



CLASSIFICATION OF FIBRES

The history of **fibres** is as old as **human civilization**. Traces of **natural fibres** have been located to ancient civilizations all over the globe. For many thousand years, the usage of fiber was limited by natural fibres such as **flax, cotton, silk, wool** and **plant fibres** for different applications.

Fibers can be divided into **natural fibres** and **man-made or chemical fibres**. Flax is considered to be the oldest and the most used natural fibre since ancient times



“fiber” or “textile fiber”

- A unit of matter which is capable of being spun into a yarn or made into a fabric by bonding or by interlacing in a variety of methods including weaving, knitting, braiding, felting, twisting, or webbing, and which is the basic structural element of textile products.
- It is a smallest textile component which is microscopic hair like substance that may be man made or natural.
- They have length at least hundred times to that of their diameter or width



For the standardisation, classification and easier identification of fibres, **Federal Trade Commission (FTC)** assigned generic groups of manufactured fibres according to their chemical composition like Poly ester, Poly Amide. Acetate etc.

Classification of Fibres

- Natural Fibers
 - Vegetable Fibres
 - Animal Fibres
 - Mineral fibers
- Man Made fibers
 - Regenerated fibres
 - Synthetic fibres
- Inorganic fibres



Classification of fibers can be done by:

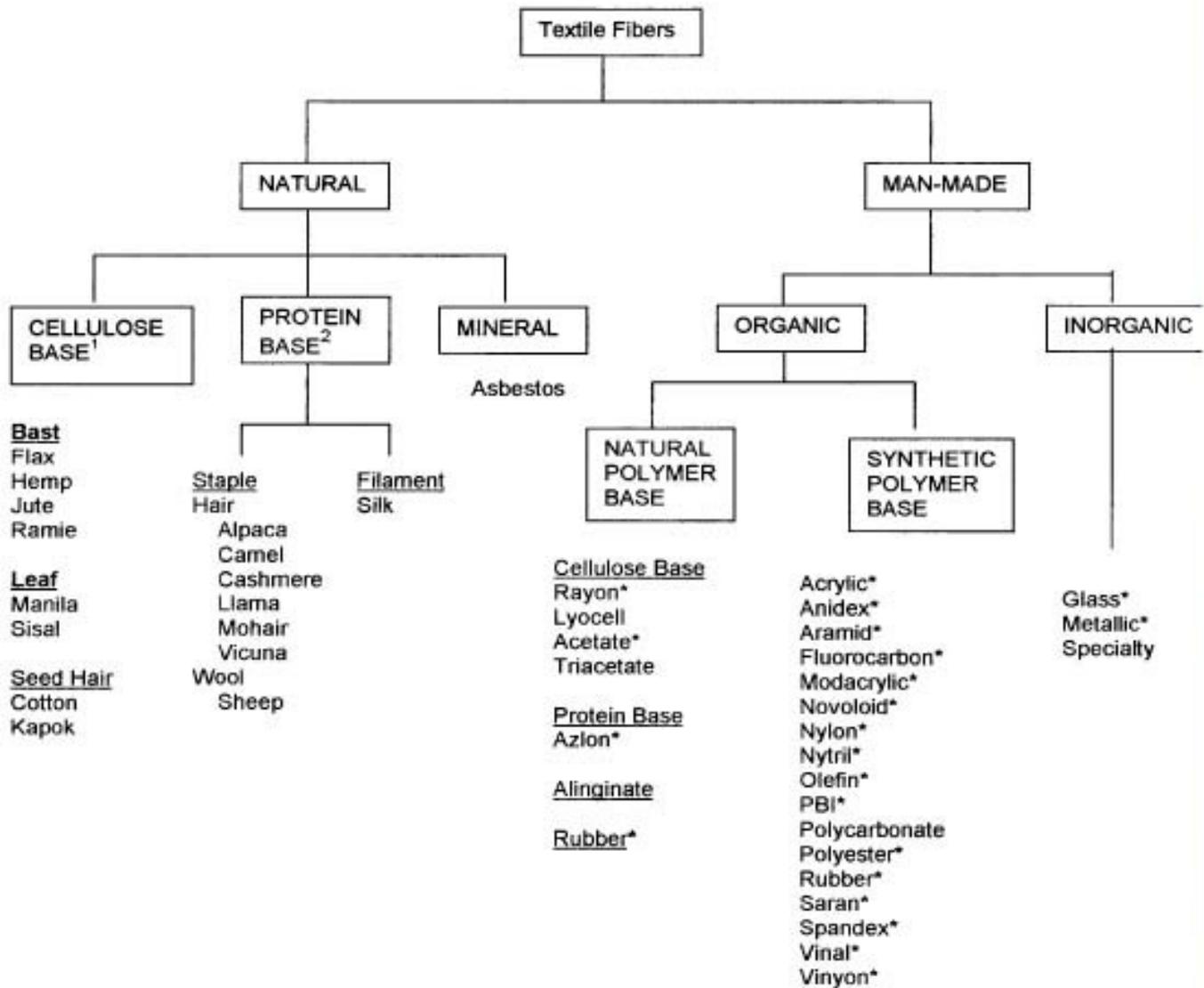
Type (Natural and manufactured)

Length (Short staple, long staple, continuous filament)



Size (Ultra fine, fine, regular, course)

General Classification of Textile Fibers



NATURAL FIBRE

- Any hair like raw material directly obtainable from an animal, vegetable or mineral source that can be convertible after spinning into yarns and then into fabric.
- Under them there are various categories:
 - (1) plant
 - (2) animal
 - (3) minerals

Vegetable fibers

they can be further on classified as:

(a) fibre occurring on the seed (raw cotton , java cotton)

(b) phloem fiber (flax, ramie , hemp, jute)

(c) tendon fibre from stem or leaves (manila hemp, sisal hemp etc)

(d) fibre occurring around the trunk (hemp palm)

(e) fibre of fruit/ nut shells (coconut fibre – Coir)

cotton and linen are the most important among them.

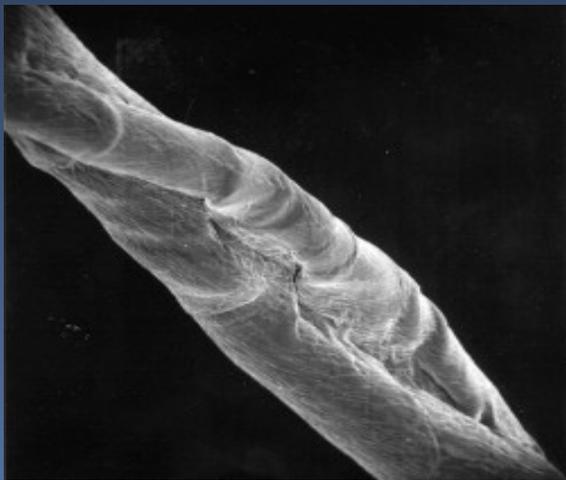
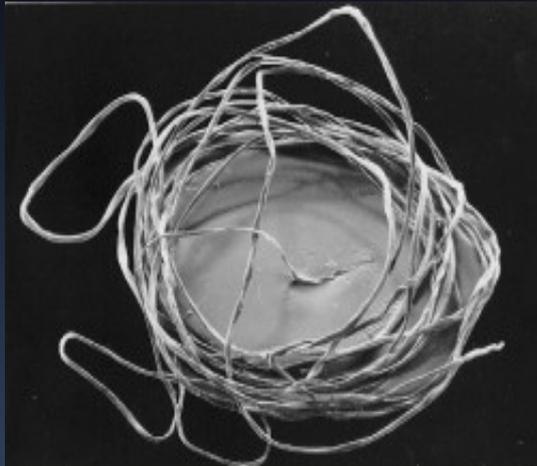




Vegetable fibres

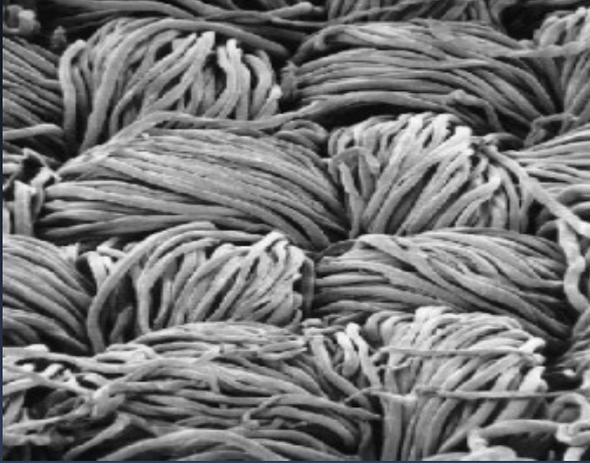
- Bast fibres
 - Low Lignin content – Linen or Flax (raw and bleached) and Ramie
 - High Lignin content – Jute, Hemp
- 

(1) Cotton



- Cotton is a soft fibre that grows around the seeds of the cotton plant .cotton fibre grows in the seed pod or boll of the cotton plant . each fibre is a single elongated cell that is flat twisted and ribbon like with a wide inner hollow (lumen).
- **Composition**
- 90% cellulose,6% moisture and the remainder fats and impurities.
- the outer surface is covered with a protective wax like coating which gives fibre an adhesive quality

PROPERTIES



It has 8% moisture regain

- The cellulose is arranged in a way that gives cotton unique properties of strength, durability, and absorbency.
- it is fresh , crisp , comfortable , absorbent , flexible, has no pilling problems and has good resistance to alkalis.
- it has poor wrinkle resistance, shrinkage, poor acid resistance , less abrasion resistance , susceptible to damage by moths and mildew, needs lots of maintenance and stains are difficult to remove.
- its fibre length ranges from ½ inches to 2 inches
- it has 10% increase in strength when wet.
- it has a flat twisted tube shape

KAPOK FIBRE



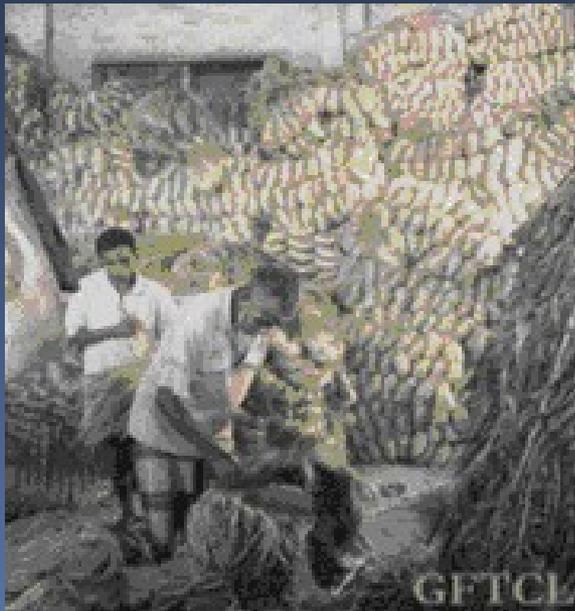
- Kapok fiber is a silky cotton-like substance that surrounds the seeds in the pods of the ceiba tree.
- **Properties**
- **It can support as much as 30 times its own weight in water and loses only 10 percent of buoyancy over a 30-day period.**
- **It is eight times lighter than cotton**
- it is extremely used as a thermal-insulator.
- it is also lightweight, non-allergic, non-toxic, resistant to rot and odorless.
- since it is inelastic and too fragile, it can't be spun.
- it has outstanding characteristics of lightness, impermeability, thermal-isolation and eco-naturality.

BAST FIBRE



- **Bast fibre (fiber) or skin fibre is fibre collected from the Phloem (t bast surrounding the stem of a certain plant)**
- **Properties**
- The bast fibres have often higher tensile strength than other kinds, and ropes, yarn, paper, composites and burlap.
- A special property of bast fibers are that the fiber at that point represents a weak point.
- **They are obtained by the process called retting**

JUTE FIBRE



Jute is one of the cheapest natural fibres and is second only to cotton in amount produced and variety fibres are composed primarily of the plant cellulose and lignin .

Properties

- Jute is a long, soft, shiny vegetable fibre that can be spun into coarse, strong t
- It is thus a ligno -cellulosic fibre that is partially a textile fibre and partially wood.
- The plant grows up to a height of 2.5m and its fibre length is about 2m.
- it is generally used in geo textiles.
- it has a good resistance to micro organisms and insects.
- it has low wet strength, low elongation and inexpensive to produce

RAMIE FIBRE



Ramie is one of the oldest fibre crops, having been used f

Properties

- Ramie requires chemical processing to de-gum the fibre.
- it is fine absorbent ,quick drying fibre, is slightly stiff and possesses high natural lustre.
- its plant height is 2.5m and its strength is eight times more than cotton.

HEMP FIBRE



Depending on the processing used to remove the fiber from the stem, the hemp naturally may be creamy white, brown, gray, black or green.

Properties

- it is yellowish brown fibre
- Hemp fibers can be 3 to 15 feet long, running the length of the plant.
- Characteristics of hemp fibre are its superior strength and durability, resistance to ultraviolet light and mold, comfort and good absorbancy

COIR FIBRE



- Fibre mechanically extracted from dry mature coconut husk after soaking.
- It is long, hard and strong fibre but with lower softness, lower water absorption capacity, and shorter life than long retted fibre.

ANIMAL FIBRES

- **Animal fibers are natural fibers that consist largely of proteins such as silk, hair/fur, wool and feathers.**
- **The most commonly used type of animal fiber is**

They can be classified further as

Hair Fibres (Staple)

Secretion Fibres
(Filament)

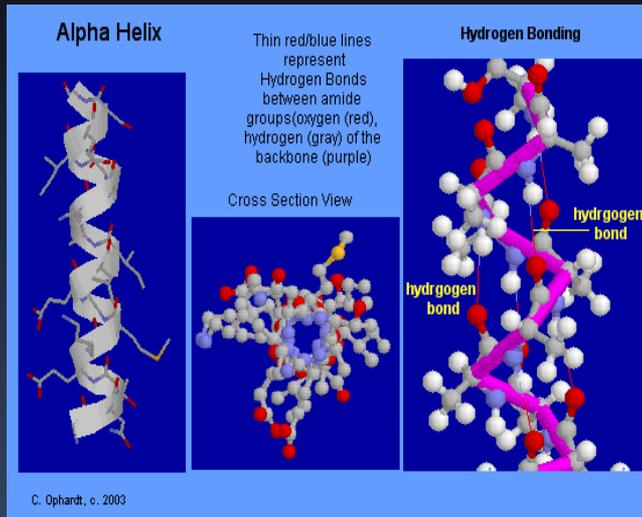
Wool

Silk

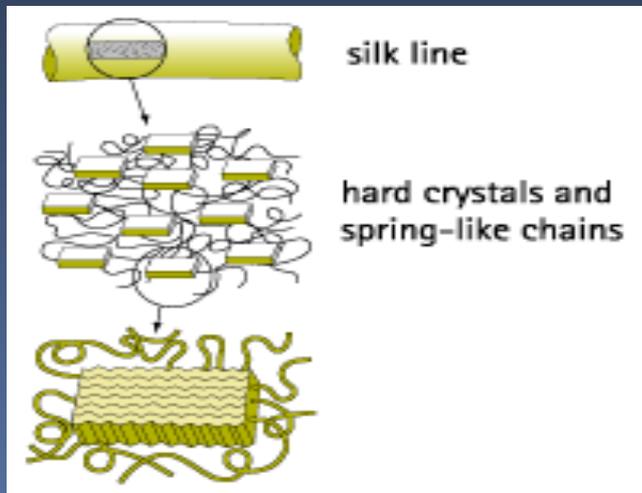
Speciality hair fibres

Spider Silk
(Insect fibre)

SILK FIBRE

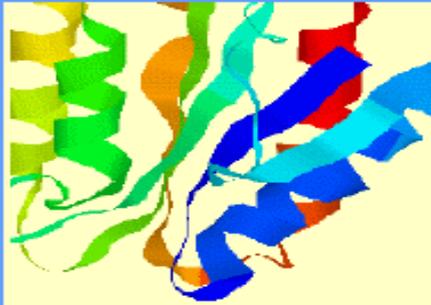


- silk is a natural fiber that can be woven into textiles. It is obtained from the cocoon of the silkworm larva, in the process known as sericulture
- **properties**
- it's a fine continuous strand unwound from the cocoon of a moth caterpillar known as the silkworm.
- it is the longest and thinnest natural filament fibre with the longest filament around 3000yards.
- it is relatively lustrous ,smooth, light weight, strong and elastic.
- it is essentially composed of protein fibre and is naturally a white coloured fiber.



Types of silk

Both helices and sheets
in same protein



C. Ophardt, c. 2003



- **Domestic silk-**
- ***Mulberry silk : This is a white to yellow colored silk. It is fine and is used mainly for apparel.***
- **Wild silk-**
- ***Muga silk : This is a golden yellow coloured silk .It is obtained from the semi-domesticated silkworm ,which feeds on the aromatic leaves of Som and Soalu plants.***
- ***Eri silk : This is got from the domesticated silkworm. It feeds mainly on castor leaves.***
- ***Tussar silk : Tussar Silk, also known as Kosa Silk, is valued for its purity and texture. Kosa Silk is drawn from cocoons especially grown on Arjun,***

WOOL



- **Wool is the fiber derived from the fur of animals principally**
- **properties**
- it has the highest moisture regain i.e., 14%.
- it exhibits felting property and is easy to spin
- due to crimp present in it, it has heat stored within
- the length of the fibre is around 3-15 inches.



- there are two types of wool namely clipped or fleece wool taken from live sheep and pulled wool removed from sheep already dead.
- merino wool is the best grade of wool.
- In addition to clothing, wool has been use
carpeting, felt,
wool insulation and upholst



MINERAL FIBRE



- Asbestos is the only natural mineral fibre obtained from varieties of rocks.
- **properties**
- It is fibrous form of silicate of magnesium and calcium containing iron and aluminium and other minerals.
- It is acid proof, flame proof and rust proof.
- Its particles are carcinogenic and hence its use is restricted.

MAN MADE

Regenerated Fibres

- **Cellulosic** – Cotton linters and wood pulp

Viscose rayon, Cupra-ammonium, Cellulose Acetate (secondary and triacetate), Polynosic, High Wet Modulus (HWM)

- **Protein** – Casein fibre from milk
Groundnut Fibre,
Zein fibre
Azlon fibre from corn and



- Natural man made fibre

- **(A) Cellulosic fibres**

- Cellulose is one of many polymers found in nature.
- Wood, paper, and cotton all contain cellulose. Cellulose is an excellent fiber.
- Cellulose is made of repeat units of the monomer glucose.
- The three types of regenerated cellulosic fibres are rayon, acetate and triacetate which are derived from the cell walls of short cotton fibres called linters.
- Paper for instance is almost pure cellulose

(B) Non Cellulosic Man made fibres:

Protein:

Azlon Fibre from Soya and Corn

Casein of Milk

Ground nut

From other Sources:

Mineral: Glass, Ceramic and Graphite

Metallic Fibres: By mining and refining of metals like silver, gold, aluminum and steel.

Rubber Fibres: Sap tapped from the rubber tree.
(Fibre forming polymer is either natural or synthetic)

RAYON

- **Rayon is a manufactured regenerated cellulosic fiber.**
- it is the first man made fibre .
- it has a serrated round shape with smooth surface.
- it loses 30-50% of its strength when it is wet.
- Rayon is produced from naturally occurring polymers and therefore it is not a synthetic cellulosic fiber.
- The fiber is sold as artificial silk
- there are two principal varieties of rayon namely viscose and cupra ammonium rayon.



ACETATE

- A manufactured fiber in which the fiber forming substance is cellulose acetate.
- Acetate is derived from cellulose by reacting purified cellulose from wood pulp with acetic acid and acetic anhydride in the presence of sulfuric acid.

The **Acetate Fiber Characteristics**

- Luxurious feel and appearance
 - Wide range of colors and lusters
 - Excellent drapability and softness
 - Relatively fast drying
 - Shrink, moth and mildew resistant
 - Special dyes have been developed for acetate since it does not accept dyes ordinarily used for cotton and rayon.
- 

Man made Synthetic Fibres

- Polyamides-Nylon 66, Nylon 610, Nylon 6 etc
- Polyester-Terylene, Terene, Dacron etc.
- Polyvinyl derivatives
 - Polyvinylchloride
 - Polyvinylchloride acetate
 - Polyvinylchloride –Acrylonitrile
 - Polyacrilonitrile
 - Polyvinyl alcohol
 - Polystyrene and Copolymers
 - Polyvinylide Chloride and Copolymers
- Polyolefins
 - Polyethylene
 - Polypropylene

MAN MADE SYNTHETIC FIBRE

POLYESTER, NYLON
ARAMID, ACRYLIC
MODACRYLIC, SPANDEX
OLEFIN, VINYLON
SARAN, NYTRIL
TEFLON / FLUOROCARBON

ALGINATE :

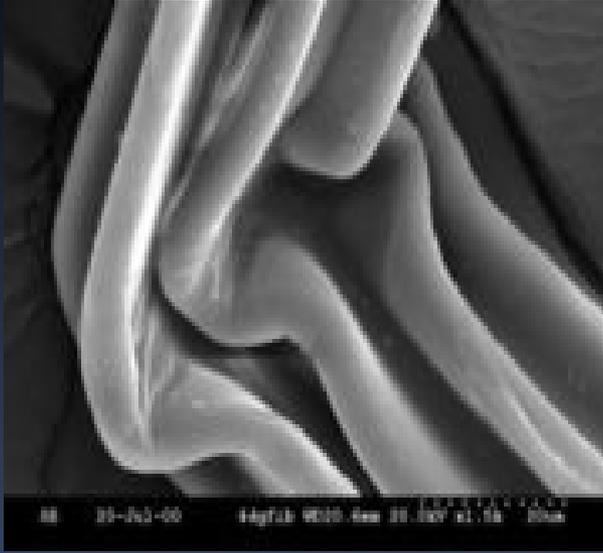
Minor fibre made of a jelly like

calcium alginate derived from

certain forms of sea weed used as

scaffolding in such fabrics as

surgical dressings which can be



- **POLYESTER**
- Polyester is a category of polymers which contain the ester functional group in their main ch
- The term "polyester" is most commonly used to refer to polyethylene terephthalate (PET).
- it has a high melting temperature
- it can be dyed with only disperse dyes
- they are thermoplastic, have good strength and are hydrophobic
- the fibre has a rod like shape with a smooth surface.
- it is lustrous and its hand is crisp.
- it has excellent resiliency and is the best wash and wear fabric.
- there are problems of static and

NYLON



- Nylon is one of the most common polymers used as a fiber.
- There are several forms of nylon depending upon chemical synthesis such as nylon 4, 6, 6.6, 6.10, 6.12, 8,10 and 11.
- Nylon is found in clothing all the time, but also in other places, in the form of a thermoplastic material.



- Nylons are also called polyamides, because of the characteristic amide groups in the backbone chain.
- These amide groups are very polar and are linked with each other with hydrogen bonds.
- nylon is a regular and symmetrical fibre with crystalline regions and make fibers.
- the fibre has a smooth rod like shape with a smooth surface

RUBBER FIBRE



- **Rubber is an elastic hydrocarbon polymer that naturally occur colloidal suspension, or latex, in the sap of some pla**
- The manufacturing process consists of extruding the natural rubber latex into a coagulating bath to form filament.the material is cross linked to obtain fibres which exhibit high stretch
- It can be synthesized.



- Natural rubber is essentially a polymer of isoprene units, a hydrocarbon diene monomer.
- Synthetic rubber can be made as a polymer of isoprene or various other monomers
- The material properties of natural rubber make it an elastomer.
- Rubber exhibits unique physical and chemical properties.
- Rubber's stress-strain behavior exhibits the Mullins effect, the Payne effect and is often modeled as hyper elastic.

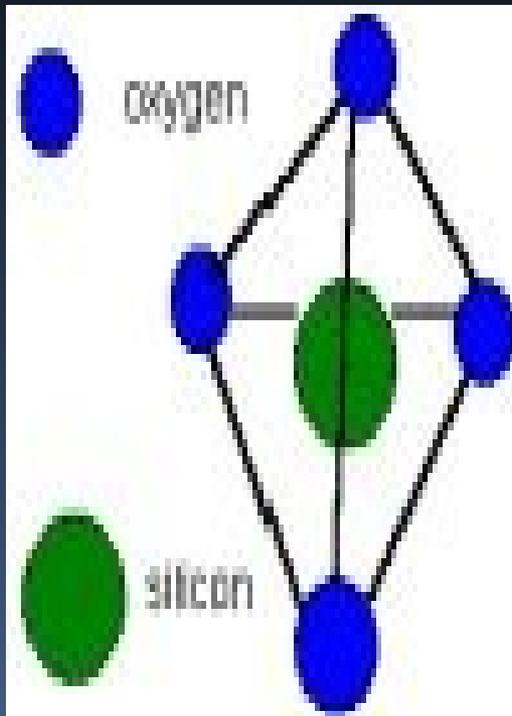
Inorganic Fibres

- **Glass** – Silica sand, lime stone and other minerals
- Ceramic – Alumina, Silica and Graphite fibres - Carbon
- **Metallic fibres**- Aluminium, silver, gold and stainless steel

GLASS FIBRE



- It is also known as Fiberglass that is a material made from extremely fine fibers of glass. Glass fiber is formed when thin silica-based or other formulation glass extruded into many fibers with small diameter by textile processing
- it has a high degree of viscosity
- The basis of textile grade glass fibers is silica, SiO_2
~~-. In its pure form it exists as a polymer, $(\text{SiO}_2)_n$ -.~~
- In order to induce crystallization, it must be heated to temperature



- The first type of glass used for fiber was soda-lime glass or A glass which is
- By trapping air within them, blocks of glass fiber make is used as a reinforcing agent for many polymer products.
- it has a good thermal insulation, with a thermal conductivity of 0.05 W/m

- Because glass has an amorphous structure, its properties are the s
- Humidity is an important factor in the tensile adsorbed, and can worsen microscopic crack defects, and lessen tenacity.
- It has no effect on exposure to sunlight even after extended periods.

METALLIC FIBRES



- **Metallic fibers are manufactured fibers composed of metal, plastic-coated metal, metal-Gold and silver have been used since yarns for fabric decoration. More recently, aluminum yarns, aluminized nylon yarns have replaced g**
- They are made through laminating process.
- Coated metallic filaments help to minimize tarnishing.



- When suitable adhesives and films are used, they are not affected by salt water, chlorinated water in swimming pools or climatic conditions.
- If possible anything made with metallic fibers should be dry-cleaned.
- Ironing can be problematic because the heat from the iron, especially at high temperatures, can melt the fibers.
- They are used mainly for decorative purposes.

Thank you