



BAMBOO: AN ALTERNATIVE SOURCE FOR PRODUCTION OF TEXTILES

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Bamboo Trees



"Bamboo fiber comes from nature, and completely returns to nature in the end" therefore bamboo fiber is praised as "the natural, green, and eco-friendly new-type textile material of 21st century".



INTRODUCTION

- Bamboo is fastest growing woody plant on this planet. It grows one third faster than the fastest growing tree. Sometimes the growth of Bamboo is approximately three feet over a night..
- Bamboos are plants of global interest because of their distinctive life form, their ecological importance and the wide range of uses and values they have for humans.
- Bamboo has tremendous economic potential. Bamboo use in India has a long and wide history. Millions of people in India depends on bamboo for housing, food, fuel, paper and even cloth.
- Bamboo and its related industries already provide income, food and housing to over 2.2 billion people worldwide.



- India has one of the richest bamboo resources in the world, second to China in Bamboo production.
- The annual bamboo production in the country is estimated at 3.23 million tons.
- According to Forest Survey of India (FSI), in India bamboo grows in 8.96 million hectares of forest area, which constitutes about 12.8% of total forest area of the country.
- Government of India runs National Bamboo Mission (NBM) to promote growth of bamboo sector.
- Generating employment opportunities for skilled and unskilled persons, especially unemployed youths.



- Governments such as India, China and Burma with million hectares of bamboo reserves collectively, have begun to focus attention on the economic factors of bamboo production.

- The numbers of species of bamboo existing in India are approximately 130 .

- India is one of the largest producers of bamboo in the world next to China and Brazil



Bamboo Fibre.....

- Bamboo is a regenerated cellulose fiber produces from bamboo pulp.
- Bamboo fiber is biodegradable textile material.
- As a natural cellulose fiber, it can be 100% biodegraded in soil by microorganism and sunshine.
- It's decomposition process doesn't cause any pollution environment.
- "Bamboo fiber comes from nature, and completely returns to nature in the end" therefore bamboo fiber is praised as "the natural, green, and eco-friendly new-type textile material of 21st century".
- Physical and chemical properties of bamboo fiber are nearly close viscose.



Bamboo Fibre Properties

- It has good durability, softness, luster, stability, moderate tenacity, good spinability.
- Bamboo products are further characterized by its good hydrophilic nature, excellent permeability, soft feel, excellent dyeing behavior and its antimicrobial property.
- It is facts that Linen, Hemp based fabrics are coarser than bamboo fabric. Bamboo can be spun purely or blended with other materials such as cotton, hemp, silk, polyester and viscose etc.
- Bamboo fiber is naturally anti-bacterial, UV protective, biodegradable, breathable cool, strong flexible, soft and has a luxurious shiny appearance.



Bamboo Fibre Properties

- Bamboo fiber absorbs and evaporates sweat very quickly.
- Its ultimate breathability keeps the wearer comfortable and dry for a very longer period.
- It is 3-4 times more absorbent than cotton fabric .
- Fabrics made from bamboo fiber are highly breathable in hot weather and also keep the wearer warmer in cold season.
- Bamboo is naturally cool to the touch. The cross-section of the bamboo fiber is filled with various micro-gaps and micro-holes leading to much better moisture absorption and ventilation.
- It is also very warm in cold weather, because of the same micro structure as the warm air gets trapped next to the skin.



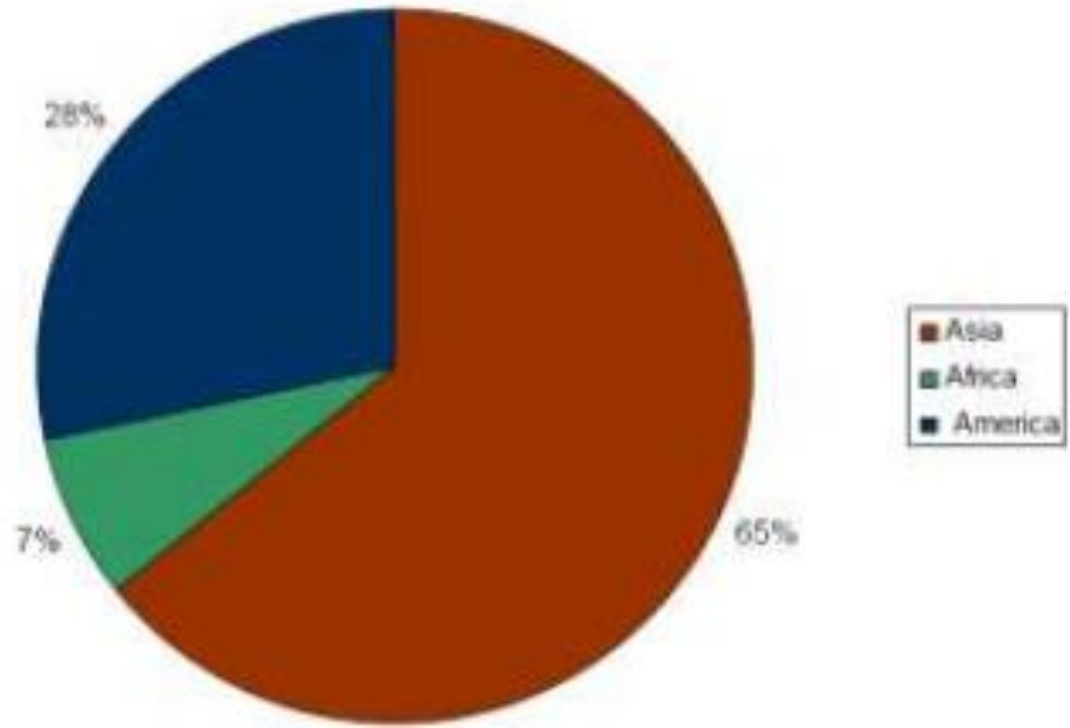
Bamboo Fibre Properties

Bamboo fiber can be softer even than silk fibre when spun into yarn.

- It has a basic round surface which makes it very smooth and to sit perfectly next to the skin.



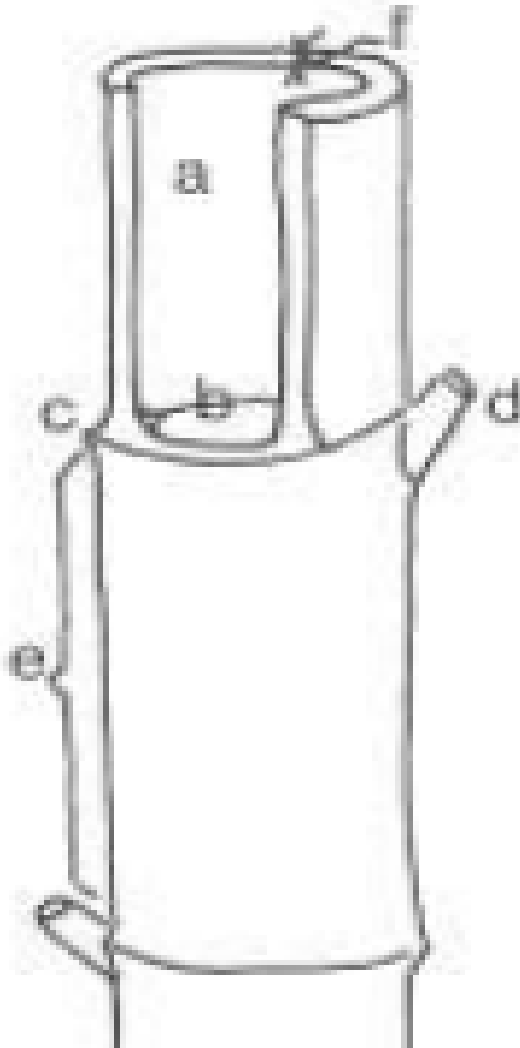
Contribution of World Bamboo Resources by Continent ⁽⁷⁾



FAO 2007



Structure of Bamboo Stem (7)



- a- Cavity
- b- Diaphragm
- c- Node
- d- Branch
- e- Inter node
- F- Wall



Classification of Bamboo Stem

Category

Specification (bottom girth in cms)

- Super class 18 cms and above
- Special class 15 to 18 cms
- Class I 12 to 15 cms
- Class II 9 to 12 cms
- Class III below 9 cms

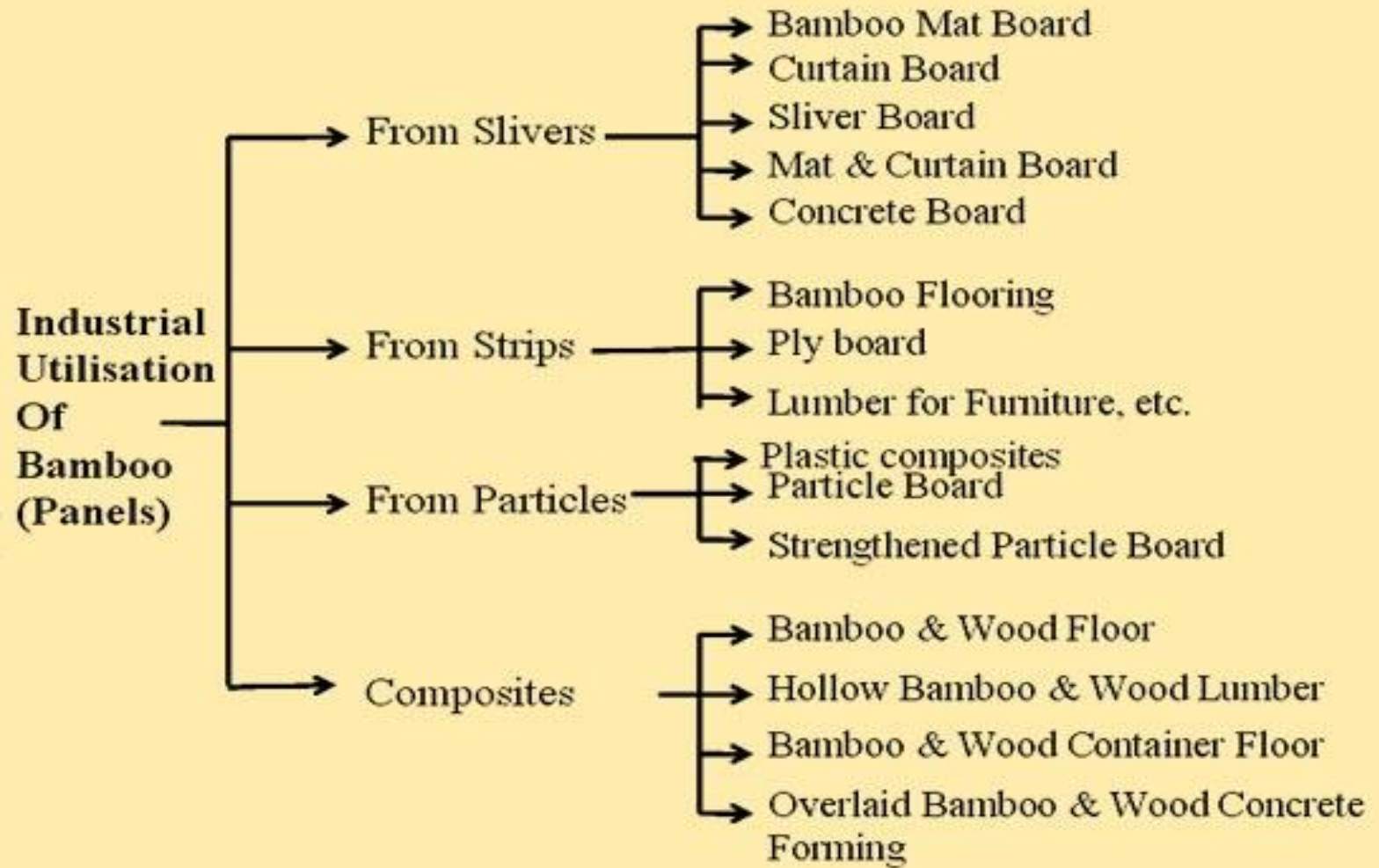


Mechanical Properties of Bamboo

- Tensile Strength (kN/cm^2)
- Compressive Strength (kN/cm^2)
- Elastic Modulus (kN/cm^2)
- Bending Strength (kN/cm^2)
- Shearing Strength (kN/cm^2)
- Fracture Behaviour



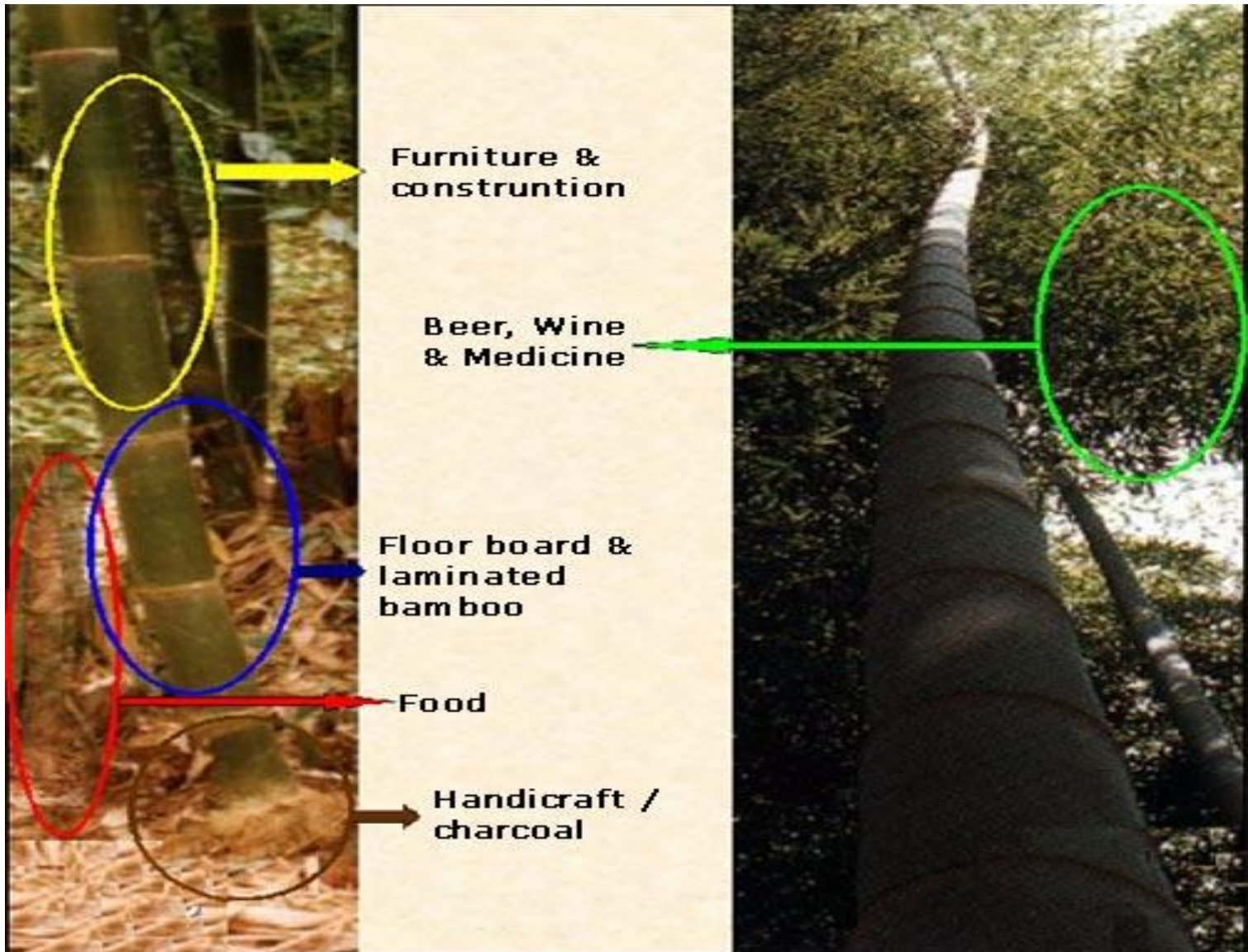
Utilisation of Bamboo ⁽⁶⁾



This process takes full advantage of the easy splitting characteristics of Bamboo in the parallel direction. Bamboo strips are split into thin slivers (0.8 – 2.0 mm & 10 – 20 mm wide). These slivers are either weaved into mats or woven to curtains with thread.



Utilisation of Bamboo ⁽⁶⁾





Different Products of Bamboo ⁽⁶⁾



Sourec: National Bamboo Mission



Different Products of Bamboo



Train Wall Boards

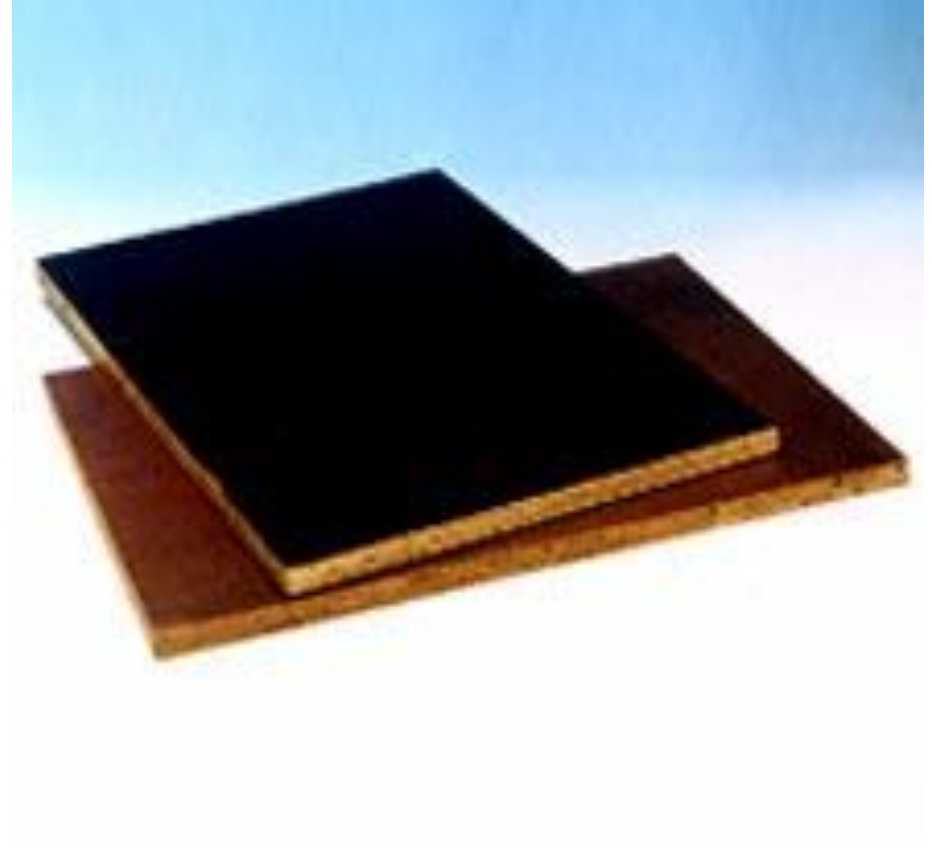


Freight Trains Boards

Different Products of Bamboo



Bamboo Mat



Sliver Board from Multi Bamboo



Different Products of Bamboo



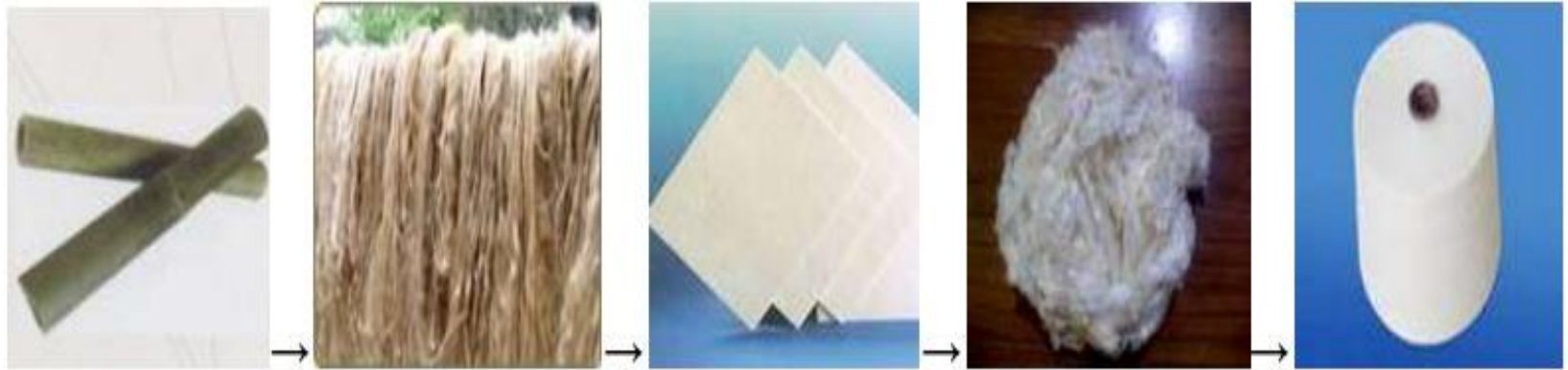
Overlaid Bamboo Mat



Sliver Board from Muli Bamboo



Manufacturing Stages of Bamboo Fibre ⁽⁷⁾

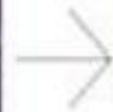
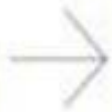
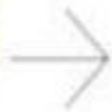


From left to right: (1) raw bamboo is gathered, (2) bamboo is crushed and processed into thick pulp (raw chemical bamboo fibre) (Pure Fiber 2008), (3) bamboo is further processed into fine pulp sheets, (4) bamboo pulp is manufactured into fibre through wet spinning process, (5) bamboo fibres are spun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

Simplified Bamboo Viscose Manufacturing Steps (Lin 2008)



Manufacturing Process Bamboo Fibre (7)



Left to right: (1) raw bamboo gathered, (2) bamboo braised into strips, (3) bamboo steamed and crushed, (4) biological enzymes added for degumming, and (5) bamboo fibre carded and spun into yarn

Simplified Mechanically-Manufactured Bamboo Fibre Process (Lin 2008)



Bamboo Trees





Bamboo Fibre & Yarn



Other Applications of Bamboo



Bathroom Series

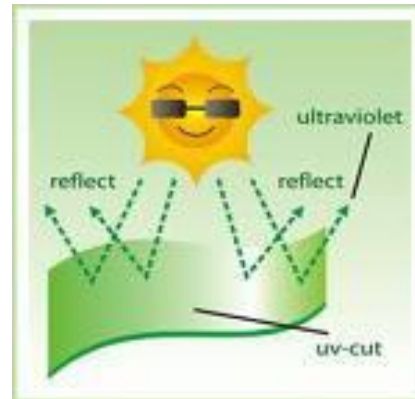


Breathable Bamboo Fabric

Decorative Materials



UV Protective Clothing





Bamboo Textiles



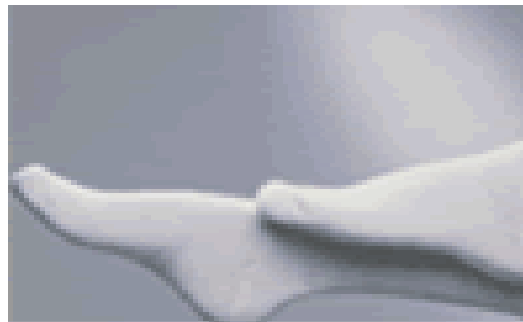
Bamboo T-shirt



Bamboo Towel



Bamboo Garment



Bamboo Socks



Bamboo Cloths

Medical Textiles

- Application as Medical Textile



Gowns



Masks



Caps



Drapes

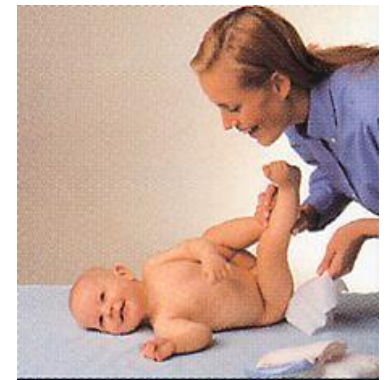
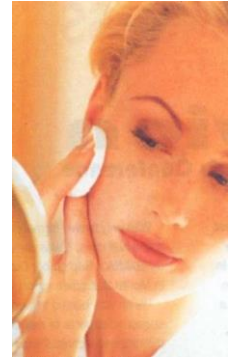
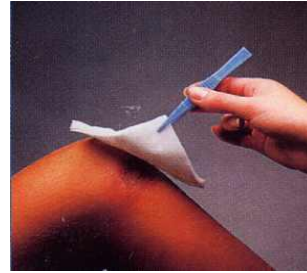


Shoe Cover



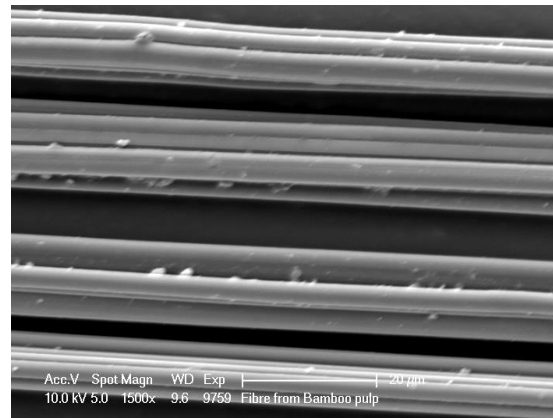
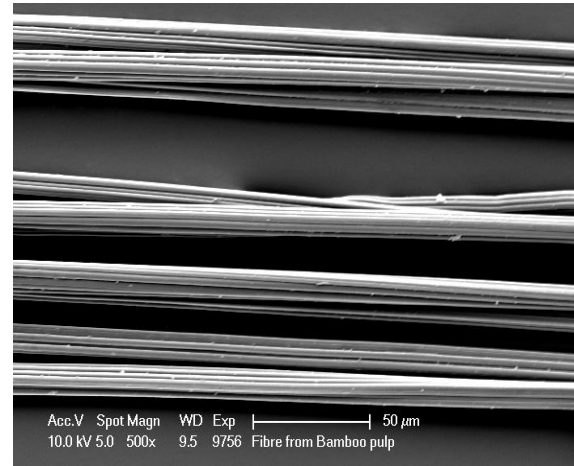
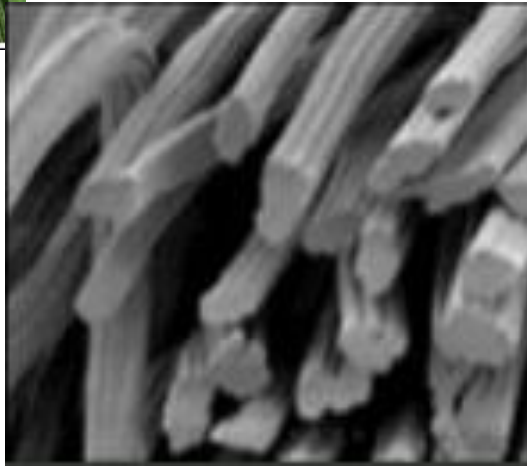
Wipes

Cosmetic / Hygiene products





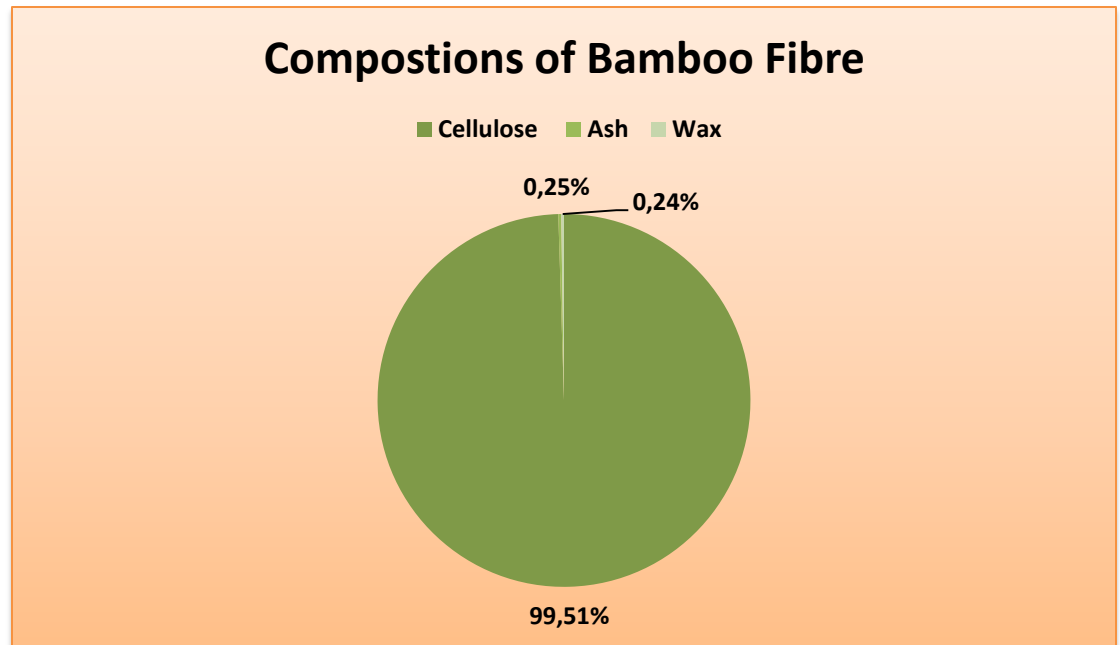
Cross Section of Bamboo Fibre





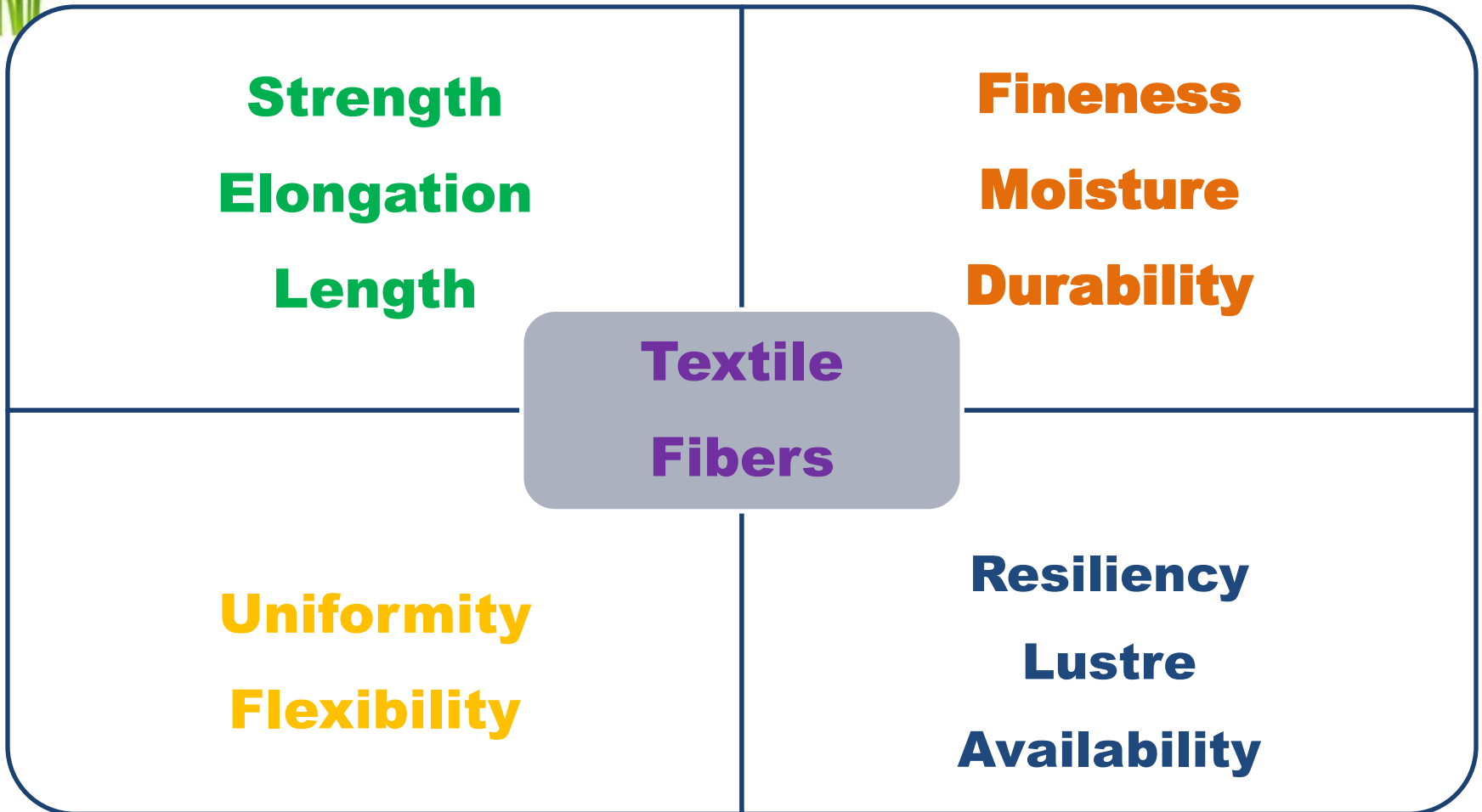
Compositions of Bamboo Fibre

- Content** **%**
Cellulose **99.51**
Ash **0.25**
Wax **0.24**





Characteristics Requirements of Textile Fibres





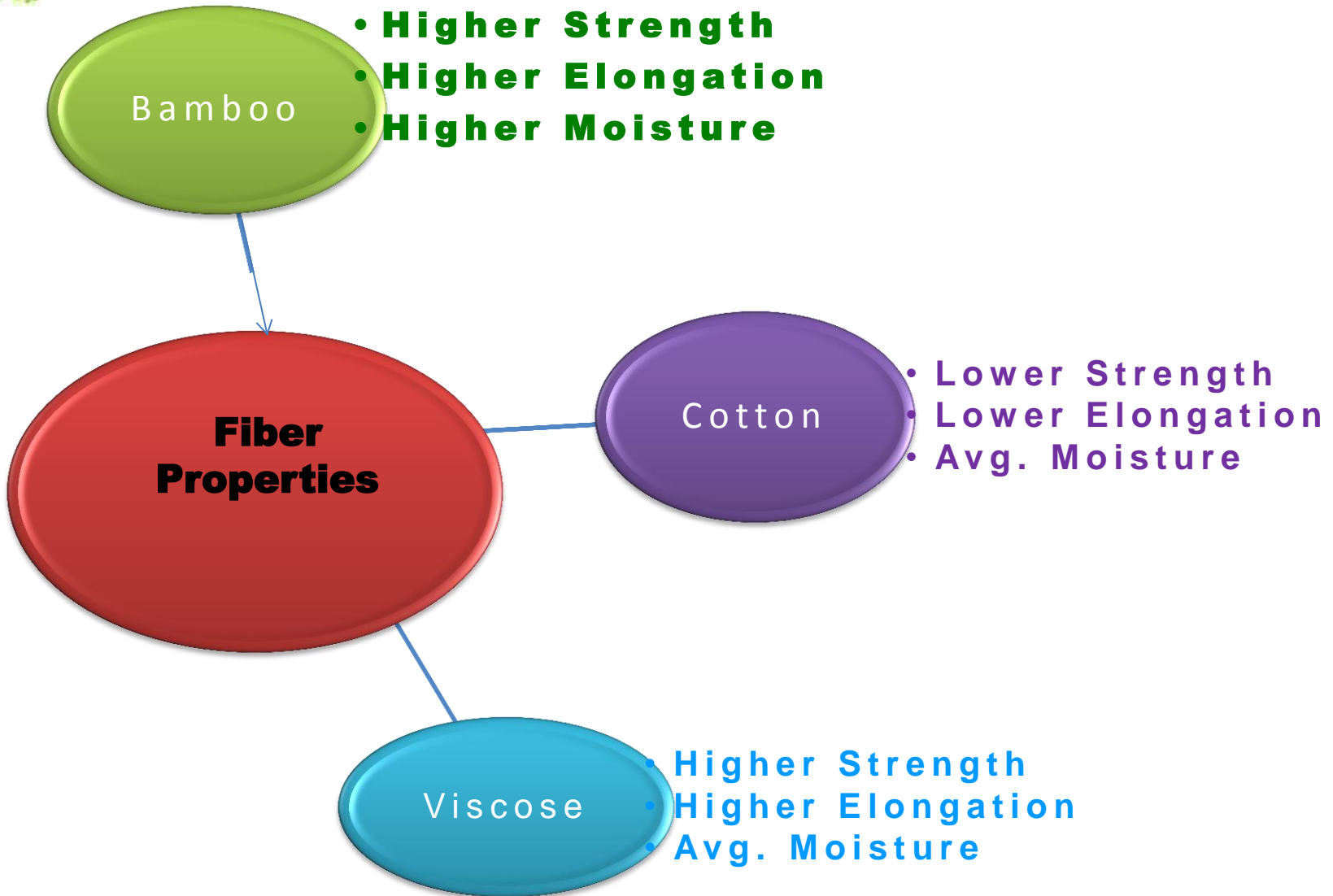
Result & Discussion

Physical Properties of Bamboo, Cotton & Viscose

| Properties | Bamboo | Cotton | Viscose |
|----------------------|--------------|--------|---------|
| Strength (gm/tex) | 45.6 | 30 | 44.1 |
| Elongation (%) | 15 | 5.3 | 14.3 |
| Short Fibre Index | 5.28 | 9.07 | 5.57 |
| Uniformity Index (%) | 92.8 | 81.1 | 92.9 |
| UHML(mm) | 38.21 | 29.91 | 36.97 |
| ML (mm) | 35.45 | 24.25 | 34.34 |
| Moisture (%) | 7.7 | 7.5 | 6.9 |
| Micronaire | 5.18 | 3.26 | 5.19 |

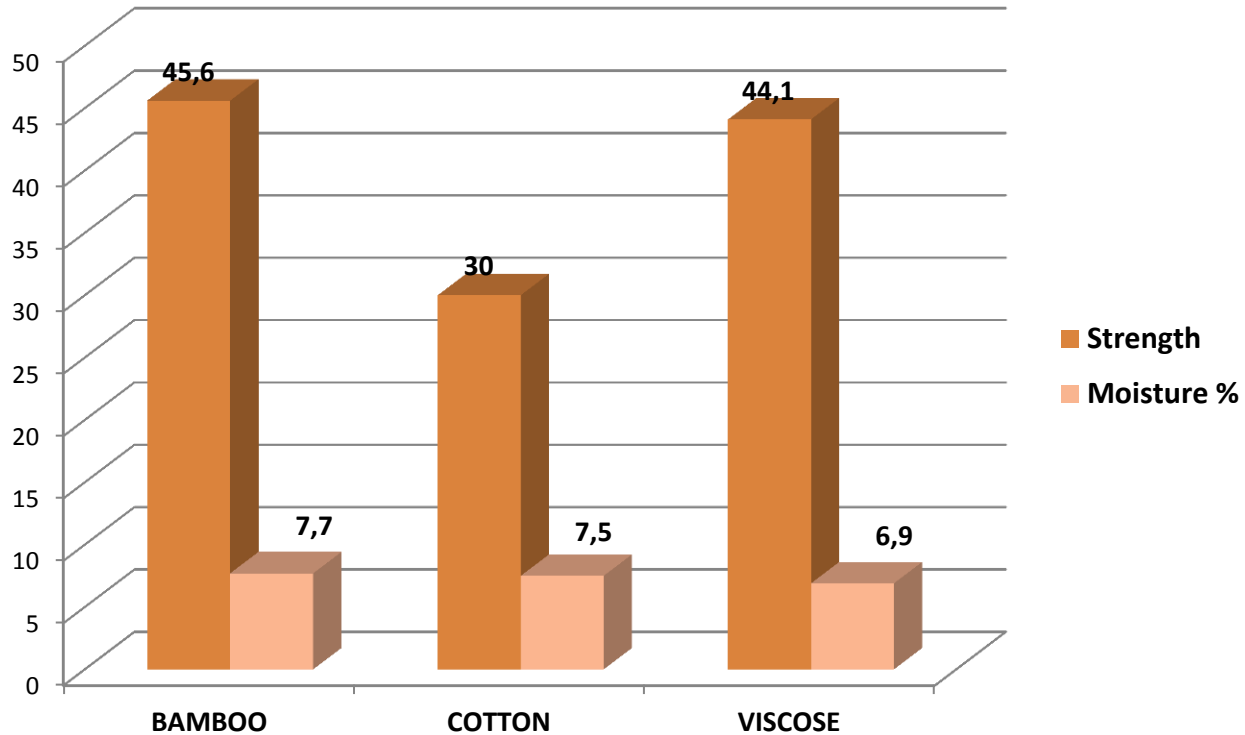


Comparision of Fiber Properties





Comparision of Bamboo, Cotton & Viscose



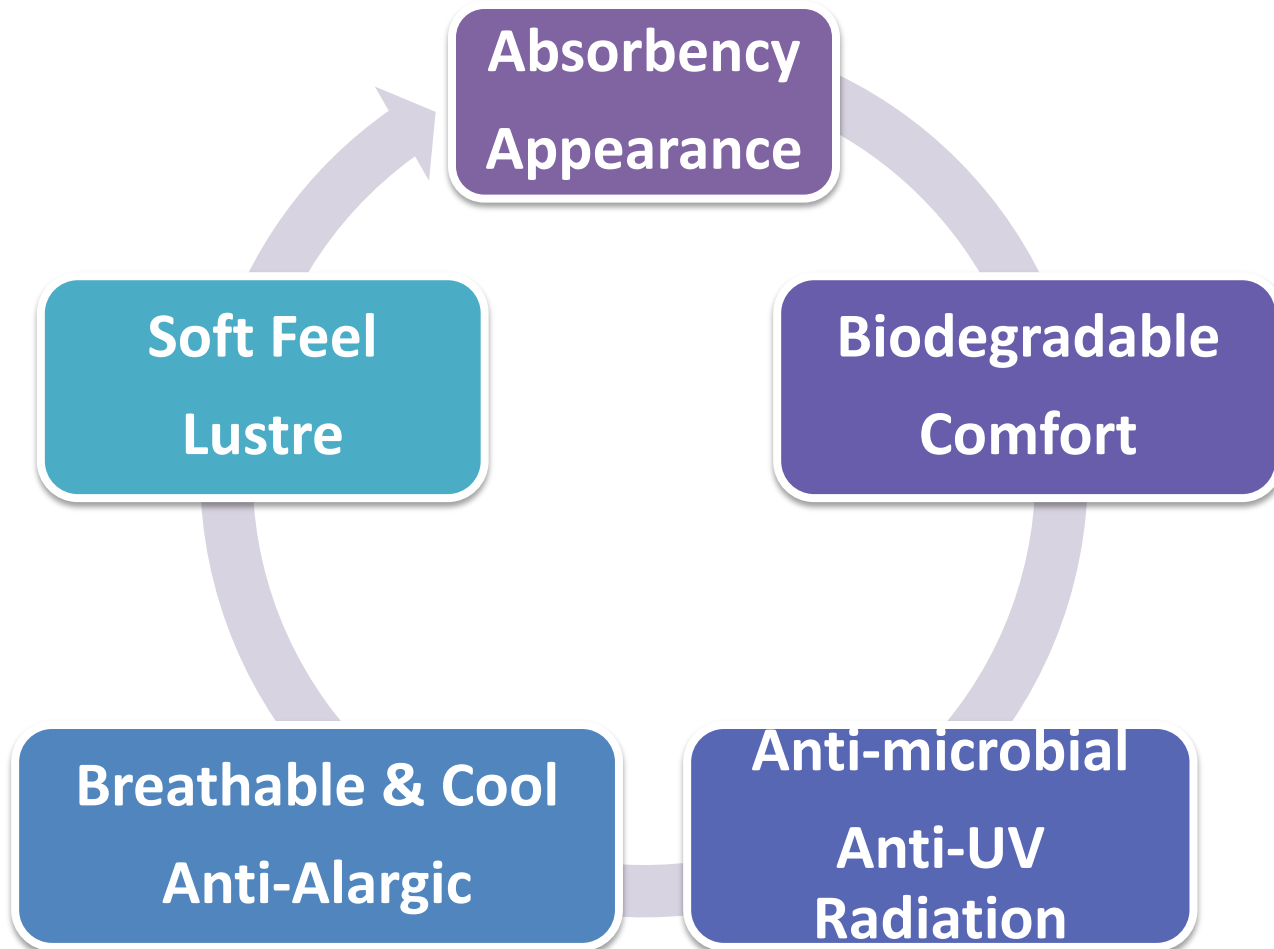


Properties of Bamboo & Cotton Yarn- 40Ne

| Properties | BAMBOO | COTTON |
|----------------------------------|--------------|--------------|
| Strength (Rkm Kgf*Nm) | 17.03 | 16.25 |
| Elongation (%) | 13.28 | 6.43 |
| Unevenness (U %) | 10.56 | 10.41 |
| Hairiness Index | 3.926 | 5.55 |
| Coefficient of variation (CVm %) | 13.34 | 13.30 |
| Breaking Force (N) | 2.47 | 2.31 |
| Breaking Work (N.cm) | 10.06 | 4.22 |
| Time to Break(sec) | 2.0 | 0.96 |
| C.S.P | 2527 | 2436 |



Property Requirements of Textiles





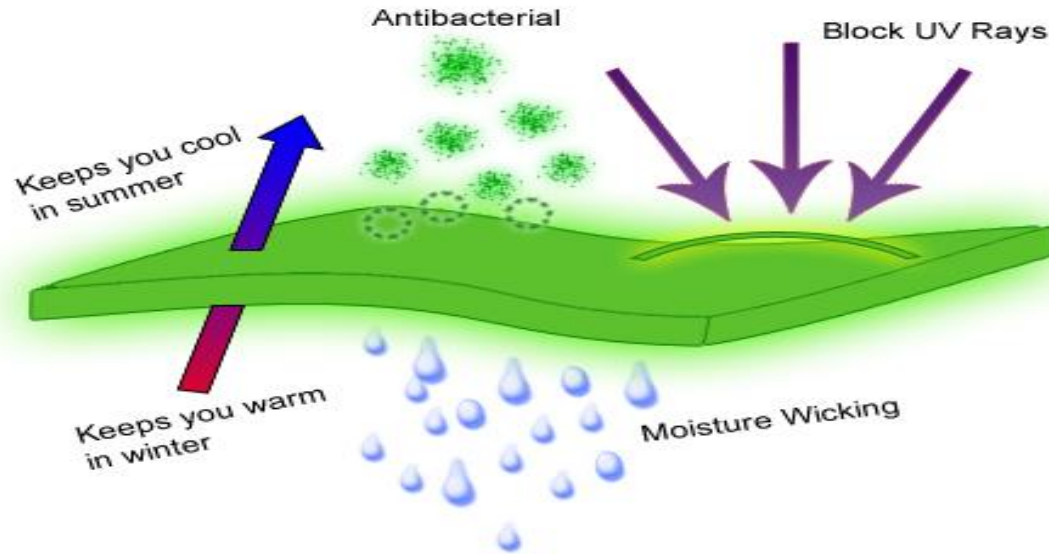
Comparison of Fabric Properties

| FABRIC PROPERTIES | BAMBOO | COTTON | VISCOSE |
|--------------------|-----------------|-------------------|-------------------|
| Strength | Higher | Lower | Higher |
| Elongation | Higher | Lower | Higher |
| Feeling | Extremely Soft | Medium | Medium |
| Lustre | Excellent | Dull | Higher |
| Comfort | Excellent | Medium | Medium |
| Breathable & Cool | Excellent | No | No |
| Anti- Bacterial | Excellent | No | No |
| Appearance | Luxurious Shiny | Medium | Medium |
| Anti- UV Radiation | Excellent | No | No |
| Biodegradable | Biodegradable | Not Biodegradable | Not Biodegradable |
| Absorbency | Excellent | Medium | Medium |
| Durability | Higher | Lower | Higher |



Properties of Bamboo Fibre

Anti –Bacterial Property



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



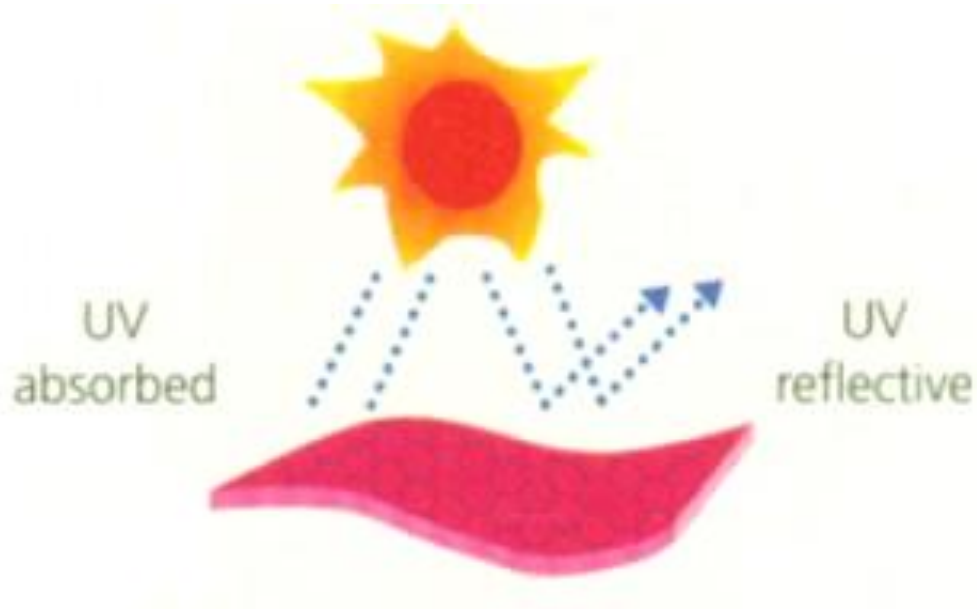
Green & Biodegradable



Sometimes the growth of bamboo is approx 3 feet over a night thus being fast growing renewable resource. It is 100% biodegradable in soil by microorganism and sunshine. The decomposition process doesn't cause pollution in environment.



Anti- UV Radiation



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



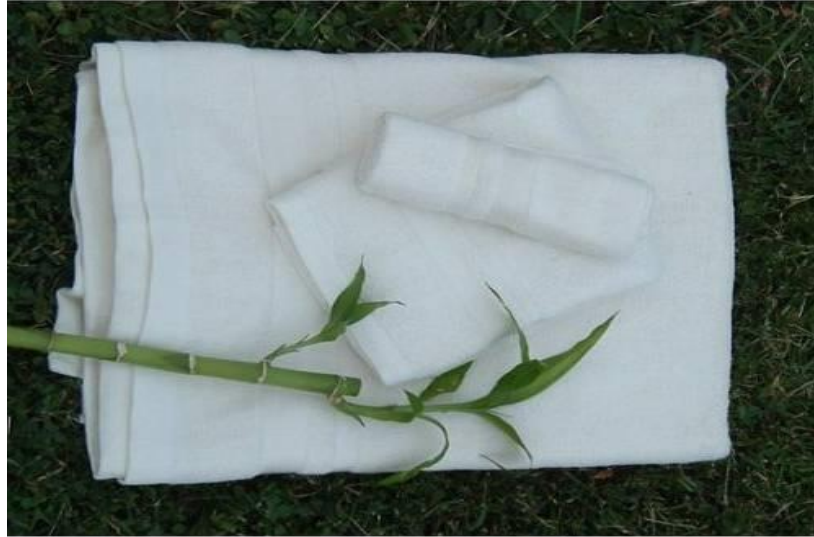
Breathable and cool



Bamboo fiber acquires unique ability of breathability and coolness. The cross-section of bamboo fiber is filled with various micro-gaps and micro-holes, which does function of moisture absorption and ventilation. With this unparalleled microstructure, bamboo fiber apparel can absorb and evaporate human sweat in fraction of time



Softer Feeling



Being regenerated cellulose fibre from bamboo pulp, softness is the inherent property of Bamboo Fibre. It gives hygienic and delicate touch to skin.



Luxurious Shiny Appearance



The cross-section of the bamboo fibre is filled with various micro-gaps and micro-holes, it absorbs more dyes as compared to other cellulosic fibres and appears luxurious and shiny. (8)



BAMBOO IN TEXTILES

- Bamboo textiles have many unique properties that collectively makes this a truly amazing fabric.
- It is breathable and cool, has a nice luster, extremely soft, better water absorption, antibacterial, bio-degradable, and anti UV radiation.
- It has wonderful silky softness.
- Bamboo fabrics (cloths) successfully avoids pilling and shrinkage problems.
- The cloths produced from bamboo is lighter and softer than cotton.
- ✓ Bamboo fibres are quickly emerging now in the fashion world.
- ✓ Bamboo fabric is not widely known, but considering these benefits, there is a considerable and growing market for bamboo fabric products.



Conclusions

Bamboo textiles have many unique properties which fulfill all the requirements of present scenario of human beings .

"Bamboo fiber comes from nature and completely returns to nature in the end" therefore bamboo fiber is praised as "the natural, green and eco-friendly new-type textile material of 21st century".

- **“In Future, BAMBOO can be An Excellent Alternative Source for Production of Textiles”**



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THANKS