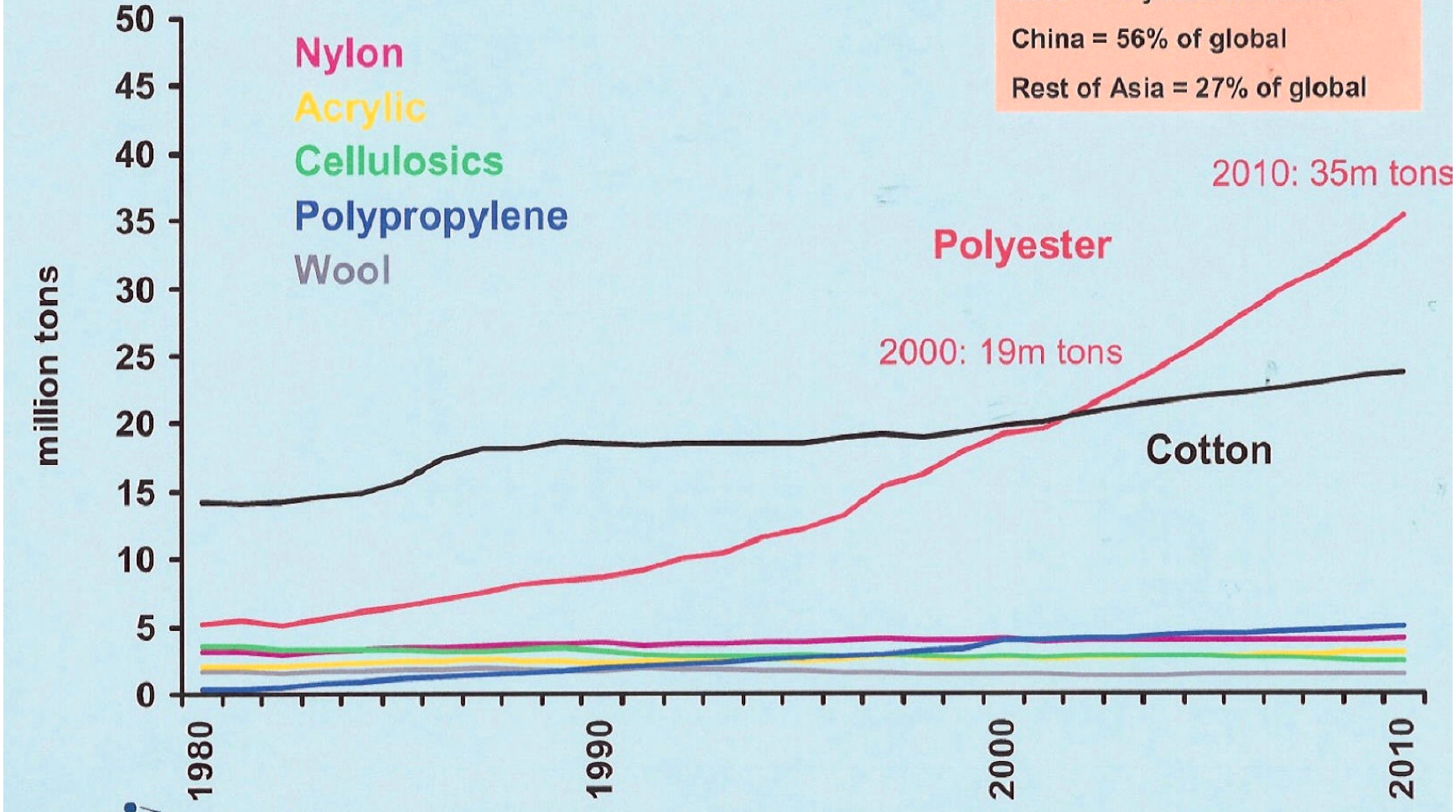
Textile colouration

Mr Mac Fergusson
RMIT University

Worldwide Demand by Fiber Type



PCI Fibres

Wool fibre production

- Relatively stable over the past five years.
- Some increase in production possible as flocks increase after prolonged drought conditions.
- Production of finer qualities increasing as farmers seek to capitalise on higher prices.

Dyes for wool

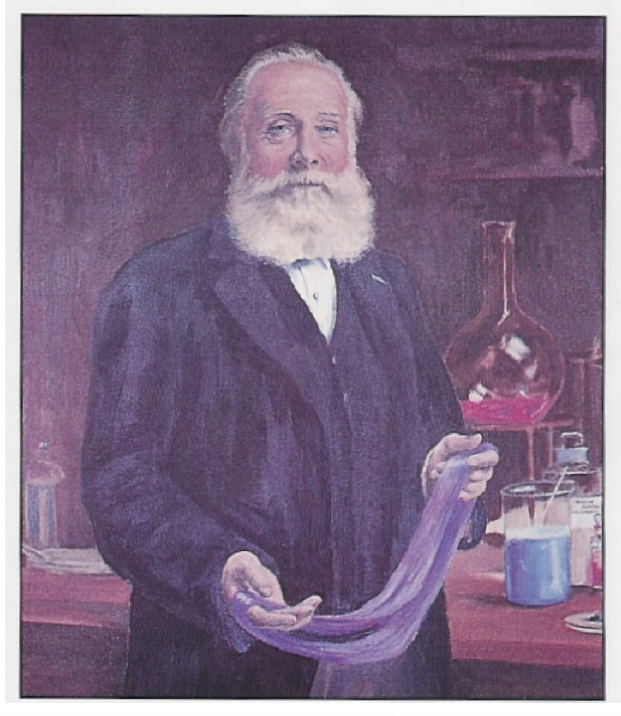
- Acid dyes
  - Level dyeing type
  - Milling type
  - Chrome dyes
  - Premetallised
    - 1:1 Premetalised
    - 2:1 Premetalised
  - Reactive

Natural dyes versus synthetic dyes

- Natural dyes – generally earthy colours, shades vary with seasons.
- Colour fastness generally low.
- Very polluting, due to the use of heavy metals.
- Synthetic dyes – bright shades of good all-round fastness when applied correctly.

Synthetic dyes

- William Henry Perkin
- discovered mauvine in 1856,
- using aniline as
- raw material.



Classification by application

- No universal dye.
- Different dyes are required for different fibres.
- Therefore, differing dyeing conditions are required when fibre mixtures are used.
- Different dyes are used to meet specific requirements.

Premetallised dyes

- Applied to both polyamide and wool
- 1:1 type specifically for wool but can be applied to nylon. Black often falls into this category. When applied to wool dyed at very low pH 2.5-3.0 using H_2S0_4.
- Shades generally earthy and dull; no bright blues, reds or greens.
- 1:2 type dyed from neutral bath using amphoteric amine ethoxylate as levelling agent.

Fast acid dyes

- So-called milling dyes - larger molecule, more difficult to dye level, dyed under slightly acid conditions using $(NH_4)_2\ S0_4$ and levelling agent.
- Full range of shades.
- Some not fast enough for washable wool, i.e. wool that has been made shrink resistant. Reactive wool dyes are normally used for this product.

Wool reactive dyes

- Introduced in the 1960s.
- Particularly suitable for dyeing washable wool, where bright clean shades are required.
- Dye combines chemically with the fibre to form a very strong bond that will withstand domestic washing.

Choice of dyes

- Shade
- Fastness requirements
- Cost
- Dyemakers pattern cards assist the dyer in making the choice.

Dyestuff selection

- Cost – cheapest combination.
- Technically the best without cost considerations.
- Combination that gives the desired properties to the customer's specification at the cheapest possible price.
- Machinery considerations can affect dyestuff selection.
- Fibre type can also influence selection criteria.

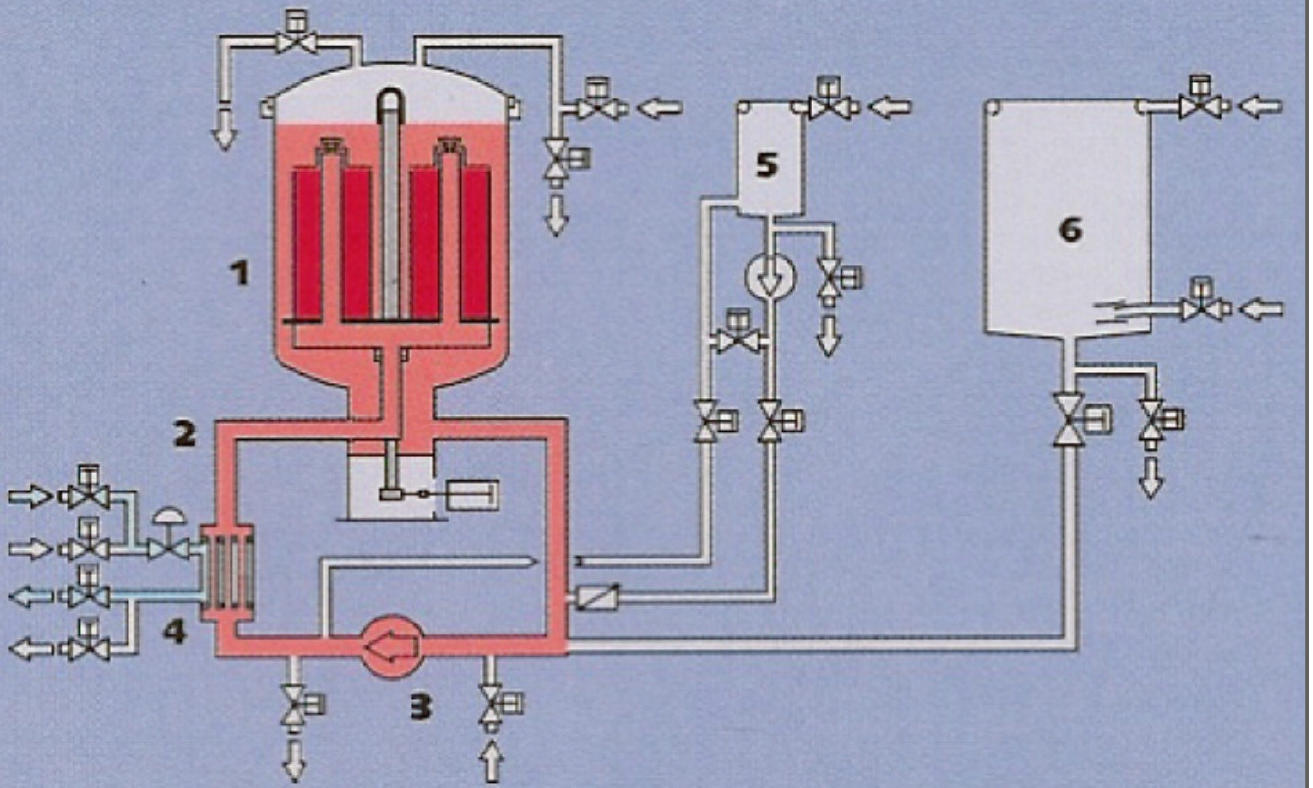
When can colour be introduced?

- Loose fibre
- Top or sliver
- Yarn
- Fabric
- Garment
- Printing, either fabric or garment.

Dyeing machinery

- Different machines are required.
- Loose fibre, yarn and top use similar machinery. Liquor is circulated through the material.
- Fabric dyeing - the material is moved through the liquor, or the fabric and liquor move together.

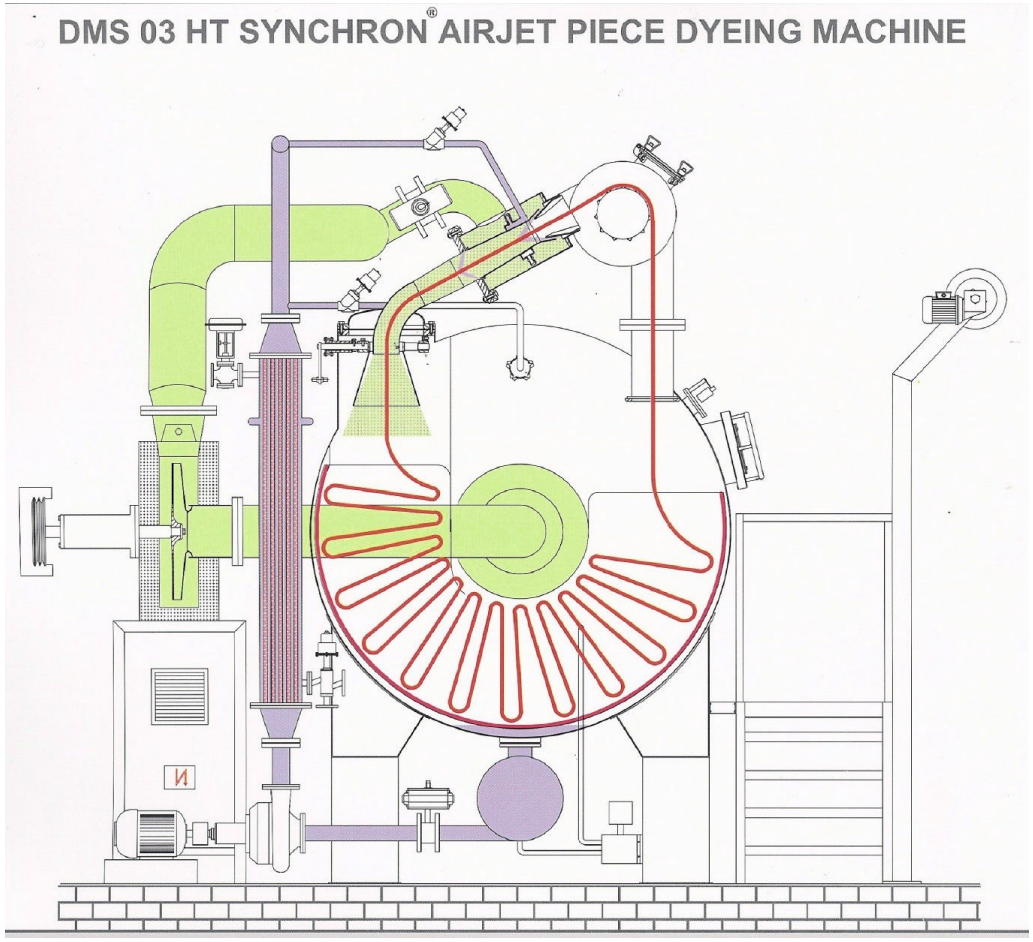
Function scheme



1 Dye autoclave
2 Cirkulation system
3 Dye bath pump with frequency reversing gear
4 Heat exchanger
5 Addition tank with salt dissolving function
6 Reserve tank

Example of unlevelness

Channelling due to density variations

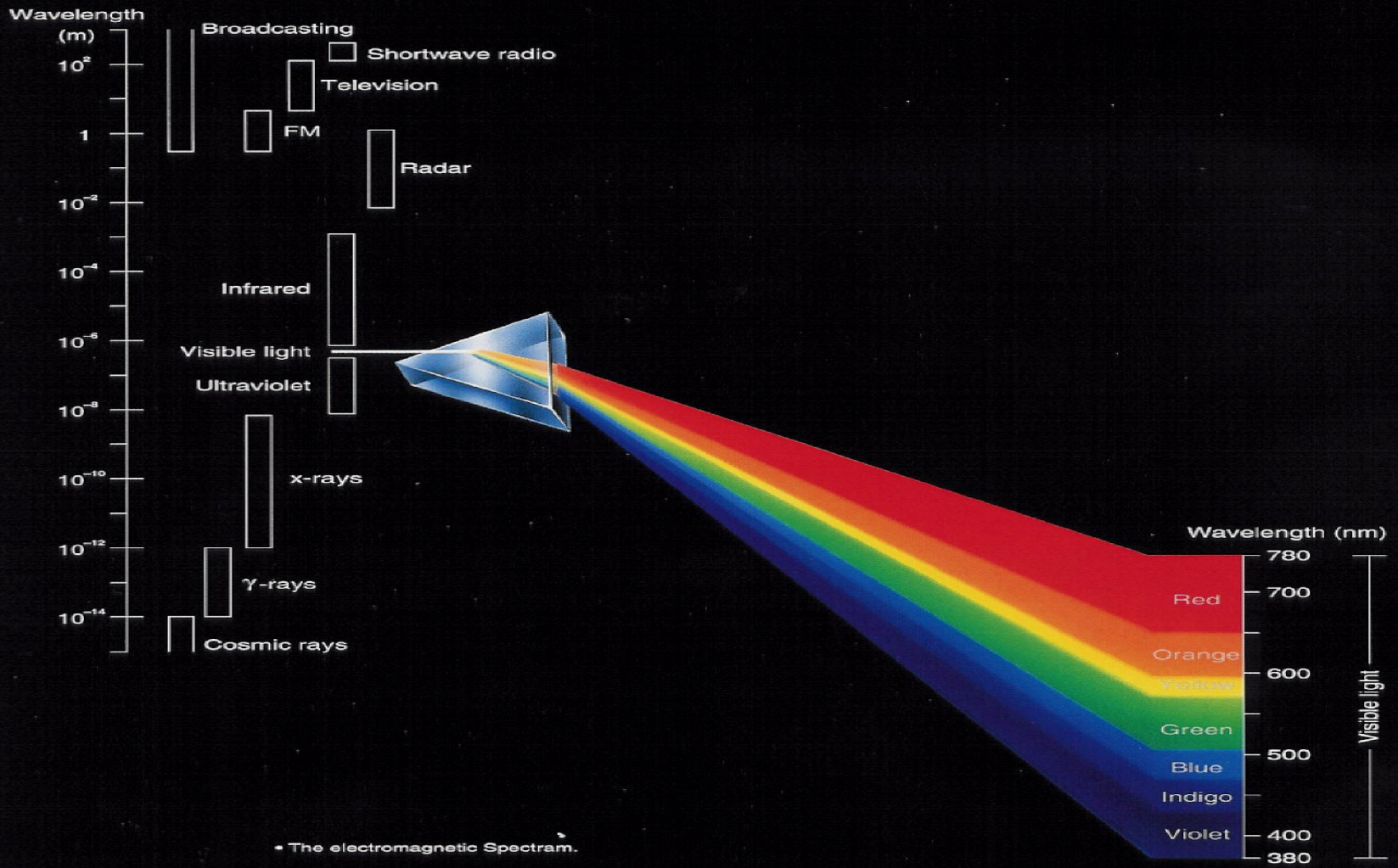


HT Jet dyeing machine

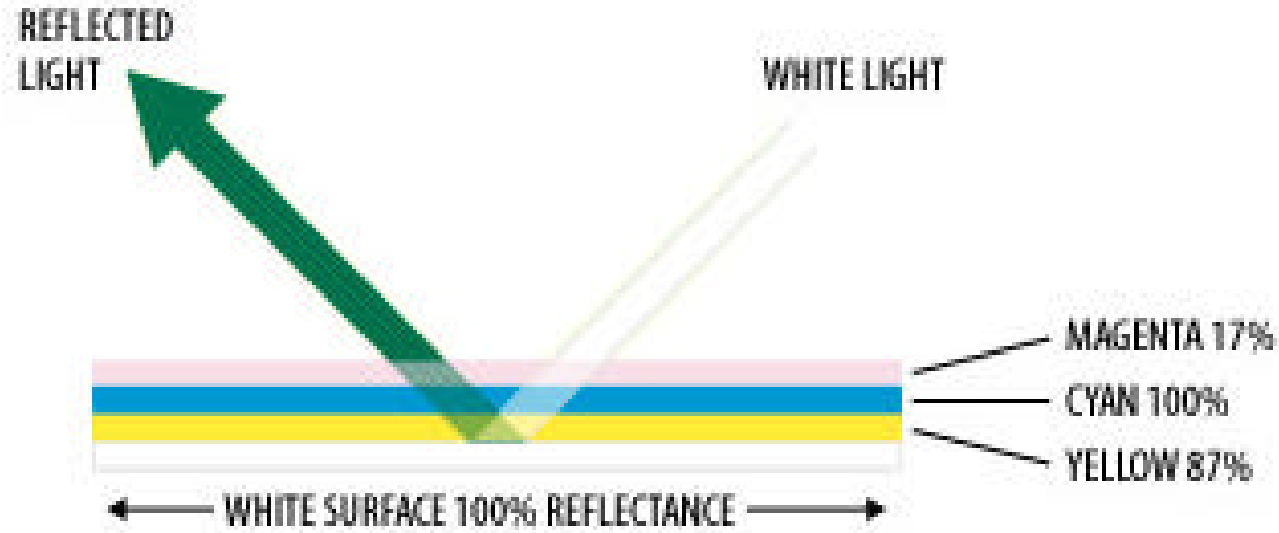
Nature of light

Light is an electromagnetic radiation.
Visible light from 350nm -700nm.
Below 350nm - ultraviolet radiation.
Above 700nm – infra-red radiation.

Human beings can perceive specific wavelengths as colors.

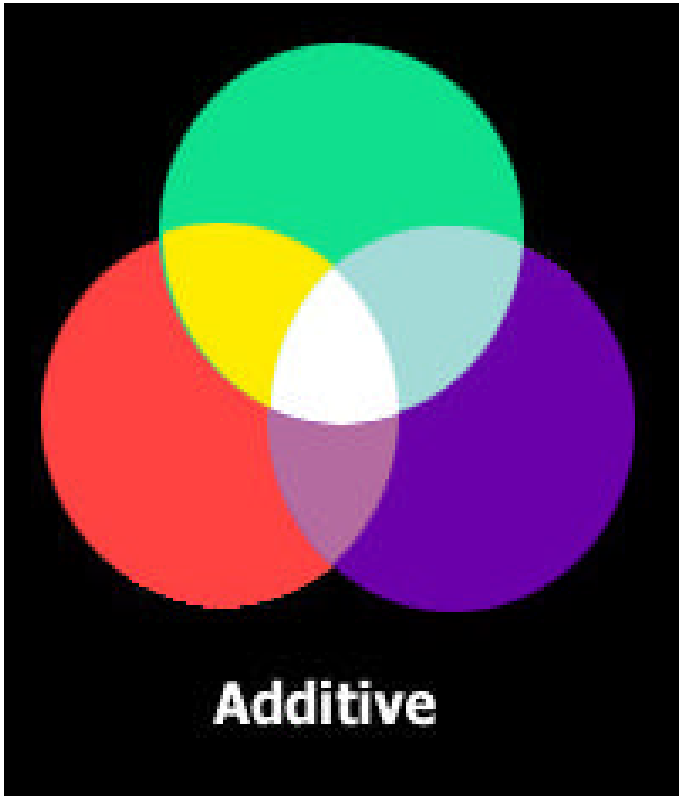


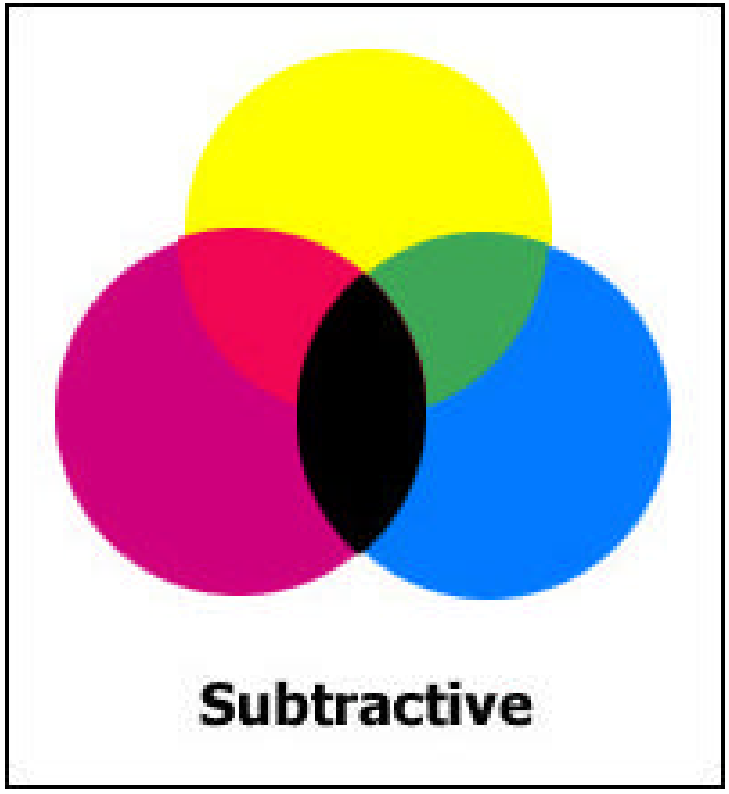
• The electromagnetic Spectram.


REFLECTED
LIGHT
WHITE LIGHT
MAGENTA 17%
CYAN 100%
YELLOW 87%
WHITE SURFACE 100% REFLECTANCE

How do we see colour?

- The human eye contains receptors: rods and cones.
- Rods are specific to the intensity of light.
- Cones distinguish colours:
  - one cone is very sensitive to red
  - one cone is very sensitive to blue
  - one cone is very sensitive to green.





Colour matching systems

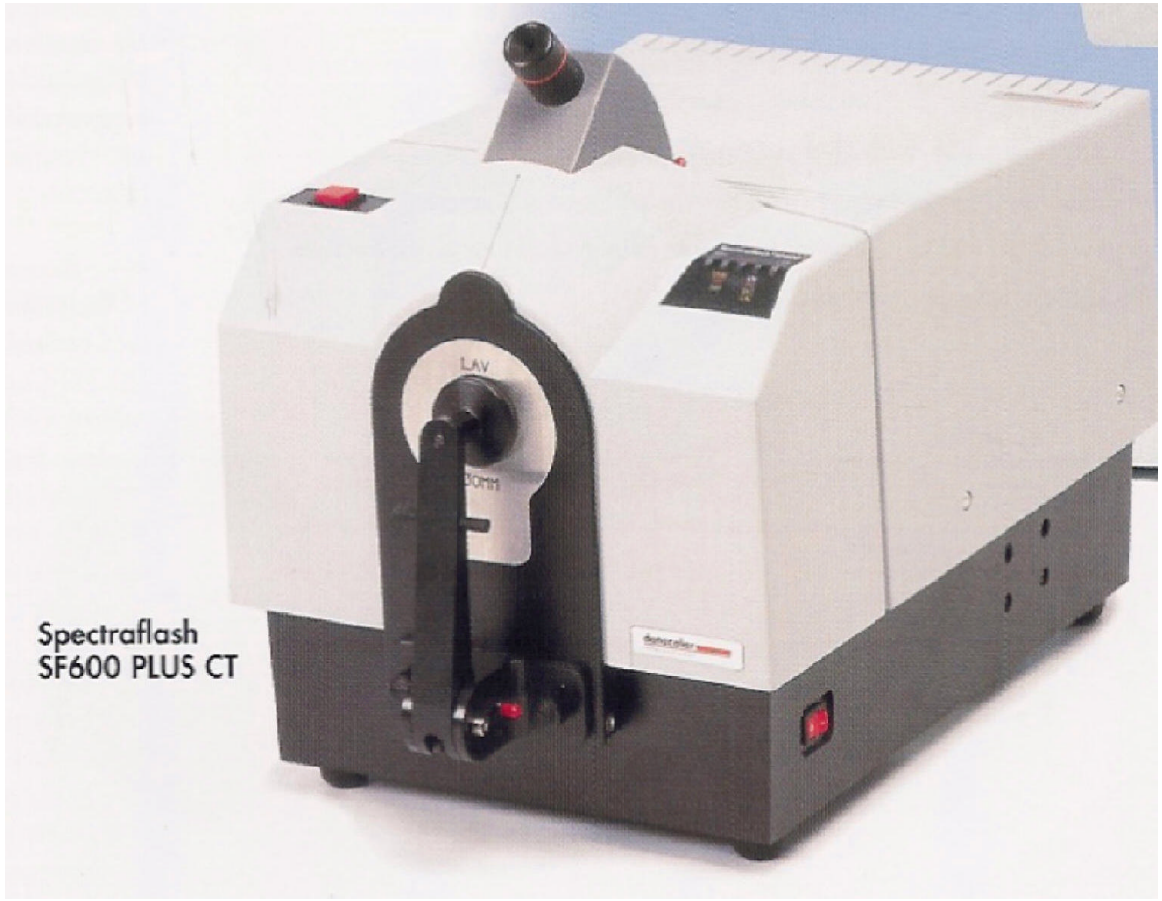
Colour matching

Three factors influence colour matching:

1. **The object** – whether rough, smooth, glossy or opaque will affect the colour.
2. **The illuminant** – standard lights D65 or TL84 are used for matching. Colours can change dramatically in different lights. This is known as ‘metamerism’.
3. **The observer** – the eye influences colour perception.

Metamerism

- This occurs when the colour matches under one light but not under another.
- Typical light sources:
  - D65 is standard northern daylight
  - TL84 fluorescent light, usually in stores
  - tungstan filament globes.
- A perfect match is made under D65
  - but may not match under other light sources.



Spectrophotometer

Defective colour vision

- So-called ‘colour blindness’
  - affects about 8% of the male population.
- It is due to defective receptors in the eye.
- About 1% have only monochromatic vision i.e. black and white.
- Can be tested using the Ishihara test plates.

Fabric finishing

Any process that improves the performance or characteristics of a textile fabric.

Temporary or permanent.

Process may be either mechanical or chemical.

Drying

- Following any wet process, the first operation finishing is drying.
- The stenter is the most common dryer.
- The fabric is held during the drying operation on pins or clips. This ensures control of the finished width.
- Polyester wool blends are heat-set after scouring prior to dyeing.

The stenter

Types of finishes

Mechanical finishes

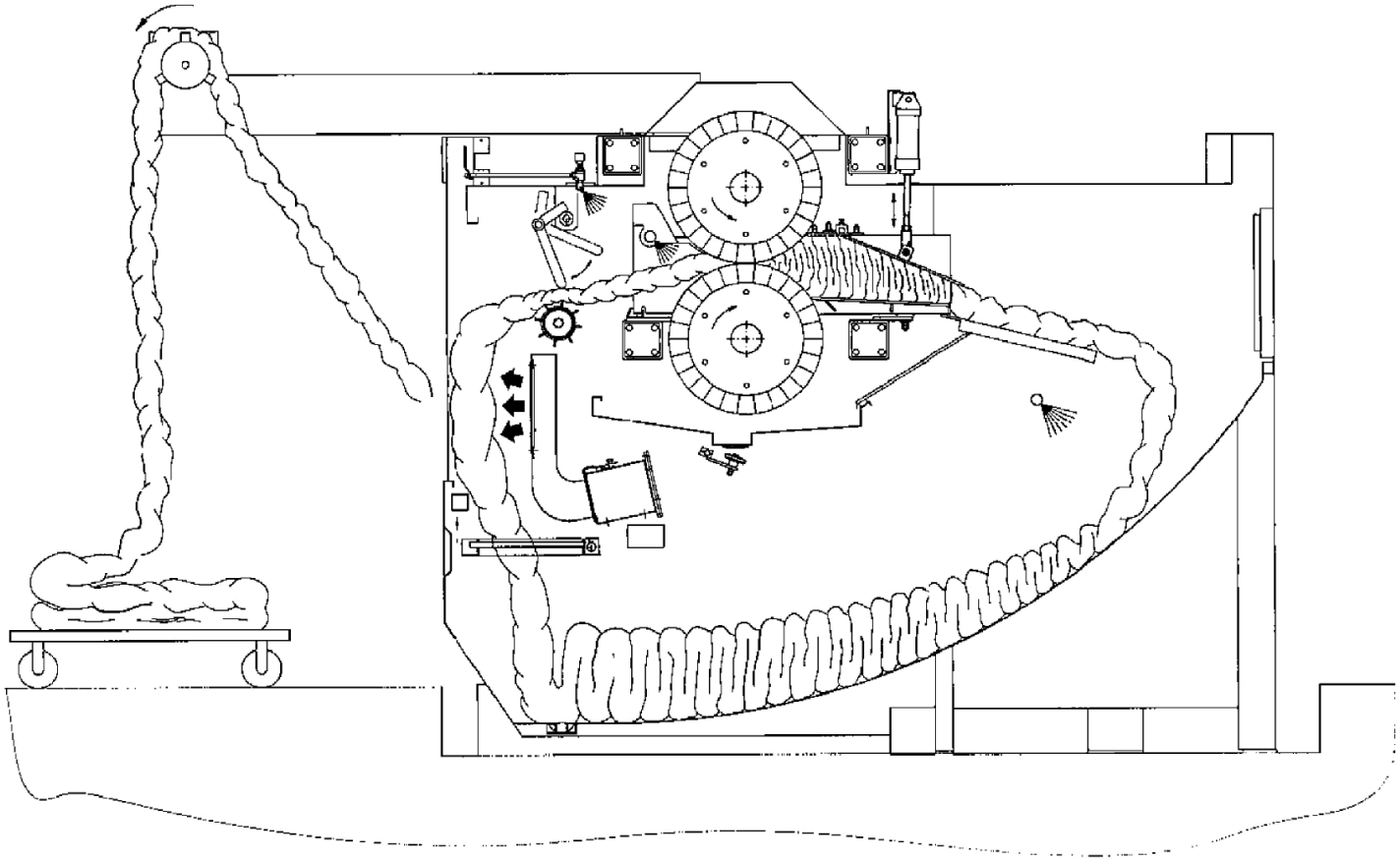
- Milling or felting of wool fabric
- Pressing
- Decatising
- Brushing or raising.=
- Singeing
- Shearing

Chemical finishes

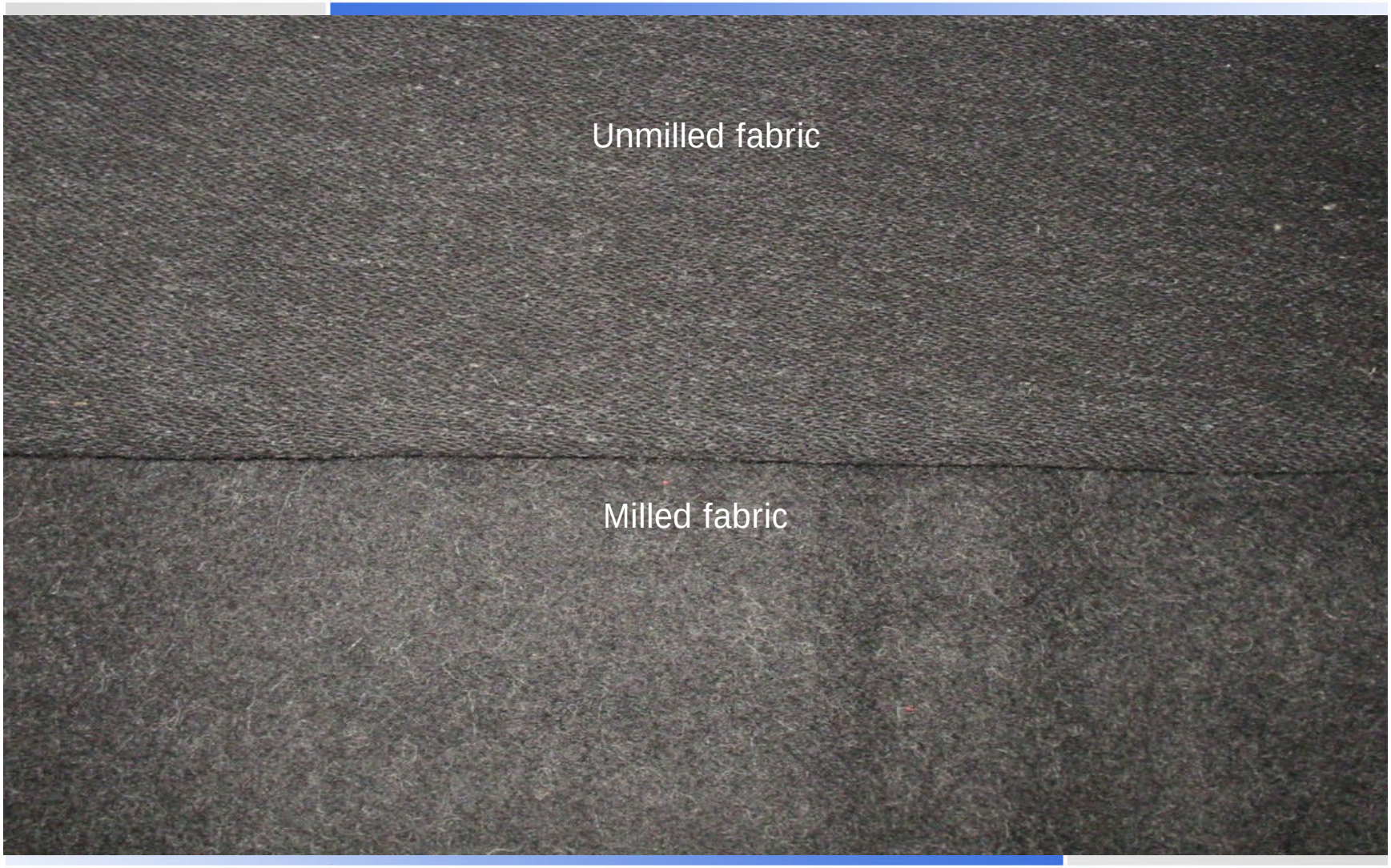
- Shrink-resist treatments for wool
- Flame proofing
- Water proofing
- Micro-encapsulated finishes.

Milling

- Milling – an important process, particularly for woollen fabrics.
- Process relies on the both the scales of the fibre and its elasticity.
- Some worsted fabrics may be lightly milled to achieve cover.
- Modern milling machines can include scouring.



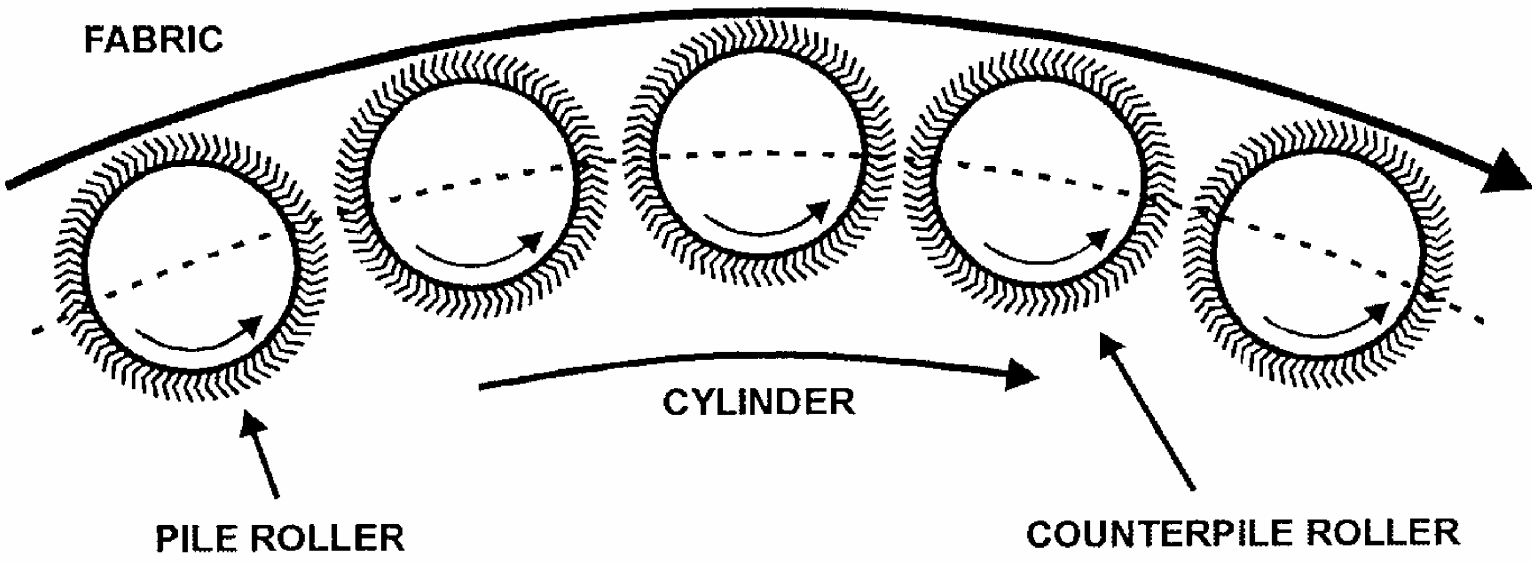
Flexicom machine - Zonco


Unmilled fabric
Milled fabric

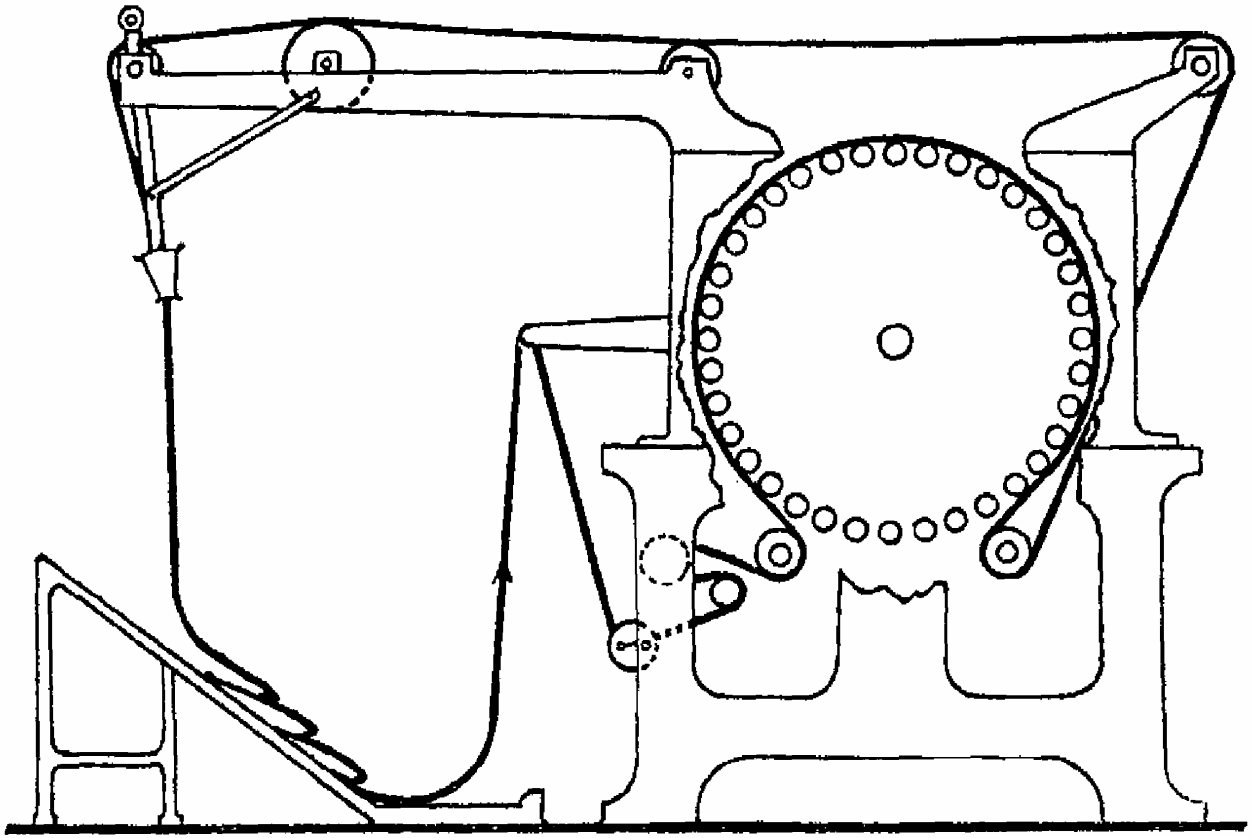
Raising

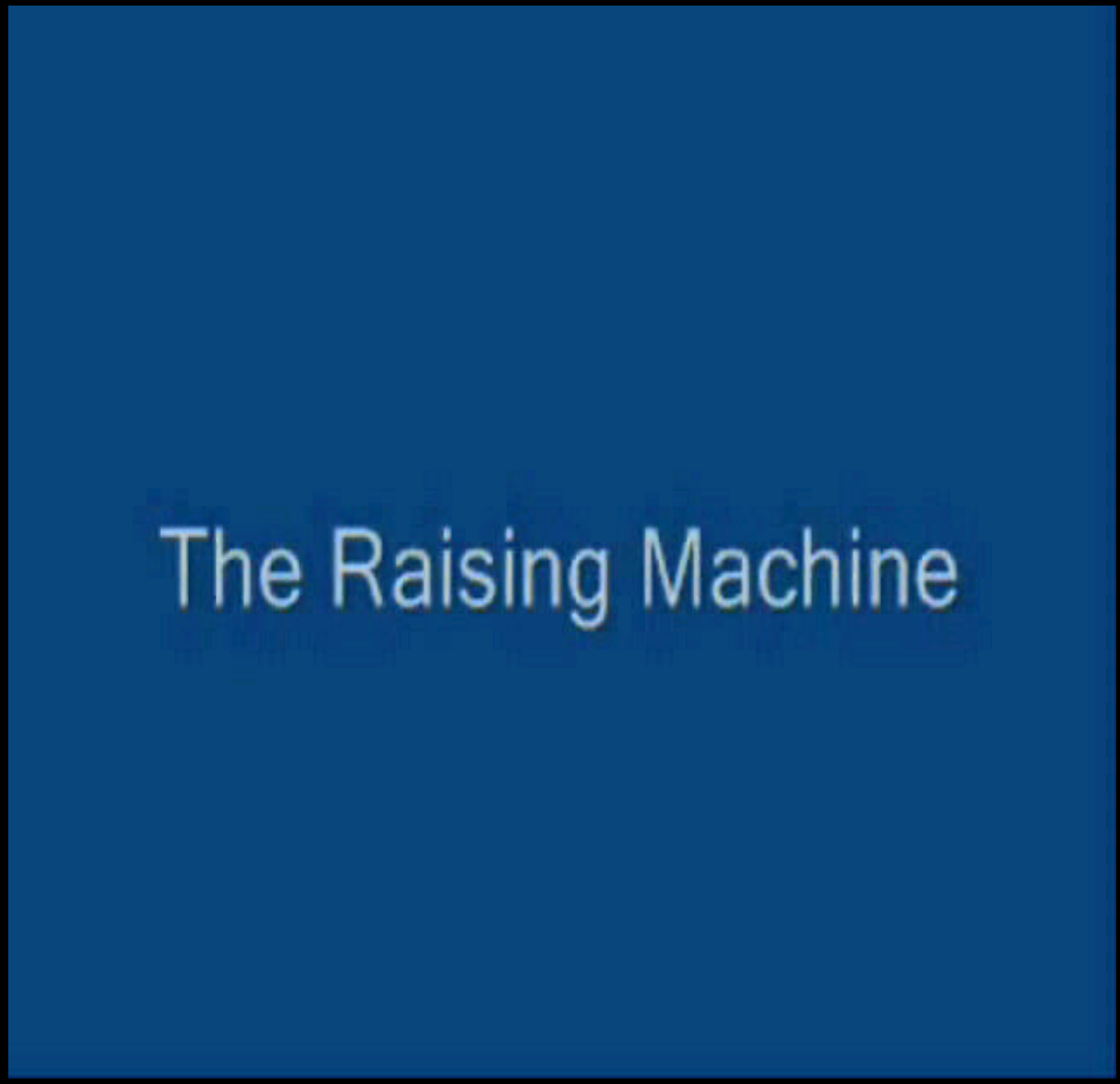
Increasing the bulk of the fabric:

- to give the fabric a pile
- commonly used for blankets and polar fleece
- heavy raising using wire
- light treatment using emery paper to give ‘peach skin’ effect.



A schematic diagram of a double-action raising machine





Raising machine

Singeing

- Polyester-wool blends are singed, usually after dyeing, to minimise pilling.
- The fabric is passed over an open gas flame.
- Both the face and back are singed at the same time.

Shearing or cropping

- This process removes surface loose fibre.
  The fabric is usually brushed to lift loose fibres to the surface.
- It is important in worsted fabrics to have a clear finish.
- Raised fabrics are cropped to give a uniform surface finish – common to woollen fabrics.
- Woollen flannels – a milled cloth is cropped to give a uniform surface.

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Cropping / shearing machine

Decatising

- Wet decatising is used to give set to the fabric prior to wet processing.
- Finish decatising imparts some lustre to the finished fabric.
- Conveys a degree of set to the fabric.
- Increases dimensional stability.
- Improves the finished handle of the fabric.

Vapofinish from Bisio, Italy

Chemical finishes

- Modify the fibre surface:
  - to enhance performance
  - to modify wearer performance.
- Change the properties of the fibre:
  - to increase resistance to various agents
    - Insects.

Antishrink wool

- Removes scales and changes elastic properties.
- Current treatments consist of chlorination and the addition of a resin.
- Chlorination can be either wet or dry.
- This treatment changes the dyeing properties of the fibres.
- Shrink-resist wool dyes darker.

Non-shrink wool

- Two processes are used:
  - For top - treatment with gaseous chlorine (the KroyProcess, a continuous process).
  - Wet chlorination using the sodium salt of di-chloro-isocyanuric acid (Basolan DCTM BASF).
- Chlorination modifies the surface scale structure:
  - A cationic resin, Hercosett, is usually applied as an after treatment.
  - The resin treatment covers any scales that have not been completely damaged.

Flame proofing

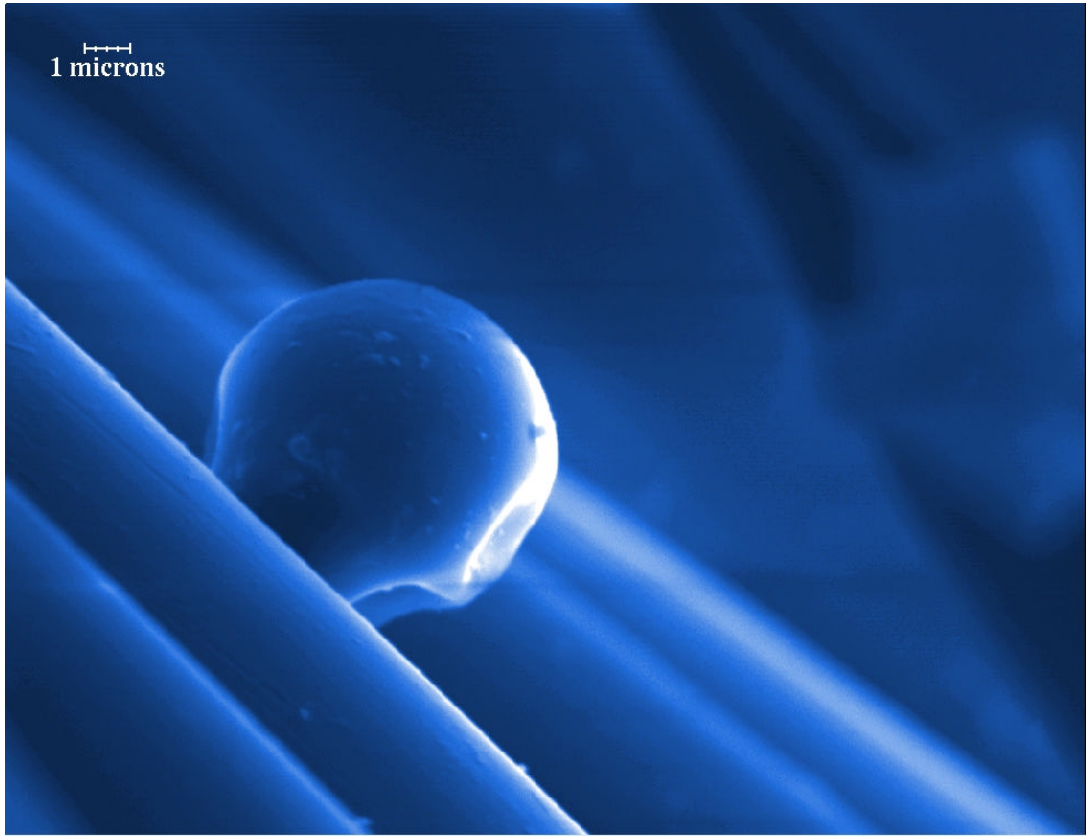
- Important process for special fabrics:
  - Firefighters' uniforms, aircraft upholstery, military applications.
- Wool has a high ignition temperature 570°-600°C.
- For certain applications a specific treatment is required.
- A durable flame retardant is obtained using zirconium hexafluoride complexes.

Water-resistant finishes

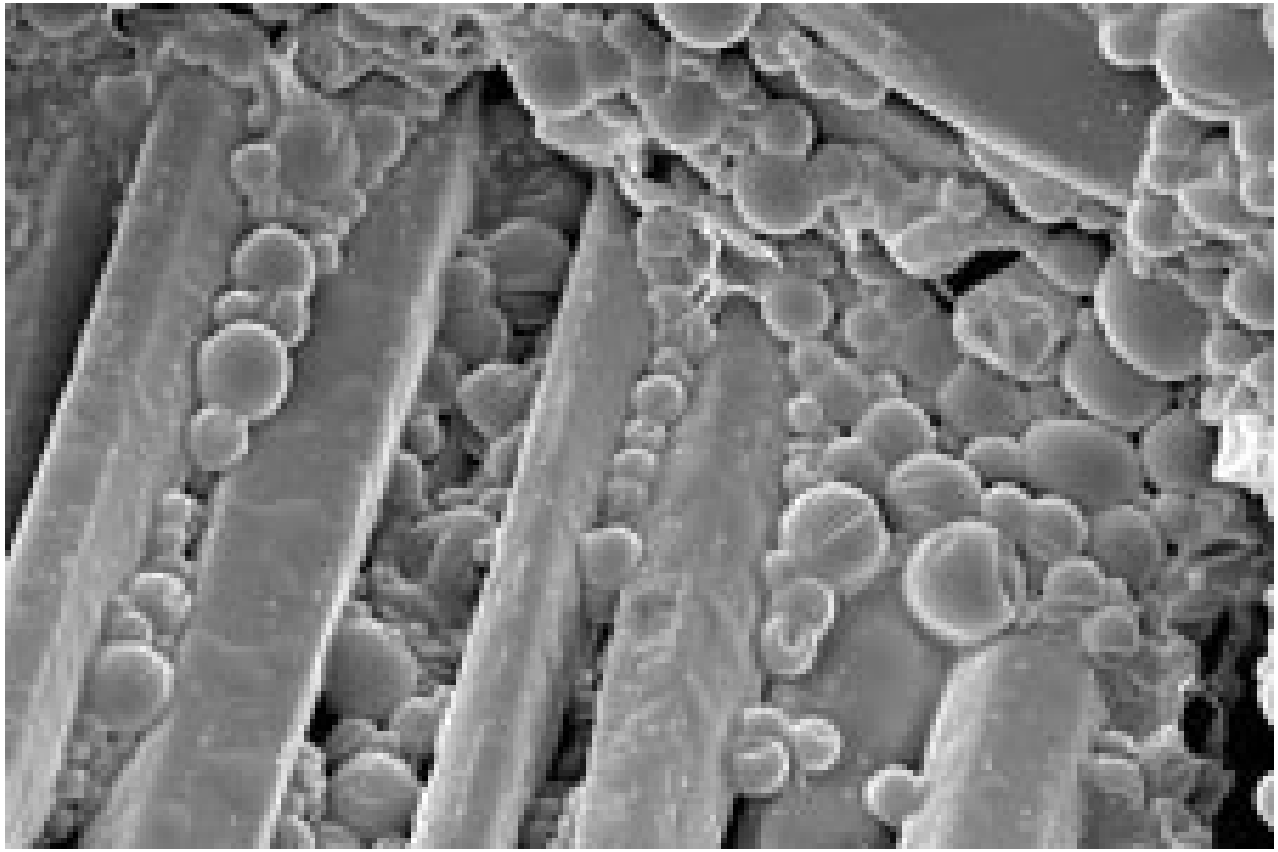
- Simplest utilises the principle of aluminium soaps.
- This is the standard shower-proof process.
- Does not yellow the fabric.
- Fluorochemical finishes provide both oil and water repellency.
- Silicone polymers are used extensively as water repellent finishes.

Micro-encapsulated finishes

- What is micro-encapsulation? A miniature container that protects the chemical from evaporation, oxidation and contamination until its release is triggered.
- Typical size 3 – 9 microns.
- Release can be triggered by gentle rubbing.
- Applied to the fabric together with a reactive resin, so that the micro-capsule will withstand normal household washing.



Courtesy of Devan Chemicals, Belgium



Microcapsules applied per m².

Applications for micro-capsules

- Fragrances
- Skin care products
- Anti-microbials
- Deordorants
- Odour masking products
- Insect repellents
- Cosmetic oils
- Vitamins

Inspection

- Final operation in the finishing process.
- Consistent quality.
- Reduces returns.

Thank you