TEXTILE FIBRES

Sue Scott

RMIT University

School of Fashion and Textiles

CLASSIFICATION

Natural

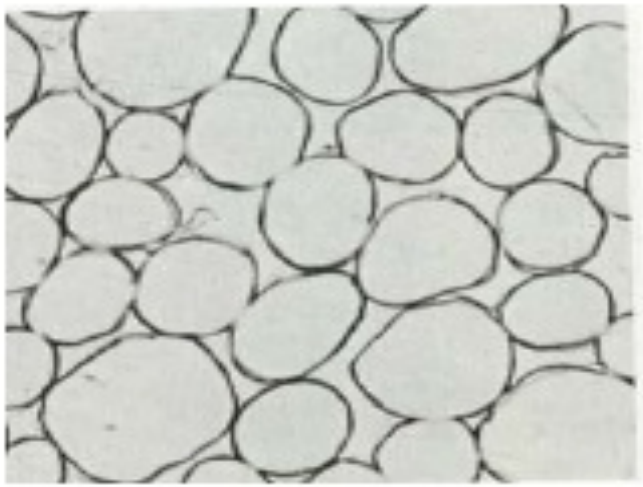
Animal
Protein

Wool
Mohair
Cashmere
Alpaca
Silk

Plant
Cellulose

Cotton
Linen
Hemp

WOOL



Cross section 500x

Longitudinal view 500x

PROPERTIES OF WOOL

Wool is naturally crease resistant, flexible, elastic and absorbent.

Length: varies according to breed 50mm -400mm

Fineness: Average micron range 16 – 28

Moisture: natural moisture content of 16%. Can hold up to 30% without feeling unduly damp.

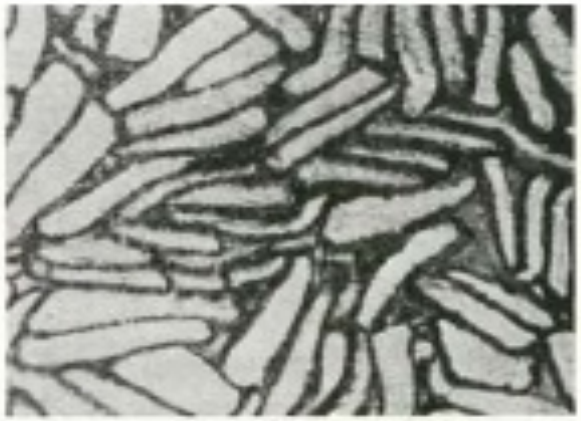
Resistant to: most acids, poor resistance to alkalis.

Shrinkage: tendency to shrink, can also felt.

SILK

Tussah Silk

Cross-Section
500x



Longitudinal
500x

PROPERTIES OF SILK

Silk a continuous natural filament formed by the silkworm.

Length: Staple (wild) or filament (cultivated).

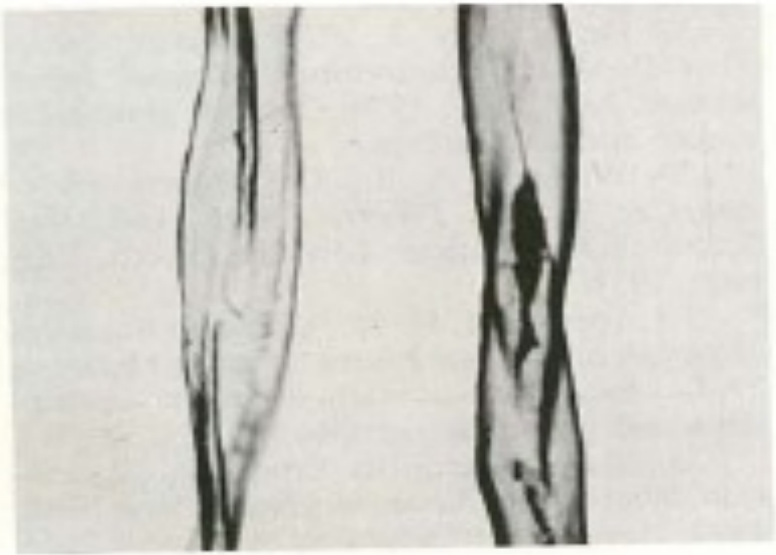
Moisture: Good absorbency, natural moisture content 11% making it comfortable to wear.

Resistant to: most acids, poor resistance to alkalis.

Shrinkage: Good dimensional stability.

COTTON

Cross section 500x

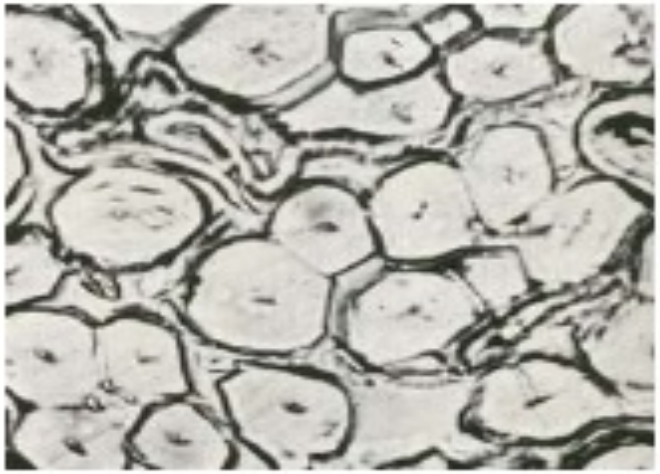


Longitudinal view 500x

PROPERTIES OF COTTON

- Cotton accounts for 50% of the worlds fibre usage, it has good strength.
- Length: 10mm – 55mm
- Fineness: varies according to variety. Measured in micronaire.
- Moisture: A hydrophilic fibre. Natural moisture content of 8-10%, can absorb up to 25%.
- Resistant to: Resistant to alkalis, affected by acids.
- Handling: Poor wrinkle resistance due to fair flexibility and elasticity properties.

FLAX (LINEN)



Cross section 500x

Longitudinal view 500x

PROPERTIES OF LINEN

- Linen, bast fibres from the stem of the flax plant.(linum usitatissimum)
- Length: 12cm – 50cm
- Fineness: Fiber diameter averages 15 to 18 microns.
- Moisture: A hydrophilic fibre. Natural moisture content of 11-12%.
- Resistant to: Resistant to alkalis, affected by acids.
- Handling: Crease and wrinkle badly.

CLASSIFICATION

Synthetic

Staple or Filament

Regenerated

Made from processed cellulose wood pulp

Viscose
Lyocell (tencel)
Cellulose ester
Acetate
Triacetate

Man Made

Made from chemicals derived from petroleum, coal & gases

Polyamide (nylon)
Polyester
Polypropylene
Polyacrylonitrile (acrylic)
Elastanes
Aramids (Kevlar)

DEFINITIONS

- Polymer – from Greek means. Poly – many Mer – unit.
- Filament – fibre of an indefinite length.
- Monofilament – a single filament.
- Multifilament – yarn consisting of many continuous filaments.
- Staple fibre – Natural fibres or cut lengths of manufactured fibres. 25mm-300mm
- Dope solution – solution before extruded through spinerette.
- Thermoplastic – Thermo heat, plastic can be moulded.
- Hydrophilic – ability to absorb water.
- Hydrophobic – lacking the ability to absorb water.
- Hydroscopic – ability to absorb moisture from the atmosphere.

SYNTHETIC FIBRE PRODUCTION.

Will depend on the nature of the polymer.
Does it melt or dissolve?

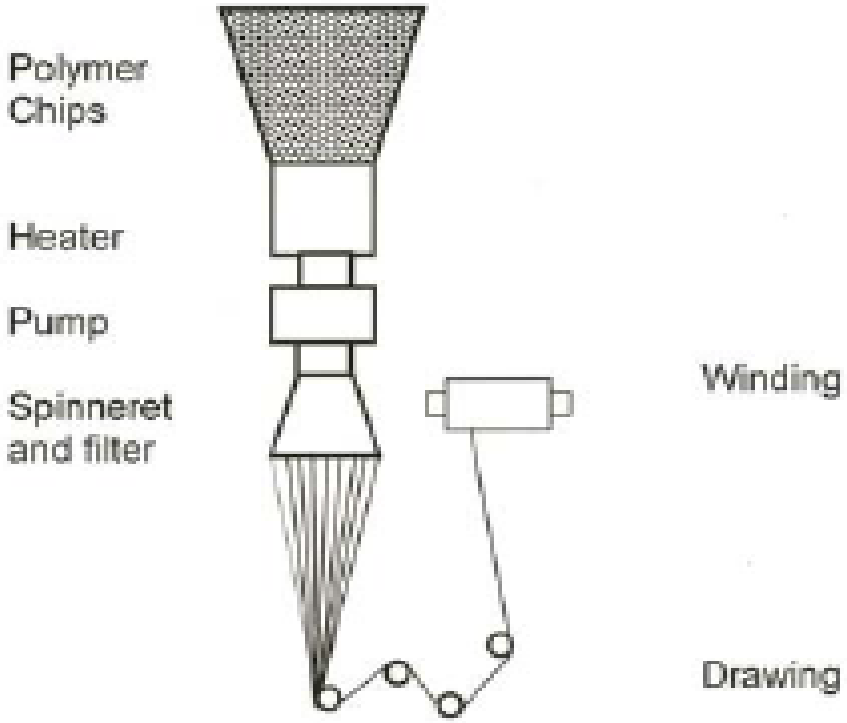
Melt Spinning – Nylon, Polyester, Polypropylene

Dry Spinning – Acetate, Triacetate, some Acrylics and Elastanes.

Wet Spinning – Viscose, some Acrylics and Elastanes.

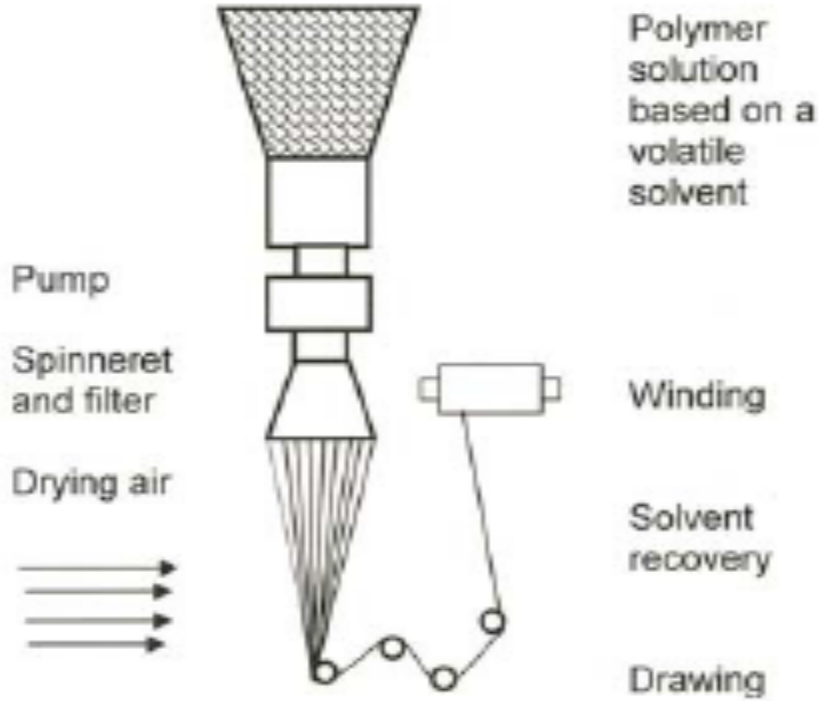
MELT SPINNING

Melt spinning is used for synthetic polymers which are thermoplastic (melt when heated).
Note that the fibres must be cooled slowly to provide for controlled extrusion, which helps to provide even fibre properties.



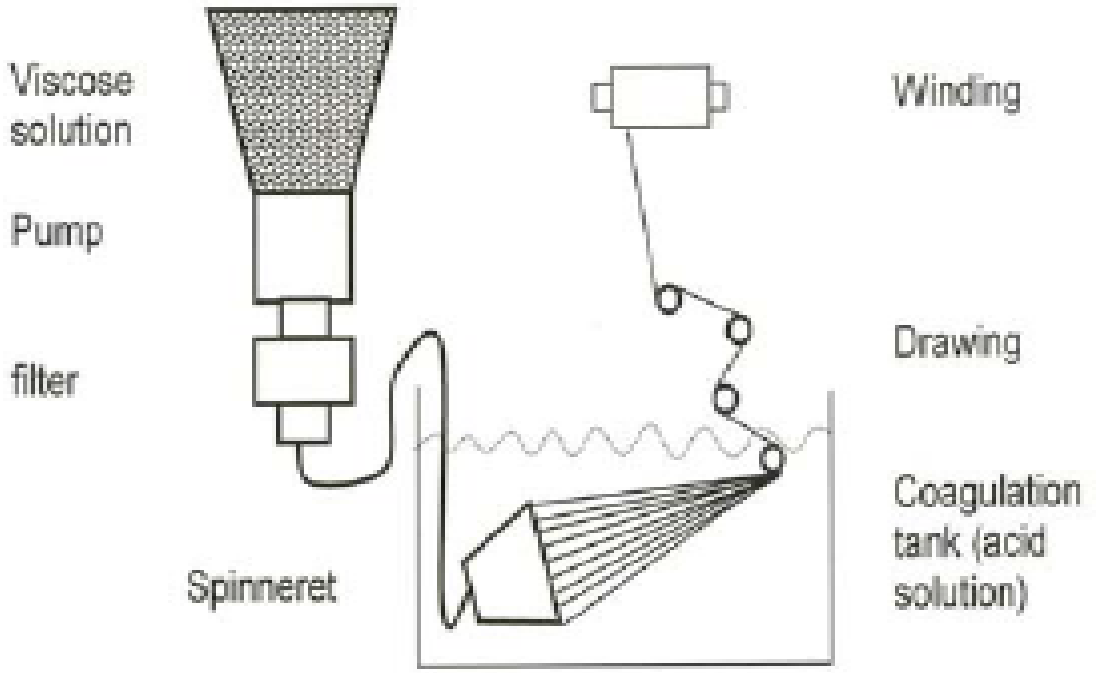
DRY SPINNING

Dry spinning is used for synthetic and regenerated fibres where the polymer is dissolved in a solvent chemical to form the thick spinning solution (dope). Solvent laden air is processed through a condenser to recover the solvent.

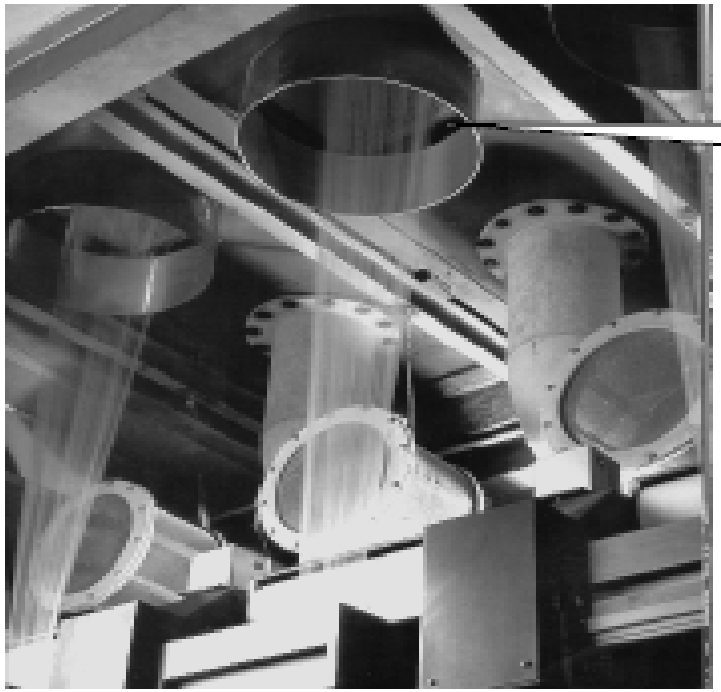


WET SPINNING

Wet spinning is used for synthetic and regenerated fibres where the polymer is dissolved in a solvent chemical to form the thick spinning solution (dope). Coagulation (hardening) is caused by a chemical reaction between the polymer solution and the bath chemicals.

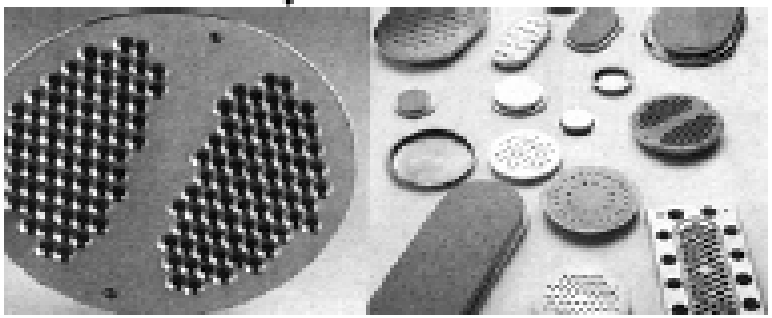


SPINNERETS



Polyester filaments being *extruded* from spinnerets

Typical spinnerets

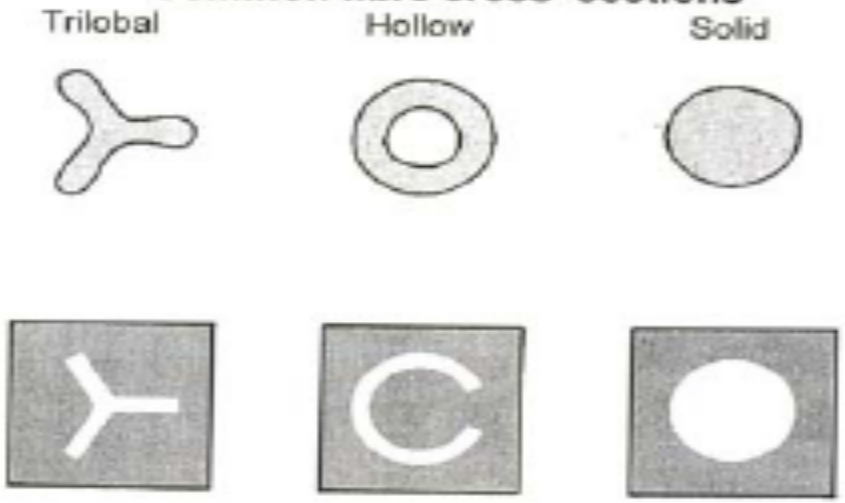


SHAPE OF FIBRES

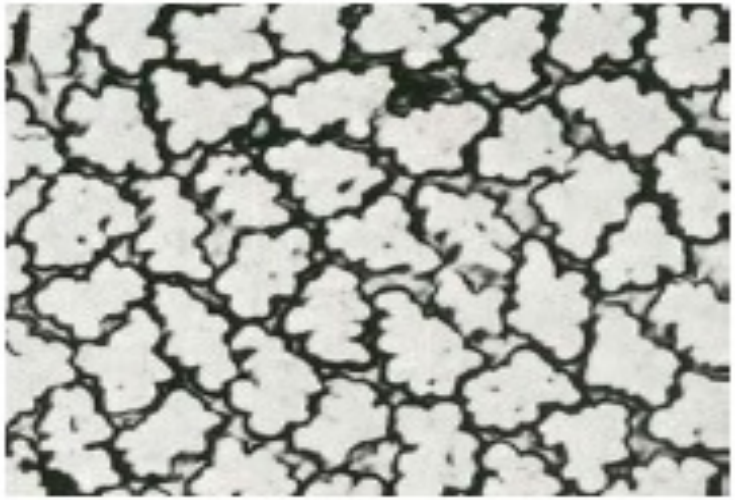
Extrusion

After the spinning solution (polymer) is prepared the next process involves pumping the thick, viscous solution through a metal nozzle called a spinneret.
The spinneret contains many holes which are very small (cut by electron beam or laser), each hole forms one filament. The shape of the hole determines the fibre's cross-section.

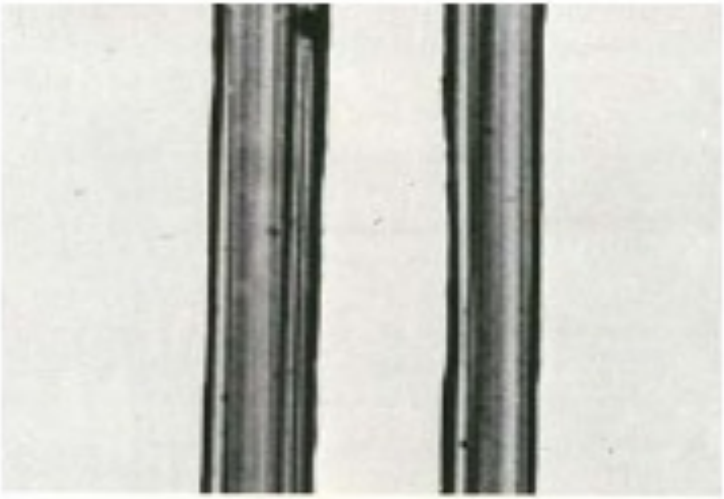
Common fibre cross–sections



VISCOSE



Cross section 500x

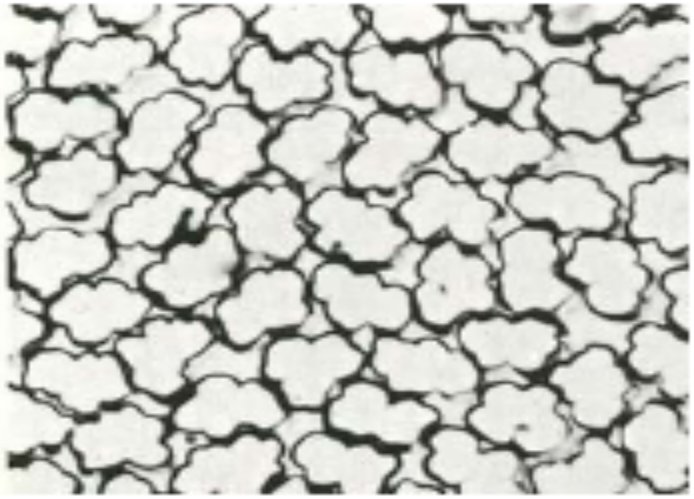


Longitudinal view 500x

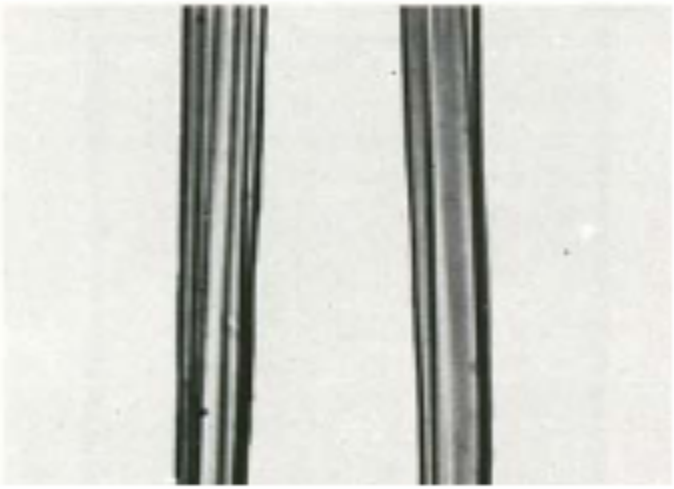
PROPERTIES OF VISCOSE

- A staple or filament fibre made from regenerated cellulose.
- **Length:** staple or filament
- **Moisture:** A hydrophilic fibre, natural moisture content of 11%.
- **Strength:** Lower than cotton due to it physical structure.
- **Resistance to:** Acids – Poor. Alkalies – good
- **Elasticity:** Poor.

ACETATE



Cross section 500x

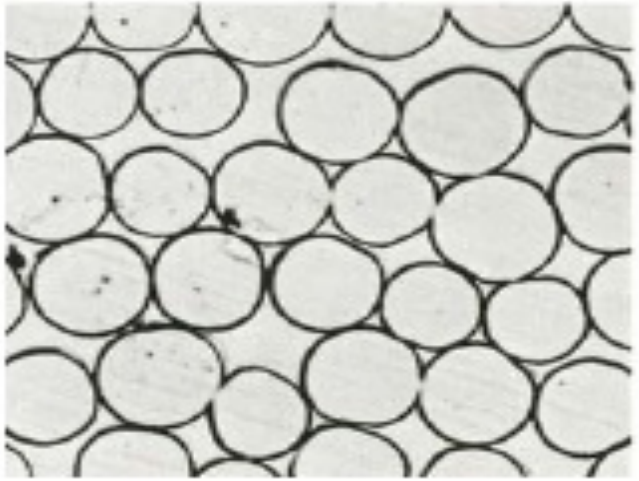


Longitudinal view 500x

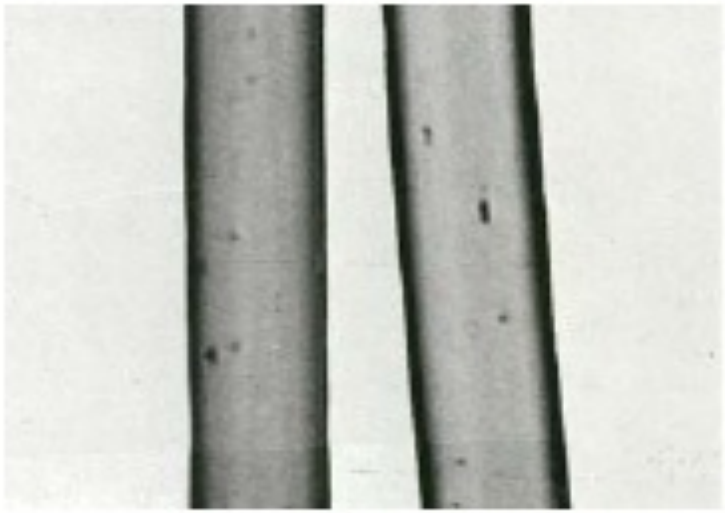
PROPERTIES OF ACETATE

- **Length:** staple or filament
- **Moisture:** Acetate is more absorbent than triacetate. Acetate has a natural moisture content of 6% and triacetate 3.5%
- **Strength:** Low strength, weaker when wet.
- **Effect of Heat:** Thermoplastic fibre, heat settable.
- **Resistance to:** Acids – Poor. Alkalies – good
- **Elasticity:** Acetate has poor elastic recovery and poor wrinkle recovery. By contrast triacetate has good wrinkle recovery.

NYLON



Cross section 500x

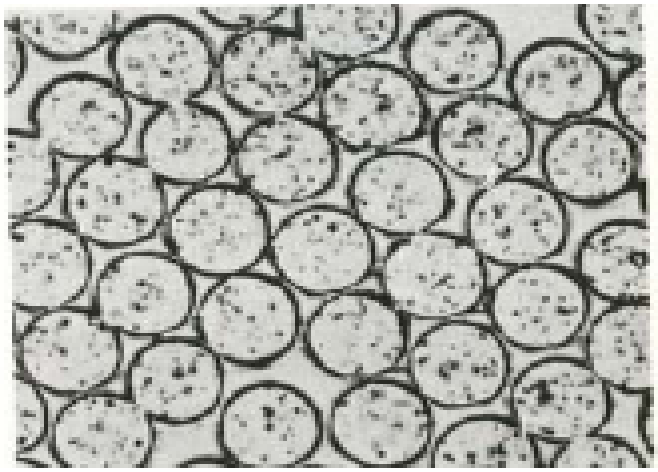


Longitudinal view 500x

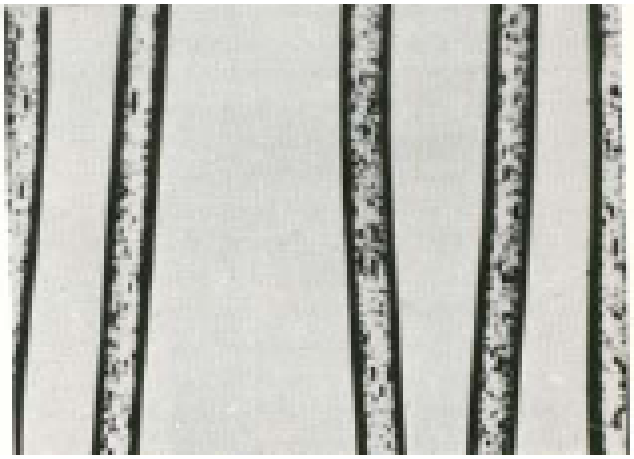
PROPERTIES OF NYLON

- A synthetic fibre also known as polyamide.
- Made from chemicals, derived from coal & gas.
- Length: staple or filament
- Moisture: A hydrophobic fibre, natural moisture content of 1.5% – 4%. Can be engineered to "wick" moisture away from the body.
- Strength: Depends on tenacity style.
- Effect of Heat: Shrinks from flame, melts and burns. A Thermoplastic fibre, heat settable.
- Resistance to: Acids – Poor. Alkalies – good
- Shrinkage: No problems.
- Elasticity: Excellent.

POLYESTER



Cross section 500x

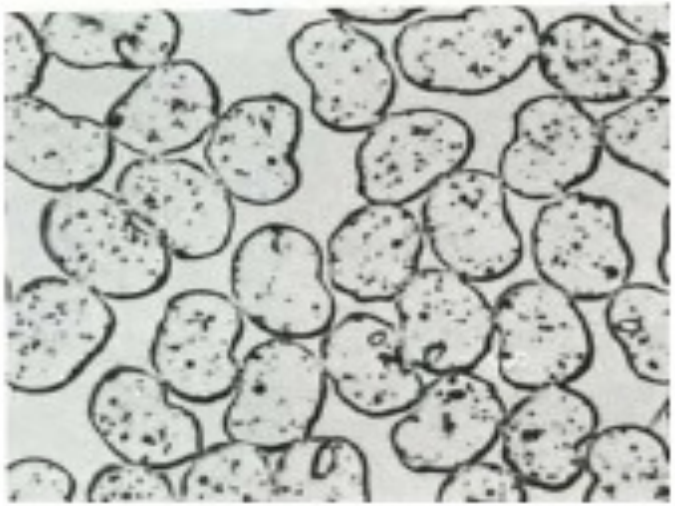


Longitudinal view 500x

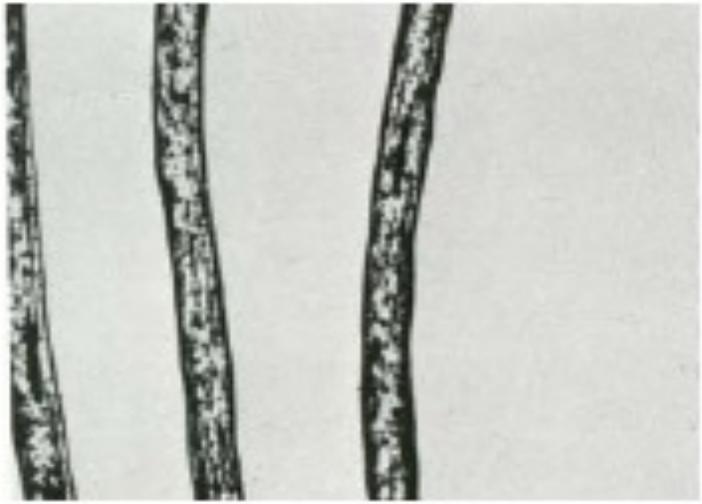
PROPERTIES OF POLYESTER

- A synthetic fibre made from chemicals derived from petroleum, coal, air and water.
- Length: Staple or filament.
- Moisture: A hydrophobic fibre which has natural moisture content of 0.5%.
- Strength: Depends on tenacity style.
- Effect of heat: Thermoplastic and heat settable.
- Resistant to: Acids good, Alkalies satisfactory.
- Shrinkage: No problems.
- Handling: Excellent crease resistance.

ACRYLIC



Cross section 500x

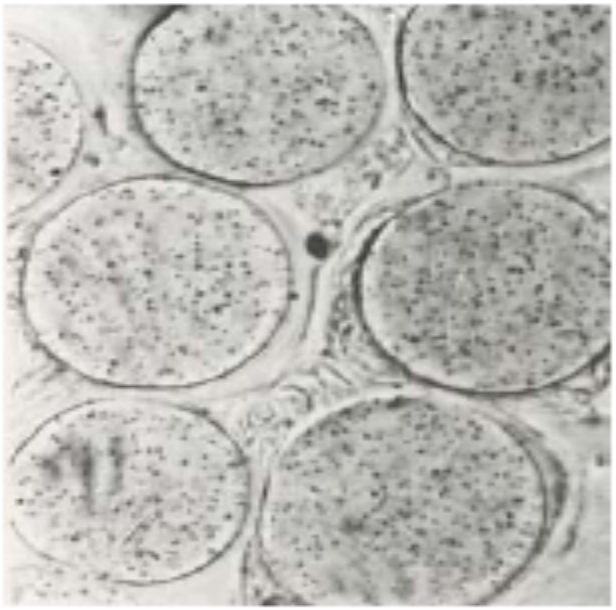


Longitudinal view 500x

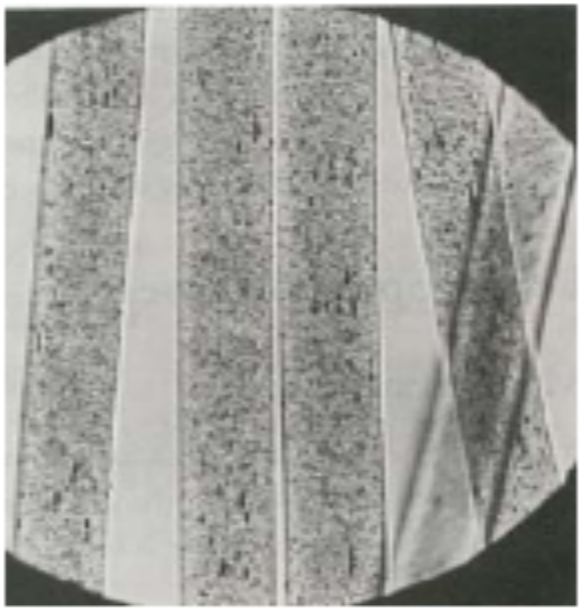
PROPERTIES OF ACRYLIC

- A synthetic fibre derived from petroleum, coal air and water.
- **Length:** Staple or filament.
- **Moisture:** hydrophobic, which has natural moisture content between 1 & 3%.
- **Strength:** Strong
- **Resistant to:** Good chemical resistance.

POLYPROPYLENE



Cross section

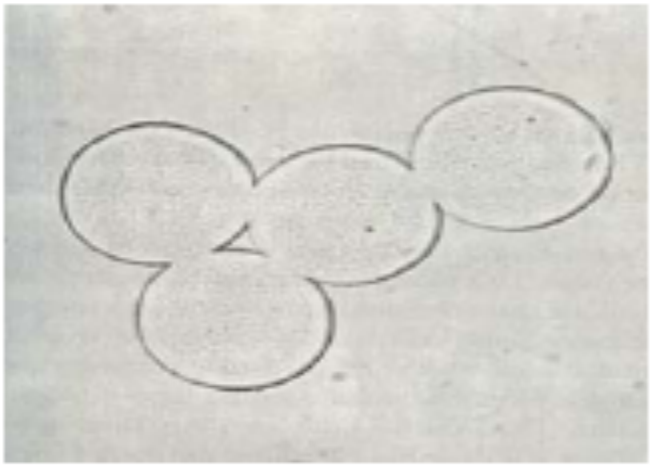


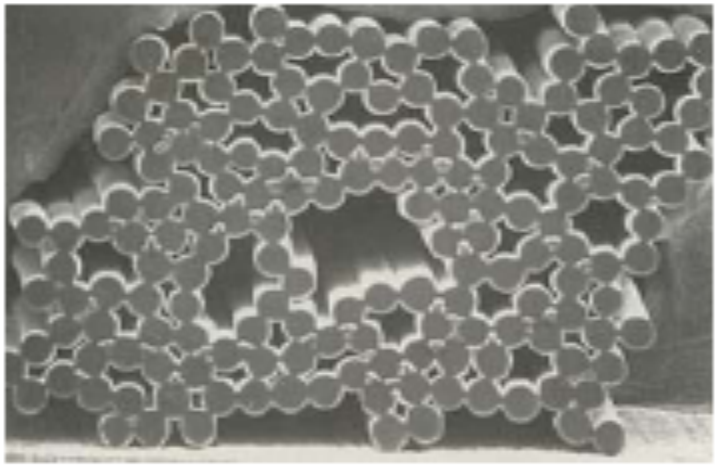
Longitudinal view

PROPERTIES OF POLYPROPYLENE

- Is made by polymerising propylene gas.
- **Length:** Staple or continuous filament.
- **Moisture:** A Hydrophobic fibre, natural moisture content of 0.1%. May be made to "wick" moisture.
- **Strength:** Very strong depends on version.
- **Resistant to:** Good to acids and alkalies.
- **Handling:** Lightest of all synthetic fibres.

ELASTANE





Cross section

PROPERTIES OF ELASTANE

- A man made, synthetic, segmented polyurethane polymer fibre characterised by its high elasticity.
- **Length:** Extruded as monofilament or multifilament.
- **Stretch:** After stretching it will recover to original length ie. 100% recovery.
- **Moisture:** Low moisture regain 1.0%.
- **Resistance to:** Chemicals is generally good.

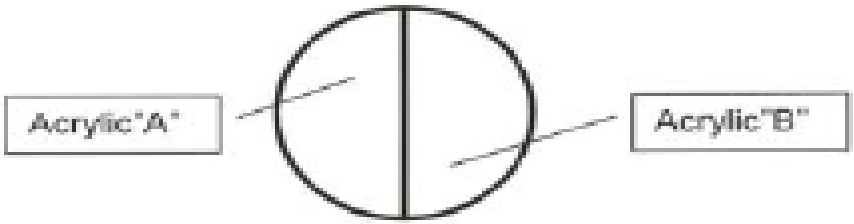
BICOMPONENT AND BICONSTITUENT FIBRES

Bicomponent and Biconstituent fibres

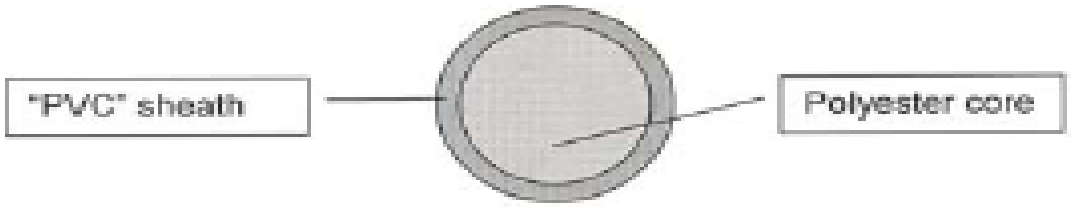
Bicomponent fibres are made by combining "generically similar" polymers at the spinning (Extrusion) stage to produce fibres with enhanced properties. Thus a "high bulk" acrylic is made by extruding two forms of acrylic in a "side by side" configuration. See below
Biconstituent fibres are made by combining "generically different polymers at extrusion. An example is a"Core – Sheath" fibre with a polyester core surrounded by a PVC sheath to form a melt bondable fibre for non woven applications.

Bi component

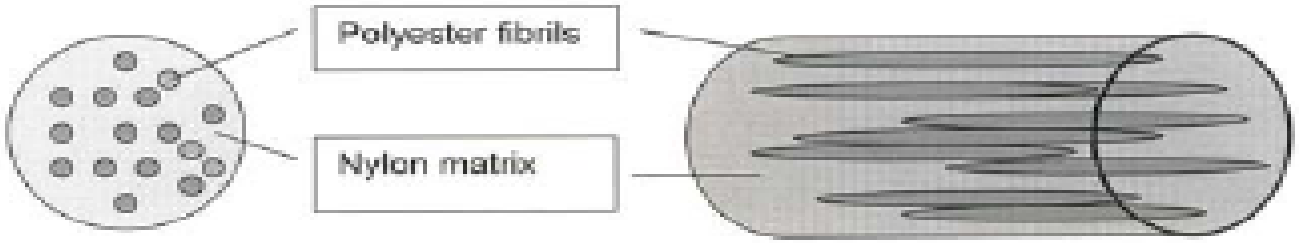
Side by Side – "High bulk acrylic"



Core Sheath – "Tontine"



Matrix – Fibril – "Fortran"



Bi constituent

Fibres produced are:

- Source - 70% Nylon 6 matrix, 30% polyester fibrils
- Mirafi - Polypropylene matrix + Nylon fibrils (Geotextiles)

Fortran - Nylon matrix + Polyester fibrils (Carpet pile)