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STUDY ON CHEMICAL TREATMENT FOR LONG SISAL FIBERS FOR THE DIRECT EXTRUSION PROCESS

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Abstract

As of late, normal fiber built up composites have gotten a lot of consideration due for their many potential benefits like light weight, non-grating, non-poisonous, minimal expense and biodegradable properties. Normal fiber built up composites has numerous applications as a class of underlying materials as a result of the instance of manufacture, somewhat minimal expense of creation. Albeit the engineered strands like glass, carbon have high explicit strength, their fields of utilization are restricted as a result of their inborn greater expense of creation. Regular strands built up composite material can be prepared by direct expulsion pressure forming. In this interaction the impact of hotness on the lattice is extremely high, thusly warm corruption is significant concern. The descriptive word of the undertaking where is to investigation of compound treatment on sisal filaments and their co-connection with the last mechanical properties of formed part.

***Keywords**:* Twin screw, Extruder, Chemical Treatment, Coupling agent, Extrusion Process.

1. Introduction

As of late polymer framework composites supported with filaments like glass, carbon, aramid, and so forth are getting in more uses in light of their great mechanical properties. Be that as it may, they are very costly materials. Composites produced using glass fiber as support cause intense bothering of the skin, eyes, and upper respiratory parcel. When delivered, glass fiber doesn't debase and brings about ecological contaminations and undermines creature life and nature. The new ecological guidelines and vulnerability about oil and wood assets have set off a lot of interest in creating composite materials from normal strands.

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This interest in the normal filaments has brought about countless alterations to bring it at standard and surprisingly better than manufactured strands. On account of such gigantic changes in the nature of regular filaments, they are quick arising as a building up material in composites. Various grids prior and then afterward treatment by various strategies; alongside this they present an outline of ongoing advancements of sisal fiber and its composites. The properties of sisal fiber interface between sisal fiber and framework, properties of sisal fiber-built up composites and their half breed composite.

Sisal fiber is gotten from the leaves of the plant Agave sisalana, which was begun from Mexico and is currently predominantly developed in East Africa, Brazil, Haiti, India and Indonesia (Nilsson, 1975; Mattoso et al., 1997). It is gathered under the wide heading of the "hard filaments" among which sisal is put second to manila in solidness and strength (Weindling,1947). The name "sisal" comes from a harbor town in Yucatan, Maya, Mexico (Nilsson, 1975). It implies cold water. Agave plants were developed by the Maya Indians before the appearance of the Europeans. They arranged the strands manually and utilized it for ropes, covers and dress. It is one of the most broadly developed hard fiber on the planet and it represents a large portion of the complete creation of material filaments (Lock, 1962; Wilson, 1971). The justification behind this is because of the simplicity of development of sisal plants, which have short reestablishing times, and is genuinely simple to fill in a wide range of conditions. A decent sisal plant yields around 200 leaves with each leaf having a mass structure of 4% fiber, 0.75% fingernail skin, 8% other dry matter and 87.25% dampness. Accordingly, a typical leaf weighing around 600g yields around 3% by weight of fiber with each leaf containing around 1000 strands (Kallapur, 1962). The fiber is extricated from the leaf either by retting, by scratching or by retting followed by scratching or by mechanical means utilizing decorticators (KVIC, 1980). The breadth of the fiber changed from 100□m to 300□m (Mukherjee and Satyanarayana, 1984).

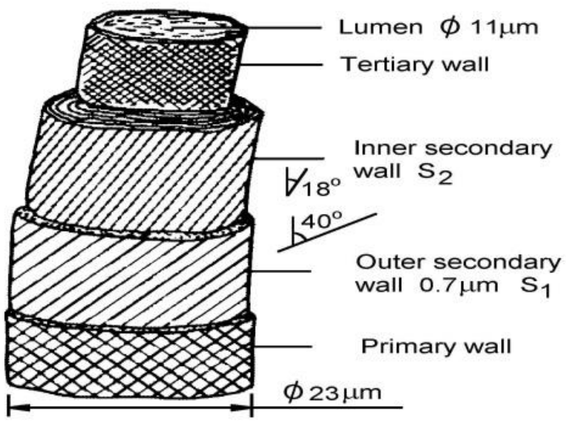

Figure 1. Schematic sketch of a sisal fiber cell with approximate dimensions

Continuous Fibre Composites:

Long fiber fortifications produce a critical improvement in the strength of thermoplastic based composite parts (Bartus et al.). The primary restriction for the creation of long biofibre composites is the capacity to take care of them into the intensifying framework. Short strands of around 3 mm or less can be pre-compounded and pelletized utilizing group or nonstop frameworks which can be later feed into the container of a twin screw extruder. The filaments can likewise be pelletized utilizing the technique depicted before on this paper, yet this is a work escalated measure with appropriateness at a lab scale. The objective is to devise a Direct Long Fiber Thermoplastic (D-LFT) measure utilizing ceaseless sisal rovings. The sisal rovings are described by their tex number, characterized as the quantity of grams of material per kilometer of wandering, and the tpi, characterized as the quantity of turns per inch. The tex number is pivotal in the assurance of the rates of fiber added to the composite material though the tpi is a boundary that influences the pulling strength, for the most part expanding as the number increments, yet in addition influences the capacity to de-package and scatter the strands into the polymer dissolve. The determination of the right blend of tex and tpi numbers for the sisal rovings altogether affects the adequacy of the assembling method. To accomplish the common properties needed for car parts, normal strands are utilized related to glass filaments.

2. Literature Survey

Barkakaty (1976) has announced the underlying parts of sisal fiber. He has concentrated on the atomic design of the Para crystalline cellulose, which frames the significant constituent of the fiber by x-beam diffraction method. He likewise concentrated on the multicellular construction, surface geography, and break morphology and the impact of synthetic treatment on sisal fiber.

Mattoso et al. (1997) have announced the extraction strategies, morphology and substance alterations of sisal fiber and its application as support specialists in polymer composites.

Mukherjee and Satyanarayana (1984) have concentrated on the mechanical properties of sisal fiber like beginning modulus (the degree to which the fiber opposes the distortion in the low strain district is known as the underlying modulus of the fiber), extreme rigidity, normal modulus and percent extension as a component of fiber width, test length and the speed of testing. It was accounted for that tractable properties of fiber fluctuate with test length of the fiber.

Padmavathi and Naidu (1998) have concentrated on the synthetic opposition and rigidity of sisal strands (Agave veracruz). It was noticed that sisal strands were more impervious to concentrated HCl contrasted with different acids. The filaments treated with 18% arrangement of NaOH showed more pliable burden than the other artificially changed strands.

Edwards et al. (1997) have concentrated on the utilization of FT-Raman microscopy to the non-ruinous examination of sisal strands.

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Chand and Joshi (1995) have explored the impact of gamma light on design and dc conductivity of this sisal fiber. It was discovered that openness of sisal fiber to gamma-illumination expanded the dc conductivity, which has been clarified based on microstructure.

Singh et al. (1998) have concentrated on the adsorptive collaboration between sisal fiber and coupling specialists utilizing contact point estimations and Fourier change infrared spectroscopy. It was tracked down that high contact point and decreased hydroxyl bunches on titanate-treated filaments favor its better hydrophobicity over different medicines.

Joseph et al. (1992,1993ab, 1994) have explored the mechanical, rheological, electrical and viscoelastic properties of short sisal fiber built up LDPE composites as an element of preparing strategy, fiber content, fiber length and fiber direction. They have revealed that the fiber harm regularly happens during mixing of fiber and the polymer by the liquefy blending strategy can be abstained from by embracing an answer blending technique. They have likewise detailed that unidirectional arrangement of the short strands accomplished by an expulsion interaction improved the rigidity and modulus of the composites along the hub of the fiber arrangement by in excess of two overlap contrasted with arbitrarily situated fiber composites.

3. Materials and Methods

Matrix Preparation

Thermoplastic is a thermosetting polymer that fixes (polymerizes and cross connections) when blended in with a hardener. Thermoplastic tar of the grade LM-556 with a thickness of 1.1–1.5 g/cm3 was ready with a combination of thermoplastic and hardener (HY-951) at a proportion of 10:1.

Fibre Preparation

The normal strands like Sisal, banana void natural product pack filaments and bamboos were separated by the method involved with retting and decorticating. The relieved filaments were then completely washed and brushed to free the tissue completely and dried. The dried strands were diminished by slamming to eliminate the undesirable short and broken filaments.

Surface Treatment

As the regular filaments bear hydroxyl bunches from cellulose and lignin, subsequently, they are amiable to alteration. The hydroxyl gatherings might be engaged with the hydrogen holding inside the cellulose atoms along these lines lessening the action towards the network. Substance alterations might actuate these gatherings or can present new moieties that can viably interlock with the grid. Pre-treatments of the fiber can clean the fiber surface, artificially alter the surface, stop the dampness ingestion cycle and increment the surface roughness. Initially, every one of the filaments were washed with water for multiple times, dried at room temperature for 48 hours, then, at that point, were drenched in 10% sodium hydroxide (NaOH) answer for 24

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hours lastly washed with extremely weaken hydrochloric corrosive (HCl) to eliminate the lingering salt. Then, at that point, the strands were washed with refined water twice or threefold. The washed strands were dried at room temperature for 2–3 days.

4. Chemical Treatment on Interfacial Adhesion

Alkali Treatment

Salt treatment of cellulosic strands, additionally called mercerization, is the typical strategy to create top notch filaments. Antacid treatment further develops the fiber-grid attachment because of the expulsion of normal and counterfeit contaminations. Besides, soluble base treatment prompts fibrillation which causes the separating of the composite fiber group into more modest filaments. As such, soluble base treatment diminishes fiber measurement and subsequently expands the viewpoint proportion. Subsequently, the advancement of an unpleasant surface geology and upgrade in perspective proportion offer better fiber-lattice interface bond and an increment in mechanical properties. Salt treatment expands surface unpleasantness bringing about better mechanical interlocking and the measure of cellulose uncovered on the fiber surface. This expands the quantity of conceivable response locales and permits better fiber wetting. The conceivable response of the fiber and NaOH is as underneath.

Fiber-OH + NaOH ------- Fiber-O^-Na^+ + H_2O

Soluble base treated normal filaments supported the support in the thermoplastic grid in the composite appearance wonderful compound bond and better interface attachment and in this way expanded the elasticity of Hybrid composite examples. The disappointment of Natural fiber–thermoplastic Hybrid examples, portrayed by fragile disappointment, showed long tails after the dominating harm. It is hence assessed that an interfacial association in the current composite would bring about a higher extension to break because of soluble base treatment. we can obviously ingest the fiber wetting of the treated fiber and furthermore great fiber grid association.

Figure 2. Fiber is immersed in NaOH solution

Silane Treatment

Silane is utilized as coupling specialists to adjust fiber surface. It goes through a few phases of hydrolysis, buildup and bond arrangement during the treatment interaction with the fiber. Silanols structures within the sight of dampness and hydrolysable alkoxy gatherings. It responds with cellulose hydroxyl gathering of the fiber and further develops fiber network grip to settle composite properties. The substance sythesis of silane coupling specialists (bifunctional siloxane particles) permits shaping a compound connection between the outer layer of the cellulose fiber and the pitch through a siloxane span. This co-reactivity gives atomic coherence across the interface locale of the composite. It additionally gives the hydrocarbon chains that limits fiber enlarging into the framework. Regular filaments show micropores on their surfaces and silane coupling specialist go about as a surface covering which enters into the pores and foster precisely interlocked covering on their surface. Silane treated fiber built up composite gives preferred rigidity properties over the basic treated fiber composites.

Figure 3. NaCl solution is prepared

After Treatment

After treatment the weight part of the fiber determined as follows:

The weight reduction was determined from the accompanying condition:

Weight reduction = (Wo-W1/Wo)×100 - - - - >(1)

Weight loss= (500-424/500) ×100

=0.152 or 15.2%

where Wo means the heaviness of sisal strands previously NaOH treatment, and W1 the heaviness of filaments after having been treated with NaOH.

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Figure 4. Fiber weighing machine

The strength and stiffness of continuous fibre composites

At the point when a heap is applied corresponding to the strands, viably little burden is conveyed by the framework. The chief motivation behind the grid is to tie the filaments together. For long filaments, stress is steady over the entire length of the strands. This romanticized composite is the beginning stage for all hypotheses of support. At the point when a heap is applied corresponding to the filaments, the heap is disseminated with respect to the general volume parts of the fiber and framework, the composite's mechanical properties toward this path can be portrayed by The Rule of Mixtures. On the off chance that we accept the strands and grid act flexibly and are impeccably clung to one another and think about what happens when a strain c is applied consistently in the fiber heading (Figure 1), the all out power will be the amount of the powers in the fiber and framework.

Formula used to calculate:

The Young's modulus of the composite Ec in the fiber heading is: -

$$\mathbf{E_c=V_fE_f+(1-Vf)E_m}\text{---------}\mathbf{(2)}$$

Where,

Vf = volume part of filaments

Ef = Young's Modulus of filaments

Em = Young's Modulus of framework

The elasticity of the composite σuc is given by: -

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$\sigma_{uc} = \sigma_{uf} V_f + \sigma'_m (1 - V_f)$------(3)

where,

σuf= extreme strength of fiber

σ'm = stress in lattice at a definitive strain of the strands

Vf = volume part of filaments

Processing Steps

Continuous regular filaments are gotten from wandering through overhead lines to the extruder station.The strands are spread and preheated before prologue to the joining extruder, where they will be blended in with the liquid sap at 1/3 separation from the extruder die.The liquid combination is pushed through a framing bite the dust and sheared to the length needed for molding.The extrudate will move to the pressure molding.The eventual outcome will move to managing and completing station.

Implementing Method

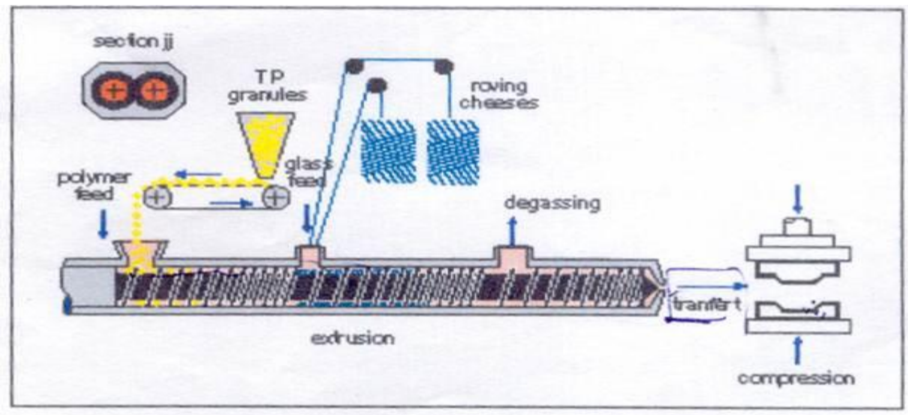

Figure 5. Schematic diagram of single step process of Natural fiber reinforced thermoplastic product

5. Conclusion

• The impact of different boundaries like soluble base treatment, fiber stacking of Natural fiber supported thermoplastic composites has been contemplated.

• The regular filaments utilized like Sisal Fiber (SF) have shown great similarity with the grid.

• The composite with soluble base treated filaments displayed a somewhat higher elasticity than the one with untreated strands.

• The salt treatment of regular filaments worked on the nature of the fiber/framework interface.

• Tensile test results showed that NaOH treatment utilized significantly affect the mechanical properties of Natural fiber built up composites.

• Out of the composites tried most extreme rigidity was gotten for the fiber stacking (weight part) of 25-30%. This can be considered as the ideal fiber stacking.

• It can be inferred that soluble base treatment of the normal strands is important to get composites with moderate mechanical properties just as better bond among filaments and network.

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A Brief Author Biography

Bommanna K – Author has received his M.Tech degree in Machine Design and next Pursuing Ph.D in Composite Materials from Visvesvaraya Technological University. Since 2013 he has been a researcher in the Department of Mechanical Engineering at the T.John Institute of Technology. His scientific interests focus on problems concerning Natural composites, machining processes and tools, efficiency, monitoring and diagnostics of machining processes. He has participated in 2 international and 3 national research projects, presenting results of his work at 6 international and 10 national conferences, published more than 12 scientific papers in international and national journals, book chapters, as well as conference proceedings. He is also having patents for his research work.