International Journal of Recent Advances in Multidisciplinary Topics
Volume 4, Issue 3, March 2023
https://www.ijramt.com | ISSN (Online): 2582-7839

Development of Calotropis Fabric

S. Vishnupriya[1], K. Kanishka[2], R. Vishnupriya[3*], Sudev Dutta[4]
[1,2,3]Student, Department of Textile Technology, Bannari Amman Institute of Technology, Erode, India
[4]Assistant Professor II, Department of Textile Technology, Bannari Amman Institute of Technology, Erode, India

***Abstract*: Calotropis commonly called milk weed is a large shrub belongs to Apocynaceae family, species *Calotropis gigantea* which can yield a durable fibre commercially known as "bowstrings of India". It is grown in water scary areas which do not require fertilizer and cultivation. The stem of the plant is potential for its fibres which possess good strength and flexibility. The fibres can be produced as fabrics as it has abrasion resistant. The stems of Calotropis gigantea is collected undergoes drying for a week under shade as it contains latex. The stem is subjected to retting for efficient fibre extraction. The fibre is extracted manually from the bark of the stem. The collected fibres are cleaned and mixed with organic cotton. Calotropis fibers are coarser and cause discomfort for the wearer, they are blended with organic cotton to improve comfort. The selected fibres are metered and mixed. The homogeneous state is obtained by mixing the diverse fibers together. In terms of nonwoven technology dry laid process is carried out and laying is done. The type of lay used is random lay. Carding parallelizes and individualizes the formed web. Yarns are made using Open end spinning. Fabric is made from these yarns for a possible application.**

***Keywords*: calotropis fibre extraction, blend, open end spinning.**

1. Introduction

Understanding "sustainable fashion" and learning how "eco-friendly" our clothes are are topics of growing interest. Wool is a breathable, biodegradable, and extraordinarily adaptable natural animal fibre. So, this wool can be a true vegan alternative fabric of the animal based wool fabrics.

A. Concerns of Animal Wool

Wool is a naturally occurring animal fibre that comes primarily from the fleece of sheep, but it can also be obtained from a variety of other animals, including camels, alpacas, goats (who also produce cashmere and mohair), and goats.

Wool has historically been considered a sustainable fibre because sheep participate in the natural carbon cycle by eating the organic carbon that is stored in plants and turning it into wool. Fifty per cent of the weight of wool is pure organic carbon.

However, in reality, there are still ethical, environmental, and sustainability issues that need to be addressed. Sheep and cows both produce large amounts of methane gas, just like other animals used in agriculture. In addition, there have been many reports of trees being cut down and land being cleared in order to make room for grazing. Grazing in a non-sustainable way is a common practise in an a developing a country like India. On top of these environmental impacts of wool, sheep are often subjected to terrible animal cruelty. According to video exposés by PETA, sheep are mutilated, mistreated, and skinned alive at nearly 100 facilities across four continents. These worries have encouraged people and supporters of sustainable fashion to look for wool substitutes that don't use any animals. Woocoa, a wool-like material created by university students in Colombia, was recognised for its innovation at the Biodesign Challenge last year and won a prize. Nullarbor is a vegan wool made from by-products of the coconut. Tencel, organic cotton, bamboo, hemp, soybean fabric, linen, and recycled fibres are additional eco-friendly wool substitutes. The demand for a cruelty-free, vegan wool substitute that is not only warm and opulent but also sustainable.

B. Calotropis

Flowers from the Calotropis plant, also referred to as Bowstring Hemp, are presented to Shiva and Ganesha in Hinduism. It has been utilised in Ayurveda for its therapeutic qualities. It has been used successfully as an insecticide and bio-compost in farming. Since the beginning of time, Calotropis has been used to create clothing for royalty and children.


Fig. 1. Calotropis

All over India, Calotropis gigantea and Calotropis procera flourish in profusion. Calotropis does not require replanting, pesticides, water, or care. It is a pioneer plant that restores ecosystem diversity and allows the forest canopy to grow once more. After harvesting, it grows back in 6 months and produces twice a year. Using it for ages, farmers have been a fungicide, pest repellant.

C. Vegan Wool an Alternative for Wool

Vegan wool, uses a hollow cellulose fibre grown in abundance in arid areas of South India, without the need for fertilisers or pesticides. Although the fabric has the same

*Corresponding author: vishnupriyaravichandran7@gmail.com

qualities as traditional wool, it is entirely made of plant materials: 30% calotropis and 70% organic cotton.

D. Sustainability Dimension

There are many other benefits to this product, including the fact that:

- Farmers can turn dry, unusable land into profitable land by growing the Calotropis plant.
- Compared to wool fabrics made from protein, fabrics made of vegan wool cellulose fibres do not shrink after every wash and are generally simpler to maintain.
- Vegan wool fabrics are environmentally friendly throughout the entire life cycle, from farming and processing to final disposal.
- These fabrics have antimicrobial properties that protect against the most common skin diseases caused by staph bacteria, according to scientific research.

2. Extraction of Calotropis Fibre

A. Calotropis Fibre Extraction

Calotropis gigantea is a small to medium-sized shrub or tree that is indigenous to Southern Asia and Africa. It can grow to a height of 4 m and typically looks waxy with a lot of milky sap. The ash-colored, smooth stem occasionally branches almost at the root. The leaves are thick, waxy, oblong-ovate, opposite, and grey-green.

Fig. 2. *Calotropis gigantean* plant

The characteristics of Calotropis are:

- Abundant
- Easily available and evergreen
- Grow in water scary areas
- Requires no fertilizers
- Potential to process into fibres
- Strong and durable
- Thermal regulating
- Abrasion resistant
- Simple extraction techniques

Table 1
Composition of Calotropis fibres

Constituent	Composition (%)
Cellulose	57
Hemicellulose	19
Lignin	18
Alkali soluble substances	23

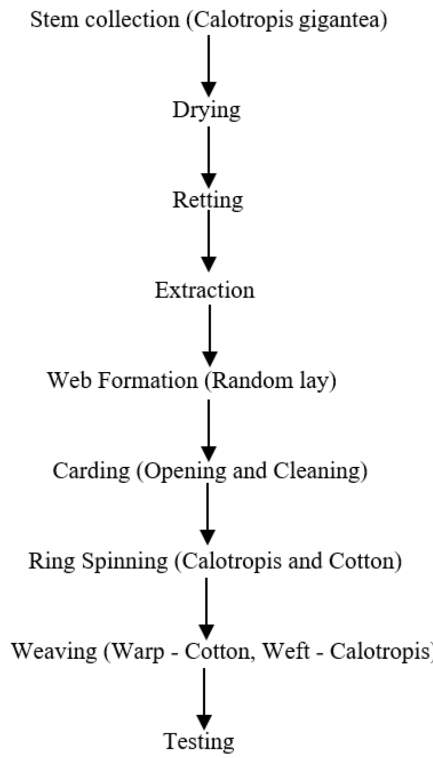

Fig. 3. Flowchart

1) Collection of stem

Depending on how mature the plant is, Calotropis gigantea is collected. The maturity of the stem is crucial because it determines physical characteristics like softness, strength, and others. Immature plants may produce fibres with poor strength and other physical characteristics. High maturity plants may produce hard fibres that cannot be used in hygiene products.

Fig. 4. Plants with immature stem

Fig. 5. Plants with matured stem

2) Drying

Calotropis gigantea stems are collected and allowed to dry for five days because the plants produce latex. The plant's leaves are taken off after drying. The stems are then moved to begin the retting process.

Fig. 6. Drying of Calotropis stem

Fig. 7. Stem after the removal of leave

3) Retting

Retting is a method for using a natural microbial process to extract fibres from plant stems. It involves delicately breaking down the plant stem to separate the fibre from the woody core and make fibre extraction easier. Retting entails the destruction of non-fibrous material that acts as a bridge between cellulose fibres and fibres in woody plant parts. Because retting is a biological process, it requires both moisture and ambient temperature for microbial activity to occur. High-quality fibres are produced by water retting, but it can be expensive and uses a lot of clean water.

Fig. 8. Retting of Calotropis stem

4) Extraction

After retting, the stems were drained and taken out of the water. Two days were spent drying the stems. Carefully removing the bark from the stem allows for the manual extraction of fibres that are present in the bark. The fibre was handled carefully to prevent fibre breakage. The fibres were extracted, boiled in water, and then bleached in the sun.

Fig. 9. Extracted Calotropis fibre

3. Conversion of Fibre to Yarn

A. Web Formation – Dry Laid

A web is a thin layer of distributed fibres. During the web-laying process, a batt is made by stacking numerous webs on top of one another before bonding. A two-dimensional (web) or three-dimensional (batt) web assembly made from staple fibres or filaments serves as the framework for the finished fabric. Direct feed batt formation techniques are used in the dry-laid nonwoven industry to turn staple fibres into a web or batt structure that is uniform in weight per unit area.

Fig. 10. Calotropis web

B. Carding

Starting with fibre bales, the mechanical carding process is initiated. These fibres are opened and then moved to the card by pneumatic suction. A rotating drum or set of rotating drums are used, each of which is wrapped in card wire before being woven into a web. The precise will depend on the fibre type and the intended basis weight.

Fig. 11. Miniature carding machine

Functions of Carding are:

- The separation of fibre tufts almost to a single fibre.
- Combining fibres to balance out variations in their properties.
- Creating a uniform web of weight per unit area.

Two main processes of carding are:

1. Opening
2. Cleaning

1) Opening of Fibres

Consolidation of the opened fibre prior to carding typically only entails compressing the mass of individual fibres into a more manageable form. Maximizing the degree of opening at a particular opening device is the goal, while minimising the associated fibre damage, particularly fibre breaking. The necessity of opening is

- The fibres must be reduced to the smallest aggregate form prior to cleaning, mixing, and blending. Since only properly opened material can be cleaned, it becomes necessary to reopen the baled material into small tufts.
- In order to prepare the fibres for carding, they must be completely opened to allow for blending and minimally opened to prevent fibre damage.

2) Cleaning of Fibres

The trash and other impurities present in the incoming fibres must be removed as completely as possible for optimal nonwoven production. The factors below have an impact on cleaning

- Cotton is moved in a circular motion at a high speed, using centrifugal force to remove trash and other contaminants.
- Garbage that is heavier than the fibres have a tendency to sling out from their surface.
- The waste can pass through grid bars and separate from the fibres that cross them.
- The number of valuable fibres lost along with waste increases as the grid bar opening widens, so it is generally best to keep the number of good fibres in waste to a minimum. However, when thorough cleaning is required, more good fibre loss is unavoidable.

C. Ring Spinning

While strength of ring spun yarn is higher than rotor spun yarn. The core twist structure of rotor spun yarn reduces its strength. 20% less fibre than that spun by Ring. Spinners are constantly working to make yarn of higher quality for less money.

The best spinning technique Is typically thought to be ring spinning. The textile mills may create yarns with a high level of structural strength and a softer texture by properly setting up and utilising HDPE spinning cans. Moreover, it is simple to control drawing operation speed, ensuring consistent quality.

1) Objective of Ring Spinning

- Reducing roaming in order to get the necessary count.
- Give the strand some twist to increase its toughness.
- Twisting the strand, or yarn, and winding it into a bobbin or other suitable container.
- Roving bobbins are set up on the creel, and the roving is then carried forward from the guide and deposited straight into the drafting system, where it is drafted according to the desired count.
- The next move is involves using a ring and traveller to impart the twist, and then using the ring rail to move up and down to wind the twisted strand onto the bobbin.

Fig. 12. Ring spinning

2) Ring Spinning Process

- The proper supports are used to creele the roving bobbins.
- Guide shafts exit the roving and enter the drafting configurations.
- The roving to the final tally is lessened by the drafting arrangements.
- The drawing setups have an angle ranging from 45 to 60 degrees.
- The fibre strand is twisted after exiting the front rollers to add strength.
- The strand receives one twist for each turn of the spindle.
- The twist is produced by the spindle which is rotating at high speed
- There are two possible twisting directions: "S" and "Z."
- This completes the spinning of the fabric
- The front roll, also known as the delivery speed and traveller rational speed, regulates the quantity of twist incorporated into the yarn.
- In practise, spindle speed (n spindle) is substituted for traveller speed in the equation above because spindle speed is marginally greater.
- Twisting happens concurrently with yarn winding.
- The yarn winds on the package as a result of the disparity in speed between the traveller and the spindle.
- The ring diameter, which must be tiny to increase spindle rotation at the same traveller pace, sets a limit on the size of the yarn package.
- The required count of calotropis yarn is 24s.

Drafting:

The following factors should affect the break draught:

- Kind of fibre
- Fibre length

- Primary draft for roving T.M.
- Zone of Main Draft

Table 2
Setting parameters

Ring frame	Count	TPI	Average Speed	Average Delivery m/r
LR 6/S	24	16.26	17,500	26.7

Short cradles are used in the upper arm most frequently for cotton fibres. Depending on the type of drafting system, the front zone setting ranges from 42.5 to 44 millimetres. When the proper size top roller is □ynthesi, there should be a gap of roughly 0.5 to 0.7mm between the front top roller and top apron. The manufacturer of the machinery typically handles this. If a technician modifies this parameter, there will undoubtedly be an increase in flaws, especially with carded count. Hence, care should be required to arrange the front zone according to the machinery when processing cotton fibres.

Traveller and Ring:

- The diameter, flange width, and ring profile of a ring are dependent on factors such as the fibre, twist per inch, machine lift, maximum spindle speed, winding capacity, and others.
- Because of the low mass of the traveller and the need to quickly dissipate the heat created between ring and traveller, the operating speed of the traveller has a maximum limit.
- The traveller speed will not be a limiting factor if the cotton combed yarn is being used for knitting. The yarn strand is not strong enough since the yarn TPI is lower. Therefore, yarn tension will be the limiting element.

A few things to think about:

- A 42mm ring with a 180 mm lift can be □ynthesi for sizes 12 to 24.
- A 40 mm ring with a 180 lift can be □ynthesi for sizes 24 to 36.
- A 38 mm ring with a 170 mm lift can be □ynthesi for sizes 36 to 60.
- A 36 mm ring with a 160 mm lift can be used for 70s to 120s.
- It is preferable to choose a smaller ring diameter and lower production if winding is a difficulty.
- Due to better heat dissipation, the anti-wedge ring profile is superior. Use an elliptical traveller to prevent startup breaks in hosiery counts.
- To prevent fibre accumulation on the traveller, use a special type of traveller cleaner. Travellers with waste do not start up well.

It is recommended to □ynthes ORBIT rings or SU-RINGS at spindle speeds greater than 20,000 rpm. The heat created can be dispersed without any issues because these rings have a larger surface area of contact and can withstand higher pressures and speeds. Typical ring and traveller profiles cannot operate at speeds more than 20,000 in order to create yarn of high quality.

3) Characteristics of Ring Spun Yarns

- Tensile properties: Two crucial characteristics of any spinning yarn are elongation and breaking strength. A staple yarn's strength is influenced by a number of fibre characteristics, the structural geometry of the yarn, and the spinning conditions.
- Mass irregularity and flaws: The yarn's mass unevenness along its length is another crucial quality factor. The change in the quantity of fibre endings per unit length is what causes this unevenness. The following are crucial steps that might lessen yarn irregularity and associated flaws:
- Customization of fibres, Increased fibre parallelization will reduce inter-fiber interaction to a minimum, and control over how quickly fibres travel.
- Hairiness is a feature that describes the quantity and size of fibre ends and loops that protrude from the body of the yarn.

4. Conversion of Yarn to Fabric

To create woven fabric, a loom is used, whether it be a simple hand loom or an advanced machine loom. These fundamental operating principles are explained using the basic building blocks of a straightforward shuttle loom. In order to create a plain weave fabric on this two-harness loom, adjacent warp yarns are strung through alternate healds, and the weft thread passes over and then beneath alternate warp threads.

A. Process

1) Winding

The cone is wound with the thread during winding. To cut down on waste, the warp threads are all wound into cylinders that are the same length.

2) Warping

The process of preparing a warp looks like this. To achieve the desired pattern, the fabric's entire warp thread count—which, in some cases, can reach 16,000—is arranged side by side. Frames and reels are used to support the warp cones. The yarn is next wound onto bobbins, which are substantial steel cylinders, and transferred to warp beams (small cylinders mounted on the loom).

3) Sizing

Sizing is used to strengthen delicate single yarns for weaving. Single and double threads are the two categories. In contrast to single-ply yarn, which is extremely delicate and challenging to weave, double-ply yarn is created by twisting two or more yarns together. After being dipped into a bath containing a sizing agent, the warp threads are stiffened.

4) Drawing-in

Each yarn must run in a specific order to create a fabric with a different structural makeup, so it is strung on the drop wire of the warp stop motion and pulled one at a time through the heddle's eyelets and the reed's teeth. Threading may be skipped and each thread tied to its corresponding warp if the loom is continuously weaving fabrics with the same structure.

5) Weaving

The material is □ynthesized and the fabric is made using originality in design and construction when the weft and warp threads come together.

Fig. 13. Tabletop handloom

- Fabric Construction: Satin
- Warp: 60s Organic Cotton
- Weft: 24s Calotropis yarn

Fig. 14. Weaved fabric

5. Testing

A. Testing of Fibres

1) Testing of Calotropis Fibres

The fibre of the tropical shrub plant Calotropis gigantea (CG), which has a high seasonality and a naturally high yield, is taken from the plant's stem and twisted into a specific shape. Excellent biocompatibility and non-toxicity are two qualities of this fibre. Because the fibres are hollow, air pockets are created inside the fabric, which adds lightness and thermal-regulating qualities. It uses a cheap extraction method.

2) Testing of Organic Cotton Fibres

Organic cotton is produced using techniques and supplies that have little negative impact on the environment. Organic farming practises increase and maintain soil fertility, minimise the use of poisonous and enduring pesticides and fertilisers, and create biologically diverse crops. Independent certification bodies certify that organic farmers only employ techniques and supplies that have been given the green light for use in organic farming. Chemical fertilisers and toxic, long-lasting pesticides are not used in the cultivation of organic cotton. Additionally, using genetically modified seeds in organic farming is prohibited by federal regulations.

B. Testing of Yarns

1) Yarn Count Test

It is necessary to measure the sample's length and weight in order to determine the yarn count. An analytical balance, a Knowles balance, a quadrant balance, etc. are the tools used for this task, along with a winding reel. The yarn count can be obtained directly from the Beesleys balance using this method. If the provided yarn sample is insufficient to carry out the tests using the aforementioned techniques, the yarn count can be accurately verified using the Beesleys scale.

Fig. 15. Beesleys balance

2) Twist Per Unit Length

One of the basic design criteria for yarns is twist. The number of twists in a metre of yarn, or yarn twist, is another crucial characteristic of yarns, particularly twisted yarns. To hold the various fibres or filaments together, a yarn is given a certain number of helical turns, or twist. Twist is typically expressed as how many turns there are in a unit length of yarn, such as twists per inch or twists per metre. Both the S and Z directions can be used to twist a yarn. The twist of the yarn affects a variety of fabric characteristics, including strength, dyeing and finishing capabilities, and fabric feel. The twist factor, which is a term used frequently to describe a degree of twist and is not dependent on yarn.

Fig. 16. Twist tester

3) Yarn Evenness Test

Fig. 17. Evenness tester

The variation in mass per unit length, also known as the evenness, serves as an expression of a yarn's evenness. Even with a well-maintained mean count, the appearance of the fabric can occasionally be significantly altered, so the surface irregularity of the yarn is of particular importance in relation to the processing properties. In essence, yarn uniformity is assessed by determining either the variation in diameter along a yarn's length or the variation in mass per unit length (or the number of fibres per cross-section). Visual evaluations and electronic processes are employed for this reason.

4) Yarn hariness tester

Hairiness is the term used to describe the appearance of short fibres and loops poking out from the surface of yarn. While hairiness is preferred in some fabrics, such as soft knits, brushed fabrics, and flannels, it is not preferred in other fabrics, such as shirts. Yarn hairiness has an impact on the feel, comfort, and other surface-related characteristics of the fabric (thermal insulation). Weavability is also greatly influenced by the hairiness of the yarn, as the protruding hairs have a tendency to snag on nearby yarns, leading to yarn breaks and loom stops. In air-jet weaving, it is particularly crucial.

Fig. 18. Yarn hairiness tester

5) Tensile Strength Test

One of a yarn's most crucial quality characteristics is its tensile strength because it greatly affects both the end product's tensile properties and how effectively it can be turned into fabric. The tensile strength attained by a single or folded yarn of a specific type and composition is frequently given special consideration. The processing of the yarn and the final properties of the fabric produced are both greatly influenced by yarn elongation. For testing yarn strength, a wide variety of instruments are available, including monofilament testers that work on the principles of a pendulum, an inclined plane, a strain gauge, and testers for constant tension hanks of the pendulum or ballistic type. These instruments range in complexity, have recording devices on some, are automatic on others, and are both FGRWQ5JM; LO8, relatively simple and complicated. It can be challenging to decide which type to use. Strength testing involves determining the load-strain curve, stress-strain curve, breaking point, etc.

Fig. 19. Tensile strength test

C. Testing of Fabric

In the weft and warp directions of the fabric, respectively, calotropis and organic cotton yarns are used. Performance of the woven material is tested.

1) Tensile Strength Test (ASTM D5034-09 2017)

To measure tensile strength and elongation, use a tensile strength tester. For both treated and untreated samples, this test is conducted. The sample measures 25 cm by 5 cm. To aid in clamping, the sample's edge has been marked. Both jaws are closed around the fabric sample. On either side of the sample's 2.5 cm edge, there are two fixed jaws. The centre portion of the fabric is stressed. The speed can be adjusted, and the gauge length is 3 inches depending on the fabric. Both jaws can move and one jaw is fixed. The sample is broken, and the test lasts for 23 seconds. Once the sample is torn out, the movable jaw begins to descend.

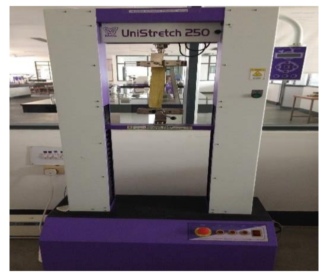

Fig. 20. Tensile strength tester

2) Thickness Test (ASTM D1777-96)

The ASTM D1777-96 standard is used to gauge the fabric's thickness. The fabric sample is pressed with a standard fixed load from the top of the thickness tester, sandwiched between the anvil and a circular pressure foot. When the dial gauge is set to zero, the fabric is placed in various locations with the thickness gauge, the reading is recorded, and the average value is used to determine the fabric's thickness. In mm, the thickness is expressed.

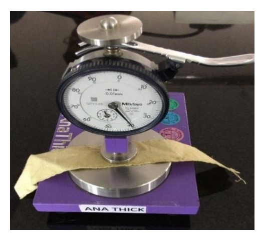

Fig. 21. Thickness tester

3) Stiffness Test (ASTM 1388-18)

The ASTM 1388-18 standard is used to measure the stiffness of the fabric. The Shirley stiffness tester employs the cantilever theory. A stiffness tester is used to measure the fabric's bending length. On its own weight, the horizontal fabric strip is permitted to bend like a cantilever and an index. The fabric sample is 6" X 1" in size and placed on the tester's surface. It is then smoothly moved using the bending length scale. The length of the overhanging portion is double the length of the bending portion when the sample's tip reaches a plane inclined at 41.5° below the 24-horizontal line. In order to improve the sensitivity of the length measurement, The slide on the Shirley apparatus is directly calibrated in centimetres, and this angle is used to increase the sensitivity of the length measurement. Fabric stiffness is calculated. The Shirley apparatus uses this angle.

Fig. 22. Stiffness tester

4) Air Permeability Test (ASTM 737-18)

Depending on the fabric's properties and the intended use, air passes through each square centimetre at a different rate. The amount of air that can pass through a given area of fabric in one second at a pressure equal to one centimetre of water is known as the fabric's air permeability. A circular clamp is used to hold the fabric sample in place, and a spring-loaded clamp is used to secure it.

The measurement space is 5.07cm2. The suction pump is used to flow atmospheric air through the sample at a constant rate. As the pressure decreases diagonally, the fabric is kept at the necessary air flow rate, which was set and shown on the digital display metre. At 29 degrees Celsius and 3000 mm mercury, the airflow rate in the rotameter was measured in cm3/sec/cm2. The procedure is repeated five times in five different locations within the sample, and the average airflow rate is assessed each time. The sample's air permeability was calculated using the formula by using the following equation.

$$Air\ permeability = \frac{\text{Average rate of airflow}}{\text{Area of sample exposed to air}}\ \text{cm}^3\text{/sec/cm}^2$$

Fig. 23. Air permeability tester

5) Abrasion Test (ASTM D4157 – 13(2017))

One aspect of wear is abrasion, which is the rubbing away of the fabric's yarns and fibres. Abrasion comes in three different forms: plane abrasion, edge abrasion, and flex abrasion. The four samples are taken, and using a standard cutter, each fabric sample is cut into 26 pieces of a 38mm diameter. Prior to abrasion, the fabric's weight was calculated, and it is mounted in the sample holders with a circle of uniform foam in its back.

The instrument's top has a 400 g load mounted on it. Abrasion tests are conducted over a period of 100 cycles. The fabric weight is determined following abrasion. The average of the four samples' individual values is used to calculate the amount of fabric abrasion. Abraded fabric is evaluated using changes in appearance, mass loss, strength loss, and thickness change.

Fig. 24. Abrasion tester

6. Result and Discussion

A. 6.1 Testing of Fibres

1) 6.1.1 Testing of Calotropis Fibres

Table 3
Calotropis fibre test

Parameter	Value	Unit of Measurement
Fibre length	20	mm
Uniformity ratio	35	mm
Fibre Strength	20	g/tex
Fibre Fineness	2.9	mic

2) Testing of Organic Cotton Fibres

Table 4
Organic cotton fibre test

Parameter	Value	Unit of Measurement
Fibre length	30	mm
Uniformity ratio	47	mm
Fibre Strength	22	g/tex
Fibre Fineness	3.6	mic

B. 6.2 Testing of Yarns

1) Yarn Count Test

Table 5
Yarn count

Samples	Yarn count		Fineness (Tex)	
	Warp(s)	Weft(s)	Warp	Weft
1			18.222	19.4
2			14.578	123
3	60	24	9.718	13.1
4			11.662	9.8
5			1.229	5.6

2) Twist Per Unit Length

Table 6
Twist per unit length test

Samples	Twist per inch	
	warp	weft
1	84.86	80.22
2	85.28	78.13
3	87.39	12.19
4	89.96	79.28
5	76.41	65.43

3) *Yarn Hariness Test*

Table 7
Yarn hairiness test

Samples	Yarn in mm		Average number of hariness	
	Warp(mm)	Weft(mm)	Warp	Weft
1	1	1	639	888
2	2	2	132.6	754
3	3	3	48.6	345
4	4	4	26.2	344
5	4	4	16.8	123

4) *Tensile Strength Test*

Table 8
Tensile strength test

Samples	Tensile strength(mpa)		Elongation (%)	
	Warp	weft	warp	weft
1	20.2	18.9	10.1	14.2
2	10.1	12.0	9.7	13.5
3	19.5	18.1	11.4	11.3
4	18.8	10.8	8.6	10.5
5	12.1	17.2	6.3	14.1

7. Conclusion

The growing divide between disposable fast fashion and long-lasting, sustainable clothing is one of the factors contributing to the unfavourable outlook for sustainability in the fashion industry. Can the clothing industry close the gap? A designer thinks so and hopes a new fabric called can be helpful. The name of this "woolly" fabric, which was created in part to lessen the enormous carbon footprint left by the apparel industry, is vegan wool. Although vegan wool has the same qualities as regular wool, it is entirely made from plant materials-specifically, 70% organic cotton and 30% Calotropis. Although there are many wool imitations in the market, this fabric stands out because it is vegan and waste-free. In the process of producing vegan wool, waste materials are converted into a bio-nutrient and insect repellent compound. Vegan wool has been dubbed "more sustainable than dirt" because of these extensive efforts to create an environmentally friendly material. Calotropis is a tall, flowering shrub that can survive in harsh growing conditions without human intervention, water, fertiliser, or pesticides. It is part of the desert plant that is used to make vegan wool. In Africa, several countries in Southeast Asia, and the Middle East, it grows wildly in deserts and other arid climates. The large, pale flowers on the plant, also known as giant milkweed, are on thick stalks. It has been said that the strong plant fibres resemble silk. But the adaptable flowering plant also has other fascinating applications, from carpets to medicines. The majority of the producers in the vegan wool supply chain are female, and this work provides them with employment opportunities in arid regions of the world where most plants and crops cannot survive. By creating a new agricultural channel, the company also strengthens rural economies. Calotropis can be grown on dry, barren land that is unsuitable for many crops, converting it into cropland that can generate income. However, caution should be exercised to prevent the plant source from being depleted if vegan wool becomes a popular industry trend because there is currently a limited supply of Calotropis.1.2 billion tonnes of greenhouse gases were produced in 2015 by the fashion sector. According to current estimates, this industry is responsible for about one-fifth of the world's water pollution and one-third of the microplastics in the oceans. To combat the effects that the current waste will inevitably have on the environment, many apparel companies are dedicated to developing new techniques and styles. Some of these advances include production methods that produce less waste, clothing made primarily of plants, and eco-friendly shoes made from recycled materials like wool, ocean plastic, and even trash. But will these trends be sufficient to mitigate the environmental problems we foresee in the near future? Global apparel and footwear production is projected to reach 102 million tonnes by 2030. That is the same as 500,000 blue whales, in terms of weight. Nevertheless, there is still hope for a more environmentally friendly textile and apparel sector. However, this change will ultimately be fuelled by shifting consumer demands and expectations.

References

[1] Reema Bora and T Padmini, "Fiber extraction from Calotropis gigantea stem with different retting methods and its comparison", 2019.

[2] K. Renugadevi, P. K. Devan, M. Chandra Sekhara Reddy, P. Karthik, Tiju Thomas, "Optimization of surface treatment in Calotropis Gigantea (CG)-fibre yarn by simple techniques and characterization of CG fibre yarn reinforced laminate", 2020.

[3] M. J. Raghu, and Govardhan Goud, "Effect of water absorption on mechanical properties of calotropis procera fiber reinforced polymer composites", 2020.

[4] Negi Divya, Bisht Ajay Singh, "A Review on Brief Study of Calotropis gigantea Linn", 2021.

[5] Gaurav Kumar, Loganathan Karthik, Kokati Venkata Bhaskara Rao, "Antibacterial activity of aqueous extract of Calotropis gigantea leaves – an in vitro study", 2010.

[6] Aruna M, Sudhakar Muniyasamy, "Evaluation of mechanical properties of calotropis giganteastem fiber-rein forced composite material", 2017.

[7] S. G. Wiedemann, L. Biggs, B. Nebel, K. Bauch, K. Laitala, I. G. Klepp, P.G. Swan, and K. Watson, "Environmental impacts associated with the production, use, and end-of-life of a woollen garment", 2020.

[8] Barkha Darra Wadhwani, Deepak Mali, Pooja Vyas, Rashmy Nair and Poonam Khandelwal, "A review on phytochemical constituents and pharmacological potential of Calotropis procera", 2021.

[9] F. Fidan, I. Kucukkurt, A.Eryavuz, I. H. Cigerci, M. Yardimci, A. Ozdemir, "Effects of shearing procedures on oxidant antioxidant status in Chios sheep", 2009.

[10] Mohammad Hassan Mazaherifar, Hamid Zarea Hosseinabadi, Camelia Cos, Camelia, Maria Cristina Timar and Sergiu Valeriu Georgescu, "Investigation on Phoenix dactylifera/Calotropis procera Fibre-Reinforced Epoxy Hybrid Composites", 2022.

[11] Chandrabhan Seniya, Sumint Singh Trivedia, Santosh Kumar Verma, "Antibacterial efficacy and Phytochemical analysis of organic solvent extracts of Calotropis gigantea", 2011.

[12] Zahra Mohebi, "The important medicinal and industrial properties of Calotropis procera (Aiton) W.T", 2021.

[13] Hua Wang, Muhammad Qasim Siddiqui, and Hafeezullah Memon, "Physical structure, properties and quality of cotton", 2020.

[14] Hiren Doshi, Hitesh Satodiya, Mukund Chandra Thakur, Farzin Parabia, Arif Khan, "Phytochemical Screening and Biological Activity of Calotropis Procera (Ait). R. Br. (Asclepiadaceae) Against Selected Bacteria and Anopheles stephansi Larvae", 2011.

[15] Amit Gupta1 and Sushama R. Chaphalkar, "Immunosuppressive activity of crude saponins from the leaves of Calotropis gigantea, Calamus roteng and Artocarpus integrifolia", 2015.

[16] Somnath Maji, Rajesh Mehrotra and Sandhya Mehrotra, "Extraction of high-quality cellulose from the stem of Calotropis procera", 2013.