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Examination of mechanical properties of drumstick based composites: a sustainable approach

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ABSTRACT

We can make a composite material by combining two or more materials to form a unique material with a unique combination of properties like stiff and long fibers etc. A Natural fiber composite is created using with Polyester resin. The use of natural fiber as reinforcement for composite has lot of interest. One of the reasons may be the origin of fiber from natural sources. In this work a plastic resin of high strength and required weight was formulated by using drumstick fiber. Flexibility of the fiber can be improved to a greater extent by this process. The Drumstick fiber was treated with chemicals such as NaOH and HCl solutions. Quality control tests like tensile strength test were conducted to test the quality of the fiber generated.

KEY WORDS: Drumstick fiber, NaOH treatments, Polyester Resin.

1. INTRODUCTION

Environmental safety and awareness is the prerequisite to any responsible manufacturer. Manufacturers have to follow strict regulations globally in the prevention of environment. The industry at the same time will strive hard for the increase of productivity keeping in mind the safety of the environment. This can be achieved by adopting renewable sources for energy and renewable materials and materials made from natural sources.

The planning horizon is defined by a set of periods. Each period is characterized by demand, duration, electricity cost and maximum peak power. The costs are considered as the sum of electrical, holding, setup and power demand costs.

Non- fibrous materials like whole straw or reed can act as sound absorbers. Electricity demand response has been considered as a critical methodology to realize the strategy of sustainable development for manufacturing enterprises by effectively reducing the increasing electricity demand and Greenhouse Gas emissions. Little work has been implemented on the decision-making for the real time electricity demand response in industrial manufacturing systems considering system throughput constraint. In this paper, an analytical model is established to identify the optimal energy control actions and estimate the potential capacity of power demand reduction of typical manufacturing systems during the period of demand response event without compromising system production.

Sustainability in manufacturing systems is an urgent requirement for today's manufacturing companies. This paper focuses on sustainable manufacturing operations scheduling, a subject which has been attracting increasing interest from researchers in recent years. This paper presents a state of the art review of this field. First, it characterizes what can be considered as sustainable manufacturing operations scheduling, and introduces the relevant challenges and issues.

Traditionally, metal working fluids (MWF) are known to improve machining performance despite poor ecological and health side effects .Although there is much controversy on the effectiveness of NDM(Near Dry Machining), it is agreed that a lack of science-based modeling prevents its widespread use. This paper presents a new method to predict tool-wear/tool-life performance in NDM by extending a Taylor speed-based dry machining equation.

2. MATERIALS AND METHODS

Materials Usage: The materials used for the preparation of composite are Drumstick fiber, polyester resin, MEKP as catalyst and cobalt oxide as accelerator. The NaOH are used for the surface treatments of the fiber.

Material Preparation: The Drumstick fibers were cut into 250 mm length and 100 mm width. Once the fiber has been prepared then it has undergone the surface treatments. The base treatment has been done with the 5% of NaOH solution. The fiber is placed in the 5% NaOH solution for 1 hr and it has been taken out and washed in the distilled water. Then it has been allowed to dry for 24 hours at room temperature. Drumstick fiber is available in naturally. It has thick peel which has a three dimensional array of fibers. Their bio degradability nature can contribute to a healthier ecosystem and low cost production.

Then, it involves manual placement of dry fiber in the mold or mandrel and succeeding application of resin matrix. The wet composite is then rolled using hand rollers to facilitate uniform resin distribution, to ensure better interaction between the reinforcement and the matrix and to achieve the required thickness. The layered structure is then cured. In general, the hand layup fabrication process is divided into four essential steps: mold preparation, gel coating, lay-up, and curing.

Figure.1. Drumstick fibre

Figure.2. Fibres Treated in NaOH and Fibres in Dry Condition

Preparation of composites: The composite has been with three layers of drumstick fiber. The polyester resin mixture was poured into mould plate, then drumstick fiber was placed in the mould plate (hand layup) and then polyester resin mixture was applied. After that weight has been applied manually around 25 kg and then it has been kept for 24 hours for curing.

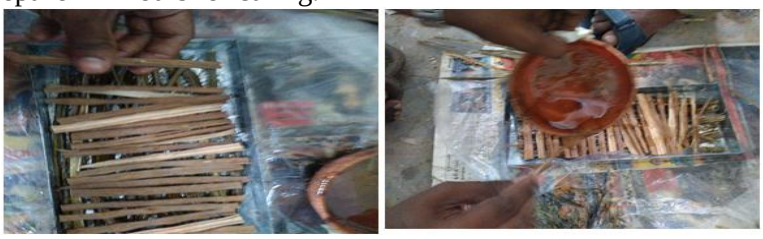

Figure.3. (a) Alignment of Fibre and (b) Resin is applied

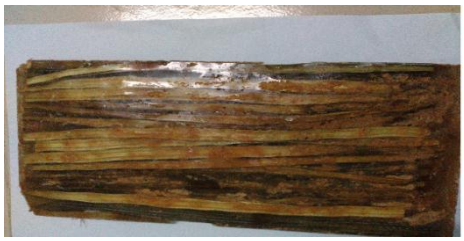

Figure.4. Prepared composite plate

Tensile test: Tensile test was performed for the fibre reinforced composite. The work piece was made following the standard ASTM D3039.The tensile test specimen has been cut in to 250mm x 25mm. The specimen is held in the grip and load is applied and the corresponding deflections are recorded. Load is applied until the specimen breaks and break load, ultimate tensile strengths are noted. Tensile stress and strain is recorded and stress vs strain graphs are generated. The size of the tensile test specimens are (250mm*25mm*5mm).

Figure.5. Tensile test specimens (a).before test, (b)Tensile piece loaded for tensile testing(250mm*25mm*5mm)

a

b

c

Figure.6. (a), (b), (c). Tensile test specimens after testing

3. RESULTS AND DISCUSSION

Tensile Test: Tensile test was performed for the drumstick fiber reinforced composite. The work piece was made following the standard ASTM D3039. The specimen is held in the grip and load is applied and the corresponding deflections are recorded. Load is applied until the specimen breaks and break load, ultimate tensile strengths are noted. Tensile stress and strain is recorded and stress vs strain graphs are generated.

Table.1. Tensile test results for Triple layer drumstick fibre composite

Description	NaOH Treated Fibre	Untreated Fibre	HCl treated Fibre
Tensile strength (MPa)	21.610	17.392	19.026
Load at break (kN)	2.520	2.360	2.280
Yield stress MPa	13.007	11.563	11.051
Load at peak (kN)	4.220	3.640	3.960

Table 1 indicates that the triple layer drumstick fibre composite and it enhances about the comparision of NaOH treated fibre,Untreated fibre and HCl treated fibre. Then the tensile strength has a more strength compared with their untreated and HCl treated fibre. If the load peak also have high in NaOH treated fibre.If the yield stress also more in NaOH treated fibre.

Table.2. Tensile Test Results for Double layer HCl treated Fibre Composite

Description	HCl treated
Tensile strength(MPa)	16.847
Load at break (kN)	2.080
Yield stress (MPa)	12.515
Load at peak (kN)	2.800

Table 2 indicates about their double layer of drumstick fibre, then the alignment of fibres are may be bidirectional arrangement of them It has been supposed for 0̊ and 90̊ of fibres aligned. If the HCl treated has less strength because it will destroy their cellulose content of fibre and enhances about weakness of fibre.

Stress - strain graph of NaOH treated, HCl treated and untreated drumstick fiber reinforced composites obtained from tensile test is shown in Figs. 7-11. Figure. 7 is for NaOH treated drumstick fiber composite. In this graph, it is observed that yield stress is 13.25 MPa and tensile strength is 21.610MPa. Figure. 8 is for untreated drumstick fiber composite. In this graph, it is observed that yield stress is 11.563 MPa and the tensile strength is 17.392 MPa. Similarly the NaOH treated fiber has more strength compared with untreated fiber composite. Figure. 9 is for HCl treated drumstick fiber composite. In this graph it is observed that yield stress have 11.051 MPa and the tensile strength have 19.026 MPa. In Figure 10 comparison of Triple layer composite chart has been tends to their variation of tensile strength in NaOH treated, untreated and HCl treated in tensile results. They were more tensile strength and yield stress in NaOH treated fiber. Figure 11 is for double layer HCl treated drumstick fiber has a tensile strength of 16.847 MPa and yield stress have 12.515 MPa. Then the HCl treated fiber has some less tensile strength compared with their NaOH treated fiber of them.

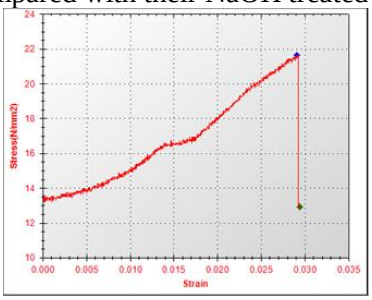

Figure.7. Stress Vs Strain graph of NaOH treated drumstick fiber composite

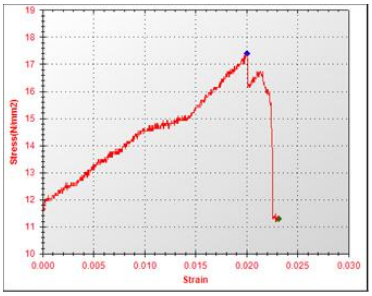

Figure.8. Stress Vs Strain graph of untreated drumstick Fiber composite

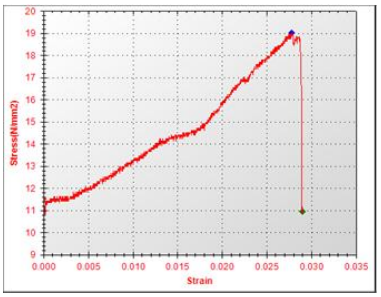

Figure.9. Stress Vs Strain graph of HCl treated drumstick Fiber composite

Stress and strain graph indicates about their Elastic limit to fracture point. If the stress will be started about Elastic behavior and it will reached their yield point due to proportional limit. Then the stress can be supposed to their flow of yield strength to ultimate strength due to strain hardening. After the ultimate strength region, it will be a Neck region due to fracture point. From the beginning stress condition to yield point are may be elastic behavior. If the condition states that yield point to fracture point are may be plastic behavior.

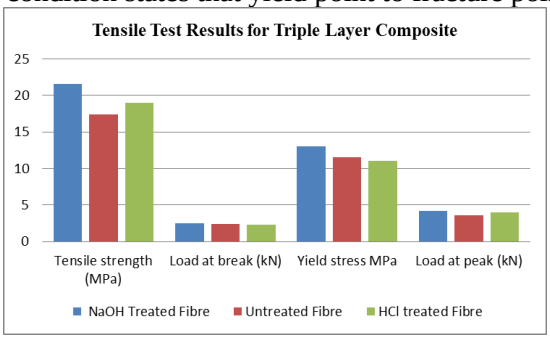

Figure.10. Tensile Results for Triple layer composite chart

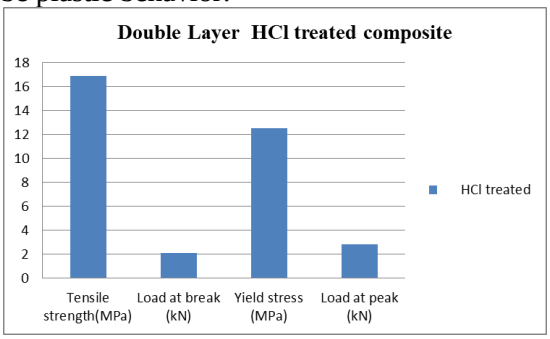

Figure.11. Tensile test results for Double layer HCl treated composite chart

4. CONCLUSION

This paper represents the fabrication of environmental friendly composite using drumstick fibre by hand layup method and then the weight is applied manually. This work finds their mechanical property by undergoing tensile test on treated and untreated in Drumstick Fiber specimen. We have identified their Tensile strength of double layer and triple layer of drumstick fibre composite material.

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