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MICROSCOPIC EXAMINATION OF FIBER

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ABSTRACT

A fiber is a material that has an appearance of a thread and can be either an indiscrete elongated portion or a continuous filament. In order to keep tissue together, fiber is crucial to both plant and animal biology. It is a thin thread made of artificial or natural material, particularly it is used to manufacture rope or cloth. Fibers which are originated from shoes, rope, and carpet, are also regarded as trace evidence. This study focused on weave patterns and single-thread analysis. After placing thread fibers on a microscopic slide with a drop of glycerin on it, the fiber samples were analyzed for different features and photographed under an appropriate lighting setup.

Keywords: Fiber identification, microscope, weave pattern, Thread, cotton, wool, silk, polyester, fabric, etc.

INTRODUCTION

The textile industry defines the word fiber as a raw material for textiles, which are fine and thin, and have a high length- to- thickness ratio. The general characteristics include flexibility and fineness. Although textile has been used by humans for a very long time, they have recently been employed more in the industrial field and can be classified as industrial, geotextile, architectural, etc. [1]. In cases involving intimate contacts, such as murder, physical assault, and sexual offense, where there may be cross transfers between the victim's and suspect's clothes, fibers prove to be crucial evidence. In hit- and- run cases, the force of impact between the victim and a car frequently results in strands, fibers, or even entire articles of clothing sticking to various parts of the car. Additionally, fibers may become fixed on screens and broken glass during an attempted break- in. The ability of the criminalist to trace the origin of the fibers to a single or a small number of sources ultimately determines its value as forensic evidence, regardless of where and how they are found. The value of fiber evidence has been diminished in this regard due to the mass manufacturing of clothing and

textile. Fibers retrieved at a crime scene seldom allow for the very confident identification of a specific individual [2]. The classification of fibers divided into two categories – Natural fibers and synthetic fibers [3]. Natural fiber is any fiber that is not created by humans or synthetic material. They may come from either plants or animals. Natural fibers can be categories as follows based on where they came from

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animal fibers, mineral fibers, plants fibers. Animal fibers are silk and wool, feathers fibers, horse hair, goat hair and sheep's wool are among them. Mineral fibers are fibers found in nature that have been minimally altered and obtained from minerals. These can be further classified as metal fiber, asbestos. Plant fibers cellulose is the primary component of plant fibers [4]. Man-Made fibers this board category includes fibers that can be produced synthetically from basic beginning materials like coal and oil, or they can be created from naturally occurring polymers. Therefore, the phrase "man-made fibers" describe the process of producing fibers rather than the source of the polymer ingredient. Synthetic fibers condensation and addition polymers are the two main categories of synthetic polymers, distinguished by the characteristics of their components and polymer synthesis. Condensation polymerization is the processes by which monomers from one or more compounds that have two reactive or functional groups condense through a typical chemical reaction to form a linear polymer. [5]

Types of Fibers- Cotton a white, stringy strand that covers seeds taken from the cotton plant is known as cotton. Either handpicking and mechanical picking is used to harvest it from the plant, it is most important fiber. Wool is a protein- based fiber that is often derived from sheep as well as goats. Throughout the sports layering process, wool and its blends can be utilized in felt, knitted and woven construction as well as accessories. Silk the silkworms used to make silk are raised in enormous trays, typically indoors, and feed on mulberry leaves. This type of silk is produced on sizable farms owned by businesses and is referred to as cultivated silk. polyester is a synthetic fiber derived from petroleum; it is a non-renewable resource with a high carbon content. Occasionally, natural and polyester fibers are spun together to create products with mixed properties blends of cotton and polyester can be robust, resistant to rips and creases and less likely to shrink. Polyester-based synthetic fibers are more resistant to wind, water, and environmental factors than fibers generated from plants. Acrylic warm, soft and lightweight, acrylic cloth feels good on the skin. Instead of being used for its qualities, acrylic fiber is typically combined with real wool fibers or to simulate wool. Jute the stem and outer skin of the jute plant used to extract fiber. The fibers from this plant are pliable and gentle. They are easily bleached and dyed in a variety of colors, but their natural color is brown.[6]

Weave pattern- The term "woven fabric" to material made of warp and weft threads that are arranged in a rectangular pattern. Inserted width ways into the fabric, the warp threads, or the warp are oriented lengthwise in the fabric. A single weft thread is referred to as a pick and a single warp thread as an end. The weave of a woven cloth is defined as the pattern of warp and weft interlacing. There are three distinct sorts of fundamental weaves, satin, twill, and plain weaves. There are numerous variations of these weaves known as derived weaves. Plain weave the most basic and often used interlacing weave is plain weave. The smallest repeat is seen in plain weave. Throughout the fabric, the even warp threads reverse this order to under one, over one while the odd warp threads operate over one and under one weft thread. Twill weave has three or more ends and picks repeated. The surface of the cloth has diagonal lines as a result of this type of weaving. When glancing along the warp of the fabric, one can often describe the direction of the twill. One can discern between s- twill and z-twill by comparing the twist direction of yarns. Stain weave Atlas weave is another name for stain weave. It is a weave in which the binding points are positioned to provide a smooth, twill- free surface. stain weave comes in two general varieties weft - faced and warp- faced materials. We refer to this as stain warp and sateen weft. Knitted weave the process of knitting is defined as the interlacing of yarn loops to create a cloth. Weft knitting and warp knitting are two completely distinct methods for creating knitted material. Handed knitting is considered standard knitting. Every weft thread creates a loop that spans a significant portion of the fabric width. [1] Microscopic examination of fibers comparison of color and diameter using a comparison microscopic is the first and most important stage in the examination process. There isn't much cause to suspect a match until these two traits match. Additional morphological characteristics that could facilitate the comparison include the pitting of the fiber's surface with material particles and length-wise striation, or lined pattern, on the surface of some fibers included during production to lessen shine. Even while two fibers may appear to be the same color when examined under a microscopic, the dyes that were used to produce them may have different composition. In actuality, a combination of dyes chosen to produce a desired shade or color is injected into the majority of textile fibers. When the forensic examiner can demonstrate that the dye composition of the questioned and standard reference fibers is the same, the relevance of a fiber comparison is increased. [2]

METHODOLOGY

Material Required

Glass Slides, cover slips, Forceps, Glycerin, Gloves, Apron, Mask, scissor, Evidence collection druggist folds.

Instrument used: Compound Microscope.



Figure. 1: Compound microscope

Sample collection

Fiber sample were collected from the paratwada region in Amravati district. Totally 90 samples were collected, consisting of 9 different types of fibers, with five sample collected for each type. The samples were preserved in druggist folds, labeled, and then examined under a compound microscope for fiber analysis.

Procedure:

1. A fiber sample was taken and cut into small pieces.
2. Then the sample was placed on clear microscopic glass slide and covered with cover slips.
3. The slide was then examined under a compound microscope using 4x/ 0.10x magnification power.

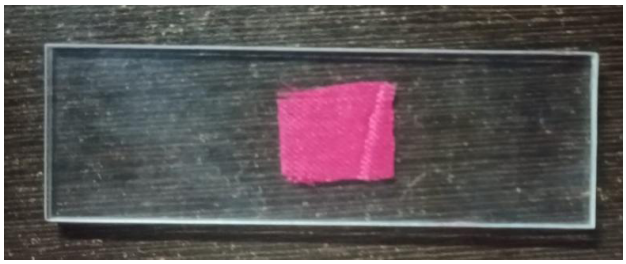


Figure .2: Sample weaving pattern in processing

1. For thread analysis, a single thread sample was taken on a clean microscopic slide and 1-2 drops of glycerin was added.
2. The sample was covered with cover slips and examined using 4x/0.10 magnification power.

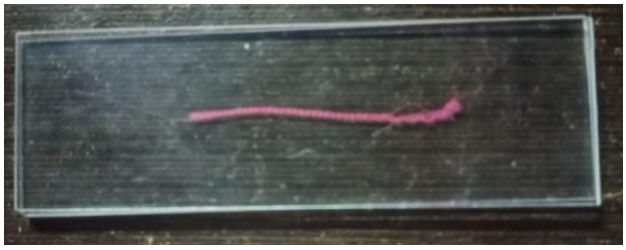
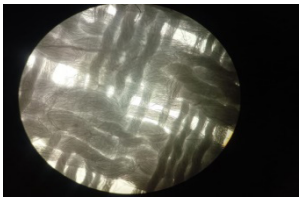
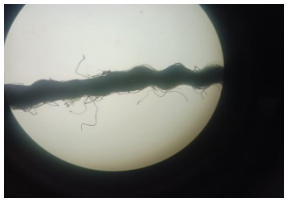
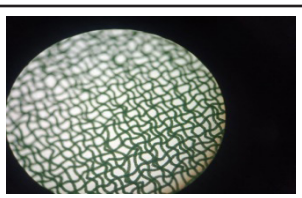
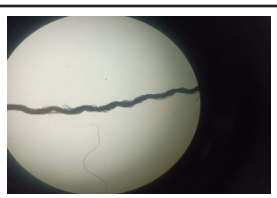


Figure. 3: Sample single thread in processing

RESULTS AND DISCUSSION

09 types of fibers were analyzed under microscope. The results are concluded as follows:

Table -1 Microscopic Examination of Fiber

Serial Number	Type of Fiber	Weave pattern	Single thread structure
1	Polyester		
		Pile weave	S-twist
2	Georgette		
		Twisted weave	S-twist

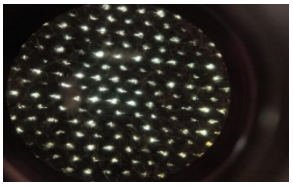
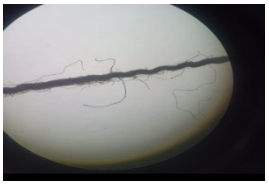
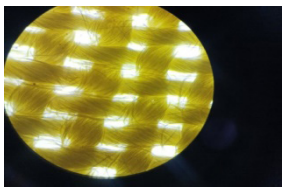
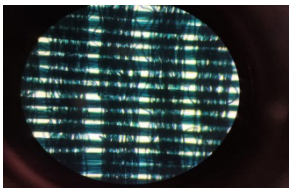
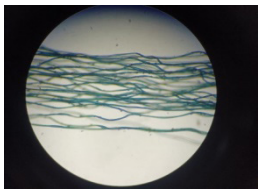
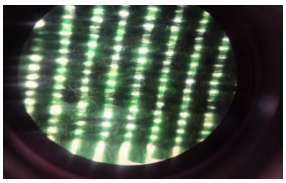
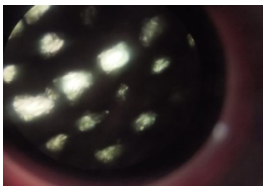
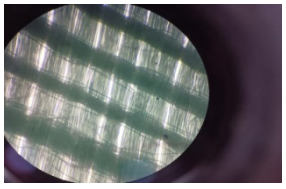
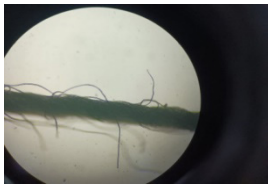
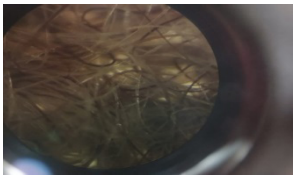
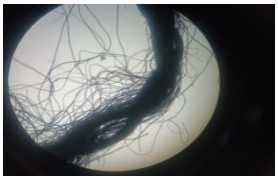
3	Cotton		
		Basket weave	S-twist
4	Rayon		
		Taffeta weave	S-twist
5	Acetate		
		Twill weave	Twisted
6	Nylon		
		Knitted weave	Multi- filament
7	Wool		
		Basket weave	Two-ply
8	Silk		
		Twill weave	S-twist
9	Acrylic		
		Non-woven weave	Two-ply

Table -2 Statistical analysis (weave pattern and signal thread analysis)

Serial Number	Types of Fiber	Weave Pattern			Signal Thread structure		
		Mean	Mode	Medium	Mean	Mode	Medium
1	polyester	2.5	4	2.5	2.5	4	2.5
2	Georgette	2.5	4	2.5	2.5	4	2.5
3	Cotton	5	5	5	2.5	3	2.5
4	Rayon	5	5	5	5	5	5
5	Acetate	5	5	5	2.5	4	2.5
6	Nylon	2.5	4	2.5	1.7	1	1
7	Wool	5	5	5	5	5	5
8	Silk	1.7	2	2	2.5	4	2.5
9	Acrylic	5	5	5	1.7	2	2

The different types of weave patterns and single thread structures were noted in this study. Microscopic analysis of the weave pattern in the polyester fibre sample revealed that the most commonly found pattern was basket weave, while in single thread structure, the most commonly found was S-twist structure. The weave pattern in the georgette fibre sample revealed that mostly found pattern was twisted weave pattern and the single thread structure revealed that mostly found structure was twisted structure. In the cotton fibre sample, the basket weave pattern was observed, while in single thread structure sample, three S-twist and two single strand structures were observed. The rayon fibre sample showed a taffeta weave pattern, and the single thread structure revealed that mostly found S-twist structure. The acetate fibre sample was found twill weave pattern, and the single thread structure revealed that the four twists and one multi-filament structure. The weave pattern in the nylon fibre sample was found knitted weave pattern, and the single thread structure revealed that the three staple, one two-ply, and one multi-filament structure. The wool fibre sample showed a basket weave pattern, and in the single thread structure, a two-ply structure was observed. In the silk fibre sample, two plain weaves, two twill weave, and one knitted weave patterns were observed. In the single thread structure sample, four twists and one S-twist structure were noted. The acrylic fibre sample exhibited a non-woven weave pattern, and in the single thread structure sample, two S-twist, two two-ply, and one staple structure were observed.

CONCLUSION

In this study, fibres were analysed under a microscope for weave pattern and single thread structure. Different types of weave patterns were found in both natural and synthetic fibres. Basket weave pattern was most commonly found in cotton, polyester, and wool fabrics. Twill, knitted and zigzag pattern were seen in silk, nylon and acetate fabrics. In the examination of single thread structure, different types of structure were observed, with the s-twist being the most common in both natural and synthetic fibres.

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