solution and mix well

STEP 3: MIXING THE RESIN ON THE FIBRE

- Put the resin on the all sides of fibre and mix well
- Place the upper mold cavity of the plate
- Fix the mold cavity into the compression molding machine

STEP 4: SETUP THE MOLDING MACHINE

- Fix the mold cavity in between the upper mold plate and lower mold plate
- Set the timer for 45 minutes
- Adjust the temperature of the compression molding machine
- After 45 minutes, Remove the mold cavity from the machine

STEP 5: REMOVE THE EXCESS FROM COMPOSITE PLATE.

- First , we remove the frames of the mold cavity
- Remove the excess resin on the edges of the composite plate
- Store the plate in room temperature for 24 hours.

12. CUTTING PROCESS.

Figure 12.1

The next process is to cut the molded plates into several shapes required to perform testing process as per ASTM standards.

FURTHER PROCESS CAN BE CARRIED OUT:

Analysis of Mechanical behaviour of the specimen.

- Tensile test
- Impact test
- Compression test
- Flexural test

Analysis of water absorption test of specimen.

- By using distilled water
- By using rainwater
- By using salt water
- By using tape water

13. CONCLUSION.

The feasibility of utilizing the coir and sugarcane fiber as alternative reinforcement in thermoplastics was studied. Chemical modification of cellulose fibers from sugarcane bagasse was studied to demonstrate the effect of modification on the mechanical properties of the composites and to study the practicability of processing these natural fibers with thermoplastics. The NaOH treated sugarcane fiber and the metal mesh reinforced polyester matrix composites are found to provide 70% improvement in tensile and 45% improvement in impact properties due to the strong interface bonding established by the fiber and the matrix and the load sharing support rendered by the metal mesh. The modification of fibers from sugarcane bagasse was successfully accomplished and it was verified that effectively improves the tensile, flexural and impact strength in comparison to the polymer pure.

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