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DEVELOPMENT OF SUSTAINABLE WATCH STRAP USING ORGANIC COTTON FABRIC REINFORCED WITH JUTE FABRIC

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Abstract - The term "sustainability" refers to the development of biodegradable, environmentally friendly, and pollution-free products. In this way, this research is concerned with the creation of a new product, a sustainable watch strap. To extend the life of the watch strap, replace the existing strap, which is made of vegan leather, with metal straps. Despite the fact that fabric watch straps are already available, this is the new idealogy developed for watch strap with the naturally herbal dyed organic cotton fabric reinforced with jute as inner layer . The tearing strength of a watch strap is an important mechanical property that was tested and the results were analysed. Because of organic cotton fabric is naturally dyed, colour fastness properties such as rubbing and sublimation were tested and the results were analysed. This study significantly results in the ecofriendly, biodegradable watch strap.

Key Words: Sustainability, organic cotton, jute, bio degradable, natural dyeing, eco friendly

1.INTRODUCTION

A watch is a portable timepiece that a person can carry or wear. It is intended to maintain a consistent movement regardless of the motions caused by the person's activities. A wristwatch is intended to be worn around the wrist, with a watch strap or other type of bracelet attached, such as metal bands, leather straps, or any other type of bracelet. Watch strap is leather or other material strap or a metal chain that secures a watch to your wrist.

This research involves in the new product development with the up gradation of extending the life time of the watch strap by using organic cotton fabric as outer layer filled with jute as inner layer.

Organic cotton is cotton that has been grown naturally without the use of any synthetic agricultural chemicals such as fertilizers, pesticides, or transgenic technology. It was first planted in the 1980s to ensure sustainable, ecological, and biodynamic agriculture. For both the environment and the skin, organic cotton is far superior. If you have skin conditions, chemical sensitivities, or allergies, it's time to think about wearing organic clothing. One of the best methods to prevent further skin issues is to do this.

Long, silky, and lustrous, jute is a bast fiber that may be spun into strong, coarse threads. Jute is one of the most reasonably priced natural fibers and is only surpassed by cotton in terms of production volume and range of applications. Cellulose and lignin are two components of plants that are typically found in jute fibers. Jute fiber is known as raw jute in the industrial world. The 1-4 meters (3-13 feet) long fibers range in color from off-white to brown. Because of its hue and high monetary value, jute is also known as the "golden fiber."

For the colored watch strap to make more sustainable product, natural herbal dyeing is done. Natural dyes are pigments that come from minerals, invertebrates, or plants. Vegetable dyes derived from plants, including roots, berries, bark, leaves, and wood, as well as other biological sources like fungi, make up the majority of all natural colors. Myrobalan: Ground Terminalia chebula tree nuts are used to make this dye. This tree can be found in south China, Indochina, Burma, Thailand, India, Sri Lanka, and Nepal. When used, it can be categorized as both a mordant and a dye, producing a light buttery yellow. Due to the soft, warm color it gives cotton, it is a crucial tannin- 7 based mordant in Southeast Asia and India. Myrobalan serves as a strong base for over dyeing. Additionally, it is the ideal shade to use as a base for teal under a single indigo dip. Myrobalan needs between 15-20% WOF when used as a tannin mordant. Use 20–30% WOF to produce a soft butter yellow.

In this research we are going to develop the sustainable watch strap using organic cotton as the outer layer with jute fabric as inner layer for the reinforcement of the watch strap.

2. LITERATURE SURVEY

Organic cotton production reduces soil erosion and other negative effects on the ecosystem while also providing a safe working environment for farmers and clean freshwater sources nearby. Organic cotton is becoming increasingly popular in the production of high-end fabrics due to its completely natural origin and lack of toxicity. The apparel industry is a major producer of organic cotton fashion products. Because of consumer demand for more organic clothing, clothing manufacturers will be forced to use more organic cotton. Many domestic and international brands are opting to produce their clothing is made of organic cotton. This paper goes over various environmentally friendly methods and suggestions for growing, processing, and manufacturing organic cotton. (1)

Because of the use of chemical dyestuffs and dying process auxiliary materials, dyeing processes can pollute the environment. There are some new significant efforts underway to reduce the environmental risk and waste generated during textile processing, as well as to develop sustainable and green materials. This literature provides a detailed elaborative review of naturally colored organic cotton fibers, naturally colored cotton fiber types, their properties, production, and recent developments from a broad perspective and from many different angles.(2)

More than 170 species of annual fibrous plants make up the genus Corchorus, which is also known as jute. Jute fiber is a highly desirable renewable resource since it is completely biodegradable and compostable. While C. olitorius L. and C. capsularis L., two domesticated species, are economically significant for the production of fiber, the wild species are valuable genetic resources for traits related to fine fiber and biotic and abiotic stress tolerance. However, there are significant limitations to jute research and cultivation. Due to late showers and low air moisture levels, the cultivation frequently needs more watering than it receives. Jute is particularly vulnerable to illness and pest infestation. Although employing pesticides is a typical preventive measure, there is also the risk that these harmful chemicals will become biomagnified by entering the food chain of the ecosystem. The retting method used to cure fibers also pollutes water, harming the ecosystem. (3)

In this research, various natural dye sources were used to color organic cotton garments. Using pre-mordanting dyeing techniques, the dyeing was done with various mordants (copper sulphate, potassium aluminum sulphate, potassium tart rate, and citric acid). The color strength (K/S) and fastness characteristics against light, washing, rubbing, and perspiration of the materials were examined. The colored 9 organic cotton fabrics' color and fastness qualities ranged from good to excellent. (4)

The traditional practice of dying textiles with natural materials is reemerging as people become more aware of the health and environmental risks associated with synthetic dyes. Some people are working hard to resurrect an ancient tradition of dyeing with natural resources like plants, insects, and minerals out of concern for both human health and the environment. These resources offer therapeutic qualities in addition to being biodegradable. Since more people are aware of natural dye's many benefits, it has become a topic of attention on a global scale. From this article, reviewed that various natural dye sources and their potential advantages for business, the environment, and human health. (5)

It was investigated how water would work on a natural fiber-reinforced composite material to cause significant swelling, which would modify the material's fine structure, dimensional stability, and mechanical properties. Hybrid composite exhibits considerable water absorption, with rates of 15.3% for hybrid coir/jute/coir composite and 11.2% for hybrid jute/coir/jute composite, according to tests on thickness swelling and water absorption. As the stacking pattern of the hybrid composites changed, so did the thickness swelling, water absorption, and mechanical characteristics. Pure coir composites' dimensional stability, extensibility, and density can all be increased through jute fiber hybridization. To comprehend the mechanisms governing the interaction between the fiber and matrix in respect to mechanical properties, the microstructures of the composites were investigated. (6)

Jute cloth underwent premordanting after being single-mordant with biomordants (myrobolan and pomegranate) and eco-friendly chemical mordant's (ferrous sulphate and potash alum), as well as double-mordant by applying biomordant and ecofriendly chemical mordant in sequence. Natural dyes from manjistha, annatto, ratanjot, and babool were extracted under standardized conditions and applied to premordanted jute fabric. After a double premordanting process employing a chemical and biological mordant, the natural dyed jute fabric's color output, levelness of dyeing, and wash fastness qualities have significantly improved. For all of the naturally colored jute cloth, the ratings for light and rubbing fastness are moderate to good. When dyeing jute cloth with natural colors derived from manjistha, annatto, ratanjot, and babool after premordanting with successive treatments of biomordant and chemical mordant, very good ultraviolet (UV) protection ratings are obtained. The order of the natural colored jute fabric's UV protection characteristics is babool > annatto > manjistha > ratanjot. (7)

In order to lessen the built environment's carbon footprint and seismic vulnerability, 10 a "systemic" approach is now absolutely necessary. Because of its little environmental impact and potential qualities as a building material, the usage of biobased composites is being more recognized as a sustainable alternative? The performance of raw jute fiber and jute threads is examined in this research in light of potential applications as structural reinforcement and thermal insulation in composite systems with inorganic matrices. In particular, the investigation focuses on the physical, chemical, and mechanical characteristics of jute fibers, threads, and diatons. They demonstrate their potential for usage as building materials. In actuality, the water absorption rates of jute fibers, threads, and diatons have been quite similar, falling between 1.83 and 2.50 g(water)/g(fiber).(8)

Jute fibre is a valuable agricultural product. It is a popular natural fibre in Third World countries such as India, China, and Bangladesh. The jute industry is vital to the Indian economy and remains a major traditional earner of foreign exchange. However, it is up against stiff competition from synthetic fibres. Jute fibres are used in high-end fields such as decorative and furnishing materials such as lamp shades, wall covers, curtains, upholstery, and so on. Today, it is the least expensive fibre for mass consumption, costing only a fraction of the price of glass fibres; in terms of volume, jute is now the world's second most important fibre, after cotton. Jute fibres have been partially replaced in traditional applications such as carpets, ropes, sacks, and so on by synthetic fibres that have some advantages over jute. Nontraditional fibre outlets must be explored in order to ensure a reasonable return to farmers. Fiber-reinforced composites are one such application.(9)

The use of jute fibres as reinforcement for the development of composite materials has increased in recent years because the environmental vexation caused by increased fuel prices, depletion of fossil fuels, and global warming are major concerns that force researchers to work in the field of green composites. Jute fibre reinforced composites can also be used to replace old materials like steel and wood. The current ingenuity in research aims to highlight the concerns and challenges encountered during the development of jute fibre reinforced composites. Fabrication methods for various types of jute fibre reinforced composites have been investigated, and mechanical properties have been reported(10).

According to these Literatures, organic cotton fabric has good UV properties, excellent dyability with natural herbal dyes, and is environmentally friendly. The jute fabric used for reinforcement has good mechanical properties, which have been studied in the above literaturesThe body of the paper consists of numbered sections that present the main findings.

These sections should be organized to best present the material.

3. OBJECTIVE:

- To make a eco friendly and a sustainable watch strap
- To increase the life time of the watch strap
- To reduce the sweat mark
- To avoid the itching or skin irritation

4. MATERIALS:

4.1. ORGANIC COTTON FABRIC:

Organic cotton is grown without the use of fertilizers, pesticides, or other toxic chemicals. Cotton trees are not sprayed or treated with chemicals in this farming method. They only use certified organic farming methods. As a result, organic cotton farming contributes to a more sustainable environment by preserving soil fertility and producing chemical-free cotton. Natural cotton is grown using environmentally friendly methods and materials. Organic farming systems replenish and maintain soil fertility, reduce the use of toxic and persistent pesticides and fertilizers, and promote biological diversity, making natural cotton an environmentally friendly fabric.

FIG 1: ORGANIC COTTON FABRIC

4.1.1. PHYSICAL PROPERTIES OF ORGANIC COTTON:

Properties / fabric	Plain Organic cotton fabric
Thickness (mm)	17
Fabric GSM (g/m^2)	104
Fabric weave type	Twill weave

TABLE 1 : PHYSICAL PROPERTIES OF ORGANIC COTTON

4.1.2. BENEFITS OF ORGANIC COTTON FABRIC:

- Environment-Friendly
- Avoid Allergies and Skin Concerns
- uses less energy,
- releases fewer greenhouse gases and due to the improved soil quality,
- Uses significantly less water

4.2. JUTE FABRIC:

Jute is one of the most reasonably priced natural fibers and is only surpassed by cotton in terms of production volume and range of applications. Cellulose and lignin are two components of plants that are typically found in jute fibers. Jute fiber is a type of bast fiber, which also includes kenaf, industrial hemp, flax (linen), ramie, and other fibres harvested from the plant's bast, sometimes known as the "skin." Jute fiber is known as raw jute in the industrial world. The 1-4 meters (3-13 feet) long fibers range in color from off-white to brown. Because of its hue and high monetary value, jute is also known as the "golden fiber."

4.2.1. BENEFITS OF JUTE:

- 100% bio-degradable recyclable and thus environment friendly
- high tensile strength with low extensibility
- very versatile natural fibers that has been used in raw materials for packaging, textiles, non-textile, and agricultural sectors

FIG 2 : JUTE FABRIC

4.3. NATURAL HERBAL DYEING:

Ayurvestra Herbal Dyeing one of the units located in kovilpalayam, where we dyed Different kinds of fabrics one of them is organic cotton, with herbal natural dye Colors with the motto of developing the sustainable dyeing.

Dye Color: yellow

Ingredients:

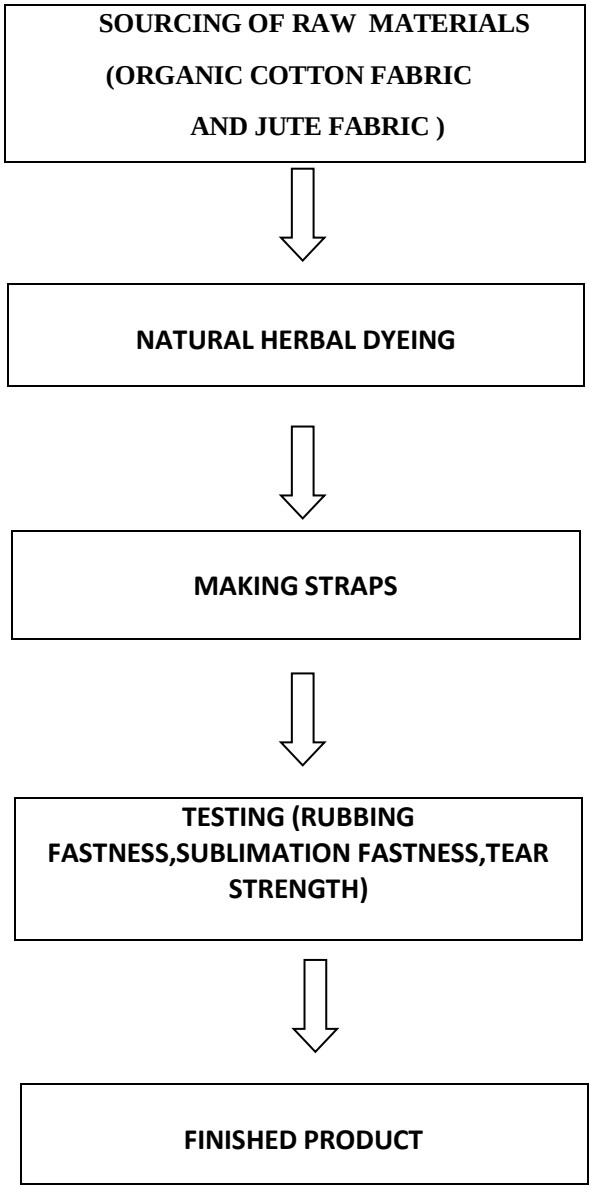
- myrobalan,
- thiribala,
- aloevera,

- curry leaves,
- neem,
- turmeric

FIG 3 : NATURALLY DYED ORGANIC COTTON FABRIC

5. METHODOLOGY

5.1.FLOW CHART



6. TESTING METHODS:

6.1. COLOUR FASTENESS:

6.1.1. RUBBING FASTNESS:

A rubbing fastness test can be performed on either dry or wet fabric with the ASTM **D1776-90**. The test specimen is placed on the Crock meter's base, and the Crock meter finger is used to rub a square of white test cloth on the colored specimen. Number of rubbing cycles could be adjusted according to our need.

6.1.2. SUBLIMATION FASTNESS:

Natural dyes are commonly tested for staining and shade change at 150 degree Celsius for 30 seconds, and the results are graded on a 1 to 5 grey scale. The AATCC test method 117-2004 standard ISO 105-P01 and the MAG presohot tester were used to test the sublimation fastness.

6.3. TEAR STRENGTH:

According to ASTM 2261, tearing strength is the amount of power needed to begin or continue tearing a cloth in either the weft or warp direction under given circumstances. A fabric or garment tear can be started by a moving fabric becoming hooked on a sharp object, and it often develops gradually along a line. The tear resistance test calculates the amount of force needed to rip a sample of material, such as plastic sheeting or film or woven or nonwoven fabrics. Manufacturers can assess the sample's strength using this test.

7. RESULTS AND DISCUSSION:

7.1. COLOUR FASTENESS:

7.1.1. RUBBING FASTNESS:

Table 2 shows the result of color change in the dyed fabric as a result of rubbing color fastness. The result shows that rating of 5 in dry state condition which represents there is no change in color, it means the fabric retains the same color without any shade variation during the rubbing action and rating of 4/5 in wet state condition, where there is a slight change in color with rubbing action.

S.NO	RUBBING CYCLES	GRADE (COLOUR CHANGE)	RATING ON GREY SCALE FOR CHANGE IN COLOUR (ORGANIC COTTON FABRIC)
1	10 (dry state)	5	Negligible or no change in color
2	10(wet state)	4/5	Change in color equivalent to grey scale step 4/5

Table 2: Results of Rubbing Fastness (change in color)

7.1.2. SUBLIMATION FASTNESS:

Table 2 shows the result of color change in the dyed fabric as a result of sublimation color fastness. The result shows that rating of 5 in dry state and damp condition which represents there is no change in color, it means the fabric retains the same color without any shade variation during the sublimation and rating of 4/5 in wet state condition, where there is a slight change in color with sublimation action.

	TEMPERATURE	**GRADE (COLOUR CHANGE)**	**RATING ON GREY SCALE FOR CHANGE IN COLOUR (ORGANIC COTTON FABRIC)**
1	150°C (dry state)	5	Negligible or no change in color
2	150°C(wet state)	4/5	Change in color equivalent to grey scale step 4/5
3.	150°C (damp state)	5	Negligible or no change in color

Table 3: Results of sublimation Fastness (change in color)

7.2.TEAR STRENGTH :

Tearing strength of the watch strap made of organic cotton fabric reinforced with jute fabric shows the average strength 4.16 for single peak fore and mean of five peak force is given as 3.64 which has the good tearing strength.

Mean strength	**Minimum strength**	**Maximum strength**	**S.D**	**CV%**
4.16	3.71	4.57	0.43	10.37

Table 4 : Results of tear strength

8.FINAL PRODUCT :

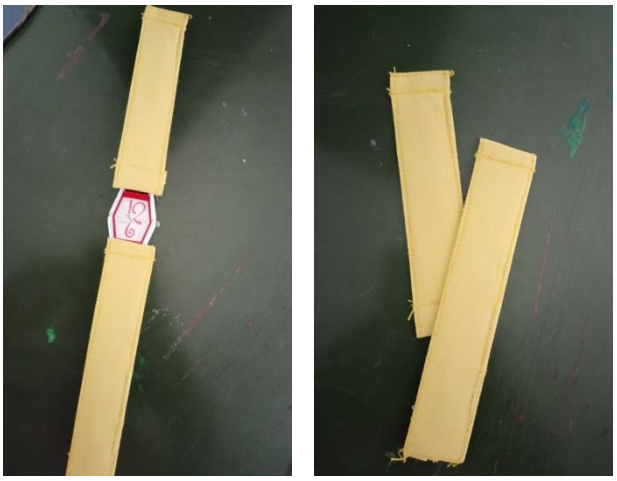


FIG 4 : SUSTAINABLE WATCH STRAP

8.CONCLUSION :

According to the findings, colour fastness demonstrated a good result of rubbing and sublimation, with no change in colour during the dry state and a slight change in colour during the wet and damp states. As a result, tear strength is an important property of the watch strap, resulting in good maximum strength. This generation is working toward sustainability, with the goal of developing eco-friendly and biodegradable products. As a result, we created an eco-friendly watch strap out of organic cotton fabric reinforced with jute fabric.

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