

# Bamboo Fiber: An Approach toward Sustainable Development

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**Abstract:** *The fashion world is constantly seeking and latching onto new materials. The adoption of eco-friendly products has become a fashion statement. Among many eco friendly products bamboo is the fastest growing tree on the earth. Bamboo, a renewable resource grown widely throughout Asia, serves as medium for manufacturing numerous utility and decorative article. The present day scenario shows that the people are more conscious about environment and also personal health. People are deeply attracted towards eco friendly fabric process because it minimizes the waste and hazardous by-product. Bamboo fabric is considered as an eco fabric because of its softness, drapability and as it is grown without using pesticides. Due to the high functional properties it can be used for medical, military, industrial, domestic, apparel and household furnishing. This paper presents an overview on properties, ecological benefits and characteristic of bamboo fiber.*

**Keywords:** Bamboo fiber, Manufacturing, Sustainable development, Apparel industry, Eco friendly

## 1. Introduction

Clothing is something that is required by all human beings. It is the most fundamental requirement needed to survive. Clothes can either be produced from natural fibers such as cotton, wool, silk, hemp and linen or from manmade fibers such as rayon; nylon etc. Textile mills take the natural and synthetic raw material and turn it into fiber, yarn and fabric. Clothing has a lot of chemicals that a normal consumer may never know about in his lifetime. On an average six hundred dyes and chemical are used, the most common are aldrin, benzo and chlorolane. These chemical can have from minor effects on the consumer's body such as rashes and allergies to major skin problems and other lung and kidney problems. Chemical in clothes can also cause prostate, pancreas, liver and bladder cancer(Cantoria, 2010) Even though clothes have many chemicals in them but they can also be produced without the over whelming use of chemicals. Clothes can be produced by using crops that are grown organically and this clothing is known as organic clothing. In organic clothing, the crops that are used as raw material are grown without the use pesticides. When fibers are derived from such crops they are woven, spun, sized, desized, scoured and finished without the use of chemicals.As the fashion brands are move towards more eco friendly fabrics, the world of textiles continues to break new grounds with innovative fibers being explored. The use of eco friendly and natural fibers like cotton, silk, jute, bamboo are on the rise and some fresh sustainable and biodegradable fibers from trees , fruits and other edible products are being explored to give more options to the world of fashion. The adoption of eco friendly products has become a fashion statement. Among these eco friendly products bamboo is the fastest growing tree on earth, a renewable resource that can be used in the production of eco- textiles.

**Table 1:** Bamboo fiber

Common Name	Local Name	Botanical Name
Bamboo	Baans (hindi) Veduru( telugu) Biduru (kannada)	Bambusa vulgaris

A bamboo fiber has a good reputation for the benefit to both human and earth in the clothing industry. With more than 87 genera and 1,500 species worldwide (Diver 1976), bamboo constitutes an economically important group of plants, especially in Asia (Parameswaran & Liese 1976). Currently, bamboo is emerging as a natural, eco-friendly raw material in the textile industry due to its many attractive properties such as fastest growth rate of any known plant, anti-microbial properties, etc. The species that is used for apparel production grows faster than any other plants. It can grow up to 122cm per day and quickly reaches heights on 12 meter. The cultivation of bamboo needs no pesticides or chemical fertilizers and therefore it is naturally organic. Bamboo requires much less land and water than cotton, organic cotton and other alternative fibers. Bamboo requires only natural rainfall where 15000 liter of water is needed to grow 1kg of cotton.

### Characteristics of Bamboo

- Bamboo is the fastest growing woody plant on this planet
- A viable replacement for wood
- An stable natural resource
- A critical element of the economy
- A renewable resource for agro forestry products
- A soil conservation tool
- An ancient medicine
- Integrally involved in culture and the arts
- A food source

## 2. Ecological Reasons for Using Bamboo for Textiles and Clothing

- **Astonishing growth-** Reaching up to 35 meter tall, bamboo is the largest members of the grass family. Bamboo is the fastest growing woody plant in the world. The high growth rate of bamboo and the fact that bamboo can grow in such diverse climate makes the bamboo plant a sustainable and versatile resource.
- **Harvesting-** Bamboo can be continually re-harvested and do not damage the surrounding environment. It is a grass and so regenerates after being cut just like a lawn without the need of replanting.
- **Green house gasses and global warming-** Extreme growth of bamboo minimize Carbon di-oxide and generates up to 35% more oxygen than equivalent stands of trees.
- **Water use-** It can take up to 20,000 liter of water to produce 1kg of cotton and 73% of global cotton harvest comes from irrigated land. Bamboo on the other hand requires only 500 liters of water to produce 1kg and no irrigation at all.
- **Biodegradable-** As a natural product derived entirely from plant cellulose, bamboo fiber is biodegradable in soil by microorganism and sunlight. Clothing made from bamboo can be composted and disposed of in an organic and environmental friendly manner.
- **Bamboo fiber** is called “Air Vitamin” or “long lived element” in the Chinese academic world. It can release 2600 anions per cm<sup>3</sup>. Anions are very helpful for human health activating cell of our body, purifying blood, assisting with recovery, calming vegetative nervous system and improving allergic constitution.

### Manufacturing Stages of Bamboo Fiber



From left to right: (1) raw bamboo is gathered, (2) bamboo is crushed and processed into thick pulp (raw chemical bamboo fibre) (Pure Fiber 2008), (3) bamboo is further processed into fine pulp sheets, (4) bamboo pulp is manufactured into fibre through wet spinning process, (5) bamboo fibres are spun into yarn

Bamboo grows naturally without using any herbicides, pesticides and irrigation. It grows with natural rainfall. There are two processes to make the bamboo plant into a textile fiber.

There are two methods of manufacturing of bamboo fiber- In the mechanical method the woody parts of the bamboo plant are crushed and then natural enzymes are used to break the bamboo walls into a mashy substance so that the natural fiber can be mechanically combed out and spun into yarn. This is called as an eco friendly manufacturing process but it is more labor intensive and costly than the chemical process. Chemically manufactured bamboo fiber is a regenerated cellulose fiber similar to rayon. Bamboo fiber is chemically

manufactured by cooking the bamboo leaves and woody parts in strong chemical solvents such as sodium hydroxide and carbon disulphide with multi phase bleaching. This method of manufacturing bamboo fiber is less time taking and not eco friendly.

The general process for producing regenerated bamboo fiber is furnished below:

- **Preparation:** Bamboo leaves as well as the soft, inner pith from the hard bamboo trunk are extracted and crushed;
- **Steeping:** The crushed bamboo cellulose is soaked in a solution of 15% to 20% sodium hydroxide at a temperature between 20°C- 25°C for one to three hours to form alkali cellulose.
- **Pressing:** The bamboo alkali cellulose is then squeezed mechanically to remove excess sodium hydroxide solution.
- **Shredding:** The alkali cellulose is mechanically shredded to increase surface area and make the cellulose easier to process.
- **Ageing:** The processed cellulose is then left to dry for 24 hours. During this process, the shredded alkali cellulose is allowed to stand in contact with the oxygen of the ambient air. Because of high alkalinity, the alkali cellulose is partially oxidized and degraded to lower molecular weights. This degradation is to be controlled to produce chain lengths shorter enough to give proper viscosities in the spinning solution.
- **Xanthation:** Carbon disulfide is added to the bamboo alkali cellulose to sulfurize the compound causing it to jell. Any remaining carbon disulfide is removed by evaporation due to decompression and cellulose sodium xanthate is the result.
- **Dissolving:** A diluted solution of sodium hydroxide is added to the cellulose sodium xanthate dissolving it to create a viscose solution consisting of about 5% sodium hydroxide and 7% to 15% bamboo fiber cellulose.
- **Spinning:** After subsequent ripening, filtering and degassing, the viscose bamboo cellulose is forced through spinneret nozzles into a large container of a diluted sulfuric acid solution which hardens the viscose bamboo cellulose sodium xanthate and reconverts it to cellulose bamboo fiber threads which are spun into bamboo fiber yarns to be woven into reconstructed and regenerated textile products of bamboo.

## 3. Chemical Composition of Bamboo Fiber

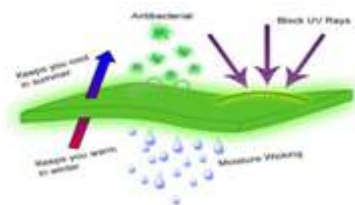
The main constituents of bamboo culms are cellulose, hemicellulose and lignin, which amount to over 90% of the total mass. The minor constituents of bamboo are resins, tannins, waxes and inorganic salts. Compared with wood, however, bamboo has higher alkaline extractives, ash and silica contents (Tomalang et al. 1980)

% Ash	%Ethanol toluene extractives	% Lignin	% Cellulose	Pentose
1.3	4.6	26.1	49.1	27.7
2	3.4	23.8	42.3	24.1
1.9	3.4	25.3	25.3	26.5

## Properties of bamboo fiber

### • Anti Bacterial Property

Bamboo fiber has natural functions of anti-bacteria and deodorization character. Bamboo possesses a unique anti-bacteria agent named "bamboo Kun". This substance imparts the natural functions of anti-bacteria and deodorization



### • Anti UV Radiation

Due to anti-ultraviolet nature, it is suitable for making summer clothing for the protection of human skin from damages of ultraviolet radiation



### • Thermal Regulating Property

Bamboo fabric is thermal regulating. It reduces temperature in hot weather and warms the body in cool weather.

**Antistatic-** A characteristic of bamboo fiber is such that it absorbs moisture due to micro-gaps and static electricity is hard to be generated. Bamboo fiber does not contain free electron and thus it is antistatic.

## 4. Application of Bamboo Fiber in Apparel Industry

Bamboo fabric has been growing in popularity because of the aforementioned unique properties. Bamboo fibers are the newest thing to hit the textile arena. Clothes made of this fabric sell for around the same price as ordinary clothes and have a distinctive softness and cool, light texture. The fabric is highly versatile.

- Bamboo intimate apparels:** Include sweaters, bath-suits, mats, blankets, towels, etc. may have comfortable hand, special luster, good water absorbance and are available in bright colors.
- Bamboo non-woven fabric:** It is made by pure bamboo pulp, which has same property as viscose fibers. However, bamboo has wide prospects in the field of hygiene materials such as sanitary napkin, masks, mattress, and food-packing bags due to its anti-bacterial nature.
- Bamboo sanitary materials:** Include bandage, mask, surgical clothes, and nurses' wears and so on. The bamboo fiber has natural effects of sterilization and bacteriostatic, therefore it has incomparably wide foreground on application in sanitary material such as sanitary towel, gauze mask, absorbent pads, and food packing and so on.

- Bamboo bathroom series:** Bamboo towel and bath robe have soft and comfortable hand feeling and excellent moisture. Bamboo fiber socks Different medical products made from bamboo fiber absorption function. Its natural antibiosis function keeps bacterium away so that it would not produce bad odor.

## 5. Conclusion

The textile industry is a major pollutant in view of the high dependence on pesticides and chemical fertilizers and water. Life standard is nowadays getting higher. The demands of people in all areas are increasing as well as the requirements regarding new textile materials with new or improved properties which are important for the required higher comfort or industrial use The versatility of bamboo fiber makes it an excellent substitute of cotton for the manufacturing of protective, healthcare and hygiene textiles which ranges from gauges, wipes, bandages, patient-nurses uniform, etc. Therefore, bamboo fiber is praised as "the natural, green, eco-friendly with high medicinal value new-type textile material of 21st century".

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