

ORGANIC FIBERS: SUSTAINABLE SOLUTION FOR TEXTILE INDUSTRY

Abstract

Textile processing industry uses thousands of dyes and chemicals resulting in discharge of polluted liquid effluents. The different kinds of dyes used in textile printing consist of hazardous heavy metals. It is one of biggest sector in India which discharge untreated textile effluents on open land, from here it seep into aquifers and increase the contamination of ground water besides air and surface water pollution. The management of waste and other environmental issues in textile industry using appropriate technology and sustainable practices is a very important issue now a day throughout the world. So, there is need to produce the textile materials which are eco-friendly. One of the steps regarding eco-friendly textile is sustainable and organic fiber production. The sustainable fibers can provide a sustainable solution to this sector. The various types of sustainable fiber which are promising in nature are organic cotton, bamboo, soya, hemp and jute etc. It is pertinent to mention that in organic fiber production no synthetic chemicals are used so, usage of sustainable fibers and organic are the one of the best solution to keep our earth clean and to minimize pollution of water, soil and air. Hence, this article discusses about various environmental friendly, ecological viable and organic fibers which can be used in textile and fashion sector for better tomorrow.

Keywords: Cotton, Organic Cotton, Natural Fiber, Textile, Environment, Dye.

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I. INTRODUCTION

The Fabric manufacturing is one of the oldest industries and most important part of the basic human needs after food and shelter. The textile and fashion industry use enormous amount of fresh water and excessive energy resources in various operations. These industries are major source of effluents in the environment and generate huge amount of waste water. The different types of operations in textile industry pollute water and create the problem of air pollution also. It is well known that cotton is the most important raw material for textile and fashion industry. Approximately 20 million tons of Cotton is processed globally annually. The cotton fulfils around one third consumption of textile and clothing. In India cotton covers around 7% of the total crop coverage after the rice. Cotton has great impact on environment being sharing significant proportion in total agricultural business as leading crop. Due to increasing pollution problems people are becoming aware about environmental issues throughout the world. The one of the solution for sustainable and organic fibres is sustainable agriculture or organic farming (Jajpura & Singh, 2015 and Singh & Jajpura, 2016).

II. IMPACTS OF TEXTILE AND FASHION SECTOR ON THE ENVIRONMENTAL

There is no doubt that textile sector provide livelihood to millions of people however, textile industry generate huge amount of waste. Moreover, this sector consumes excessive amount of good quality fresh water and generates bulky volumes of effluents from various steps through textile processing. It is estimated that the globally textile industry uses approximately 378 billion liters of water each year. It has been predicted that about 700 gallons of fresh water is utilized to make a single cotton t-shirt. The effluents from dyeing and finishing processes are generally rich in color, containing residues of toxic dyes and chemicals, and require proper treatment before being released into the environment. According to Ghoreishi and Haghghi (2003) the textile effluents are very high in color, suspended solids, heavy metals, pH, BOD and COD etc. The environmental problems created by textile industries included wastewater discharge, solid waste disposal and air emissions. The nature and characteristics of textile industry effluents through various processes is depicted in table 1.

Beside discharging wastewater and disposing solid waste in to the environment, textiles industries also emit a lot of air pollutants in the air which create health hazards and other environmental issues. The table 2 shows the summary of the different kinds of air pollutants emitted during various processes while textile manufacturing.

Hence, it is evident from table 1 and table 2 that the textile industries have a lot of environmental implications and solution to these issues is sustainable textiles and organic fibres.

III. SUSTAINABLE TEXTILES AND ORGANIC FIBRES

To meet the environmental and social aspects, textile and fashion industries are focusing more on sustainable products throughout the world. A sustainable textile uses environmental friendly and ecological viable raw materials, in-exhaustible and long lasting resources, use maximum natural dyes and rely minimum on synthetic chemicals to reduce

the environmental impacts. The sustainable textiles develop step by step keeping in mind the concept of sustainable development. The term sustainable development was coined by G. H. Brundtland while addressing World Commission on Environment and Development in 1987. The sustainable development may be defined as “developing in such a way that fulfilling our needs without compromising the ability of our future generations to meet their own needs”.

The practice of cultivation of natural fibers by employing traditional agriculture does not degrade the environment i.e. here producer does not use the synthetic fertilizers, growth hormones, insecticides and weedicides etc. There is no doubt that excessive use of manmade chemicals enhances the growth of fiber crops at very fast rate but it pollutes the environment. Moreover, fibers grown by using excessive chemical may also be harmful for human health as they may contain residues of these chemicals.

The fibers grown by using traditional agriculture and indigenous technology can curb the environmental issues in textile industries at a large scale. These organic fibers are not only biodegradable but they are also free from pesticides and other harmful chemicals. The sustainable textiles make use of natural fibers grown without using synthetic chemicals i.e. pesticides and fertilizers etc. The natural fibers like organic cotton, bamboo, flax, hemp, jute, ramie, sisal and abaca etc. grown with minimum use of manmade chemicals. These chemicals consists of pesticides, growth regulator, weed control chemicals and many more.



Figure 3: Composition of World Apparel Fibre Consumption by Fibre Type, In Percentage

The cotton is one of the main fibres used for clothing since pre historic time. It has been estimated that cotton fiber play a major role in textile industries globally. However, cultivation of cotton in the era of modern agriculture relay on excessive use of synthetic chemicals. The excessive input of these manmade insecticides/pesticides, weedicides, growth hormones and fertilizers give rise to alot of environmental issues. These include surface and groundwater pollution, excessive use of fresh water, loss of biodiversity, air pollution, soil pollution and contamination of food chain etc. It has been predicted that after petrochemical industry, textile industry is ranked second most polluting sector. According to World apparel fibre consumption survey report (2013) cotton alone has contributed more than 32% of fiber requirement globally. Moreover, 10% of global fiber requirement was fulfilled by other natural fibers as evident from figure 1. The other fibers of natural origin include wool, silk and flax. The trends have shown that nearly 25-33% of fiber demand in textile sector is governed by cotton fiber. Although cultivation of cotton especially in developing countries

provide livelihood to millions of people but is considered to be environment damaging. As per the estimate “About 54% of the total pesticides used in Indian agriculture are consumed on cotton alone, though it accounts for only 5-7% of the total cultivated area” (Puri et al, 1999).

Organic fibres cover a wide range of natural fibers and these fibres are grown by using the practice of organic farming. It is farm practice in which uses organic manure, bio-fertilizers and traditional farm practices i.e. integrated pest management or natural pesticides which favors good quality of food and fibre. Although cotton fiber has major share in textile production but nature has provided a lot natural fibers which are comparable to cotton and are eco-friendly e.g. organic cotton, bamboo, flax, hemp, jute, ramie, sisal and abaca etc.

1. Organic Cotton: The cotton grown without using pesticides and synthetic chemicals is known as organic cotton. We can say it is like organic food and such type of cotton is environmentally-friendly as compare to traditional variety as it uses different kinds of chemical inputs. There is no or minimal use of manmade industrial nutrients i.e. synthetic fertilizers for organically produced cotton. Organic cotton production has minimum irrigation demand, negligible environmental impacts and has low carbon foot prints. According to Foglia and Ferrigno, 2009 the production of organic cotton has reached to 145,865 tonnes in the 2007/08 at an average annual growth rate of 185 percent over the past three years. It has been reported that various nations globally produced cotton organically in 2013-14. The 96% of total production of this cotton was shared by five countries namely India, China, Turkey, Tanzania, and the U.S. Moreover, India alone produced 74%, followed by, China, Turkey, Tanzania, and the U.S. at 10%, 7%, 3%, and 2% respectively (Textile Exchange, 2015a). However, the cotton produced organically must be certified by some certifying agencies. According to Blackburn, 2009 the soil which is to be used for the cultivation of organic cotton should be free from the application of synthetic chemicals i. e. pesticides and fertilizers since last three successive years. Hence, it is tedious task to achieve the certificate for organic cotton from certifying agency. Initially there would be fewer yields while cultivating organic cotton due to less or no use of synthetic fertilizers and other chemicals but it has tremendous growth potential in future due to increase in ecological concern.

Beside, organic cotton there lot of bast fibers of natural origin and the cultivation of these fiber crops require no or minimum chemical input. These fibers may be called as sustainable fibers and some of them are jute, sisal, abaca hemp, linen, and kenaf etc. The sustainable fibers require minimum or no application of chemical inputs i.e. pesticides, growth hormones and fertilizers as compared to traditional cotton cultivation. Some of the natural fibers that can be used for apparel production are mentioned below in brief:

2. Hemp: After organic cotton it is very promising natural fibres that is grown for manufacturing of rope, parachutes and denim and is grown without the use of chemicals, pesticides, herbicides or fertilizers. The fibers of hemp are naturally rough and it is the one of the major drawback of hemp fibers. However, new techniques have been established to produce soft and durable textiles by using hemp fibers. The cultivation of hemp naturally requires little irrigation, negligible synthetic fertilizers and chemical pesticides.

3. **Linens:** The material made from fibres of plant flax is known as linen. The linen fibre is very strong as compare and durable to cotton. It is a nature fiber and requires negligible synthetic fertilizers and other growth promoters. Due these reasons this fiber is environmental friendly in nature. Linen is calm and cool and suitable for summer wear i.e. very useful in hot and arid climate.
4. **Bamboo:** Bamboo is a highly renewable grass, eco-friendly in nature and is 100% biodegradable. It is very interesting that there is no chemical modification while spinning bamboo into yarns. The natural enzymes present in the plant are used for disruption its walls into a pulp so that the usual fibers can be mechanically scoured out and spun into yarn. The fabrics made from bamboo plant are anti-microbial, hypoallergenic and thermal regulating. Bamboo has a wider application due to its comfort, soft, lustre and absorbency. The other way for manufacturing yarn from bamboo plant is by chemical treatment by regenerating the cellulose fiber, which makes Bamboo Viscose.
5. **Banana:** Banana is grown in more than 130 countries worldwide and it is world's second most important fruit crop. According to an estimate more than 71 million metric tonnes of banana is produced worldwide annually. The banana fiber has a lot of application e.g. packing industry, for making currency, rope manufacturing and sanitary products etc. One of the most important outcomes of using banana stem and leaves to produce its fiber is the management of organic waste. Moreover, banana fiber can also be blended with different kinds of fibers beside cotton fiber. The blending of banana fiber with other fibers is very promising technique to manufacture blended apparels. The cultivation of banana requires minimum synthetic pesticides and fertilizers i.e. cause minimum environmental degradation. Furthermore, its cultivation reduces deforestation and provide livelihood to people. Venkata subramanian et al. (2014) have reported that banana fiber is used to produce fabrics in Japan and Nepal at large scale.
6. **Corn:** Corn fibre is 100% biodegradable and eco-friendly in nature. There is little requirement of water for irrigation, synthetic fertilizers and other chemical input for corn crop. As compare to cotton it posses good dye ability. It is expected that corn fibre can be used for manufacturing of sportswear, jacket and coatetc. in the future as claimed by certain researcher.
7. **Coir:** Traditionally the fibers of coconut are used for rope and mat manufacturing. These fibres have high lignin and low cellulosic content and they are light weight, resilient durable and biodegradable in nature. Beside rope and mat the fibre from coconut may also be used in apparel.

Beside these natural fibres research are going on throughout the world for sustainable and organic fibres e.g. soya, pineapple, wool and aloe vera etc.

IV. CONCLUSION

It is well known that earth is the only planet where we can live therefore; Sustainability in textile and fashion industries is a solution to reduce the environment pollution. There is no doubt that textile industries generate economic growth, but it is associated with side effects of health hazards of different kind of pollution. It is necessary to

take care of such pollution by introducing alternate raw material, organic fibres, clean technology, regulatory measures and awareness creation in textile and fashion industry. The fiber of natural origin grown organically is a simple and promising solution for textile industry to reduce environmental issues. The principal of producing organic fiber is similar to the principal of organic food production i.e. no use of synthetic chemical. Various countries throughout the world are adopting this practice of organic fiber production. The different types of natural fibres grown organically have a potential to curtail the environmental pollution. One of the most environmental degrading steps in textile is dyeing process. The natural plant and flower based dyes is answer to this problem. Moreover, different kind of enzymatic operations and biopolymers may be used to curtail environmental issues in textile sector. This practice also helps in promotion of the concept of green and clean environment with conservation of biodiversity keeping in mind the rights of future generation.

Table 1: Textile Industry Effluent Characteristics

Sr. No	Process	Effluent Composition	Nature
1	Sizing	Starch, waxes, carboxymethyl cellulose (CMC), polyvinyl alcohol (PVA), wetting agents.	High in BOD, COD
2	Desizing	Starch, CMC, PVA, fats, waxes, pectins	High in BOD, COD, Suspended Solids, Dissolved solids (DS)
3	Bleaching	Sodium hypochlorite, Cl ₂ , NaOH, H ₂ O ₂ , acids, surfactants, NaSiO ₃ , sodium phosphate, short cotton fibre.	High alkalinity, high Suspended Solids
4	Mercerizing	Sodium hydroxide, cotton wax	High pH, low BOD, high DS
5	Dyeing	Dyestuffs urea, reducing agents, oxidizing agents, acetic acid, detergents, wetting agents.	Strongly coloured, high BOD, DS, low Suspended Solids, heavy metals.
6	Printing	Pastes, urea, starches, gums, oils, binders, acids, thickeners, cross-linkers, reducing agents, alkali.	Highly coloured, high BOD, oily appearance, suspended solids, slightly alkaline.

Source: Pollution Research Group (PRG), (1998). "Waste Minimization Guide for the Textile Industry – A Step towards Cleaner Production". University of Natal, Draft Volumes 1-2.

Table 2: Air Pollutants Generated During Textile Manufacturing

Sr. No	Process	Sources	Pollutants
1	Energy production	Emissions from boiler	Particulates, N ₂ O, SO ₂
2	Coating, drying and curing	Emission from high temperature ovens	Volatile organic components (VOCs)

3	Cotton handling activities	Emissions from preparation, carding, combing, and fabrics manufacturing	Particulates
4	Sizing	Emissions from using sizing compounds (gums, PVA)	NO _x , SO _x and CO
5	Bleaching	Emissions from using chlorine compound	Chlorine, chlorine dioxide
6	Dyeing	Disperse dyeing using carriers Sulphur dyeing; Aniline dyeing	Carriers H ₂ S, Aniline vapors
7	Printing	Emission	Hydrocarbons, ammonia
8	Finishing	Resin finishing heat setting of synthetic fabrics	Formaldehyde
9	Chemical storage	Emissions from storage tanks	Volatile organic components
10	Wastewater treatment	Emissions from treatment tanks	Volatile organic components, toxic emissions

Source: Parvathi, C., Maruthavanan, T. and Prakash, C. (2009). "Environmental impacts of textile industries". The Indian Textile Journal, November issue, Available from www.indiantextilejournal.com

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