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SILK FIBRE OBTAINED FROM SILKWORM AND ECOTEXTILES

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ABSTRACT

Fibre is a thread like substance used in textile industry for the production of goods or provision of services. Two major groups of textile fibres are natural & synthetic. Natural Fibres are subdivided into animal, vegetable and mineral fibres. All animal fibres are proteins, all vegetable fibres are cellulose, all mineral fibres are mineral based. Eg:-Silk, cotton, wool, linen, jute etc. Natural fibres tend to have complex and distinctive internal and external features. Natural fibres have variable diameter, cross section and possibly color banding. Natural fibres have an edge over artificial fibres and silk excels all the fibres for a number of inherent characteristics such as lusture, softness, elegance, versatility, wear ability, yarn strength etc. Silk fibre is constituted by two important proteins, fibroin (73.5 %) and sericin (22.28 %). The chemical formulae of sericin is C_{15} H $_{25}$ N $_{5}$ O $_{8}$ and that of fibroin is C $_{15}$ H $_{23}$ N_5 O_6 (Mondal *et al.*, 2007). Although silk and wool are protein fibers, yet only wool gets stretched when soaked in water because of presence of α – helical configuration in wool and parallel β configuration in silk fibroin (Kamili, 2000). The silk industry is giving employment to 63 lakh people in the country including 46 lakh farmers, three lakh reelers and 14 lakh weavers (Srinidhigowda, 2010). The overall silk exports for the current financial year are expected to reach Rs. 30 billion, J Sampath of the Central Silk Board recently said, while speaking at the opening ceremony of the 12th Silk Mark Expo in Chennai on December 24 (Anonymous, 2011). The textile industry is a gigantic industry – and it is gigantically polluting. The textile industry uses copious amounts of two things: water and chemicals. It is the number one industrial polluter of water in the world (Anonymous, 2004). So, there is a need for sustainable ecotextiles. Sustainable products are environment friendly, support communal harmony, as well as capable of supporting fashion needs. whereas eco textile are textile product, produced in ecofriendly manner and processed under eco-friendly limits defined by agencies like oekotex, ifoam etc. (fibre2fashion, 2011). Silk, Cotton, Wool and Hemp are important ecotextile and needs to be exploited, branded and marketed at a higher extent.

INTRODUCTION

Textile fibres are of immense importance in the textile industry. Two major groups of textile fibres are natural & synthetic. Natural Fibres are subdivided into animal, vegetable, mineral. All animal fibres are protein, all vegetable fibres are cellulose, all mineral fibres are mineral based. Eg:-Silk, cotton, linen, jute etc.

Animal Fibres

- The most important is wool. wool is animal hair which is spun into thread before being woven into cloth Other animal fibres include natural "fur" coats and rabbit hair in glove linings.
- Silk fibres from the cocoon of the silkworm is used in high quality clothing.

Vegetable Fibres

- Due to their biological origins, they have complex three-dimensional shapes.
- Their characteristics can be highlighted using biological stains.
- Cotton & linen are the most important vegetable fibre in the textile industry.
- Manila, hemp, and jute are coarse fibres used in twine, rope, and door mats.

Mineral Fibres

- Asbestos is a fibrous mineral that is used for insulation due to its non flammability (e.g. safe insulation).

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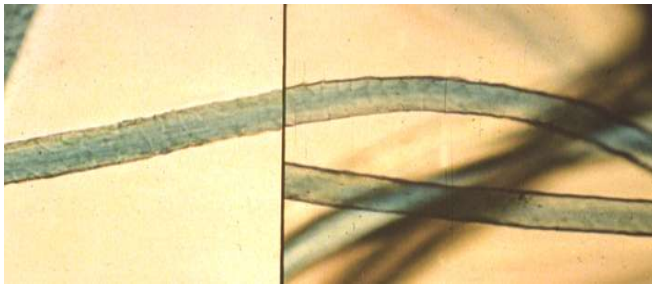
- Asbestos is no longer widely used due to its health hazard.
- Mineral wool is made by melting glassy minerals, with uses similar to that of asbestos.

Synthetic Fibres

- Are all polymers, i.e. compounds made of repeating units.
- Two categories: regenerated & synthetic.
- Rayon was the first regenerated fibre, formed by forcing cellulose in solution through an extrusion die to form solid fibres.
- Acetate fibres are also cellulose based.

Few examples of the synthetic fibres are as under:-

- Polyester – quite strong with a fairly high melting point; used in clothing.
- Polyolefin's (polyethylene & polypropylene) –resistant to water and bacterial action; used for indoor/outdoor carpeting.
- Acrylics – a good insulator; used for blankets and sweaters.
- Spandex – a stretchable fibre; used for athletic wear.
- Polyamide – extremely strong; used for bulletproof vests.
- Fibreglass – strong and chemically resistant made from molten glass; used for insulation, surfaces, and some clothing items.



(Microscopic view of the natural fibre silk)

Silk as a natural fibre

Natural fibres tend to have complex and distinctive internal and external features. Natural fibres have variable diameters, cross section and possibly color banding .Natural fibres have an edge over artificial fibres and silk excels all the fibres for a number of inherent characteristics as:-

- Silk gains precedence over other fibres because of its lusture, softness and elegance
- It is the only fibre which is directly woven into a fibric in its raw state.
- Pure silk knitted fabrics have very good scope because it is a synonym for elegance, and silk garment are prized for their vanity versatility, wear ability and comfort.
- High hairiness value.
- High Single yarn strength.
- High elongation.
- Good Abrasion resistance as these fibres are man-made and as their surface is smooth, they are lesser friction resulting in decreased abrasion.
- Decreased bursting strength.
- High area shrinkage.

Silk constituents

Silk fibre is constituted by two important proteins, fibroin (73.5 %) and sericin (22.28 %). The chemical formulae of sericin is C15 H 25 N5 O 8 and that of fibroin is C 15 H 23 N 5 O6. A fibrous protein is composed of heavy (H) chain, Light (L) chain and glycoprotein linked by disulfide bonds. The second being sericin a natural macromolecular protein, serving as an adhesive to unite fibroin for making silk cocoons of silkworm, *B. mori*. Recently, silkworm is being used as biofactory for the production.

Attributes of sericin and fibroin

The sericin and fibroin have following properties which distinguish it from other protein meoties as- Anti Oxidant, Coagulant, Chemo Protective, UV Protective, Moisturize, Anti Oxidant, Water absorbency, Insulation properties, Dyeing affinity, Lusture, Thermo tolerance, Thin, long ,light and soft etc.

Textile Fibres

Sustainable Textile:- products that have been environmentally friendly, support communal harmony, as well as capable of supporting fashion needs. Whereas eco Textiles are any textile product, which is produced in ecofriendly manner and processed under eco-friendly limits (defined by agencies like oekotex, ifoam etc.). Any crop cultivated by using organic principles of agriculture like organic manures and bio fertilizers can be considered Organic. Natural fibres Silk, cotton, linen, jute etc. which are obtained from natural sources and may be considered eco-friendly based on the process of cultivation and processing.

Past of Eco-Fibres

Natural fibres—cotton, flax, silk, and wool—represent the major fibres available to ancient civilizations. The earliest known samples of yarn and fabric of any kind were found near Robenhausen, Switzerland, where bundles of flax fibres and yarns and fragments of plain-weave linen fabric, were estimated to be about 7,000 years old. Cotton has also been cultivated and used to make fabrics for at least 7,000 years. It may have existed in Egypt as early as 12,000 B.C. Fragments of cotton fabrics have been found by archeologists in Mexico (from 3500 B.C.)., in India (3000 B.C.), in Peru (2500 B.C.), and in the southwestern United States (500 B.C.). Cotton did not achieve commercial importance in Europe until after the colonization of the New World. Silk culture remained a specialty of the Chinese from its beginnings (2600 B.C.) until the sixth century, when silkworms were first raised in the Byzantine Empire.

Need for Ecotextiles

The textile industry is a gigantic industry – and it is gigantically polluting. The textile industry uses copious amounts of two things: water and chemicals. It is the number one industrial polluter of water in the world[1].

Water is used at every stage in fabric manufacturing: to dissolve chemicals to be used in one step, then to wash and rinse out those same chemicals to be ready for the next step. It takes between 10% and 100% of the weight of the fabric in chemicals to produce that fabric[2]. The production of the fabric covering your sofa required between 4 and 20 pounds of chemicals. The chemically infused effluent - saturated with dyes, de-foamers, detergents, bleaches, optical brighteners, equalizers and many other chemicals - is often released into the local river, where it enters the groundwater, drinking water, the habitat of flora and fauna, and our food chain. As Gene Lisa has said, "There is not a 'no peeing' part of the swimming pool." We're all downstream. And many of these chemicals remain in the fabric that you bring into your room to outgas into your air, or be absorbed through your skin. Over time, with use, we abrade tiny particles of the fabric that we then ingest or inhale. One yard of organic cotton fabric conventionally processed into fabric contains 75% organic cotton fibres and 25% chemicals, many of which are proven toxic to humans and animals[3].

Silk

People often ask if silk can be raised organically. Yes, absolutely, although it is exceedingly hard to find. Feeding the silk worms organic food is not a trivial eco choice. The fibre preparation stage of silk is called scouring. Silk is lusterless, stiff and harsh until it is scoured, which removes the outer gelatinous layer of matter from the silk filament. Here again, unless the silk is scoured in an environmentally friendly manner, it is not a good eco-choice. The silk scouring water can be laden with chemicals, and must be treated. Even if chemicals are not used, and only soaps are used, the water must be treated before being released into the local eco-system to avoid potentially disastrous results for the local flora and fauna.

- Organic silk or vegetarian silk is made from the cocoons of wild and semi-wild and domesticated silk moths of India and China.
- In its production the pupae are not stifled or killed to obtain reeled yarn but the open ended cocoons are spun into yarn.

Greater degree of fibre purity, resulting in better yarn luster and uniformity than normal spun silk. Since the fibre is spun, it has better fibre strength and durability. The most common scouring chemical in India, a major source for silk, is perchloroethylene, or perc, the dry cleaning fluid. Perc's toxic profile is not benign. The National Toxicology Program has designated it as "reasonably anticipated to be a human carcinogen." The International Agency for Research on Cancer (IARC) has designated perc as a "probable human carcinogen." Because of the mobility of PCE in groundwater, its toxicity at low levels, and its density (which causes it to sink below the water table), cleanup activities tend to be especially difficult, inefficient, and, mostly, unsuccessful.
Here again, scouring chemicals are dissolved and used in solution so that vast quantities of water are used in silk scouring, so that water treatment is a primary concern. So, if silk scouring is performed either with or without chemicals and if that untreated water is returned to the local eco-system untreated, as it usually is, it is a step to be assiduously avoided.

Special Note

In J & K government woollen mill at Srinagar is established (manufacturing) which has a capacity of 2,018 woollen and 1,576 worsted spindles.

Leading Countries are

US, Canada, New Zealand, Denmark.

Other Eco friendly Fibres – New Innovations are as-

- BAMBOO
- CORN FIBRE
- SOYA BEAN FIBRES
- PINEAPPLE FIBRES
- BANANA LEAF FIBRES
- BLACK DIAMOND FIBRES

Try to minimize your purchase of fabrics which are blends of natural and synthetic fibres or blends of two or more different synthetic fibres (polyester and acrylic).

Because there is no hope of recycling these fabrics right now. At end of life, these fibre blends go directly to the landfill to degrade and exacerbate global warming. End of life issues are of prime importance among the eco considerations when choosing a fabric. Blends of two or more natural fibres are OK if they are in an organic FABRIC because that means the fabric is compostable at end of life (the optimal end of life solution – far above recyclability of synthetics). Please note that, if the fabric is NOT an organic fabric and is just made of organic fibre, chances are that it is infused with chemicals that prevent you from composting the fabric at end of life.

The primacy of end of life issues

Let end of life issues be a serious guide for you. At end of life, can you take the fabric off your sofa, compost it and grow tomatoes from it? Unless it is a 100% natural fibre, a 100% organic fibre and processed organically, that is, unless it is an

organic fabric, you cannot. By composting your fabric and thus diverting organic matter away from the waste stream the production of methane gas and leachate formulation in landfill sites is avoided, thus reducing global warming. As well as diverting waste away from landfill, what is seen as rubbish by many can be transformed into a valuable resource. Making your own compost creates a free source of soil conditioner and nutrients for the garden, with very little effort.

Search for a fabric or product that is certified by any third party, independent textile certification agency

There are lots of different competing textile certifications right now, so the scene is currently confusing. The only ones in use in the USA currently that are sufficiently comprehensive are: GOTS (The Global Organic Textile Standard). SMART, Sustainable Materials Rating Technology, which uses the GOTS standards, Cradle to Cradle. Care must be taken to widen the knowledge base and issues of concern for all products specified by responsible professional architects and interior designers. Green Guard is so weak as a guide to correcting environmental issues with a product that it is only marginally useful; and should be abandoned for one of the stronger certifications. Oeko-Tex 100 is a standard that has gained some acceptance. Unfortunately Oeko-Tex 100 addresses only category human and animal health concerns from using the fabric. It does not address or require any action to ameliorate any issue in any of the other three categories. But there is a subtlety here: Much of the pioneering of "green" is being done by small companies who cannot afford to certify all of their products immediately. In the absence of certifications, ask questions and, mostly, ask for data. Also take care to insure that the certification scheme you are relying on for judging the green attributes of the product you are buying is a third party certifications. A large number of self-serving certification schemes developed and promoted by industry trade associations are not intended to promote progress in reducing the toxicity of the process or product or its carbon footprint. Here again, ask for the data and the criteria. There are many organizations which certify the fibre used in the fabric.

Companies Going Sustainable

Cutter & Bucks – Fall'04 with 50 % organic, Coop of Switzerland- Sum '02 with 5% organic ,Gap Inc – launched first organic cotton collection in Sum06, Marks & Spencer - Fall'03 with 5% organic cotton, Nike – Fall 02 with 5-10% organic cotton and Lycra H&M launched first collection in Fall'05, Nordstrom – Sum 02 with 5 % Organic, Pratibha Syntax: Successfully selling blended knits of organic cotton, Bamboo, recycle cotton and other eco fibres. Tree Hugger-launched his first Bamboo blended collection in sum 06.Timberland- Spr03-Spr-06 with 5-10% organic, Under the Canopy - Successfully running eco fashion business using all sustainable fibres. Wal-Mart- Spring 07 (fully organic and blends).

Pay attention to the carbon footprint of the fabrics you buy

Bast fibres, such as hemp, linen and abaca; and natural bamboo fibre (NOT bamboo viscose necessarily) are fiercely carbon positive choices. If the natural fibres are raised organically or sustain ably, and especially using the no till method, this is a further carbon positive fact. Demand carbon footprint lifecycle analyses. These analyses can be so surprising as to be counter-intuitive. For instance, British consumers are better off, carbon footprint wise, to buy roses imported from distant Ghana than to buy roses grown in near-by Belgium.

Keep yourself educated on the progress of the eco-textile community

It is small now but passionate, and much progress can be made if you support the movement. Many new techniques are possible such as using ultrasound for dyeing, thereby eliminating the use of water entirely; and drying fabrics using radio frequencies rather than ovens, saving energy.

Demand organic textiles

Tell manufacturers and stores what you want and will buy. Yes, it's complicated and irritating – and ecotextiles are really hard to find - and they are also more expensive right now (mostly because of low volume but also because of the slower production speeds in production without chemicals). But eco consciousness in textiles is major progress in reclaiming our stewardship of the earth, and in preventing preventable human misery.

Eco fashion and silk

Ecologically responsible fashion like other things in the ecorealm, calls the aesthetic sense of the customer. Eco fashion has made several big names from both the domestic and international fashion fraternity. Silk fibre comes in vibrant colors, shades and hues, that brings you close to mother nature. It plays an important role in our lives and can also be a reflection of our personality. Eco fashion is the way out to make the textile fibre more sustainable (Linda, 2010). Bangalore based eco fashion designer (Deepika Govind) has made Eri silk soft and supple. Eri silk has natural thermal properties and is characteristically course and rugged. Deepika has now come up with soft Eri silk with a drape and bounce that, according to her challenges the pashmina. The fabric is directly woven in respective shapes, increasing fabric utilization and wastage is reduced by 15-22%.

Demand Eco Textiles

Eco textiles are really hard to find - and they are also more expensive right now (mostly because of low volume but also because of the slower production speeds in product without chemicals). Eco consciousness in textiles is major progress in reclaiming our stewardship of the earth, and in preventing preventable human misery. If the consumer, demand or support the efforts, more progress can be made rapidly.

Branding and Marketing

- To sell or export highly fashioned products with global brands and to increase the amount of the production group in total export (E.g. Kashmiri silk Carpet, silk series).

- To sell medium level fashioned products to domestic market with regional brands.
- To produce less simple/standard products and decrease the production level of outsourcing clothing.
- Technology should be used for marketing such as e-commerce.
- To improve the infrastructure of e-commerce and e-marketing is very important in a competitive world.

Role of government

The main contributions of government should be as follows:

- Support for technology and R&D.
- Support for finance ,Support for production and quality
- Support for marketing & Other kinds of supports.
- Stronger finance structure for firms.
- Economic stability.

In the Indian Union Budget, announced last month, the import duty on raw silk (not thrown) was reduced from 30 percent to just 5 percent. But the silk trade is demanding that in order to ensure that the fruit of the fall in levy reaches the silk sector, particularly the weavers, import duty on silk fabrics should be hiked from 10 percent to 40 percent. This was echoed by Mr Narendra Kapoor, former President of Eastern UP Exporters' Association (EUPEA) and Mr Jagdish Das, President of Banarasi Vastra Udyog Sangh (BVUS), (fibre 2 fashion, 2011). The silk industry is giving employment to 63 lakh people in the country including 46 lakh farmers, three lakh reelers and 14 lakh weavers. Thus, there is considerable scope for stepping up production of raw silk in the country (Srinidhigowda, 2010). Kashmir is extremely popular for its quality of silk and its traditional silk weaving industry. The state houses two large silk factories - in Srinagar and Jammu. The factory at Srinagar was manufacturing around 300,000 meters of various types of silk fabrics, georgette, parachute and suiting.

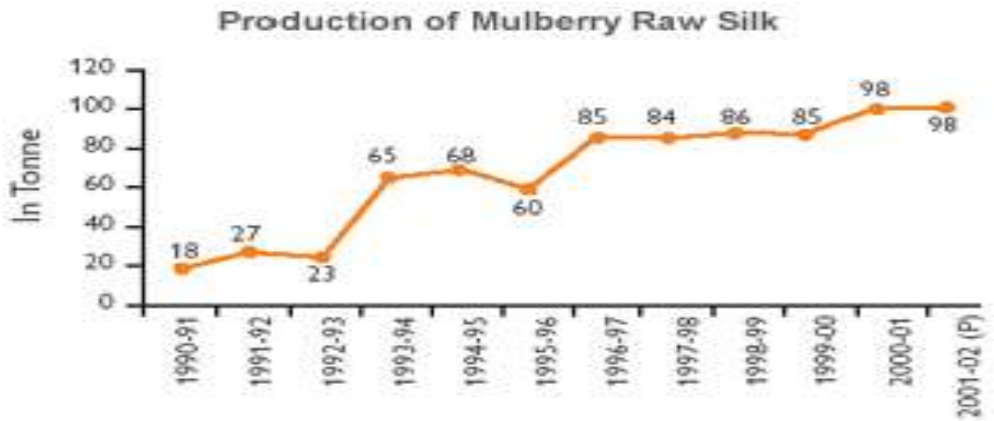
Raw silk production in J&K from 1974 to 2000

Particulars	1974-75	7977-78	1980-81	1985-86	1990-91	1995-96	1996-97	1998-99	1999-00
Production of raw silk									
Quantity (kg)	70.50	63.40	75.85	33.70	20.74	9.50	85.10	92.10	80.00
Value (lakh)	176.14	183.23	234.98	291.28	155.35	140.16	1076.00	1288.00	960.00

Raw silk production in J&K from 2001 to 2008

Particulars	2000-01	2003-04	2004.05	2005-06	2006-07	2007-08
Production of raw silk						
Quantity (kg)	21.00	18.88	17.742	17.742	9.20	8.80
Value (lakh)	0.26	0.193	0.212	0.213	1.26	1.22

[Source : Directorate of Sericulture, J&K, 2008]



Source: *India Stat*

The state also has a special package of US$ three million for the development of sericulture for price stabilization, procurement of cocoons, cultivation of mulberry plantation in private lands etc.

Silk exports to touch Rs 30 billion in 2010-11 –

The overall silk exports for the current financial year are expected to reach Rs 30 billion, J Sampath of the Central Silk Board recently said, while speaking at the opening ceremony of the 12th Silk Mark Expo in Chennai on December 24. He further said that though it is not a significant growth from Rs 26 billion worth of exports during the last fiscal, but the Board is expecting a better year ahead for the industry. He revealed that the silk weavers are drawing better returns for their produce this year, as they are drawing a price of about 2,500-2,800 per kg. In the meantime, a rise has also been witnessed in the exports to the European markets, which is for the first time after the global economic slump. Last year, where EU constituted around 35 percent of the country's overall silk exports. Silk Mark, a label certifying the authenticity and quality of the silk used in a product was also launched at the exposition. This certification label is attached to the products along with the price tag. The Silk Mark Organization of India, a subsidiary of the Central Silk Board would be supervising the certification task for silk.

Conclusion

Textile product, which is produced in eco friendly manner and processed under eco-friendly limits is known as ecotextile. There is an urge to be aware about the social, economical and ecological benefits of environmentally sustainable product development processes. Silk fibre is one of the important ecotextile and needs to be exploited, branded and marketed at a higher extent.

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