DEVELOPMENT OF YARN FROM PINE NEEDLE FIBER

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ABSTRACT

Uses of different natural fibers have gained importance in the recent years due to ecofriendly nature. Moreover, by 2020 the world total fiber demand will be 102.4 million metric tons. Use of the wastage of food crops as alternative source of raw materials for clothing is a good solution to meet up this demand. Pine needle fiber could be a good source of natural fiber. The main objectives of this project are extraction of fiber from the pine leaves and characterization of collected fiber, produce yarn from the fiber and then characterization of yarn. The properties of pine cotton blend yarn and 100% cotton yarn were studied in terms of cvm %, total imperfection index, tenacity, CSP, and elongation %. The overall results showed that the pine cotton blend yarn was good denier value which was found to be higher than that of cotton. Unevenness (U) % of pine cotton blend yarn was higher as compare to 100% cotton yarn. It was happened because drawing and doubling was carried out in same machine and doubling was done by only four plied of drawn sliver. Pine cotton blend yarn having lower strength because of higher unevenness percentage as compare to 100% cotton yarn. Breaking strength in both yarns i.e., pine cotton blend and 100 % cotton were good. Pine cotton blend yarn tenacity could be increased by changing the TPI or other parameters like-fiber fineness, fiber strength, twist level, evenness level and fiber length variation and distribution. By blending uniformity with high quality cotton fiber & use of synthetic fiber in blending desired strength of yarn could be obtained. Elongation % of pine cotton blends yarn was found to be higher i.e. 6.76 as compare to 100% cotton i.e. 5.55. So that pine cotton blend yarn could be possible to use in heavy fabric, decorative purpose, non-woven and composites also.

There are various measures taken to revolutionize the Textile Industry by using various natural wastes occurring in the environment like waste leaves, barks etc extracted from various trees. Because of biodegradable in nature.

By this project it is concluded that a pine needle yarn made of pine needle fiber by extraction of pine fiber either mechanically or chemically from the dry pine leaves. Because waste can be recycling or reused.

Key words: *- pine fibers, TPI, CSP, elongation, waste product*

Introduction

For thousands of years, natural fibers have been at the core of the textile industry. From cloth, to paper and building materials, natural fibers were always the base material. Natural fibers originate from either plant fibers, such as coir, cotton and flax, or animal fibers such as camel hair, alpaca wool, and cashmere. As a completely renewable resource, natural fibers provide many benefits both to the environment and to those involved in the market that they create. Natural fibers not only come from the environment, but also benefit it. These fibers are renewable, carbon neutral, biodegradable and also produce waste that is either organic or can be used to generate electricity or make ecological housing material. Natural fibers provide a multitude of human and environmental health as well as economic benefits. Each fiber has its own purpose in manufacturing, and provides better quality and more sustainable textiles than synthetic materials **[1].**

Natural fibers in clothing allow fabric to breathe, reducing the risk of skin rashes and allergic reactions, and also insulate the wearer against hot and cold temperatures. These fibers can also replace synthetics in industrial materials, for example, in home insulation panels. Insulation made from wool or hemp rather than fiberglass draw moisture away from walls and timber, and are safer because wool is naturally fire resistant. Synthetic materials, while inexpensive to produce, can cause more harm to the environment and economy than they do good **[1].** In order to improve food security, the livelihoods of impoverished people, and the health of the global community, the shift back to natural fibers must be made. The onset of synthetic materials has not only been destructive towards the environment, it has also had a negative economic impact on those whose livelihoods depend on the production and processing of natural fibers. In an effort to raise global awareness of the importance of natural fibers not only to producers and industry, but also to consumers and the environment. There are different natural fibers are available such as cotton, flax, hemp, wool, silk, ramie, sisal, jute etc. These natural fibers having some disadvantages like-cotton fibers are not wrinkle resistant, it has poor elasticity, and long time to dry, color fades in sunlight very easily. Flax fibers are also wrinkles very easily, expensive, shrinks, burns easily, affected by mildew and perspiration, ravels nature, difficult to remove creases, shines if iron **[1,2].** Hemp fibers are used to produce organic clothing; they are not usually treated with the same anti-wrinkle chemicals as cotton or synthetic clothing. This gives hemp clothing a tendency to bunch up and crease in certain areas it is worn. A fine wool sweater may cost two to three times more than one constructed of synthetic fibers. Some varieties of wool can be very itchy to sensitive skin. Lower quality woolens are composed of shorter, coarser fibers with many more ends to stick out and cause irritation. Silk is one of the most expensive fabrics on the market. Compared to cotton or nylon, silk is pricey. Silk is considered a luxury product; expect to pay more for it. Silk cannot be bleached or soaked in prewash products. All silk items must be air dried and steam ironed on a low setting. Wringing or twisting silk garments can ruin and permanently damage the clothing. Ramie fibers elastic properties are low, lack of resiliency, hardy than other fibers, low abrasion resistance, wrinkles easily, stiff and brittle **[2].** Jute fibers are lower crease resistance, bad drape property, create shade effects and becomes yellowish if sunlight is used, it loses strength when it is wetted.

To overcome all the difficulties one of the new natural fibers i.e., pine needle fibers. Leaves of pine, is a very new raw material it does not affect the environment because it is biodegradable in nature, no extra cost of raw material, because it is obtained from waste materials i.e., dry pine leaves, not having any skin irritations, not color fade in sunlight easily, low density, low weight. So, this project was taken i.e., "Development of yarn from pine needle fibers".

Objectives ¦

1)Development of yarn from pine needle fiber.

2)To assess the properties of Pine needle yarn obtained from pine needle fiber.

LITERATURE AND REVIEW

Theory of Natural fibers ¦

Uses of different natural fibers have gained importance in the recent years due to eco-friendly nature. Moreover, by 2020 the world total fiber demand will be 102.4 million metric tons. Use of the wastage of food crops as alternative source of raw materials for clothing is a good solution to meet up this demand. Environmental awareness, new rules, and legislation are forcing to seek new materials that are eco-friendly and do not have any harmful effect on environment. For the past several years, public attention has gone on natural fibers as a resource due to the fast growth. Now-a-days, natural fibers are widely used as reinforcements both in partially and totally biodegradable natural fiber Composites. Natural fibers like, cotton, coir, sisal jute etc. have attracted the attention of scientists and technologists **[1,2].** The promotion of the use of natural fibers as CO_2 neutral resource is believed to contribute to a greener planet. The transition towards a bio-based economy and sustainable developments as a consequence of the Kyoto protocols on greenhouse gas reduction and CO_2 neutral production offers high perspectives for natural fiber markets. Plant fibers from agricultural crops are renewable materials which have potential for creating green products and replacing synthetic materials which are currently being used such as glass fiber, carbon fiber and plastic fibers. Among others, natural fibers (e.g., flax, jute or sisal) reinforced materials have important significance for reduction of density in automobile construction components due to its higher specific stiffness and specific tensile strength **[3].** Many attempts were made by the scientists and technologists to utilize natural fibers in the fabrication of composites.

The low cost, less weight and density make the natural fibers an attractive alternative. In recent years, due to increased awareness, extensive studies have been done on various new natural fibers such as pineapple, banana, oil palm, areca nut or betel nut husk fiber, grass fiber, bamboo fiber, coir fiber, wood fibers etc. are more widely used in the world.

Properties of different new natural fibers ¦

1)Piña is a fiber made from the leaves of a pineapple plant and is commonly used in the Philippines .It is sometimes combined with silk or polyester to create a textile fabric. Piña name comes from the Spanish word Piña which literally means pineapple. Its fabric is hand loomed by only a few weavers, it is very precious and scarce, which also makes it expensive. Pineapple leaf fiber is multi cellular with an average ultimate cell length of 5 mm. The fiber is lignocelluloses in nature. Pine fiber consist of alpha- cellulose 78.11%, hollow cellulose 87.56%, hemicelluloses 9.45%, lignin 4.78%. Its length is 3-9mm, breadth 4-8mm, gravimetric fineness 1.54 tex, tenacity 50 g/tex, extension at break 2-6%, flexural rigidity (dyne cm-2) 3.8, density(gm/c) 1.48 **[3].**

2)Banana fiber is a natural bast fiber. It has its own physical and chemical characteristics and many other properties that make it a fine quality fiber. Appearance of banana fiber is similar to that of bamboo fiber and ramie fiber, but its fineness and spin ability is better than the two. The chemical composition of banana fiber is cellulose, hemicellulose, and lignin. It is highly strong fiber, smaller elongation, and shiny appearance depending upon the extraction & spinning process. Light weight, strong moisture absorption quality. It absorbs as well as releases moisture very fast. It is bio-degradable and has no negative effect on environment and thus can be categorized as eco-friendly fiber. Its average fineness is 2400Nm. **[4].**

3)Oil palm fiber is produced from empty fruit bunch that are considered as waste after the extraction oil palm fruits. The similar quality of oil palm fiber with normal wood had made it very versatile in its use. Inherent characteristics such as high moisture content will have a detrimental effect on the oil palm residues. IS clean, biodegradable and compatible than many other fibers from other wood species. Suitable for the manufacture of mattress, car seat, insulation, composite panel product and particle board **[5].**

4)The husk of the Areca is a hard fibrous portion covering the endosperm. It constitutes 30–45% of the total volume of the fruit. Areca husk fibers are predominantly composed of hemicelluloses and not of cellulose. Areca fibers contain 13 to 24.6% of lignin, 35 to 64.8% of hemicelluloses, 4.4% of ash content and remaining 8 to 25% of water content.The fibers adjoining the inner layer are irregularly lignified group of cells called hard fibers and the portions of the middle layer contain soft fibers. Areca fiber is highly hemi cellulosic and is much greater than that of any other fiber **[6].**

5) Bamboo fiber is a regenerated cellulosic fiber produced from bamboo. Starchy pulp is produced from bamboo stems and leaves through a process of alkaline hydrolysis and multi-phase bleaching. Further chemical processes produce bamboo fiber. Repeated technological analysis has proved that this kind of fiber has a thinness degree and whiteness degree close to normal finely bleached viscose and has a strong durability, stability and tenacity. Bamboo fiber fabric is made of 100% bamboo pulp fiber. It is characterized by its good hygroscopicity, excellent permeability, soft feel, easiness to straighten and dye and splendid color effect of pigmentation. Bamboo is softer than cotton, with a texture similar to a blend of cashmere and silk. It has incomparably wide foreground on application in sanitary material such as sanitary towel, gauze mask, absorbent pads, and food packing **[7].**

6)Coconut fiber is extracted from the outer shell of a coconut. It is the natural fiber of the coconut husk where it is a thick and coarse but durable fiber. The common name, scientific name and plant family of coconut fiber is Coir, Cocos nucifera and Arecaceae (Palm), respectively. There are two types of coconut fibers, brown fiber extracted from matured coconuts and white fibers extracted from immature coconuts. Brown fibers are thick, strong and have high abrasion resistance. White fibers are smoother and finer, but also weaker **[8].** Both brown and white coir consist of fibers ranging in length from 4-12 in (10-30 cm). Those that are at least 8 in (20 cm) long are called bristle fiber. Shorter fibers, which are also finer in texture, are called mattress fiber. Coir fiber consist of lignin 45.84%, cellulose 43.44%, hemi cellulose 00.25%, Pectin's and related Compound 03.00%, Water soluble 05.25%, Ash 02.22%. Coir fiber length is 6-8 inches, Density (g/cc) 1.40 Tenacity (g/Tex) 10.0, Breaking elongation 30%, Diameter in mm 0.1 to 1.5, Rigidity of Modulus 1.8924 dyne/cm2, swelling in water (diameter) 5%, Moisture at 65% RH 10.50%. [**9].**

7)Wood fibers are usually cellulosic elements that are extracted from trees and used to make materials including paper. The end paper product (paper, paperboard, tissue, cardboard, etc.) dictates the species, or species blend that is best suited to provide the desirable sheet characteristics, and also dictates the required fiber processing (chemical treatment, heat treatment, mechanical "brushing" or refining, etc.).In North America, virgin (non-recycled) wood fiber is primarily extracted from hardwood (deciduous) trees and softwood (coniferous) trees. The wood fiber can be extracted as a primary product, or collected during the milling of lumber. Wood fibers can also be recycled from used paper materials **[10].**

Pine needle fiber is also including among those new natural fibers. So one of the fiber was taken i.e. ``**Pine needle fiber**` `Leaves of pine, is also a very new raw material and it is possible to developed of yarn from pine needle fiber.

7)Pine Trees are generally found in hilly areas like Himachal Pradesh (2) etc. Fibers are extracted from the dry pine leaves. They are processed mechanically and chemically to obtain pine needle fiber. Pine needle fiber is a cellulosic fiber. It consists of 43% lignin, 52% hollow cellulose, and 5.8% extractives content. Pine needles have many uses, whether they are cut from the tree, freshly fallen, or dried **[11].** Dimension of pine needle fiber is 200 microns. Pine needles fiber is brittle in nature. There is a little scatter in the axial modulus & the ultimate tensile strength. Its average length is about 20-29.5 mm & width is 16.81 micro meter and its denier is 2.6. Pine needle can be used as a composite for low and medium strength application. Pine needle is 68.5% holocellulose, 4.56% extractives and 31.0% lignin, Pine needles (pine leaves) were analyzed for their chemical constituents, and the dimensions of the extracted fibers were determined to assess their utilization for pulp making according to their studies Cellulose content of pine needles (41%) was comparable to softwood (42%), whereas the lignin content (35.1%) was high as compared to both softwood (28%) and hardwood (20%). Ash content of pine needles (3.2%) was less than wheat straw (4-9%) and comparable to biogases (1.5-5 %). The average length of the pine needle fiber (13mm) was greater than fibers of sugarcane (1.7 mm), wheat straw (1.4 mm) and esparto (1.2mm), but less than cotton (30mm).

The average diameter of pine needle fiber (32 mm) was greater than all the common fibers used for papermaking. The composition of pine needle as per study carried out by Ghosh and Ghosh has reported 64.12 % holocellulose, 3.24% extractives and 27.79% lignin.

Pine needles are the adult leaves, which are green bundled in clusters of 1-6, commonly 2-5, needles together. Pine needles have many uses, whether they are cut from the tree, freshly fallen, or dried. Pine needles are commonly used in gardening and landscaping, can be made into decorative yet practical crafts and even have nutritional. The fine, inner fibers in the pine needles, without the dry exterior leaves, are of interest for the textile industry.The industrial process by which these can be accessed and harvested, and then very fine yarns made from them **[11, 12].**The yarns can be colored with natural dyes. Moreover, different types of pine produce different natural shades of dye, which can be used to print on textiles**.** Turning this raw material into a useful for the textile industry harbors huge potential. Pine is the second most common type of tree in Germany, after the spruce, so there is no shortage of pine needles. Tapping into this organic, biologically degradable resource is, moreover, a simple matter, involving cooperation with branches of industry that use the wood from the pines, but not their needles. The pine tree is the most common tree in Europe and Asia. About 20 to 30 per cent of its mass consists of pine needles, which amounts to about 70 to 100 kilograms (154 to 220 pounds) **[12, 13].** By treating the needles, they can be turned into paper, textile, and composite material, making them a good (local) alternative for other fibers like cotton and coir etc.

This research paper is because raw material for making pine yarn is easily available in nature, it is eco-friendly, non-hazardous, cost effective as well as low energy consumption.

EXPERIMENTAL WORK

Materials ¦

Pine trees are found in hilly areas. From which dry pine leaves as a waste are collected. These dry pine leaves were processed through chemical and mechanical action.

Specifications of pine fiber-

1) Length =25mm 2) Fiber strength= 1.26 g/d 3) Extension %= 6.06% 4) Denier=1.2

Specifications of S-6 cotton fiber-

1) Length=30mm 2) Fiber strength=2.55 g/d 3) Extension %= 7.84% 4) Denier=1.64

Fig1- Dry pine leaves and separation of leaves from pine needle

Methodology¦

- **Extraction process (Raw material to fiber)**

Pine needle fiber was extracted by following methods-

1) By mechanical process

2) By chemical process

Mechanical process:

1) The pine needle fibers consist of silica and resin, which are the principal obstructions in the converting of these needles into fiber fit for use in spinning.

2) There is an outer layer of particularly thick glazing of siliceous material which it is necessary to remove by the use of alkalis.

3) The first step was breaking the needles. This was done, preferably, between tightly-pressed rollers, either smooth or corrugated, and was for the purpose of loosening the silica which surrounds the fibers in order to more thoroughly impregnate the needles with the alkali at the proper time and to allow alkali to reach under this siliceous layer and attack the silica at all surfaces at once.

4) And then pine dry leaves were boiled in alkaline bath, and then to washed out the solution and disintegrated the fiber mechanically. By means of mechanical action pine leaves were broken up and shortened **[13].**

Chemical process:

1) After mechanical action chemical action took place by placed the pine needle in a suitable vat or tank, may be made of cast iron. This tank was each provided with a coil of perforated steam pipe. The tank was first provided with a charge of the needles. A solution of caustic soda in water was then allowed to flow into the tank through water inlet valve.

2) The strength of the solution was preferably about 3 to 4 % of soda to the weight of the charge of the needle.

3)Now vat was boiled at 212-degree Fahrenheit for ten to fifteen minutes, or until the ebullition of the water causes a head of foam to rise up above the level of the grating.

4) This step constituted the active treatment necessary to remove the outer siliceous coating of the needles. And the foam was the result of the glutinous mass of soluble glass formed by the union of the soda with the silica forming silicate of soda.

5) Then vat or tank was filled with clean water. And the steam turned gradually heat it to a temperature was about 150 degrees to 180-degree Fahrenheit then washed out **[13].**

- **Fiber to yarn conversion process**

After mechanical and chemical process, the pine needle fibers were extracted and sent to the spinning department. Firstly, various blend ratio was decided according to the spinning procedure which were as follows-

- Pine (30%) +Cotton (70%)
- Pine (50%) + Cotton (50%)

Spinning process (fiber to yarn)

- **Mixing**

First of all, fiber was opened by means of metallic comb. Then the fiber was blended with cotton at a ratio of70:30 of which 70% was cotton and 30% was pine needle fiber. And another blend Ratio was 50:50 of which 50% was the cotton fiber where other 50% was the pine needle fiber.

Fig 2- blending by hand

Carding

After blending the fiber was input in mini carding machine. And finally the card web was formed.

Fig 3- Mini carding machine

Machine specifications-

1) Length of machinable fiber=22-42mm
2) Feed volume=About 0.25-1 kg/hr
3) Feed roller diameter=30mm
4) Doffer diameter=57mm
5) Cylinder diameter=160mm
6) No of carding flats=14
7) Weight=500 kg
8) Wire points= all metallic
9) Delivery lap hank=0.0100-0.0140
10) Delivery rate(m/min) (max)=10 **[14].**

- **Drawing**

The card web was placed into prototype draw frame for making sliver. After obtained the sliver it was plied into four plies. The plied sliver was again fed into same draw frame for doubling then sliver was delivered on to the draw frame cane.

Fig4- Draw frame machine

Machine specifications

1) Suitable fiber length=21-64mm
2) Total draw ratio=2-10 times
3) Roller pressure mode=spring-weighted
4) Working width (mm) =240
5) Drafting system=3 over 3, two zone
6) Delivery lap hank=0.0100 to0.0140
7) Draft/delivery/doubling=upto13/single/6-10fold
8) Delivery rate (m/min) (max) =150 **[15].**

- **Sliver to yarn spinner**

After doubling some amount of sliver was directly input into ring spinning machine due to unavailability of mini simplex. The ring yarn was obtained directly from the sliver.

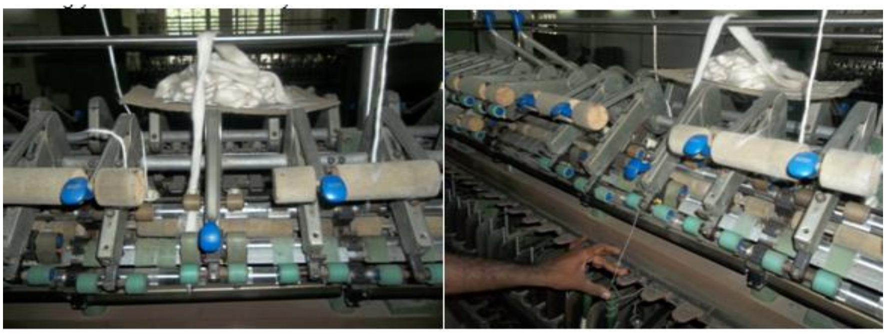

Fig 5-Spinning of fiber directly from drawing sliver in R/F

Machine specifications

1) Spindle gauge (mm) =70

2) Lift /Broken end collection =152/by pneumatic suction

3) Drafting system=super high draft, spring loaded

4) Ring diameter (mm) =30/42

5) Spindle speed/draft/TPI=10,000-15000rpm/Up to 300/18-50**[16]**

Testing of samples -

The testing of samples was carried out at different stages-

- Testing at process stage
- Yarn testing

3.3.1 Testing at process stage-

While the process of yarn formation is carried out, when a small amount of the material is prepared testing is carried out to determine whether the prepared material is accordingly to the required quality or not. This is carried out at each stage. These are few important parameters to be tested after each stage-

- Count of sliver
- Count of yarn before preparation of complete package
- Twist in the yarn before preparation of complete package

Wrap block-

The wrap block is used to measure the count of sliver. The circumference of wrap drum is one yard and for measurement of count of sliver 6- yard length is measured and then weighed on weighing balance.

The hank of sliver can be then, calculated as-
Hank = 3.24/Sliver weight

Wrap reel-

A wrap reel or skein winder is a device for measuring yarn and making it into hanks of a standard size. The reel is of a standard size and its revolutions are counted as the yarn is wrapped around it. Typically, a set number of revolutions will be used so that the hank is of a standard size., a skein or lea. For example, a skein of cotton would be 80 turns on a reel of 54 inches circumference, making 120 yards, while the standard length for wool worsted would be 80 yards. Count of yarn=64.8/yarn weight

Fig6- wrap reel

Yarn testing-

Different yarn samples which are developed are taken for quality assessment. Following quality parameters are to be tested for the developed samples-

- Twist
- Evenness
- Imperfections------- Thin places, thick places, Neps
- CSP
- Single yarn strength

The instruments used for the testing of following quality parameters are-

- Twist tester
- Uster tester 5(for evenness and yarn imperfections)
- CSP tester
- Single yarn strength tester

Determining of TPI of pine cotton blend yarn and 100% cotton yarn

Gauge length= 10-inch, Nos of readings=5

Fig 7 – single yarn twist tester

Sample	**TPI**
Pine cotton blend yarn	10.12
100% cotton yarn	11.02

USTER TENSORAPID 4 ----During routine testing, both the breaking load and extension of yarn at break are usually recorded for assessing in yarn quality. Most of the instruments record the load-elongation diagram also. Various parameters such as initial modulus, the yield point, the tenacity or elongation at any stress and strain, breaking load, breaking extension etc., can be obtained from the load-extension diagram.

Specifications of TENSORAPID4 TEST

1. A measurement must be performed according the CRE principle
2. Testing speed must be exactly 5 m/min.
3. The gauge length or the clamp-to-clamp distance should be 50 mm.
4. The pretension should be 0.5 cn / Tex.

Fig8- USTER TENSORAPID 4

USTER TESTER 5- S400 --

Features

- Capacitive measurement of mass variations and imperfections in yarn, roving and sliver of staple fibers.
- Measurement of foreign matters.
- Collection, evaluation and storage of measurement values.
- Automatic check of all measured values, diagrams and spectrograms.
- Yarn classification based on the USTER®STATISTICS.
- Editor for customizing report layouts.
- Filter functions for quick data retrieval and for the preparation of long-term reports.
- Simulation of yarn boards, woven and knitted fabrics.
- QualiProfile, graphic presentation of the overall quality.

Fig9 –USTER TESTER 5-S400

Weaving proces (yarn to fabric)

Materials used: -1) Type of yarn: 100% Cotton yarn/pine cotton blend yarn

Machine used: -1) Warp beam machine 2) CCI rapier loom

Step -1Warping process

Fig 10- preparation of warp beam

Table 1

Yarn blend	Yarn count	No of colors	Total ends	Warping speed	Width(inches)	No of beam found
100% cotton	2/20 Ne	Single	880	9	20 inches	2

Step -2 Drawing-in of warp ends(draft)

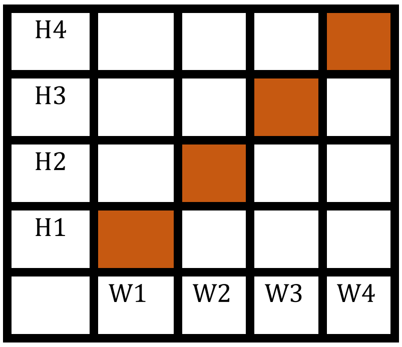

Fig -11 drafting order

Step -3 weaving system (CCI rapier loom)

The CCI Evergreen Rapier Machine is a multi-functional machine producing a variety of woven samples, including industrial fabrics, upholstery, and apparel. This system of weft insertion is based on positive picking. The weft carrier is a small griper head attached to a rod or flexible tape, called rapier that moves through the shed.

Table 2

Warp Count	Weft count and blend	Thread density/ GSM	Reed count	Ends per dent	No. of beat-ups	Warp tension	No. of heald frames	Draft/drawing order/weave/weft color scheme	Gripper speed/reed speed
2/20 Ne	8ne (p+c) blend	EPI=44 PPI=32/224.2 gm	44	2	1	1st beam=1.8 2nd beam=8	4	1234/1234/plain weave/single (Grey cotton)	7/7

WET PROCESSING (grey fabric to dyed fabric)

Desizing process-(Desized sample)

Sample A fabric weight/ NaoH weight=16.861gm/5.372gm,

Fabric weight/ NaoH weight=25.50gm/5.185gm

1)Desizing agent=5gpl 2) Water=1 litre

3)Temperature =70 degree centigrade.

- **Scouring process- (Scoured sample)**

1)Na2co3=5gpl 2) Water=1 litre

3)NaoH=2.5gpl 4) Time =1 hr

- **Bleaching process- (Bleached sample)**

1)H2O2=5ml 2) NaoH=3gpl

3)Time=1hr 4) Water =1 litre

RESULT AND DISCUSSIONS

Result-- Comparison of CSP value between pine cotton blends and 100% cotton yarn

Table 3--Specification of lea strength of Pine cotton blend & 100% cotton yarn

Sample	Lea length	Lea Weight	Lea strength	Count (Ne)	CSP of the given sample
SAMPLE A (Pine cotton blend Yarn)	120 yds	9.98gm	120 lb	6.492Ne	779.04
SAMPLE B (Pine cotton blend Yarn)	120 yds	8.075gm	88 lb	8.024Ne	706.11
SAMPLE C (100% Cotton yarn)	120 yds	6.95 gm	164.5 lb	8.00 Ne	1316

Discussions

CSP Value comparison

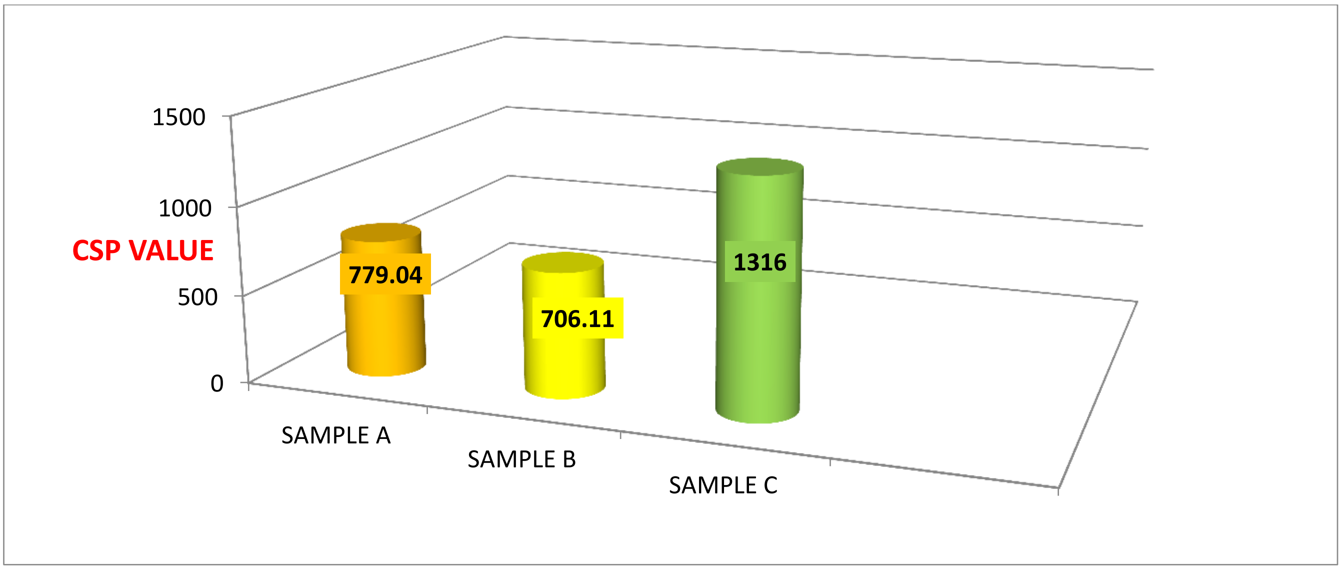

Fig no -12

In sample A and Sample B CSP value was found 779.04 with lea strength 120 lb for 6 Ne(pine+cotton) and 706.11 with lea strength 88 lb for 8 Ne. Sample C i.e 100%Cotton yarn CSP value was 1316 and strength 164.5 lb for– 8Ne Which stronger than pine cotton blend yarn.

Results

Comparison Breaking force value of pine cotton blend and 100% cotton yarn

Table 4- Breaking force of Pine cotton blend yarn and 100% cotton yarn of different count

Sample	Count	B-force(gmf)	Elongation	Tenacity (RKM)
A P+C blend yarn	8 Ne	500	5.55	6.00
B P+C blend yarn	6 Ne	444.8	4.53	4.30
C 100% cotton blend yarn	8 Ne	574.2	6.70	8.75

V=5000mm/min, Fv=42Gf, length =500mm, Plc.=30%, Material= Single yarn.

DISCUSSIONS

Elongation comparison

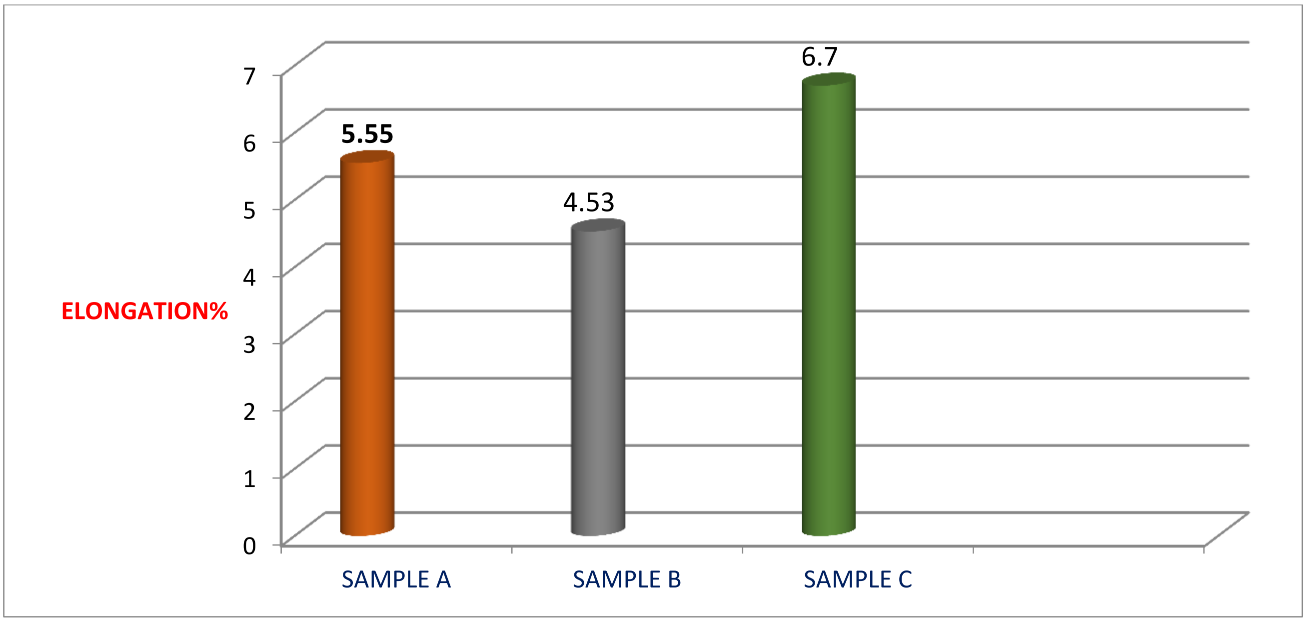

Fig no -13

Elongation in both yarn is good. Elongation % of Sample A i.e pine cotton blend yarn was 5.55% for 8Ne and Sample B i.e., pine cotton blend yarn elongation % was 4.53% for 6Ne. And Sample C i.e. 100% cotton yarn elongation was found 6.70% for 8Ne.

Results--- comparison IPI value of 100% cotton and pine cotton blend yarn

Specification of yarn IPI

V=100 m/min, T=1 min

Table 5-Single values and mass diagram, Material- Pine cotton blend yarn and 100%cotton

Sample A B C	Count	U% (avg.)	Cvm% (avg.)	Thin -50%/km (avg.)	Thick +50%/km (avg.)	Neps +200%/km (avg.)	Hairiness (H %) (avg.)
P+C Yarn	8 Ne	16.3	18.45	60	200	160	11.07
P+C Yarn	6 Ne	14.3	16.56	75	185	280	9.85
100% cotton yarn	8Ne	11.7	14.20	10	50	200	7.31

Discussions-

Tenacity or RKM value comparison

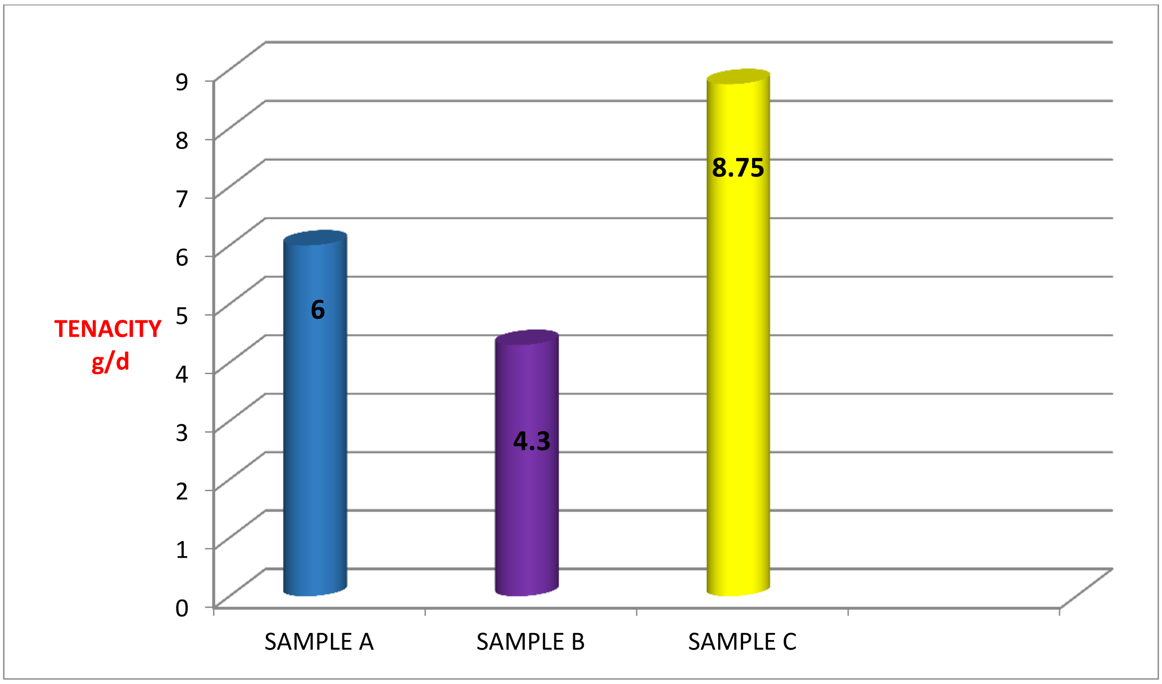

Fig no-14

RKM value of Sample A was found (P+C blend) 6 g/d for 8 Ne and Sample B (P+C blend yarn) was 4.3 g/d for 6Ne. And Sample C (100% cotton yarn) RKM value was 8.75 for 8 Ne. Pine cotton blend yarn tenacity could be increased by changing the TPI or other parameters like- fiber fineness, fiber strength, twist level, evenness level and fiber length variation and distribution. By blending uniformity with high quality cotton fiber & use of synthetic fiber in blending desired strength of yarn could be obtained.

Unevenness (u%) comparison

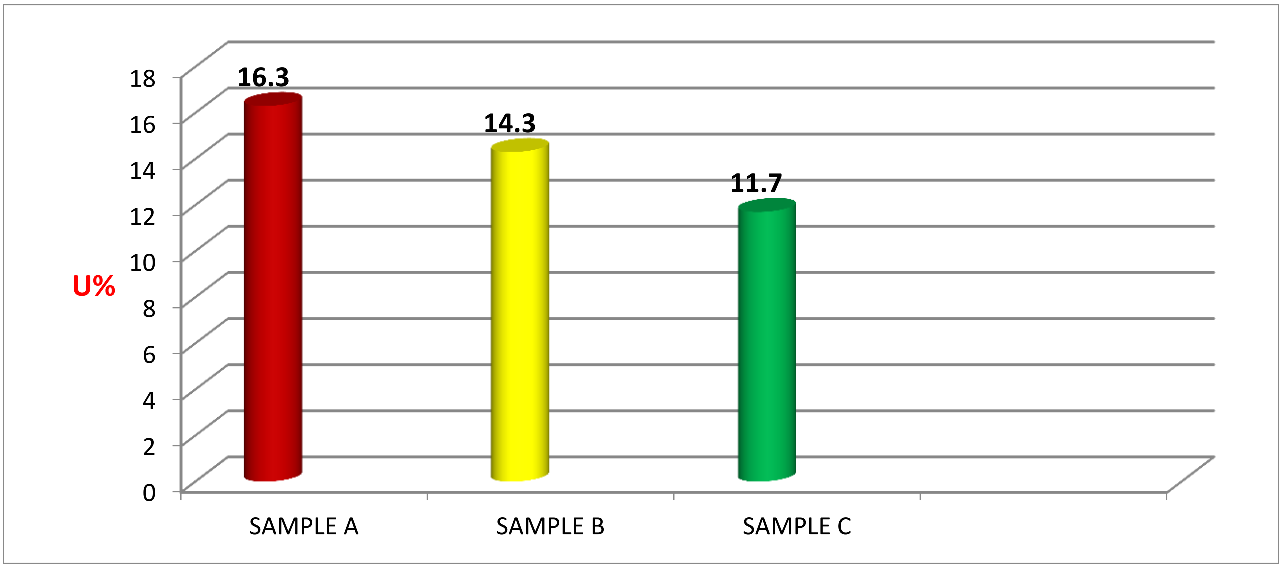

Fig no-15

Hairiness value comparison

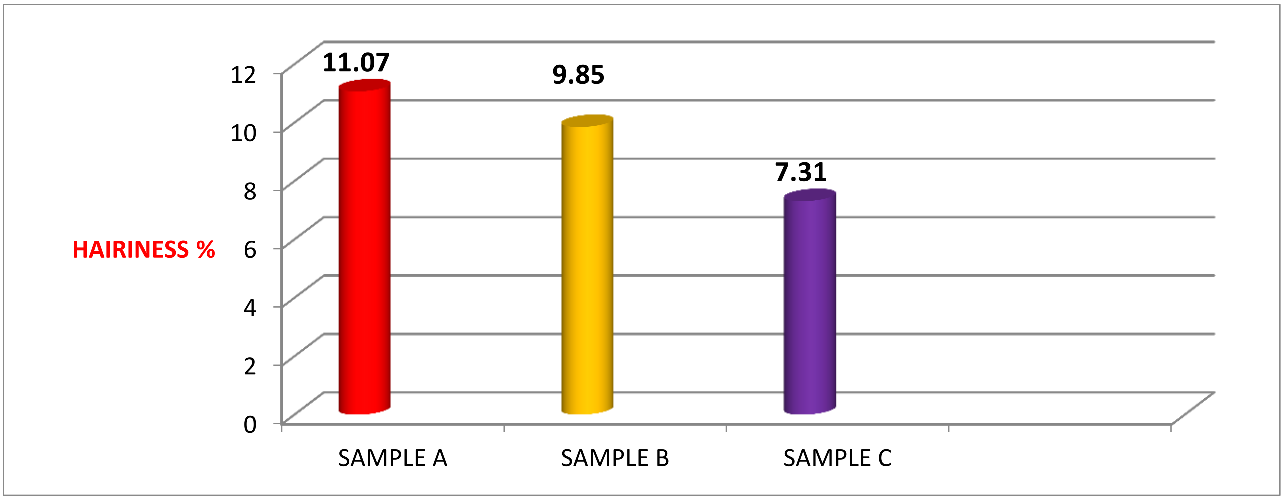

Fig no-16

U% of Sample A (p+c blend yarn) was found 16.3% for 8Ne and 14.3% for 6Ne. Sample C (100% cotton blend yarn) hairiness value was 11.7% for 8Ne. U% of pine cotton blend yarn is higher as compare to 100% cotton yarn. It was happened because drawing and doubling was carried out in same machine and doubling was done by using only four ply of drawn sliver. Pine cotton blend yarn having lower strength because of higher unevenness percentage as compare to 100% cotton yarn.

IPI (Imperfection index) comparison

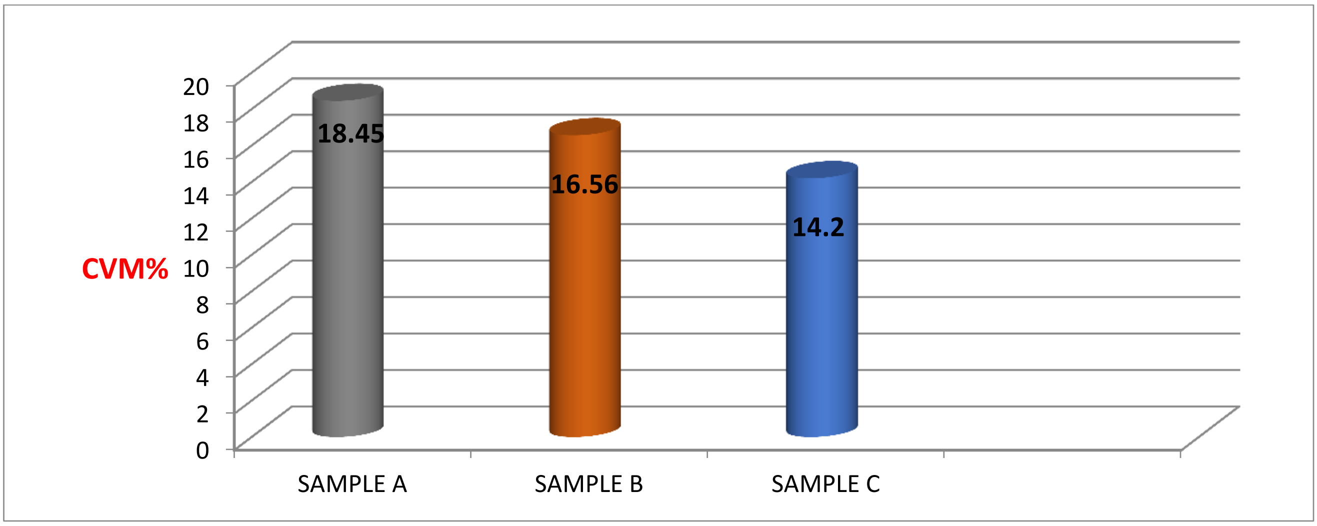

Fig no -17

Irregularity or cvm % of Sample A(p+c) was found 18.45% for 8Ne and Sample B was16.56% for 6Ne. Sample C (100% cotton yarn) cvm% for 8Ne was 14.2 which is lower than pine cotton blend yarn. Because of lower uniformity level and having bad surface properties pine cotton blend yarn having higher imperfection value than cotton.

CONCLUSION

- The properties of pine cotton blend yarn and 100% cotton yarn were studied in terms of cvm %, total imperfection index, tenacity, CSP, and elongation %. The overall results showed that the 100% cotton blend having good denier value, yarn extensibility, Tenacity, CVM%, U%, which having higher than that of pine cotton blend yarn.

- Unevenness (U) % of pine cotton blend was found higher as compare to 100% cotton yarn. It happened because drawing and doubling was carried out in same machine and doubling was done by using only four plies of drawn sliver.

- Pine cotton blend yarn having lower strength because of higher unevenness percentage as compare to 100% cotton yarn. Pine cotton blend yarn tenacity could be increased by changing the TPI or other parameters like-fiber fineness, fiber strength, twist level, evenness level and fiber length variation and distribution.

- By blending uniformity with high quality cotton fiber & use of synthetic fiber in blending desired strength of yarn could be obtained.

- Pine cotton blend yarn could be possible to use in heavy fabric, decorative purpose, non-woven and composites also. By surface modification the fiber can be used alone without blending and could be possible to make apparel also. The fabric that was produced gave khadi effect.

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