TO THE COURSE:

TECHNOLOGY OF TEXTILE PREPARATION AND FINISHING

(TXL-241)

About the course……

3 credits (3-0-0); Pre-requisites: TXL110 OR TXL111 OR PHL110 OR MAL110 OR TXN101 OR TXL111L AND TXL111P

A. Preparatory Processing

Natural and added impurities in textiles, singeing, desizing, scouring, bleaching, mercerization and optical whitening of cotton. Combined preparatory processes, carbonization, scouring and bleaching of wool, degumming of silk. Heat setting. Machinery for preparation of textiles. Surfactants and their application.

B. Finishing

Introduction to chemical and mechanical finishes. Chemical finishes for hand modification. Bio-polishing, easy care, oil, water and soil repellent finishes. Fire retardancy, antimicrobial finishes. Finishes for wool. Mechanical finishes like shrink proofing and calendering; Raising, sueding and emerising. Low liquor application techniques and machinery; Stenters and dryers.

Instructor……

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Instructor……

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Introduction to Preparatory Processes

Reference Book

Books: Part A

- Chemical Technology in the pre-treatment process of textiles, S. R. Karmakar, 1999, Elsevier Science

- Textile Scouring & Bleaching by E. R. Trotman, B.I. Publications, New Delhi

- Handbook of Fibre Science and Technology- Volume I: Chemical properties of fibers and fabrics fundamentals and preparation Part-A and B. Ed. Mena Chem Lewin and Stephen B-Sello. Marcel Dekker Inc. New York

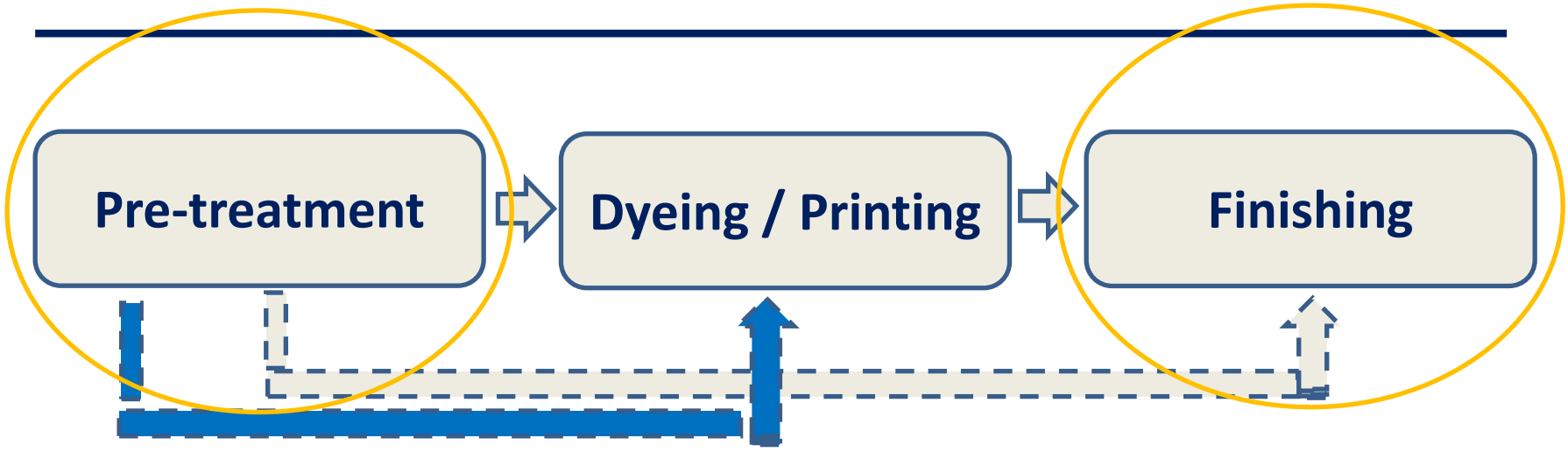
Major Textile Fibres

Natural:

- Cotton
- Wool
- Silk

Synthetic / Man made:

- Polyester
- Nylon
- Acrylic
- Viscose

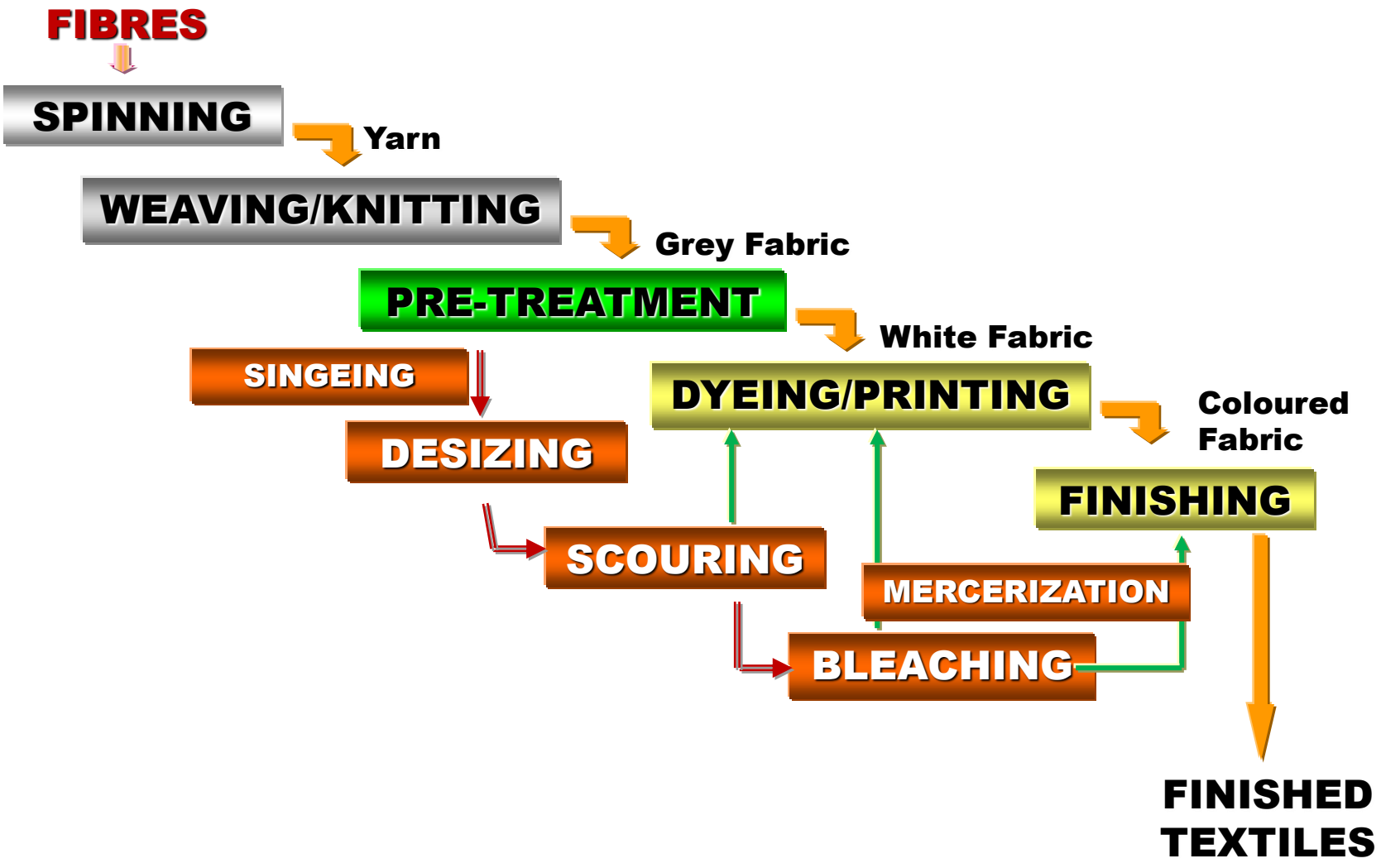


Final step of fabric manufacturing processes

- **Improved comfort**
- **Improved downstream processing**

- Appearance (aesthetics)
- Special functionalities (case basis)

- **Appearance (aesthetics)**
- **Special functionalities**
- **Feel (touch)**


FIBRES
SPINNING
Yarn
WEAVING/KNITTING
Grey Fabric
PRE-TREATMENT
White Fabric
SINGEING
DESIZING
SCOURING
BLEACHING
MERCERIZATION
DYEING/PRINTING
Coloured Fabric
FINISHING
FINISHED TEXTILES

Define – Pretreatment

Textile pretreatment is a series of cleaning operations that removes impurities which might adversely affect downstream processes like dyeing, printing and finishing.

- Natural impurities
- Added impurities

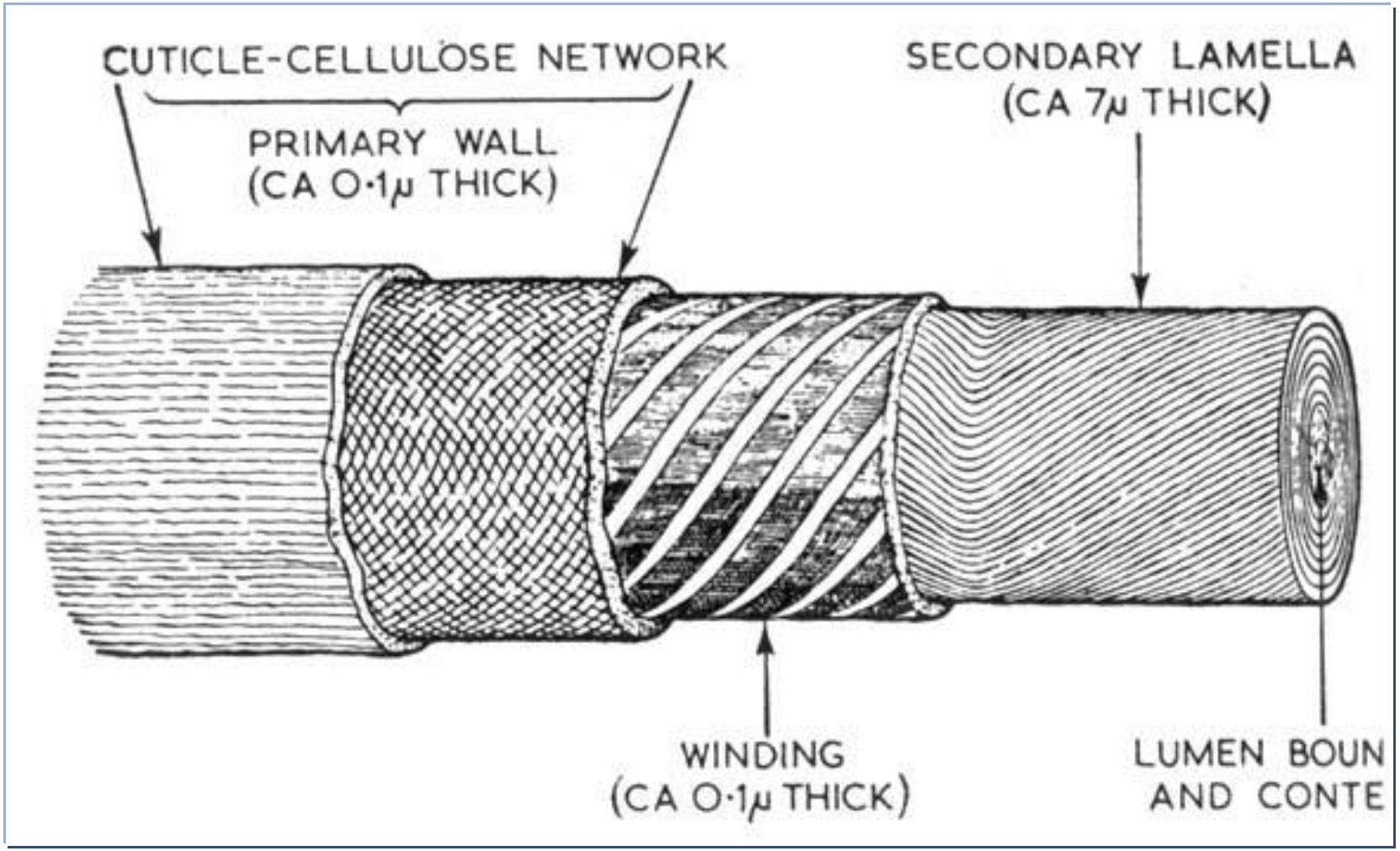
Pretreatment Objectives:

(Should be carried out with Minimum damage to the material)

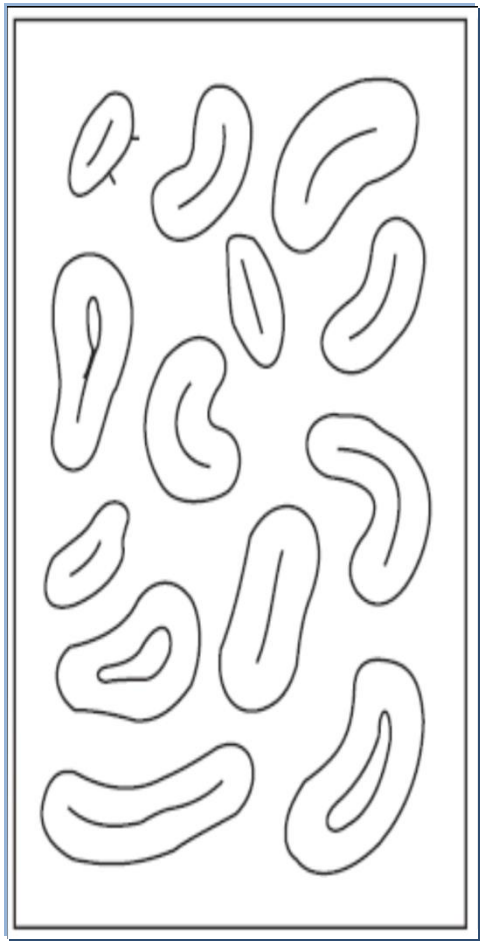
Improvement in absorbency

- Improved comfort
- Improved downstream processing (dyeing / finishing)

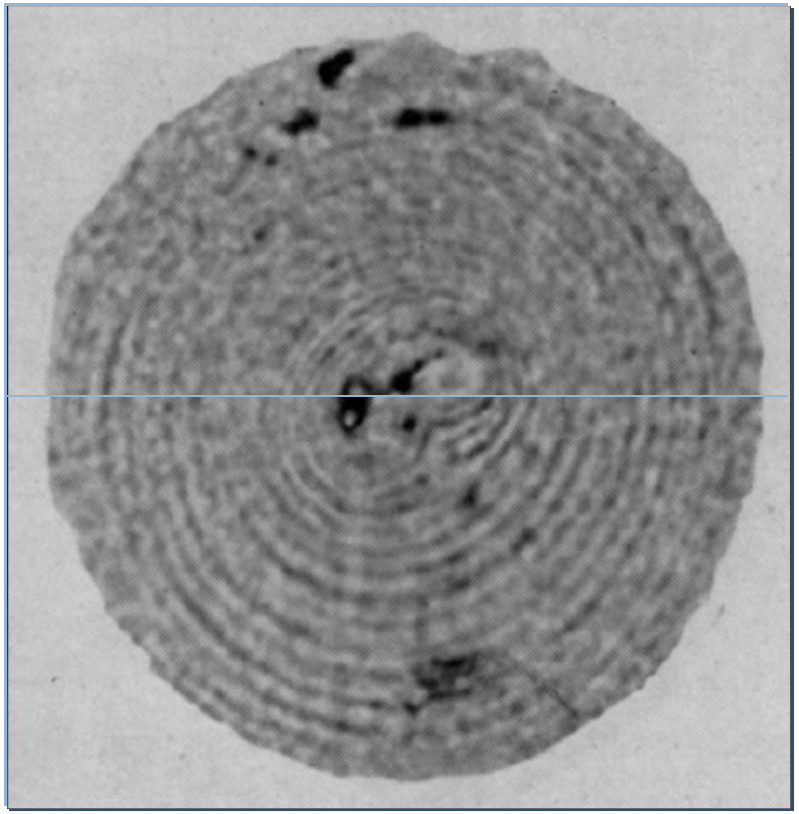
Layered components of a cotton fibre cell wall



Cotton fibres have a typical bean shaped x-section, convoluted, collapsed tube like structure

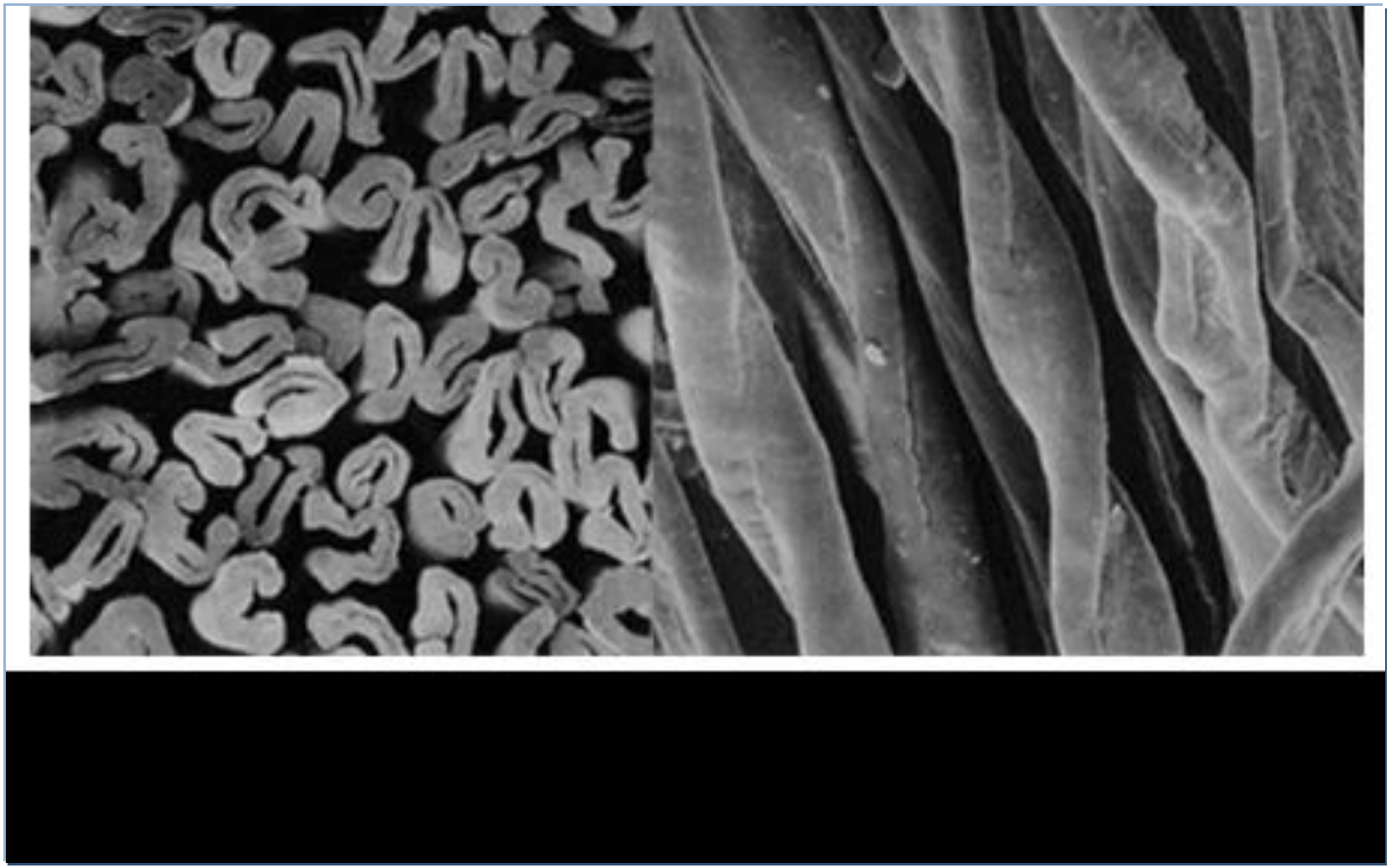


Typical cross-sections of matured cotton fibres

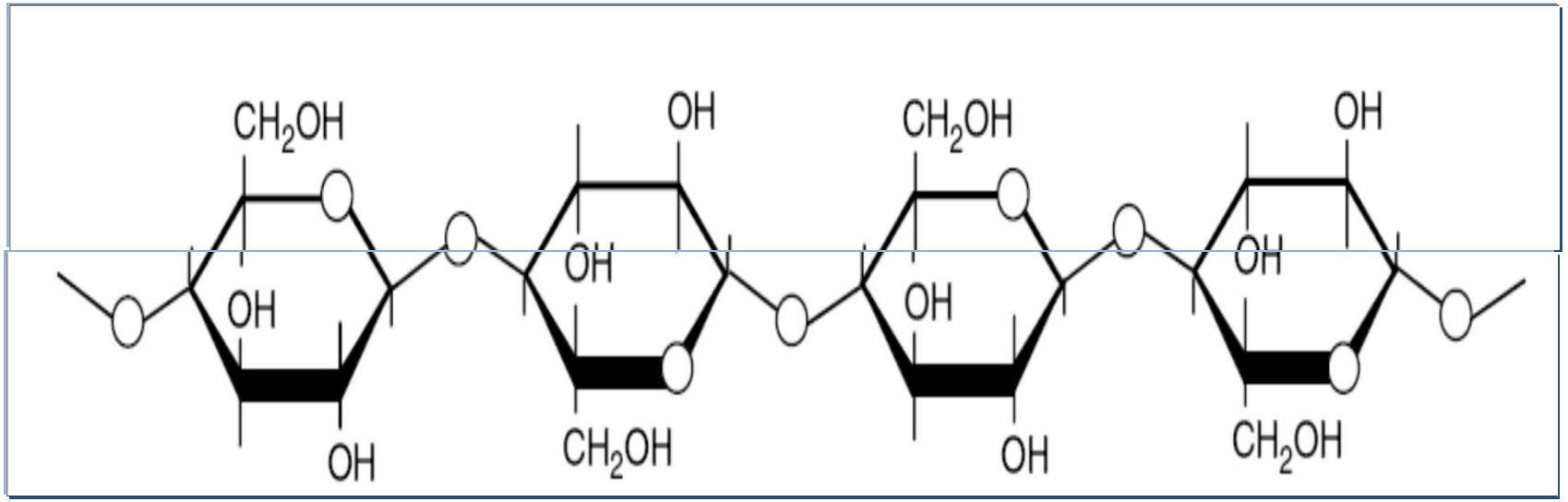


Cross-section of swollen cotton fibre showing daily growth rings

Microscopic view of cotton

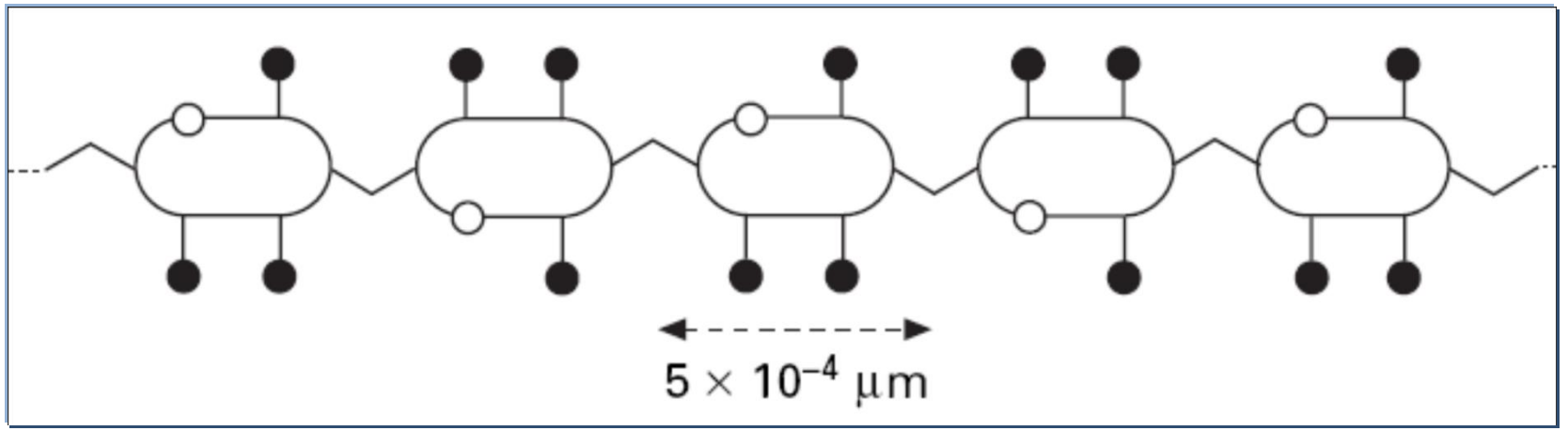


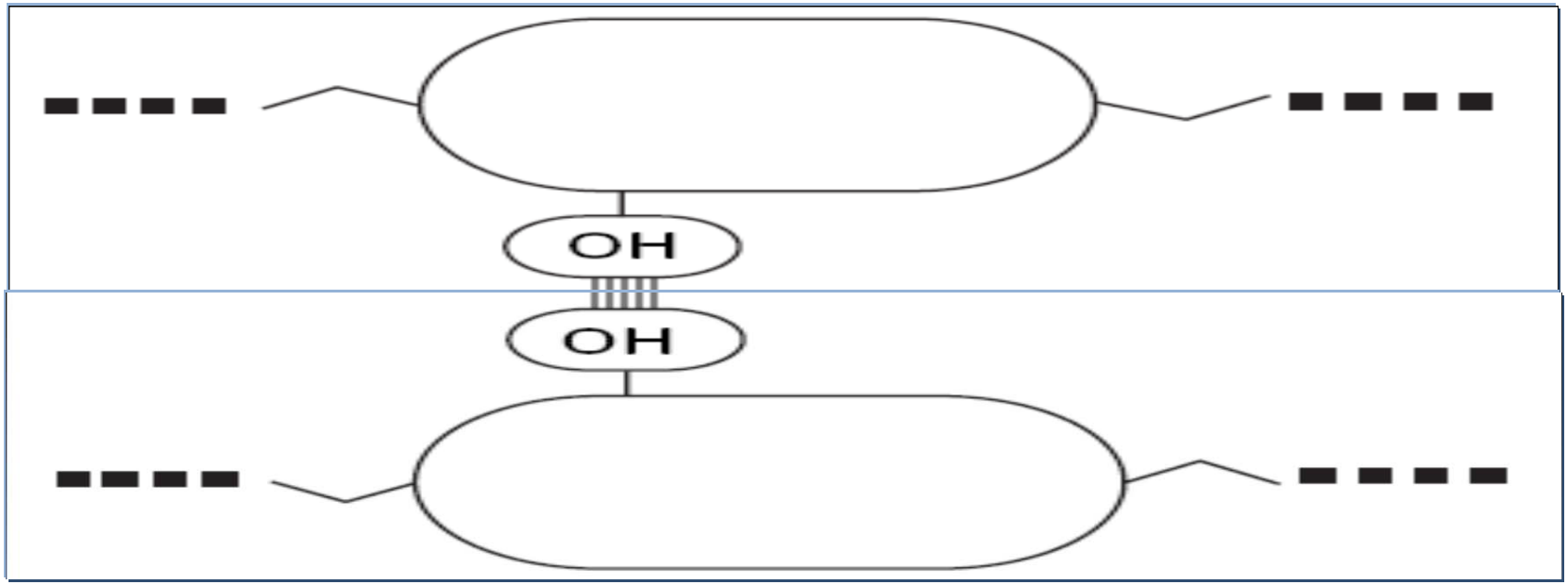
Chemical drawing of Cellulose



Polymer made up of a long chain of glucose molecules linked by C-1 to C-4 oxygen bridges with elimination of water (glycoside bonds). The anhydroglucose units are linked together as **beta-cellobiose**; therefore, anhydro-beta-cellobiose is the repeating unit of the polymer chain

Features of the cellulose molecule chain





Cotton Fibre

Constituents	Composition of a fibre		
	Typical (%)	Low (%)	High (%)
Cellulose	94	88	96
Protein	1.3	1.1	1.9
Pectic matter	0.9	0.7	1.2
Wax	0.6	0.4	1.0
Mineral matter	1.2	0.7	1.6
Malic, citric and other organic acids	0.8	0.5	1.0
Total sugars	0.3	-	-

Proteins

Nitrogenous compounds:

- Present in primary cell wall and lumen
- Yellow colour of cotton is due to presence of proteins and some colouring matter

Some amino acids:

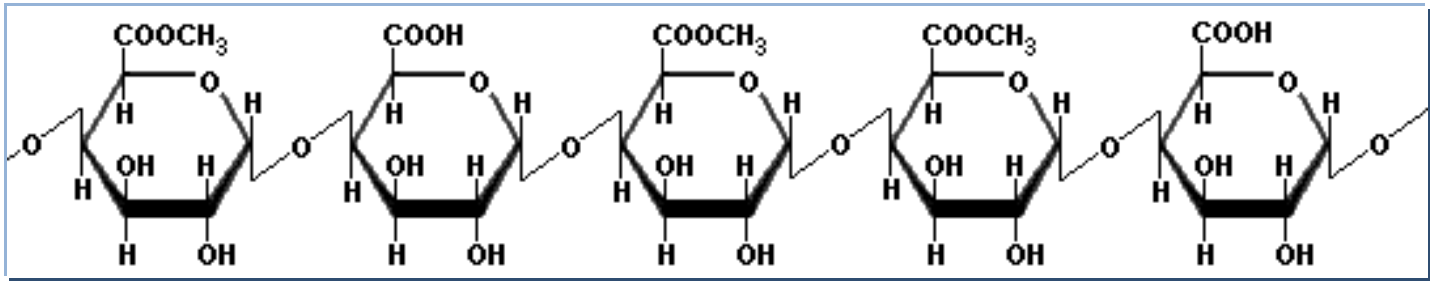
- Leucine
- Valine
- Proline
- Alanine

Pectins

- Derivatives of pectic acid
- Found in the cover of citrus fruits
- Polymer of high molecular weight

- Pectin is a polysaccharide that acts as a cementing material in the cell walls of all plant tissues. It is a polymer of α-Galacturonic acid with a variable number of methyl ester groups.

- Some COOH groups are present as Ca and Mg salts.



Components of Fats and Waxes

- The wax present in the primary cell wall of cotton protects the fibre from environmental agencies

- Responsible for the smooth handle and is a source of hydrophobicity

- In the presence of wax, cotton has poor wettability

- The wax consists of long chains of fatty alcohols, fatty acids, their esters, cholesterin & hydrocarbons

Fats and Waxes

Fats and waxes:

- Fatty acids
- Stearic acid
- Palmitic acid
- Oleic acid
- Fatty alcohols
- Cetyl alcohol ($C_{26}H_{53}OH$)
- Montanyl alcohol ($C_{28}H_{57}OH$)
- Gossipyl alcohol ($C_{30}H_{61}OH$)

Mineral Matters

- Depends on soil composition
- Determined by ash analysis

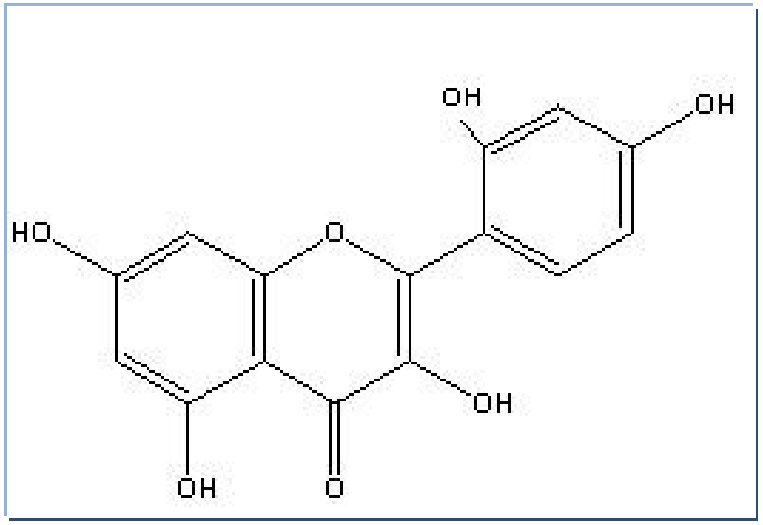
Potassium carbonate	44.8
Calcium carbonate	10.3
Potassium chloride	9.9
Potassium sulphate	9.3
Calcium sulphate	9.0
Magnesium sulphate	8.4
Aluminum oxide	5.0
Ferric oxide	3.0

Colouring Matter

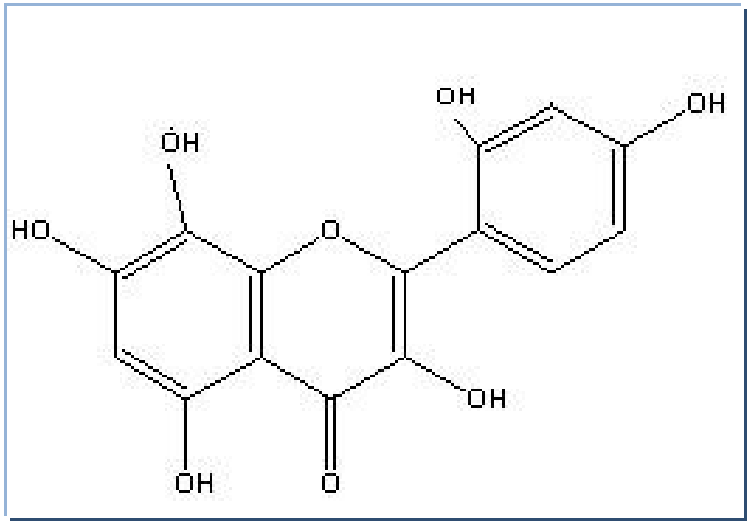
Colored pigments:

Flavones (flavus—Latin for yellow)

3,5,7,2’,4’ penta hydroxy flavone (Morrin)



3,5,8,2’,4’ Hexa hydroxy flavone (gossypetin)



Added / acquired impurities

- Mainly sizing matter (protective coating for warp yarns)
- Machine oils, lubricants, grease, etc.
- In knitting-coning oil

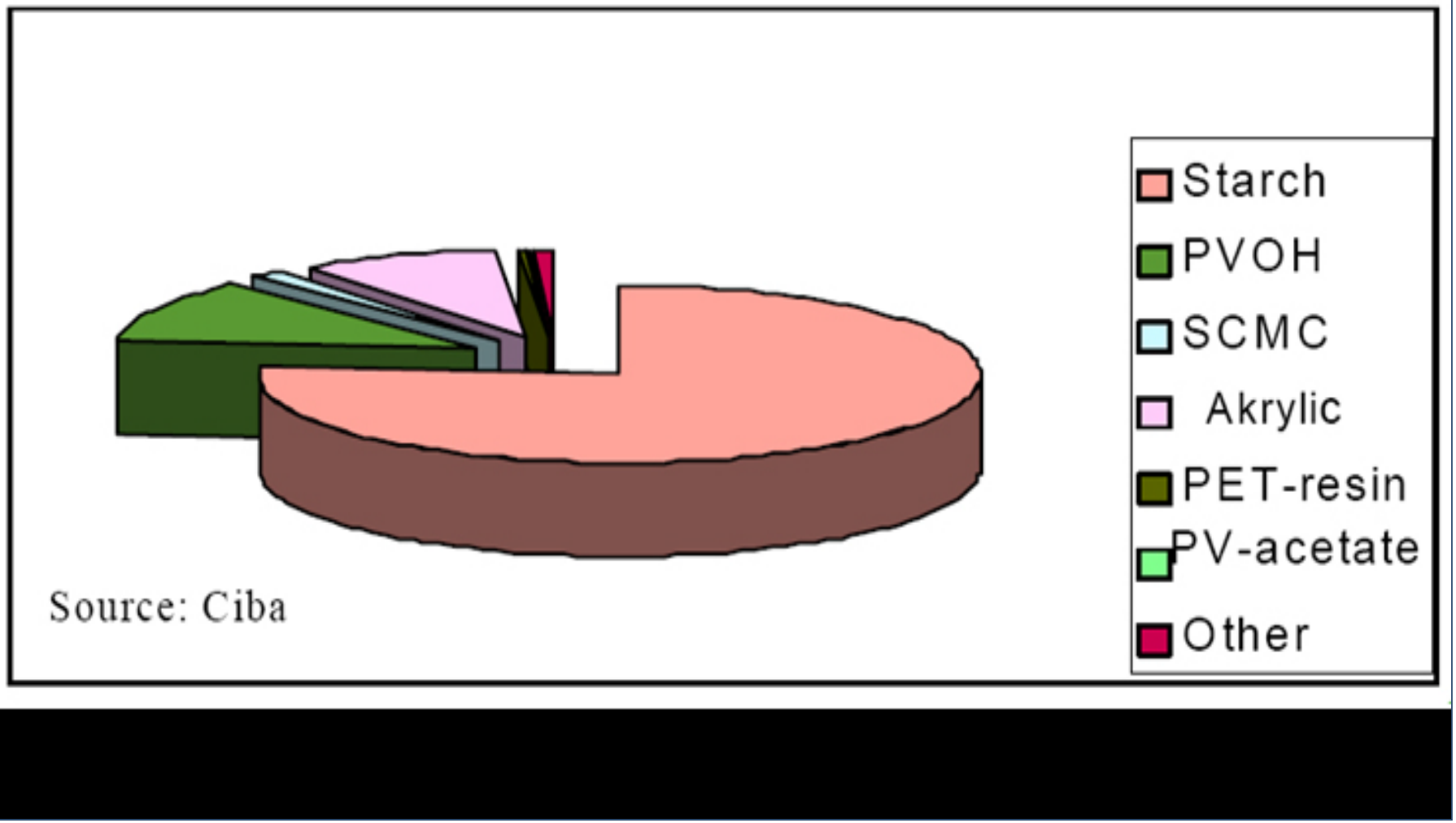
Chemistry of Size

Sizes are mainly formulations, with high molecular weight film forming polymers being the main components.

The size material applied on the warp yarns for facilitating weaving process.

- Natural / their derivatives
- Synthetic
- Blend of all these

Various sizing materials



Sizes based on Natural polymers/derivatives

Starch and its derivatives (75%)

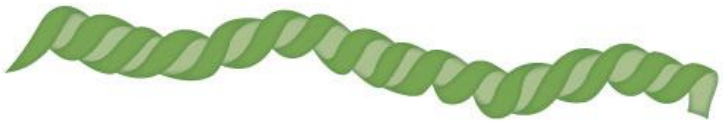
Starch has two components:

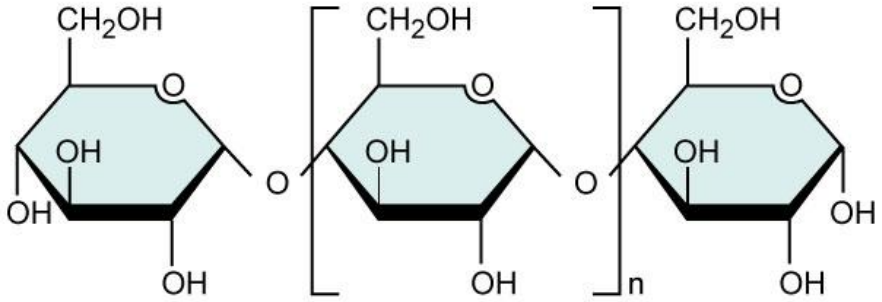
- Amylose: Relatively lower mol. wt. & water soluble (20%)
- Amylopectin: Higher mol. wt. and difficult to remove (80%)

In case of sizes based on natural polymers, add-on is of the order of ~ 15% and they generally require removal by chemical degradation. This results in high pollution of discharge.

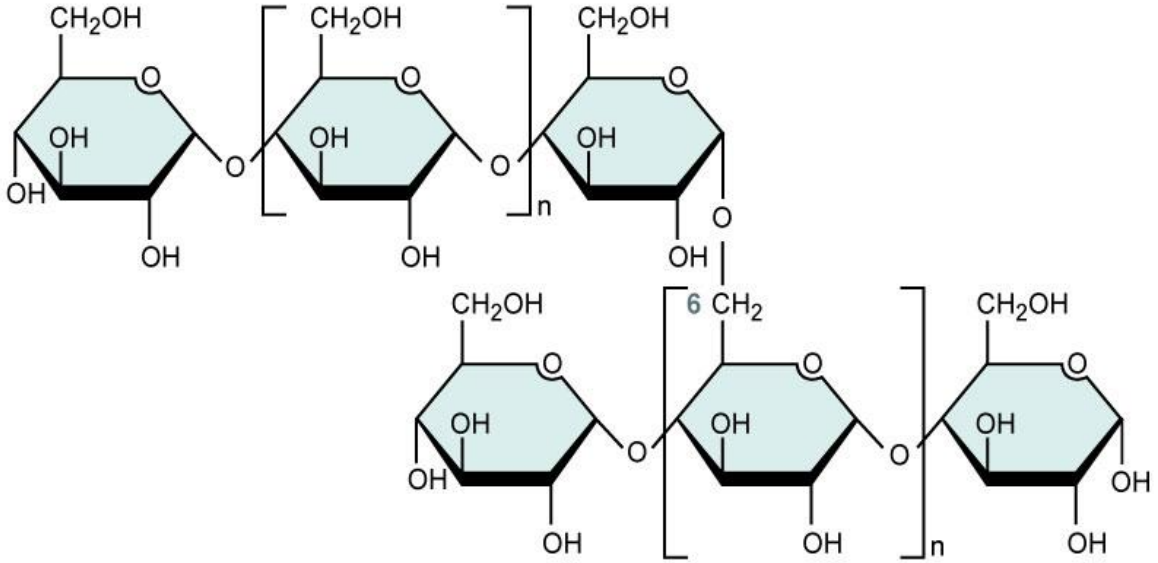
Amylose and Amylopectin

Amylose





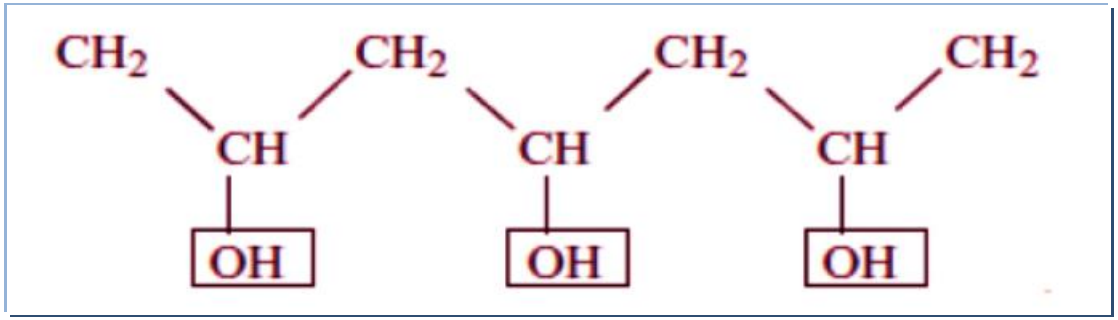
Amylopectin



Sizes based on Synthetic Polymers

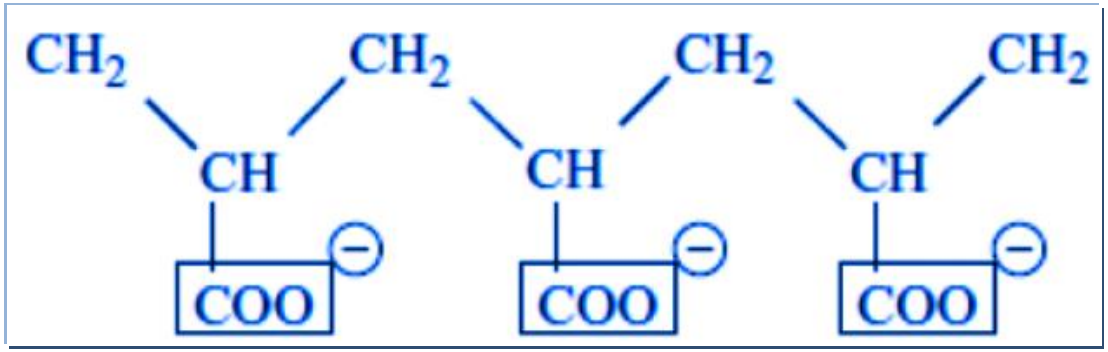
Polyvinylics:

(PVA)

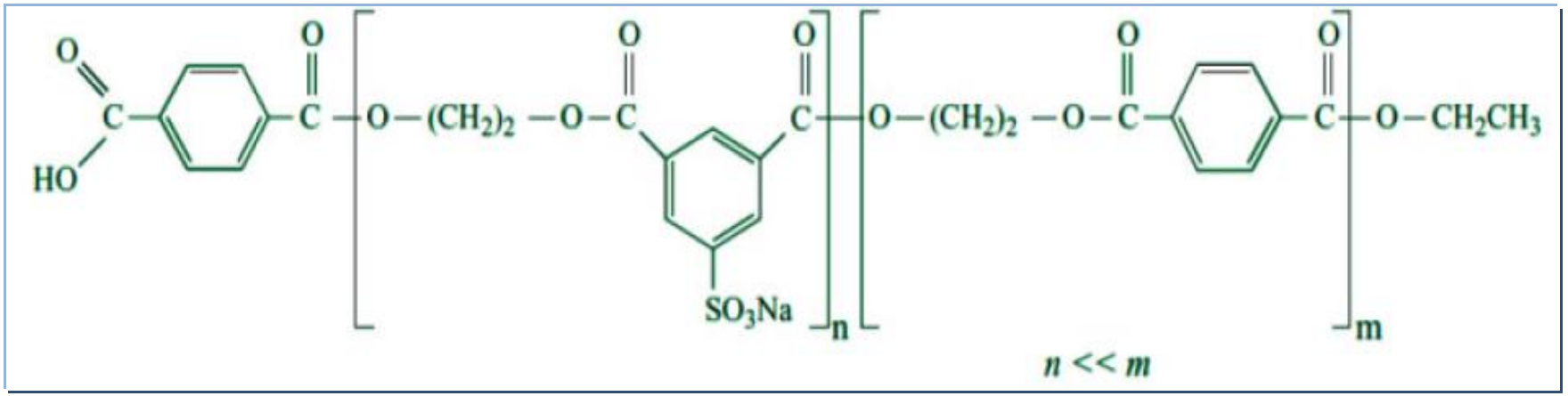


Polyacrylates:

(Polyacrylate)



Water dispersible Polyester



Mixed sizes:

These sizes are generally either water soluble or water dispersible. This results in lower pollution of discharge waters (recovery and recyclability)

Removal of impurities

- Solubilization
- Emulsification
- Chemical breakdown by
  - Hydrolysis
  - Oxidation

Important parameters:

- Temperature
- pH
- Time
- Circulation
- M:L ratio

Major Preparatory Processes

Singeing

Desizing

Scouring

Bleaching *(optional)*

OBA treatment *(optional)*

Mercerization *(optional)*

IMPURITIES REMOVED DURING PRE-TREATMENT

Short Fibres → **Singeing**

Applied Impurities (Size Material) → **Desizing**

Natural Impurities (Oil, Wax, Pectins, Proteins) → **Scouring**

Artificial Impurities (Oil, Stains, Dust, Dirt) → **Scouring**

Colour Pigments (Naturally present in cotton) → **Bleaching**