

# FLAX (LINEN)



- The word flax is derived from the old english *fleax*.
- Linen is the term applied to the yarn spun from the flax fibres, and to cloth or fabric woven from this yarn.
- The flax fiber is classified as a natural, cellulose, bast, multicellular fiber.
- It has a fiber density of  $1.50 \text{ g/cm}^3$ , and considered to be heavy fiber.

### **Fiber morphology:**

#### The macro-structure of flax:

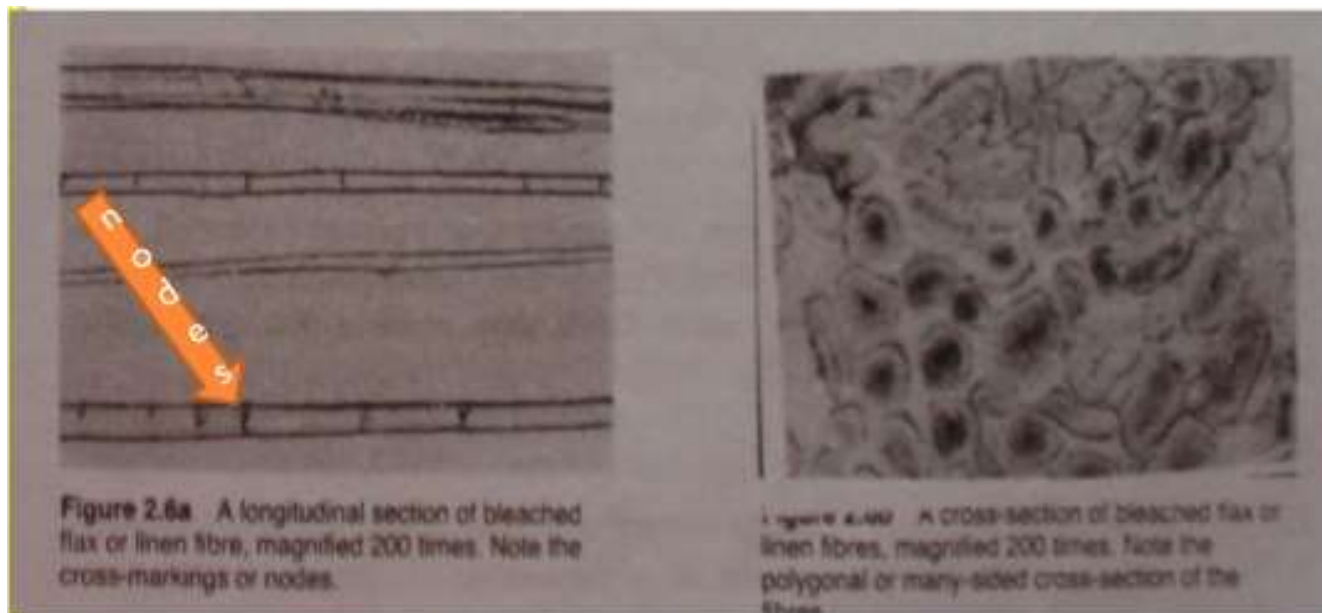
- The flax fiber is a thick, regular fiber with a subdued lustre.
- Its length ranges from about 10 cm to 100 cm, averaging about 50 cm in length.
- As the flax fiber is a strand of cells, its thickness depends upon the number of these cells in any one fiber cross-section.

- About 3 to 6 cells constitute a fiber cross-section.
- The flax cells are about 25 mm long and 10  $\mu\text{m}$  to 20  $\mu\text{m}$  thick.
- This would give an average fiber thickness ranging from about 40  $\mu\text{m}$  to 80  $\mu\text{m}$ .
- Its fiber length to breadth ratio is of considerable significance.
- For the longest and the best flax this tends to about 15000:1.
- Short flax fibers may have a fiber length to breadth ratio of 1500:1, or less.
- The colour of flax varies from light blond to grey blond, the particular shade resulting from the agricultural and climatic conditions under which it was grown and quality of retting.

- The subdued luster of flax is due to its long regular fiber surface, which is coated with a film of wax.
- This enables a significant amount of the incident light to be reflected, resulting in the subdued luster.

### Microscopic appearance of flax:

- The cross markings, known as **nodes**, on flax fibers give their characteristics microscopic appearance.
- There may be up to 800 nodes in a single flax fiber cell.



- The length of the node indicates the width or thickness of the fiber cell.
- Wherever a node occurs, it indicates a change in the spiral direction of the fibrils which constitute the cell walls.
- Such spiralling imparts strength to the cell and, hence, to the flax fiber.

### **The micro-structure of flax:**

- The flax fiber is covered with a wax film.
- The cell walls of flax are constituted of spiralling fibrils composed of cellulose polymers.
- On the whole, the flax cell is more sturdily constructed than the cotton cell, as indicated by the former's thicker cell walls.
- This explains, in part, the greater tenacity of flax compared with cotton.

## The Polymer System:

### The flax polymer and its polymer system:

- The flax polymer differs from the cotton polymer physically in that it has a degree of polymerization of about 18000, means the flax polymer is made of about 18000 cellobiose units.
- It is 18000 nm long, and about 0.8 nm thick.
- The polymer system of flax is more crystalline than that of cotton, because of its longer polymers, spiral about each other at approx  $6^\circ$  to the fiber axis, thereby contributing towards the tenacity and durability of the fiber.
- Due to greater crystallinity, the flax fibers are stronger, crisper and stiffer to handle, and textile materials wrinkle more readily than those of cotton fibers.

## **Physical Properties:**

1.Tenacity: Flax is a very strong fiber because its very crystalline polymer system permits its very extremely long polymers to form hydrogen bonds than cotton polymers.

### 2.Elastic-plastic nature:

- The very inelastic nature of flax is due to its very crystalline polymer system.
- It tends to lock its polymer into position with the aid of the countless hydrogen bonds which form between the polymers.
- Flax will resist being flexed or bent. When these are bent or flexed, their polymers are liable to break leading to fractures in the polymer system.
- These fractures become weak areas on the fiber structure, leading to wrinkling and creasing in the linen textile material.

3. Hygroscopic nature: The Hygroscopic nature of cotton apply also to flax.
4. Thermal properties:
  - Flax has the best heat resistance and conductivity of all the commonly used textile fibers. No satisfactory explanation can be offered for this.
  - With regard to other thermal properties of flax, the reasons given for cotton apply equally to flax.
5. Composition: It contains 70% cellulose, 10% gums, proteins and 10% natural impurities.
6. It is not elastic in nature.
7. Specific gravity is 1.54 same as that of cotton.
8. Strength: It is stronger fiber than cotton because of its very crystalline polymer systems as it form more hydrogen bonds than cotton polymers. Its tenacity is 4.8-6.0 gm/denier. It is 20% stronger when wet than dry.



## Chemical properties:

- The chemical properties of cotton may also be applied to flax.
- However, linen textile materials are not mercerized.
- Normal laundering will result in alkaline hydrolysis of the waxes and gums bonding the cells forming the flax fiber together.
- This results in cell ends projecting above the surface of the linen textile material, and is referred to as *cottonising* of linen.
- Severe cottonising will cause a noticeable weakening of the linen textile material.