Properties of Fibers I

- Properties of fibers can be divided under three main topics:

A) **Physical Properties**
B) **Mechanical Properties**
C) **Chemical Properties**

- To define a material as a fiber, the basic property that should be taken into account is length/width ratio.
- Remind? What should be this ratio value?

- **Primary properties of textile fibers:**

***High length to width ratio

•Tenacity

•Flexibility

•Spinning quality (Cohesiveness)

•Uniformity

A) Physical Properties

1. Length
2. Fineness
3. Crimp

Geometrical properties

4. Maturity
5. Luster
6. Softness
7. Resiliency
8. Work of rupture
9. Density
10. Appearance

B) Mechanical Properties

1. Strength
2. Elasticity
3. Extensibility
4. Rigidity

C) Chemical Properties

1. Behaviour against

a) acids, bases, oxidation, reduction, heat

2. Sorption

a) humidity, dye

3. Swelling

anisotropy

Orientation:

This concept is generally used for the assembly of the polymer chains horizontally (parallel). When the products obtained from polymers in the form of fiber, film, and etc. are exposed to tensile force in the any direction, the polymer chains are oriented in the tensile force direction.

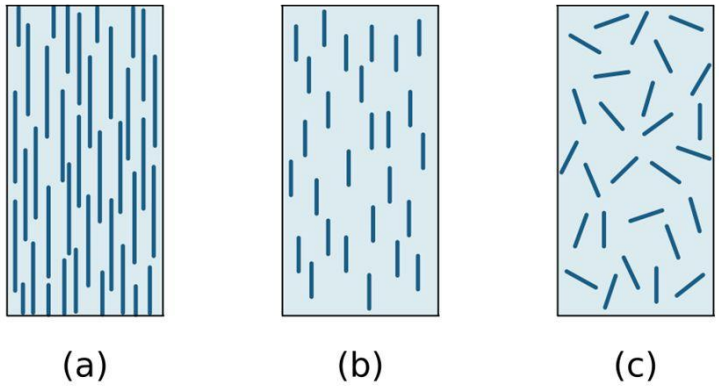
With the help of these,

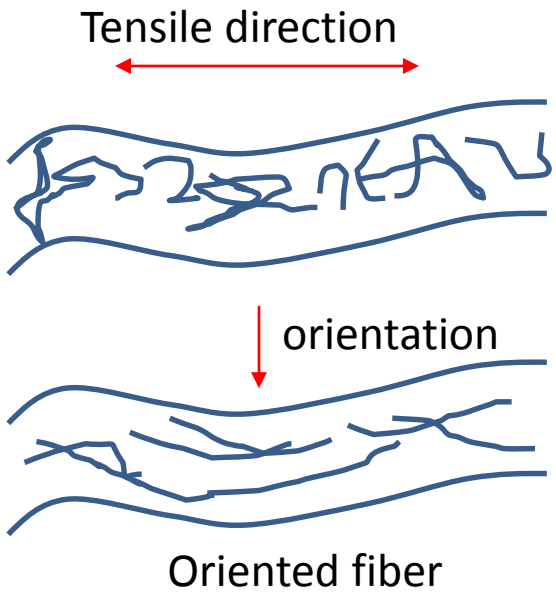
1. The polymer chains get closer,

2. The second interactions between polymer chains increase,

3. The mechnical properties of polymer such as breaking force improve,

4.the crystalinity of the polymer increases.





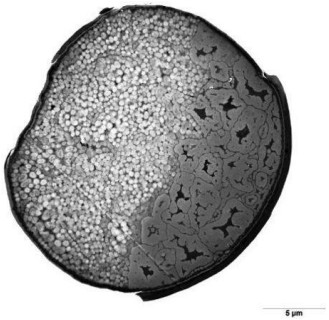
Geometrical properties

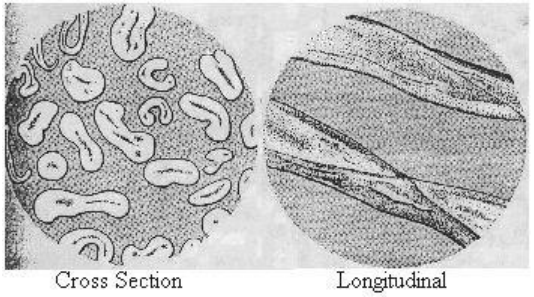
Fineness

The fineness (cross-sectional area) of the fibers is an important characteristic that effects the processability and product quality of fibers. Fibers with low cross-sectional areas have higher surface areas, consequently, the moisture absorption and dye-uptake yields of the fibers would be improved.

Sectional geometry

The sectional geometry of the natural fibers are different from each other. E.g wool is almost spherical, cotton fibers are like beans. The sectional geometry of the synthetic polymers depends on the design of the spinneret holes.

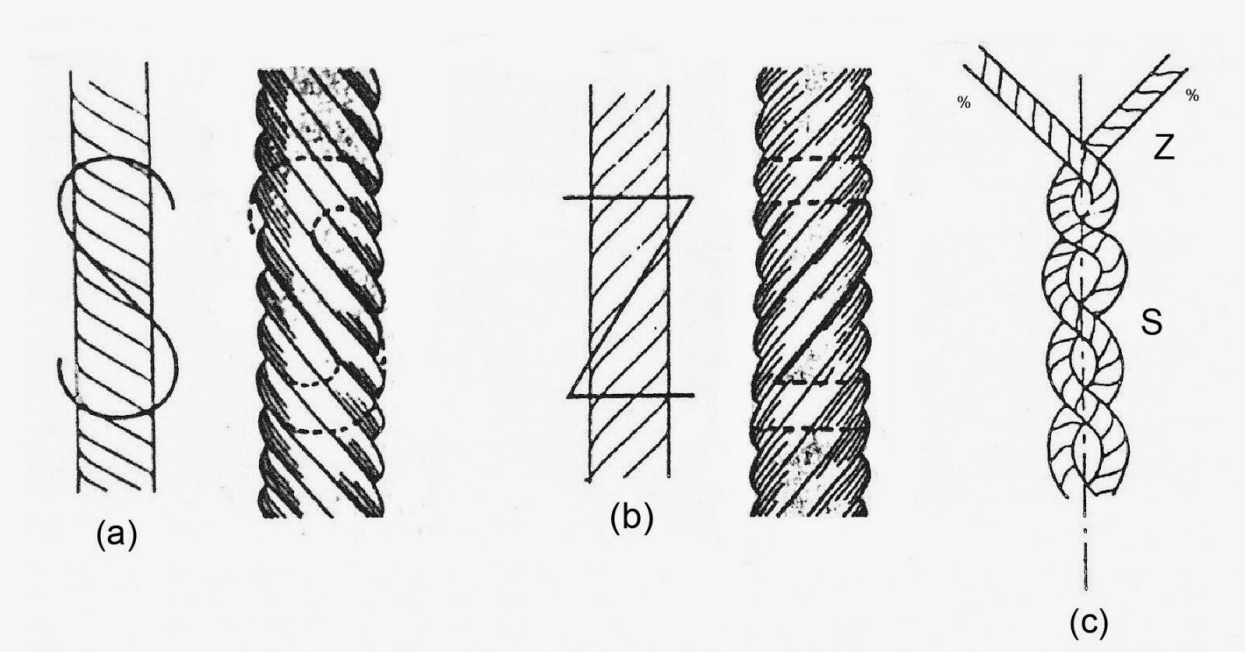




Twist

It is a measure of the length difference between the stretched and normal state of the fiber. When a fiber is examined, a nontwisted fiber seems flat, but the twisted ones seem like wavy.

The main purpose of the twisting a fiber is to prevent the gliding the filaments of the fiber under tensile load. It also protects the fibers against abrasion.



Twisting directions

1) RIGHT-HANDED TWIST. S twist or clock-wise
2) LEFT-HANDED Twist. Z twist or anticlockwise

https://articletrade.blogspot.com/2014/04/types-of-yarn-twist-different-types-of.html

Physical properties

Linear density

One of the most important data related to the fibers is **the mass of unit length** of a fiber. This measurement corresponds to the linear density of a fiber. The most common linear density measures are **denier, grex and tex.**

- ***Denier*** is the mass of a fiber (in grams) that is 9000 m in length.

If a fiber has a denier of 40, it means that 9000 m of fiber is 40 g. If this fiber also consists of 40 filaments, then the denier of each of the filament would be 1.

- ***Grex*** and ***tex*** are the mass values of a fiber (in grams) that is 10000 m and 1000 m in length, respectively.

? Homework: calculate the denier and tex values of a fiber that consists of 60 filaments with a denier value of 0,5 of each filament.

Refractive index

It is a measure of the degree of deviation of the light beam passing through the material from the incident direction. Liquids and amorphous materials have constant refractive index values and these values do not change depending on the incident direction of the light.

If a measured or an observed behavior of a material depends on the direction of the measurement or observation, it is called as isotropy. If the property of a material depends on the direction of the measurement, it's called anisotropy. Swelling and double refractive index value of the fibers are related with the anisotropic behavior of fibers.

double refractive index

The refractive index values of the fibers are different in the directions of perpendicular and parallel to the fiber axis.

This double refractive index of the fibers are found by the subtraction of the parallef refractive index value (ω) from perpendicular refractive index (ε).

DRI= $\varepsilon - \omega$

This property of the fibers are caused from the orientation of the fibers. With orientation, the polymer chains that are aligned into parallel assembly refract the perpendicular light very much.