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Extraction of Fiber from Sansevieria Trifasciata Plant and its Properties

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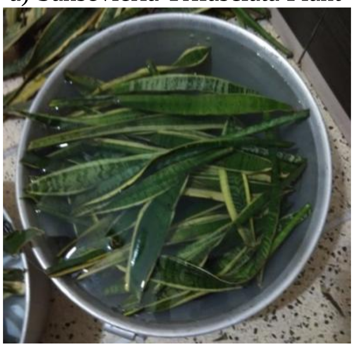
Abstract: ***Textile industry today is known to be the biggest polluter of environment resulting in ecological imbalance and depletion of resources. Due to technological advancements, ever increasing consumerism and fast fashion, these crises like situations have become a potential threat to humanity as such. Fashion Consumers all over the globe are practicing a 'use and throw' attitude resulting in textile waste choking up landfills. Feeling concerned, the governments have begun launching programs on environmental awareness; International business houses are being asked to observe strict legislations and undergo environmental audits. In the scenario, use of natural fibers and enzymes for textile processing is being encouraged. Possibility of discovering certain non-conventional sources for natural fibers is being explored. "Sansevieria Trifasciata fiber is one such lignocellulosic fiber that has likelihood for use in textile industry. It can be extracted from the leaves of Sansevieria Trifasciata Plant by various methods, one of them being water retting". In this study the extracted fiber was examined for its diameter, fineness, tensile strength and elongation in the laboratory of Northern India Textile Research Association as indicated in ASTM. The diameter of the fiber was found to be 50.76 microns with a fineness of 19.45 denier. The tensile strength and elongation of the fiber were found to be 5.97 gm/denier and 3.27 %. There is a possibility of favorably enhancing these properties through various techniques of mixing and green application processes.***

Keywords: Sansevieria Trifasciata Fiber, Tensile Strength and Denier

1. Introduction

Cellulose is a natural bio polymer and can be obtained from a large variety of plant life. The resulting fiber is renewable and bio degradable. (1) Cultivation of fiber crops and rearing of silkworms and sheep have been the traditional methods of obtaining cellulose and protein fibers, respectively. However, fiber crops are not just sources for clothing, but the by-products generated are major sources for food and means for substantial income. Recent statistics reveal that while the annual world production of natural fibers has been about 45.5 million tons, production of these fibers in India has been almost 14.5 million tons. Increasing consumption, especially in the developing countries, constraints on the natural resources required to produce fibers, and inability to increase the supply proportionate to the demand are expected to make most of the current fibers either too expensive or unavailable for commodity applications.(2) Eco friendly, bio degradable and recyclable products are gaining importance in the market which has brought natural fibre in to focus. As mentioned earlier the earth is abundantly populated with several varieties of plants that might possibly have a potential to yield valuable fibers but they are yet to be explored. Long leafy plants seemingly have higher degree of fiber yielding capacity. (2) The present study consequently study focuses on the exploration of Sansevieria Trifasciata Fiber for textile applications. "Sansevieria is a genus of about 70 species with great variation within the genus, species range from succulent desert plants such as Sansevieria pinguicula to thinner leafed tropical plants such as Sansevieria trifasciata. Sansevieria is native to India, Indonesia and Africa. It is an evergreen perennial plant forming dense stands, spreading by creeping rhizome, which is sometimes above ground, sometimes underground. Its leaves grow vertically from a basal rosette. Sansevieria trifasciata has stiff sword-shaped leaves. Leaves are banded yellow on either side with a deep green, lightly banded center. Mature leaves are dark green with light gray-green cross-banding and usually range between 70–90cm (28–35 inch) long and 5–6cm (2.0–2.4 inch) wide". "Sansevieria trifasciata, also called snake plant, mother-in-law's tongue or Saint George's sword (in Brazil) is a species of flowering plant in the family Asparagaceae". "Sansevieria species are believed to act as good air purifiers by removing toxins such as formaldehyde, xylene and toluene from the air, thereby gaining a reputation as a good cure for sick building syndrome. It converts CO_2 into O_2 at night". (3)

a) Sansevieria Trifasciata Plant



b) Water Retting

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c) Degradation of Fiber

d) Sansevieria Trifasciata Fiber

2. Experimental Procedure

Materials

1. Selection of Plant: Plants of Sansevieria Trifasciata were collected from in and around Ram Nagar, Nainital, the leaves were used to obtain the fibers.
2. Fibre Extraction: The fiber was extracted from the leaves by retting method. The leaves were collected and remained in water for seven to eight weeks. When the leaves were completely degraded in the water, the fibers were extracted by removing the outer layer. The extracted fibers were washed thoroughly to remove any traces of pulp adhering to them. They were then dried in sunlight for about five to seven hours to remove moisture.

Method

1. Fiber Diameter: Projection Microscope was used to calculate the diameter of the fiber.
2. Fiber Fineness: The fiber was tested for its fineness as indicated in ASTM D-1577:07 test method.
3. Tenacity and Elongation: Tenacity of the fibers was tested using ASTM D- 3822:07. The gauge length between the jaws was 15cm. The preconditioned fiber samples were fixed between two jaws. After the rupture of the fibers the tenacity and elongation were noted.

3. Results and Discussion

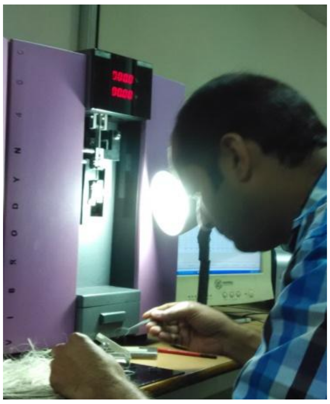
The properties of the fiber were tested in the laboratory of Northern India Textile Research Association (NITRA), Ghaziabad to find out the results.

1. Fibre Diameter

Projection Microscope

The thickness or diameter is one of its most important properties of the fiber. Fiber diameter is usually measured with a Projection Microscope. An image of fiber scraps is magnified and projected onto a screen, from which the diameter is measured. The diameter of the fiber was calculated as 50.76 microns.

2. Fiber Fineness



Fineness is one of the three most important fibre characteristics. “The fineness determines how many fibres are present in the cross-section of a yarn of given thickness. Additional fibres in the cross-section provide not only additional strength, but also a better distribution in the yarn”. Thirty fibres are needed at the minimum in the yarn cross-section, but there are usually over 100. “Fibre fineness plays an important role in determining the quality of resultant yarn and hence that of the resultant fabrics”. The fiber was tested for its fineness by Single-Fiber Weighing method. This test method is recommended for measurement of the linear density of single fibers and is not suitable for fibers shorter than 30 mm. The length of a single fiber was measured and the fiber was weighed. The linear density of the fiber was then calculated in denier units. It was found to be 19.45 denier with 13.48 as coefficient of variation.

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3. Tenacity and Elongation1

Tensile Strength Tester

Fiber Strength is considered to be next to fiber length and fineness in the order of importance amongst fiber properties. It denotes the maximum tension the fiber is able to withstand before breaking. It can be expressed as breaking strength or tenacity etc. It determines elongation percentage of fiber at break. Elongation is compared as a "percentage of the starting length". This is an important property of a fiber as it is this nature of fibers that makes them useable in the form of textile products. "They must be able to deform (e.g. at knee or elbow) in order to withstand high loading (and also during processing), but they must also return to shape. The fiber elongation should therefore be at least 1-2% and preferably slightly more". Strength and elongation are therefore inseparably connected. The fiber was preconditioned at, 21 +/- 1°C (70 +/- 2°F) and 65 +/- 2 % relative humidity. The fiber specimen was mounted in the jaws of the clamps. All slack was removed without really stretching the specimen. Care was taken to keep the specimen straight within the jaws and it was ensured that the fiber sample lay on the line of action between the force-measuring device and the point where the fiber left the moving jaw face. The tensile testing machine was started and when the fiber specimen started to break, the elongation and tensile strength were recorded on the computer. The results were as follows:

Sr. No.	Test Parameters	Test Method	Test Results
1.	Breaking Strength, gms	ASTM D-3822:07	114.99gms
	CV% of Strength		27.54
a)	Tenacity (gm/denier)		5.97
b)	Elongation at break,%		3.27
	CV% of Elongation		15.70

4. Conclusion

The fiber was extracted from natural source i.e. Sansevieria Trifasciata Plant using water retting method. The results showed that the fiber had good strength and fineness with low elongation. Due to its greater strength, cost-effective and renewable source, the fiber can be used to make products like sacks, ropes, handicrafts, mattresses for bedding and other wider applications of textiles.

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