Processing of Palmyra Palm Fruit Fiber

MUTHUVELAMMAI.S
Lecturer, B. Tech (Textile Chemistry), Department of Textile Technology (Man Made Fibre), S S M Polytechnic College

Abstract- A new variety in natural fibre and is first of its kind i.e., Palmyra Palm botanically called Borassus Flabellifer is introduced in the present work. Borassus flabellifer, commonly known as doub palm, palmyra palm, tala palm, toddy palm, wine palm, or ice apple is a large fan palm of Arecaceae / Palmae (Palm family). The plant is native to Indian subcontinent and Southeast Asia, including Nepal, India, Bangladesh, Sri Lanka, Cambodia, Laos, Burma, Thailand, Vietnam, Malaysia, Indonesia and the Philippines. Different natural fibers being used have gained importance in the recent years due to love for eco-friendly in nature. Use of the wastage of food crops as alternative source of raw materials for clothing is a good solution to meet up this demand. Palmyra palm fruit fiber could be an excellent source of natural fiber. The main objectives of this paper are extraction of fiber from the palm fruit, characterization of collected fiber, produce yarn from the fiber and then characterization of yarn. The fiber shows a good dye take up in dyeing with both reactive and basic dyes. It can be widely used in various applications such as Non-Woven's, Home Textiles, fancy items, decorative purpose, disposable bags, home textile and different value-added items.

I. INTRODUCTION

Some of the popular common names of the plant are African Fan Palm, Asian Palmyra Palm, Borassus Palm, Brab Tree, Cambodian Palm, Doleib, Doub Palm, Great Fan Palm, Ice-Apple, Lontar Palm, Palmyra Palm, Ron Palm, Sea Apple, Tal- Palm, Tala Palm, Toddy Palm, Sugar Palm, Wine Palm, Nugnu Palm, fan palm, sea apple, toddy, black palm and brab. Genus name comes from the Greek word borassos meaning the immature spadix of date palm. Specific epithet from the Latin word flabellatus meaning like an open fan. Tree sap, called toddy, is tapped for use as a beverage, hence the common name of toddy palm. Leaves were formerly used as paper in Indonesia, hence the common name of lontar palm.

The sweet sap of the Palmyra tree is called Toddy and is used in preparation of Palm jaggery. Sap is fermented to make Arrack which is an alcoholic beverage. Almost every part of the tree is useful to mankind. The fan shaped tall tree bears fruits like that of a coconut tree. The pulp is tender and the husk is fibrous similar to that in Coconut. The fruit has a black husk and is 4 to 7 inches in diameter. It is borne in clusters. The top portion of the fruit is cut off to reveal the three sweet jelly seed sockets.

II. PLANT DESCRIPTION

Palmyra Fruit is a tall, single-stemmed evergreen palm tree that can grow about 20–30 m tall and the trunk may have a circumference of 1.7 m at the base. The trunk is tall going up to a height of 30 meter. It is strong, cylindrical and black in color, with a circumference of approximately 1.5 to 2.5 meter at the base and approximately 1 meter at middle and tail parts. The hard outer wood of the trunk is used as pillars, furniture and supporting tool for kutcha houses. The trunk is also used as pipes to supply water in agricultural land and streams.

The wood is used to make walking sticks and windows grills. Dried and holed trunk is used for make boats in

coastal region. In a nutshell, the trunk is used appropriately depending on the size, texture and condition of the trunk and in no condition does it go completely waste. The tree wood will be stronger an old age tree. The old age trees are good income for the local people; the single tree cost around 700 rupees. Leaves

Palmyra tree have 20-25 large fresh-looking leaves, gray green in color that are fan shaped with a length of 1-2 meter and folded along the midrib. Leaf is divided into 30-40 linear lanceolate and ends with marginal spiny segments. Leaves have strong, woody stalk up to 2 meter long, margins with hard spines, smooth on upper surface and rough in lower area.

Leaves obtained from trees have myriad uses; including social uses like used for thatching for kutcha houses, fencing, and also to create livelihood options for local people by making mats, baskets, hand held fans, hats, rain coats. Additionally, the local people also use the leaves to make playing kits for children play. Palmyra leaves have great ecological, economical, spiritual and cultural importance since olden days. The most significant of which is that these leaves were used for writing manuscripts. Many manuscripts in Hindu culture were written using these leaves. Used leaves of thatching and fencing are used as organic manure in their farm lands. Leaf stalks are used as fuel wood and in many villages, this is one of the major fuel wood sources. The fleshy shoot apex of the tree is edible and is consumed frequently by local people growing the tree.

III. FLOWER

Like all Borassus species, B. flabellifer is dioecious with male and female flowers on separate plants. Male inflorescence is 90–150 cm long, much branched with primary and secondary branches. Male flowers are sub sessile, with narrowly cuneate sepals with truncate inflexed tips and obovate-spatulate and shorter petals, large anthers. Female inflorescence has a flowering portion to 30 cm long, with 8–16 flowers spirally arranged. Female flowers have fleshy, large, reniform sepals, smaller petals, sub trigonous ovary, recurved stigmas and sessile. Flowering normally takes place from February to April.

IV. FRUITS

Palmyra fruits are edible in all the stages. The male and female flowers are always produced in two different plants. The flowers are small, and pale-yellow growing in clusters with a white string like inflorescences. Fruits are sub globose, and again in clusters. Usually, a single tree will produce anywhere between 50 to 300 fruits. The size of the fruits ranges from 4-8 inches diameter, and are black, greenish white and black when ripe. The upper part of the fruit

must be cut off to reveal the sweet jelly seed sockets to eat. There is one to a maximum of five jelly sockets in a single fruit although it is most commonly found to have three sockets. The kernel which is soft as jelly and translucent like ice is accompanied with sweetish water. This liquid has medicinal properties and is used by the local people to treat skin diseases. The ripened fruit of outer layer also can be eaten raw or boiled. The fresh fruits are used as wheels for playing by children.

V. SEEDS

Each fruit consists of 1-3 seeds, each enclosed within a woody endocarp. These seed sockets have been the inspiration behind certain sweets called Jalbhara found in Bengal. Young palmyra seedlings grow slowly, producing only a few leaves each year (establishment phase), but at undetermined time, they grow rapidly, producing a substantial stem.

VI. HISTORY

There is varied view on its origin. Most botanists believed that it originated from Africa and then was introduced into India a long time ago. Another view is that it is native to South Asia, Southeast Asia to New Guinea Tropical Africa. Palmyra palm is widely cultivated in south Asia and Southeast Asia. It is cultivated or found in semi-wild stands in India, Sri Lanka, Burma, Thailand, Cambodia, China, West Malaysia, Indonesia, and New Guinea. In India, it is planted as a windbreak on the plains. It can also be found growing in Hawaii and southern Florida.

Female Palmyra tree showing foliage crown with fruit

Male Palmyra tree with flower

Mature Fruits of Palmyra

Gelatinous seeds of Palmyra Fruit

Palmyra palm fruit

VII. COMPOSITION

The fiber is extracted from the palm fruit. The chemical compositions of the fiber are α-Cellulose 53.4%, Hemi-cellulose 29.6% and Lignin 17%. The amount of Hemicellulose can be decreased by treating with strong alkali. The strength of fiber is 70.8 MPa,Modulus 10.8 GPa and Elongation 34.8%. The strength, modulus and elongation can be increased by alkali treatment. The fiber can be dyed with both reactive and basic dye. It can be used instead of synthetic fiber where more strength is necessary, e.g., blending with cotton fiber it can be used to produce fabric which reduce cost and increase strength.

VIII. MATERIALS AND METHODS

MATERIALS

Palm fruits are collected from in and around the areas of Komarapalayam, Tamil Nadu and then the fibers are extracted from fruit. Reactive dyes, Salt, Acetic acid, Soda Ash, Stabilizer, Hydrogen Peroxide, wetting agent, sequestering agent, Levelling agents are used.

IX. METHOD FIBER EXTRACTION

At first the ripe fruits are collected. Then the blackish husk is removed. The seeds are separated from each other with fiber. The fibers from the seeds are collected which contain yellow mesocarp and can be eaten raw or baked, often being mixed with sugar. The mesocarp is washed off by water. Then the washed fiber is boiled with normal water at a temperature of 100C to remove gum like material from the fiber and finally dried in the sun.

Fig. 1 Palm Fiber (0.5 mm)

Fig. 2 212µm fiber

Fig. 3 150µm fiber

Fig. 4 106µm fiber

X. SCOURING AND BLEACHING

The fiber is scoured and bleached in the same bath.
At first 10g of fiber is taken, then scouring and bleaching is done in open bath with the following recipe:

Hydrogen peroxide 5gpl
Organic Stabilizer 1gpl
Sodium hydroxide 4gpl
Wetting agent 1gpl
Sequestering agent 1gpl
Temperature 100^0C
Time 40 min
PH 10.5-11.0
M:L 1:40

XI. DYEING WITH REACTIVE DYE

At first 10g of fiber is taken. Then the fiber is dyed with following recipe

Dye 2%
NaCl 20gpl
Soda ash 5gpl
Wetting agent 1gpl
Sequestering agent 1gpl
Temperature 100^0C
Time 30min
PH 10.5

M:L 1:20

After that soaping is done with the following recipe
Soaping oil 4gpl
Temperature 100^0C
Time 10min

Then the dyed fibers are dried. After drying it can be said that, dyes take up quality of the fiber is very good.

XII. SPINNING OF GREY FIBERS

- PROCESS FLOW CHART

1. OPENING

The fiber is opened by Shirley opener at Bangladesh University of Textiles.

OPENING OF FIBER BY SHIRLEY OPENER

2. CARDING

The fiber was input in mini carding available at but the card web is not formed. Then the fiber is blended with cotton at a ratio of 60:40 of which 60% is cotton and 40% is palm fiber. Then the blended fiber is input to the carding machine and finally card web is formed.

CARDING BY MINI CARDING M/C

3. DRAWING

The card web was placed into prototype draw frame for making sliver. After obtaining the sliver it is plied into four ply. The plied sliver is again fed into same draw frame for doubling.

DRAWING AND DOUBLING OF FIBER BY MINI DRAW FRAME

4. SPINNING IN RING FRAME

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

5. Spinning in Rotor

The rest amount of sliver is fed into rotor. The rotor yarn is obtained directly from the sliver.

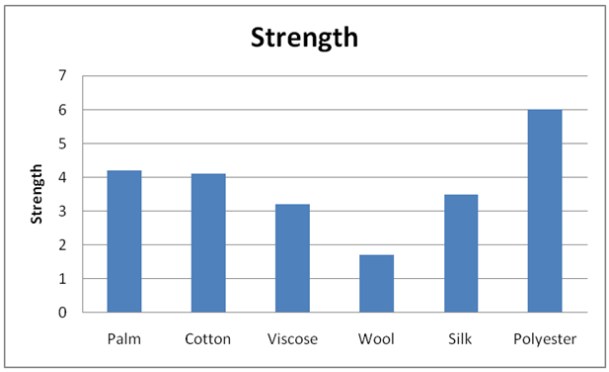
TEST

Palmyra fibre is cold washed, then hot washed then used for tests. At first tests are carried out in Uster HVI 1000. All the values are out of range. Then the fiber is tested with Uster HVI 500. Two samples were collected randomly from the available fiber which shown only the micronaire values.

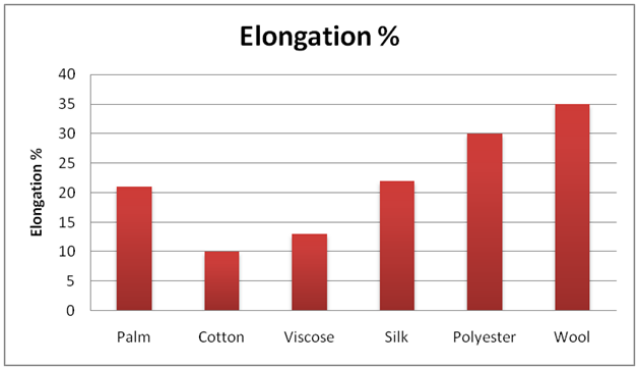
RESULTS AND DISCUSSION

The micronaire value of the palm fiber is about 7.63 which is near about the coarser cotton fiber. The fiber can be dyed with reactive dyes. By visual estimation it can be said that, dye take up and fixation in both cases is very good. Strength of palm fiber is about 4.2 g/den which is below the polyester among all those fiber. Elongation % of palm fiber is more than cotton and viscose.

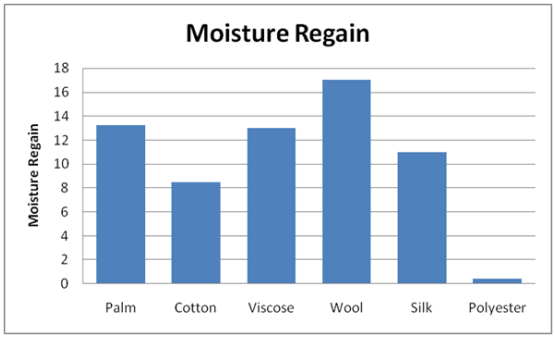
COMPARISON OF STRENGTH OF DIFFERENT FIBER



COMPARISON OF ELONGATION% OF DIFFERENT FIBER



COMPARISON OF MOISTURE REGAIN% OF DIFFERENT FIBER



It is seen that moisture regain% of palm fiber is more among all the fiber in the chart except wool. Palmyra palm fruit fiber is long staple fiber. The fiber without blending with cotton cannot be processed with the machinery which is developed only for cotton fiber processing. It is not possible to make yarn by using only this fiber in ring spinning frame as well as open end spinning frame. But after blending with 60% raw cotton, it is possible to make both ring yarn and rotor yarn. It can be stated that by visual estimation the uniformity of yarn in both ring and rotor is comparatively poor. It happened because drawing and doubling is carried out in same machine and doubling is done by using only four ply of drawn sliver. The ring yarn is normally finer than rotor yarn. But table2 shows that, the count of ring yarn is 7Ne and count of rotor yarn is 10Ne though both the yarn is produced from the same sliver. This is happened because of producing ring yarn directly from sliver.

Breaking strength of rotor yarn and ring yarn 327.0cN/tex and 400.0cN/tex respectively. The breaking strength in both cases is relatively good. The strength can be increased by changing TPI and other parameters. The strength of yarn is comparatively low because of using low quality cotton in blending. By blending uniformly with high quality cotton fiber and use of synthetic fiber in blending desired strength of yarn can be obtained. The elongation % of ring yarn is 6.81 which are nearer to elongation percentage 6.83% of 40 tex jute cotton blended yarn where cotton is 80% and jute is 40%. The yarn can be widely used in heavy fabric, fancy items, decorative purpose, non-woven, geo-textiles etc

CONCLUSION

The main objective of this study is to explore the potential use of *Palmyra Fruit* fibers in textile. The properties of fiber are determined. The fiber shows a good dye take up rate, strength, elongation% and moisture regain%. The fiber cannot be processed alone in cotton processing machine but by blending with cotton both ring and rotor yarn can be produced. The strength of yarn in both cases is relatively good. The strength of yarn depends on various parameters. By changing these parameters increase of strength is possible. The palm fiber can be used effectively instead of synthetic fiber which (synthetic) causes environmental pollution severely. This fiber can be an important source of non-woven textiles where strength is crying needs. By surface modification the fiber can be used alone without blending. The fiber can be used in geotextiles as well as in other reinforcing textile materials and in different value-added items.

REFERENCES

[1] "Pulp and papermaking potential of Palmyra fruit fibreBorassusflabelifar"Ogbuagu A. S.*, Ekpunobi U. E., Onwuka T. N. and Okoye N. H., *Der ChemicaSinica, 2013, 4(2):19-24*

[2] "Use, Production and Conservation of Palm Fiber inSouth America: A Review" Carolina Isaza, Rodrigo Bernal and Patricia Howard, *J Hum Ecol, 42(1): 69-93 (2013)*

[3] "An Investigation on the Effect of Machine of Spinning Machine on the Physical Properties of Blended Yarn" Ph. D Thesis, Dr. A N M Ahmed Ullah, JU

[4] "Tensile Test Analysis of Natural Fiber Reinforced Composite" G. Velmurugan, D.Vadivel, R Arravind, S.P. Venegetasan, A.Mathiazhagan, *International Journal of Mechanical and Industrial Engineering (IJMIE) ISSN No. 2231 –6477, Vol-2, Iss-4, 2012*

[5] "Pulping and paper properties of Palmyra palm fruit fibers" WaranyouSridach, *Songklanakarin J. Sci. Technol. 32 (2),201-205, Mar. – Apr. 2010*

[6] "Environmental Benefits Of Natural Fiber Production and Use" *Jan E.G. van Dam Wageningen University, TheNetherlands*

[7] http://forestrysust.blogspot.com/2008/12/palm-tree-in-bangladesh.html

[8] "Studies on *Borassus*fruit fiber and its composites with Polypropylene" P. Sudhakara, K. Obi Reddy, C. Venkata Prasad, Dani. Jagadeesh, H.S. Kim, B.S. Kim,S.I. Bae, and J.I. Song,*Composites Research, 26(1), 48-53(2013), pISSN: 1598-6934*