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Experimental Investigation of Surface Modification Mechanical Properties of Hybrid Composites Fabricated Though Die Moulding Process

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Abstract

In this work, surface treatment of hybrid composites fabricated through compression molding process is carried using NaOH in (6% in weight) for two different time periods (45 and 145 h). To investigate the outcome of surface modifications on mechanical properties of treated and non-treated fibers. Jute and sisal were used as reinforcement materials and PLA was used as resin.Mechanical properties like tensile strength, flexural strength have been analyzed and measured for treated and untreated natural fiber reinforced polymer nonlinear composites.It has been observed the composites ' tensile strength has enhanced due to the inclusion of natural fibers topolymers. Furthermore, the use of surface treatment method has seen a substantialrise in tensile and flexural strength.

Keywords: Surface modification, Jute, Sisal , Hybrid

1. Introduction

Over the most recent couple of years, the consumption of oil assets, the expanding mindfulness toward the earth and the incredible concern for nursery impact have animated businesses (for example car, building, nautical) to supplant ordinary engineered materials utilizing reasonable ones. Looking at these issues , green composites, made of sustainable rural and ranger service feedstock, speak to an appropriate option in contrast to manufactured fibre fortified composites.[1] Aside from these three, composites were also made from metals, earthenware, and polymers. Usage of typical fibers has been in nearness for certain ages, regardless, the divulgence and following synthetics items, for instance, glass, aramids, and carbon strands morally justified on schedule and mid-twentieth century achieved the decreased tendency for trademark fibres in different applications. The high utilization of items dependent on oil has a negative ecological effect.[2-3].Becoming natural mindfulness has likewise set off a change in perspective towards planning materials good with nature. On account of expanding natural awareness and enacted prerequisites, the utilization and end-of-life expulsion of customary composite structures, typically made of carbon, glass or aramid fibres, are getting progressively significant. Bio composites got from common fibres and customary thermoplastics or thermosets are not suffciently naturally well disposed in light of the fact that framework gums are non-biodegradable.Be that as it may, these biocomposites do now keep up a harmony between financial aspects and condition enabling them to be considered for applications in the car, building, furniture and bundling ventures. Normal fiber fortifications as short fiber, fiber, or

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texture have become better options to manufactured filaments as fortifications, because of their high flexural modulus and quality just as effect quality and modulus[4].The cost of these materials is less and are lightersimpler to fabricate. Moreover, their biodegradability have helped in them across the board for various applications like in automobile sector aviation and construction industries. Therefore some green fibers like jute oil palm fiber, hemp and sisal, Jute, etc. are someregular filaments most normally utilized as strengthening materials in polymer composite industry [5,6].To modify sisal fiber, Feng Zhou et al.[7] used saline coupling agents and investigated the chemical reaction between sisal fiber and saline.The results indicated that saline transformed the topography of the surface of sisal fiber and its chemical structure which resulted in a better cohesion .A.C.H. Barreto et al.[8] examined the sisal strands utilizing antacid arrangement NaOH at 5% and 10% focus and blanched using sodium hypochlorite (1:1) at 60-75 ° C , at that point joined with cashew nutshell fluid (CNSL) phenolic framework. It was oberved that the salt synthetic treatment expanded the crystalline part and improved sisal strands ' warm dependability contrasted with crude state.Jun Tae Kim et al.[9]contemplated the impact of surface treatment on sisal filaments under strain and without pressure to improve their soy protein lattice pliable properties and interfaces. In 2 M NaOH arrangement, the sisal strands are handled for 2h under different weights (from 0 g to 100 g weight for every fiber) and afterward absorbed the Soy Protein Concentrate (SPC) pitch for making composites which restored at 120 ° C. Morpholoy investigation on the break surfaces of the composite by SEM indicated that sisal fiber and soy lattice were better clung to after the mercerisation treatment.Min ZhiRong et al.[10] studied the result of treatment of fibers on the mechanical properties of epoxy composites reinforced by unidirectional sisal fiber. For the surface modification using such as alkalization treatment was carried. The SEM,FTIR and XRD results revealed that bonding between matrix-epoxy and sisal fibers was enhanced by using these treatments.

2. Materials and methods

Poly-lactic-acid (PLA) was utilized as matrix material. It is biodegradable material separated from corn starch. Woven Jute and Sisal as shown in figure.1 which were used as matrix materials and TheSurface treatment on Hybrid composites was performed in order to survey the effect of the alkaline on both the morphology and the mechanical properties of the fibers of jute and sisal s were pre-treated in a NaOH game plan (5% in weight) at room temperature for 45 h and 145 h and fibers were washed totally with fresh water to remove the excess of NaOH and subsequently dried at room temperature for 45 h sought after by stove drying at 100 ° C for 5 h. Properties of sisal and jute are shown in Table.1

Table 1. Properties of Sisal and Jute

Properties	Sisal	Jute
	Values	Values
Density (g/cm^3)	1.4–1.5	1.3–1.5
Length (mm)	1.5–120	900
Failure strain %	1.5–1.8	2.0–2.5
Tensile strength (MPa)	393–800	507–855

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Stiffness/Young's modulus (GPa)	10–55	9.4–28
Specific tensile strength (MPa/gcm^3)	300–610	362–610
Specific Young's modulus (GPa/gcm^3)	7.1–39	6.7–20

Figure. 1(a) Jute FiberFigure.1(b) Sisal Fiber

2.1 Tensile Strength:

The test was as per standard ASTMD3039. The size of the test sample was 250 mmx 15 mm x 1 mm. The test was carried out on a 10-ton capacity universal testing machine(UTM). The flat samples of essential size are fixed between the handles of each test machine headThe force direction applied to the sample coincides with the specimen's longitudinal axis.

2.2 Flexural strength:

Three point bend tests were carried out in agreement with the standard ASTM D790-02. The specimen of the test was 154 mmx 13 mm x 4 mm. The test was carried out on a UTM. Two parallel roller maintenances were used for supporting the specimen and the load was given through the loading of the nose between the supports.

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3. Results and discussion

Two unique sorts of common filaments like jute and sisal were utilized as fortification for making ofPLA based hybrid composites. Mechanical tests were performed and their outcomes are shown in the table 2 and are talked about in subsequent segments.

3.1 Tensile strength

It was found that the tensile strength of the processed jute and sisel composites was higher in comparison to other untreated sisal and Jute composites.Nevertheless, the strength of standard fiber reinforced PLA-based composites with a 30 percent fiber volume component shows a remarkable improvement in elasticity with the most extreme 93.MPa rating.This indicates the positive outcome of support in the product straight away. It was also shown that by using surface treatment the improved tractable properties of the significant number of composites.The lignin, cellulose layer on the fibers was extracted from 5 percent NaOH treatment, which improves the fiber wettability and consequently enhances the general surface area of contact between fiber and gum and increases the consistency and elasticity of the holding.Figure.2 shows the comparison .

3.2 Flexural Strength

In this test flexural tests of hybrid composites was performed using UTM machine and contrast of flexural properties of treated and non treated was done of jute and sisal. It was observed There was significant improvement (Approx 5 to 10%) of the composites after surface modifications of thefibers. Figure.3 Comparison of Flexural strength for treated and non-treated

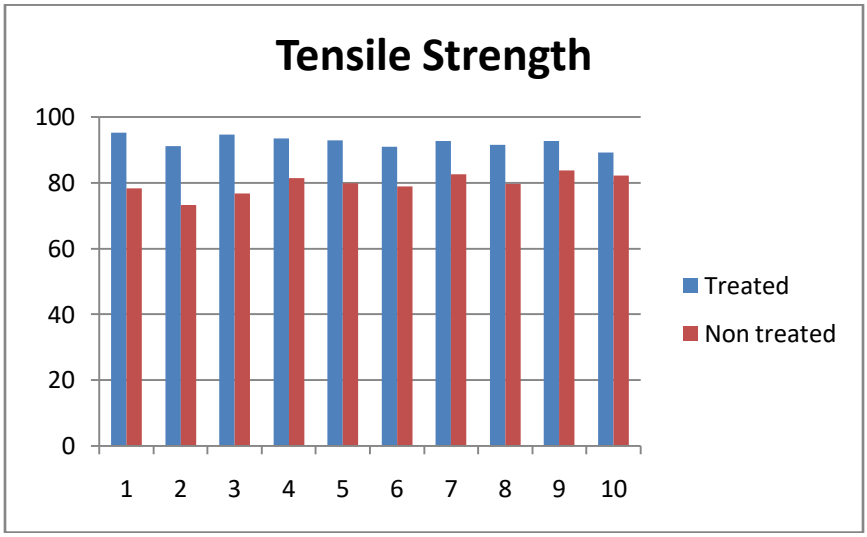

Figure. 2 Comparison of Tensile strength for treated and non-treated

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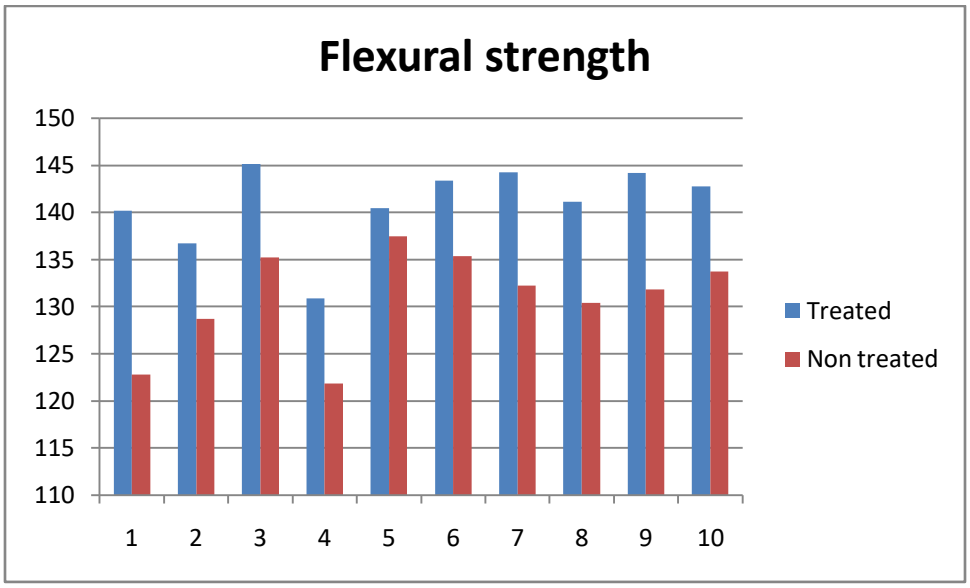

Figure. 3 Comparison of Flexural strength for treated and non-treated

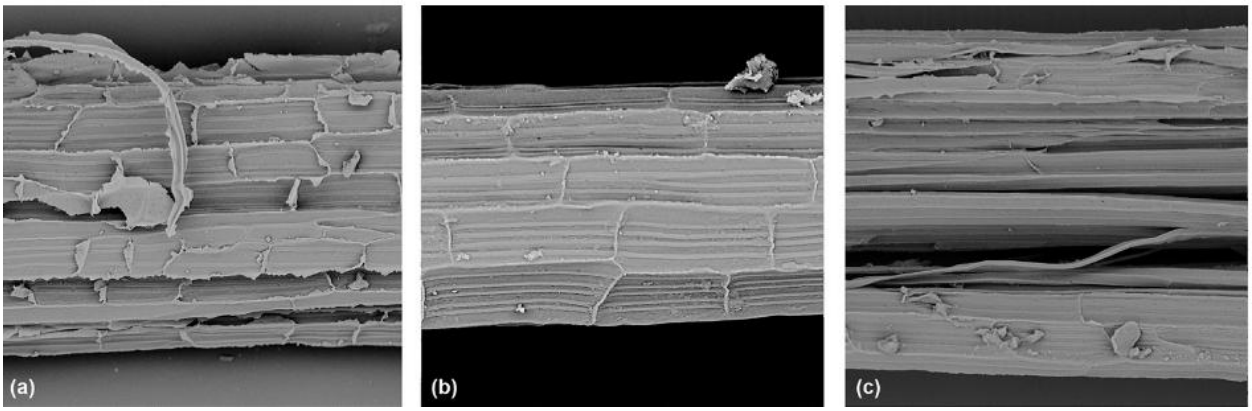

Figure 4. SEM images (a) non treated fibers; (b)Treated fibers after 45 h in NaOH and (c) After 145h.

4. Conclusions

In this work, surface treatment of hybrid composites fabricated through compression moulding process is carried using NaOH in (6% in weight) for two different time periods (45 and 145 h) were investigated.In this investigation different normal filaments like jute and sisel hybrid composites were utilized as support and the impact of surface treatment on mechanical properties has been contemplated and the accompanying end can drawn.

1.It has been discovered that mechanical properties of the composites have enhanced because of fuse of characteristic filaments to polymers.

2. Mechanical properties and these properties can be enchanced by surface treatment with alkaline treatment.Tensile strength was enhanced significantly.

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3.Substantial increase in the flexural performance of all surface treated composites. in comparison to Untreated composite based on Jute and sisel fiber shows the highest performance

4.Only composites strengthened with unidirectional layers demonstrated higher strength compared to smooth resin.

5.The fibers in the NaOH solution after 45 h do not display contaminants due to the NaOH solution's cleansing effect as shown in Figure .4

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