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REVIEW ON COMPOSITE MATERIALS MADE WITH SUGARCANE FIBER AND COCONUT COIR AND STUDYING ITS PROPERTIES

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ABSTRACT:

This review discuss on the composite material made with sugarcane fiber and coconut peel combined by epoxy resin as a adhesive. These two materials are of natural fibers which are being recently discussed by scientists and technologists by its properties over the reinforcement material which provides a advantage towards the composite material. This idea is being discussed for past few years and being analyzed on its various properties of the different natural fiber materials. Sugarcane bagasse by the organosolv process was used as a partial substitute of phenol in resole phenolic matrices. Short sugarcane fibers were used as reinforcement in these polymeric matrices to obtain fiber reinforced composites. Later, these materials are being tested according to its properties and being evaluated by the prepared composite material. Then the results will be suggested for a suitable application that can be used for better environment and growth of technology.

Keywords: Sugarcane fiber, coconut crust, composite material.

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. The natural fiber composites offer specific properties comparable to those of conventional fiber composites[1]. Natural fibers gained more opportunities due to increase in cost of fossil and non renewable resources. Many automobile sector and other industries gets more interested on natural composites and renewable resources as it contributes a eco friendly property and also it produce low cast material[2].

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 non toxic to environment, renewable property low cost specific strength and weight ratio and etc.

Composite material is a process which combines two are more materials to form a material with different possibilities. It’s made of three type, they are fiber reinforced, particle reinforced and structural[5].

Using these above material many combination of composite materials are being made used in many aspect of application like industries, automotive and many other sectors. Sugarcane fiber has a better strength and hardness which is capable of using 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 fibre pulp is called bagasse[6]. Internationally, Brazil is a major producer of sugarcane with harvest expected to be 595.13 million tons in 2013. Sugarcane bagasse is a residue widely produced and containscellulose (46.0%), hemicellulose (24.5%), lignin (19.95%), fat and waxes (3.5%), ash (2.4%), silica (2.0%) and other elements (1.7%). Bagasse is a vegetable fiber mainly constituted by cellulose that is a glucose-polymer with relatively high modulus, often found as febrile component of many naturally occurring composites[7].

The other fiber which is widely available in everywhere and mostly wasted is coconut coir. This coconut coir as many good properties which can be used as a natural fiber called as Coconut fibers. Recent research says that a coconut fiber has a better polymer matrix arrangement than glass fibers. Moreover 60 billon of coconut are being harvested in world and these coconut fibers are being wasted in most areas. Using composite material method coconut crust can be used as a useful material with low cost in many industries and etc[8][9].

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MATREIALS AND METHODOLOGY:

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. 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[11].

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. The length of extracted fiber bundles depends on extraction conditions and the extraction process[12]. The fineness of the fabric is determined by the width of the fiber bundles. The bagasse fibers must also be strong to withstand spinning and weaving processes. Fiber strength is typically determined by tensile strength referred as 'tenacity'.

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[13] 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. After this we have to make the coir dry by between 70°C-80°C for next 24 Hours. The coir fibers were then soaked into 5% of silane and 95% of methanol solution for 4 hour and dried at 70°C. After this drying process the coir was inserted into the cutting machine to cut it to small pieces. These small pieces were called whickers whose length is < 10 mm.

Methods:

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[15]. Then coconut coir fiber is spread on the resin equally without any over-deposition 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[16].

RESULTS AND DISCUSSION:

Tensile strength:

In The fiber treatment, the values of tensile strength decreased as the amount of fiber increased. The chemically treated coconut coir composites presented higher tensile strength than the fibers which were untreated[16]. This enhancement is associated to the inequity of the hydropolic character of the fibers which were treated related to reduction of polar components (-OH) and could be seen from water absorption test results.

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The tensile specimens are prepared as per ASTM – D638-03 (9" x 0.75"x 0.5") .This specification gives the drawing of the specimen to be prepared for conducting the test with tolerances. The prepared tensile specimen were inspected after machining and loaded in the tensile testing machine and the tensile force was observed during the test. The stress Vs strain curve is generated till the specimen is broken. While comparing the tensile strength (12.5 MPa) of the modified sugarcane fiber reinforced polyester matrix composites fabricated the NaoH treated sugarcane fiber/sugarcane fiber, metal mesh/sugarcane and coconut shell powder reinforced polyester composites investigated in the present work show much better tensile strength than the one fabricated by Rodrigues et al[17][18].

The above comparison proves that the present NaoH treated composites have high potential in the industrial applications. In summary, the composite with NaOH treated sugarcane fiber with metal mesh is found to provide the highest tensile properties

Flexural Strength:

This test is also called bend test with the suitable fixture as given in the specifications as per ASTM-D 790 (0.125" x 0.5" x 5.0") and subjected to flexural test. The Test is conducted in the universal testing machine in compression mode[20]. The sample is kept on bending fixture and the compressive load is given under specified conditions and the curve generated till the failure of the sample takes place. Flexural results of the composites are The incorporation of the metal mesh is ineffective, rather adverse in the improvement of flexural properties of the composites. During the bend test, the top surface experiences the tensile loading whereas the bottom surface experiences the compressive loading.

As the metal mesh is stiffer than the composite material the incompatibility is sharing different nature of loading leads to the de-bonding at the interface[22][21]. This deteriorates the flexural strength and flexural properties of polymer matrix composites. , the flexural strength (78 MPa) of the NaoH treated sugarcane fiber reinforced polyester composite in the present work is much better indicating that the process parameters selected in the present work are appropriate to obtain the composite with superior flexural properties.

From the results, the importance of the addition of the secondary filler, that is coconut filler, is seen in the HCl treated fiber reinforced composites. The deterioration of the interface bonding by HCl treatment is compensated by the load sharing effects of secondary fillers.

Impact Strength:

Impact properties of the composites are reported by the Impact test results show that the NaOH treatment shows significant improvement in the impact properties by establishing strong bonding between the matrix and the sugarcane fiber. Between the metal mesh and the coconut fillers, the metal mesh is found to be better in improving the impact properties. Impact strength of composites depends of fibers, matrix, fiber/matrix interface and the test conditions. Experimental results may be explained by the interaction observed between fiber and matrix during the mixture process[22].

Composites (PP/FSG10% and PP/FSG20%) presented high average values impact strength when compared to polypropylene. It was observed an increase of 45% impact strength[23]. This fact can be explained by good interface between fibers–matrix. These interactions between fiber and matrix can be observed in the fractured composites after impact test. It is because; the stiff and tough metal mesh absorbs certain amount of energy during the impact test[24].

The secondary fillers are not effective in absorbing the energy during the impact condition. Also, the interfaces of secondary fillers/matrix may act as a source for easy path for crack growth during the impact loading. Thus, the effectiveness of secondary filler in improving the impact properties is not substantial.

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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