

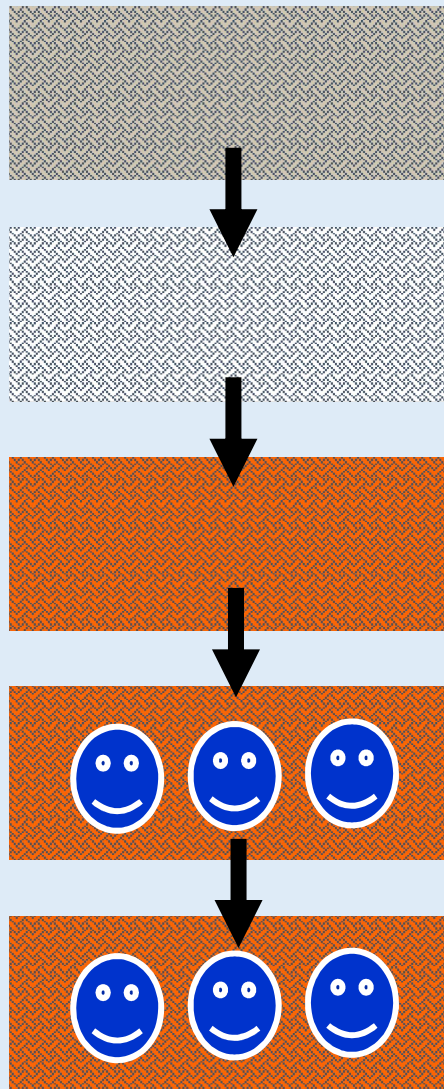
Finishing - introduction



Textile
→
finishing



Finishing - introduction



Pretreatment

aim: basic properties

Dyeing

aim: color

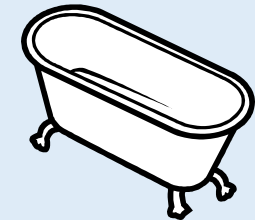
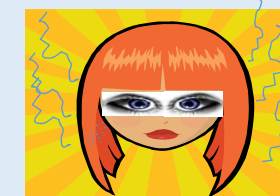
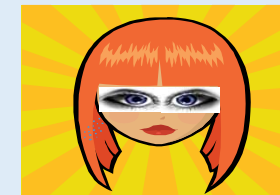
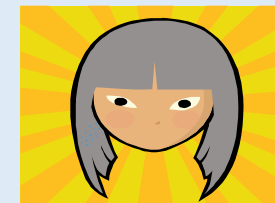
Printing

aim: pattern

Final Finishing

aim: properties for customers

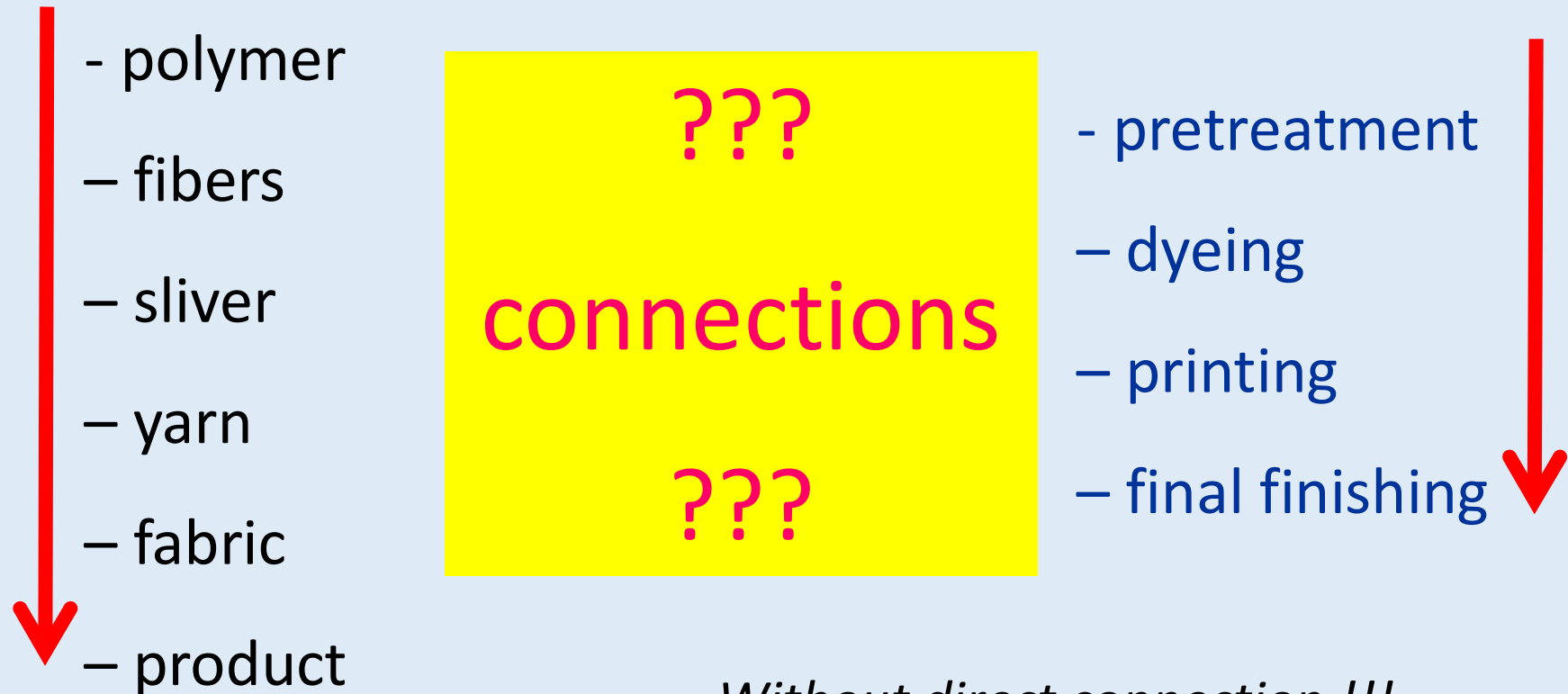
Human „finishing“



Finishing - introduction

Mechanical technology

as a change of macroscopic structure

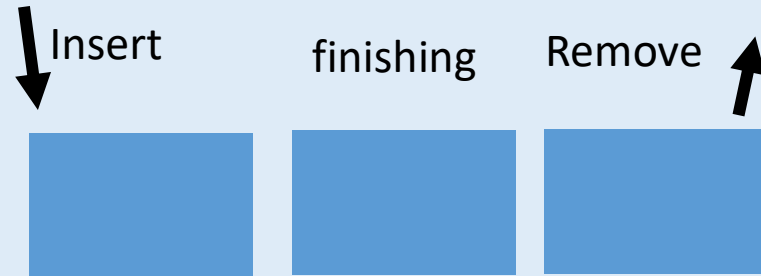


Without direct connection !!!

Finishing - introduction

- discontinual

(washing at home, cooking)



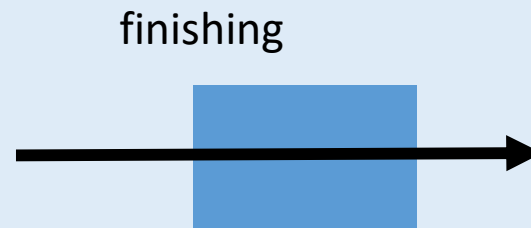
<http://www.vesko.cz/hrnec-16cm-belis-standart-1-78-41575.html>



http://www.jakbydlet.cz/clanek/500_jak-vybirat-spotrebice-domacnosti-i--pracky.aspx

- continual

(mangle, self made of noodles)



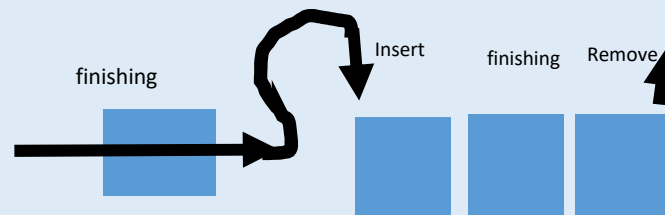
<http://www.amaterske-vareni.cz/clanky/moje-nakupni-taska/strojek-na-nudle.html>



<http://www.pro-salony.cz/zbozi/mandl-ironnette-85>

- semicontinual

(cooking of noodle soup)



<http://www.e-ott.info/2012/04/06/jak-uvarit-kureci-polevku-a-kolik-to-stoji-pro-linuxaky-man-polivka>

Finishing - introduction

Natural fibers – more contaminated by impurities = more complicated pretreatment



■ fibers
■ water
■ impurities



<http://tvbythenumbers.zap2it.com/2014/06/19/prime-instant-video-becomes-the-exclusive-subscription-streaming-home-for-wallace-gromit-shaun-the-sheep-and-other-top-series-from-aardman-animations/274966/>



<http://cottonaustralia.com.au/cotton-library/video>



Pretreatment



<http://cottonaustralia.com.au/cotton-library/video>

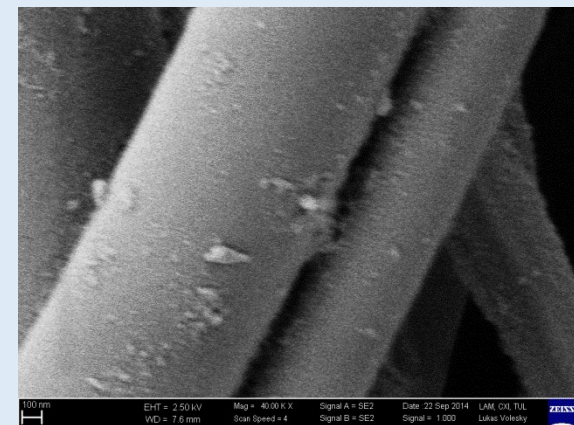


<http://tvbythenumbers.zap2it.com/2014/06/19/prime-instant-video-becomes-the-exclusive-subscription-streaming-home-for-wallace-gromit-shaun-the-sheep-and-other-top-series-from-aardman-animations/274966/>

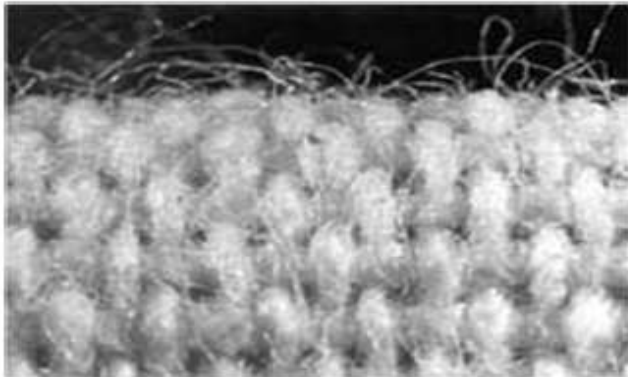
- cotton – singeing, desizing, scouring, bleaching, mercerization
- wool - washing, carbonization, bleaching
- flax (linen) – singeing, desizing, scouring, bleaching
- synthetic fibres - desizing, washing, setting



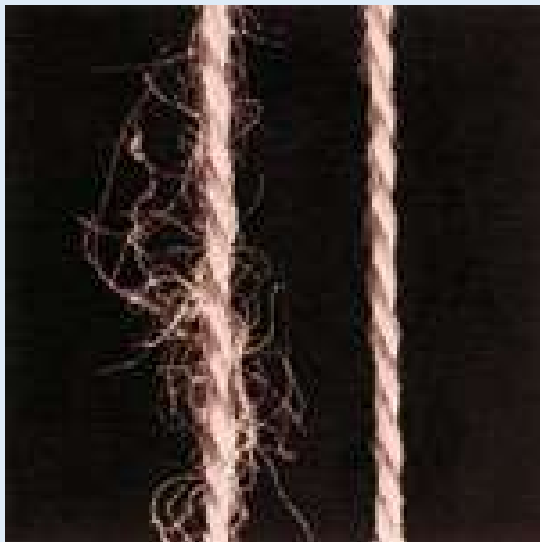
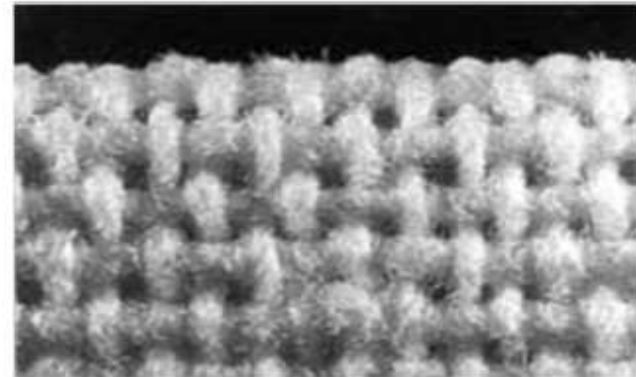
http://upload.wikimedia.org/wikipedia/commons/2/2b/Linum_usitatissimum_-_K%C3%B6hler%E2%80%93Medizinal-Pflanzen-088.jpg



Pretreatment

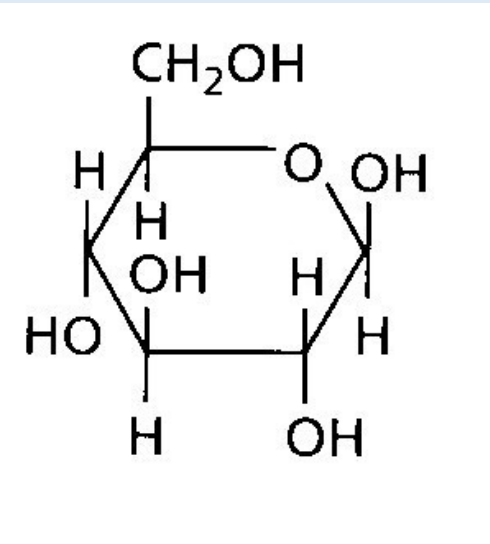
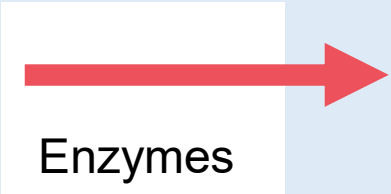
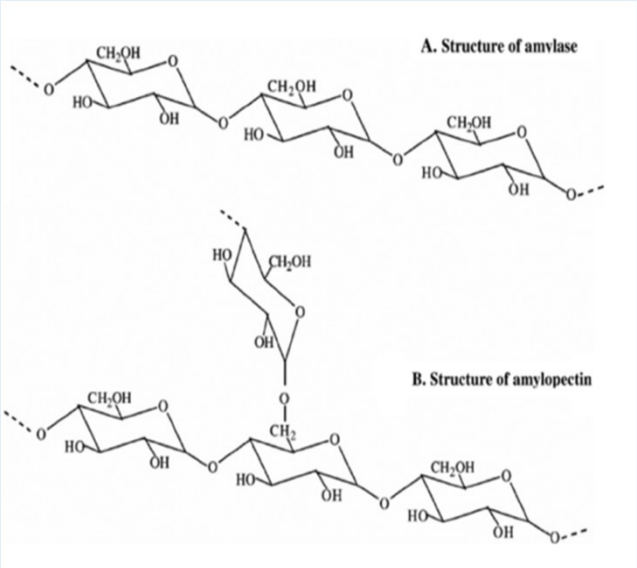


+ flame

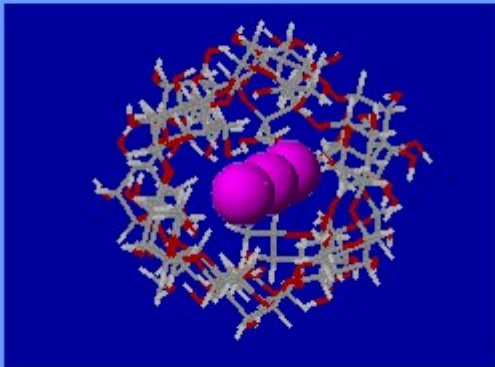
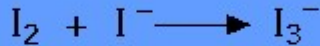


singeing

Pretreatment



Starch - Iodine Complex



Iodine slides into starch coil to give a blue-black color

C. Ophardt, c. 2003



desizing

Pretreatment

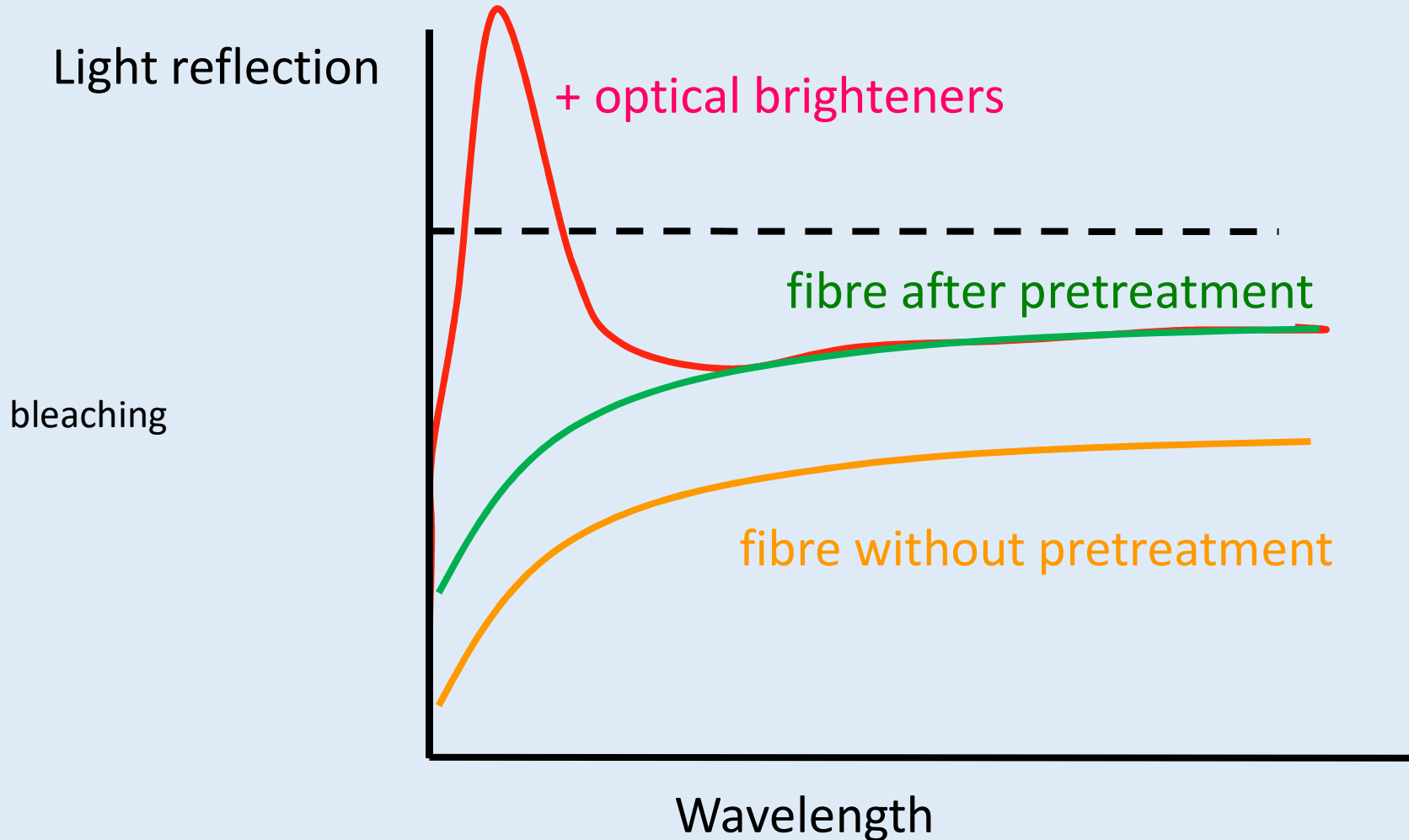


→
**NaOH or
Na₂CO₃**

scouring



Pretreatment

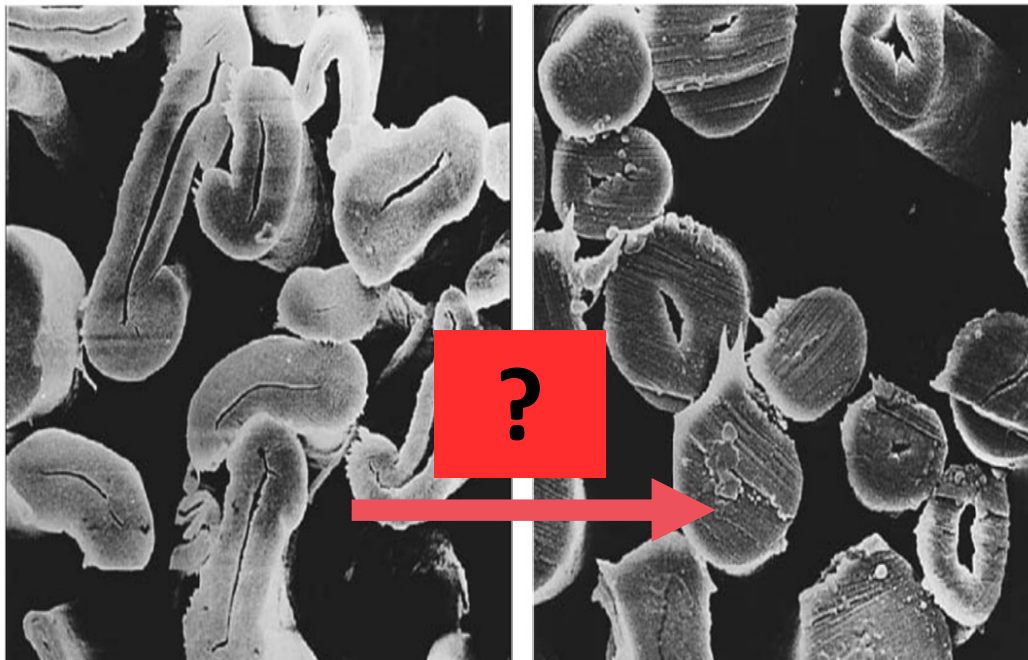


Pretreatment



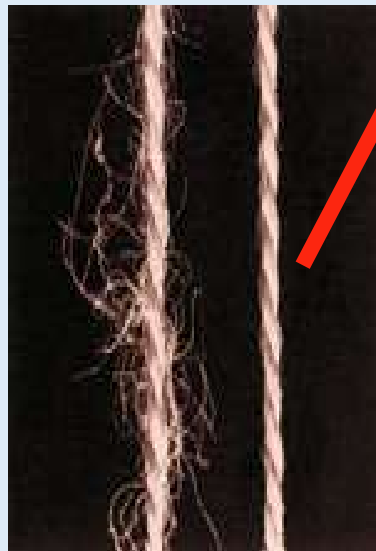
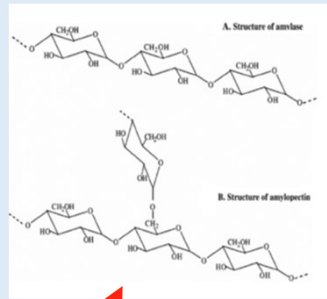
25% NaOH

mercerization

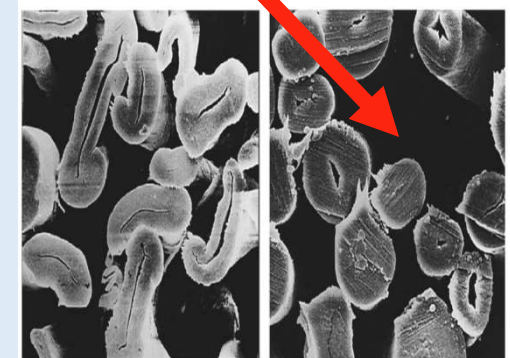
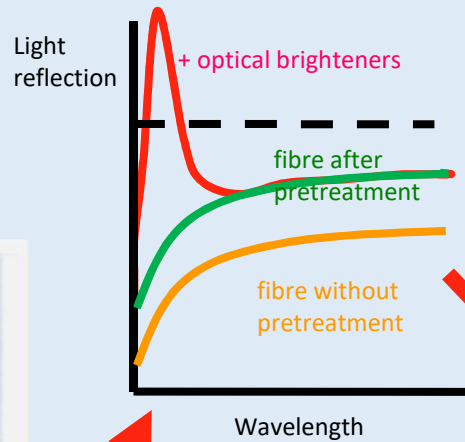


Pretreatment

singeing, desizing, scouring, bleaching, mercerization



After

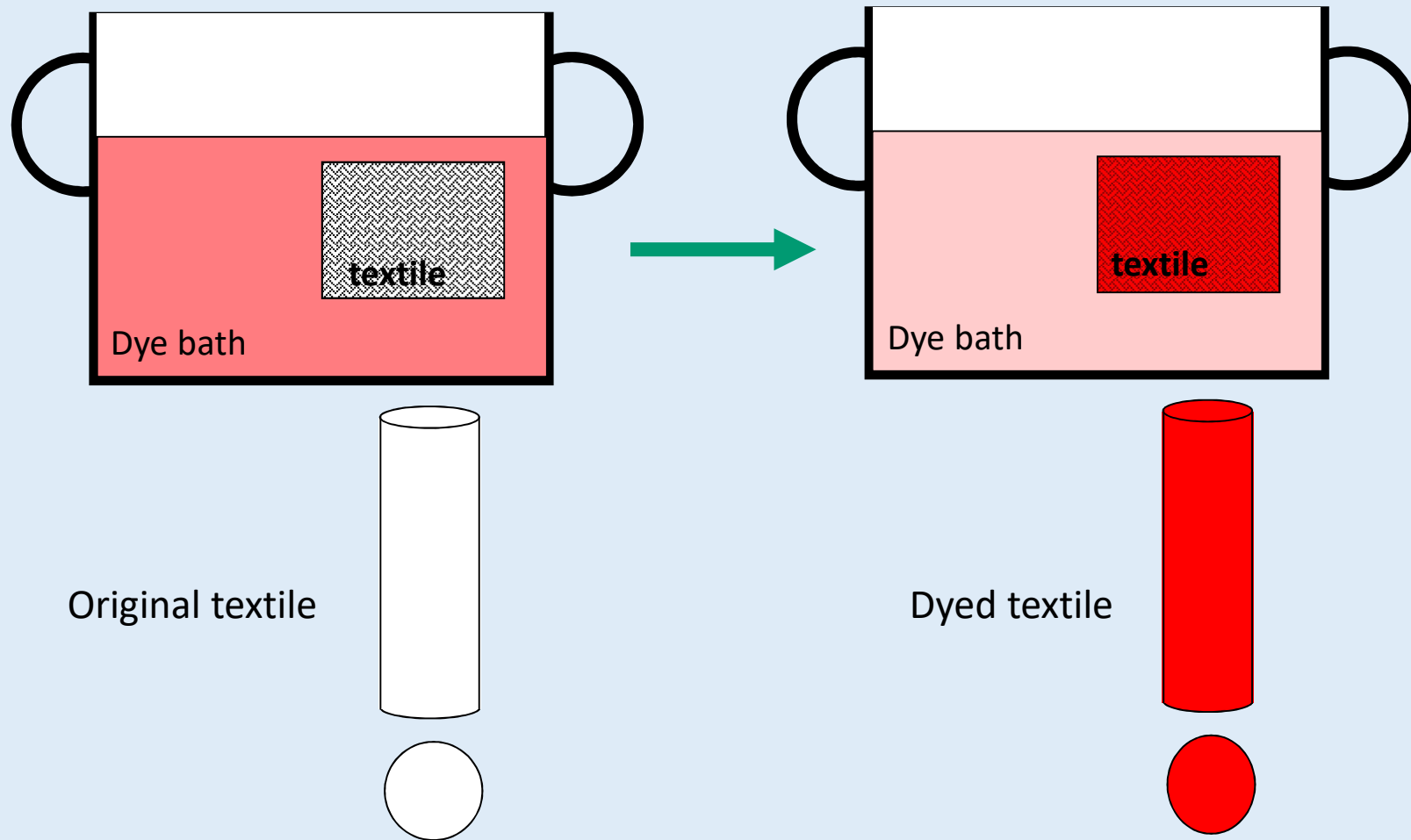


Drážka kaulónými vláknami

Drážka kaulónými vláknami

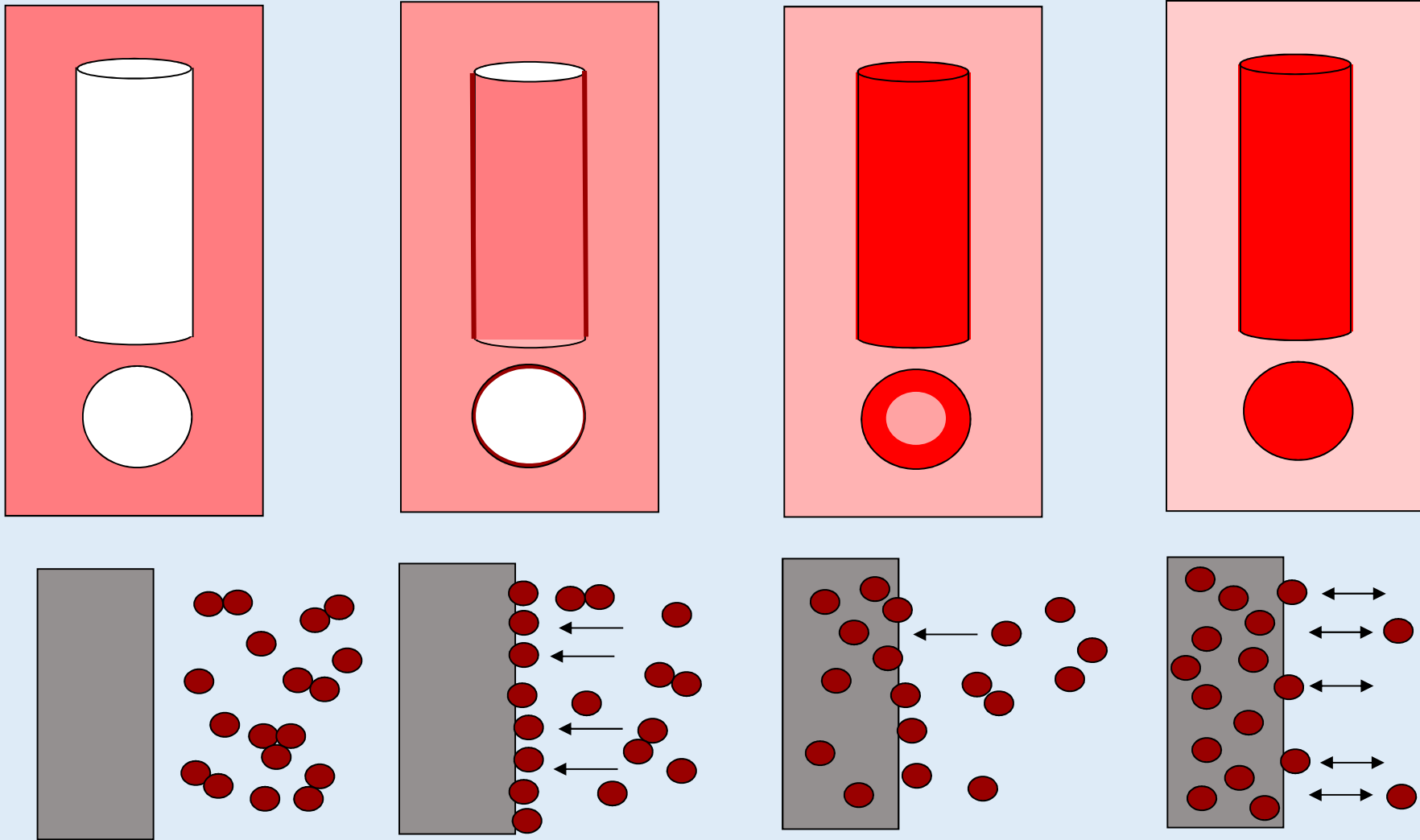
Dyeing

Exhaustion technology



Dyeing

Exhaustion technology

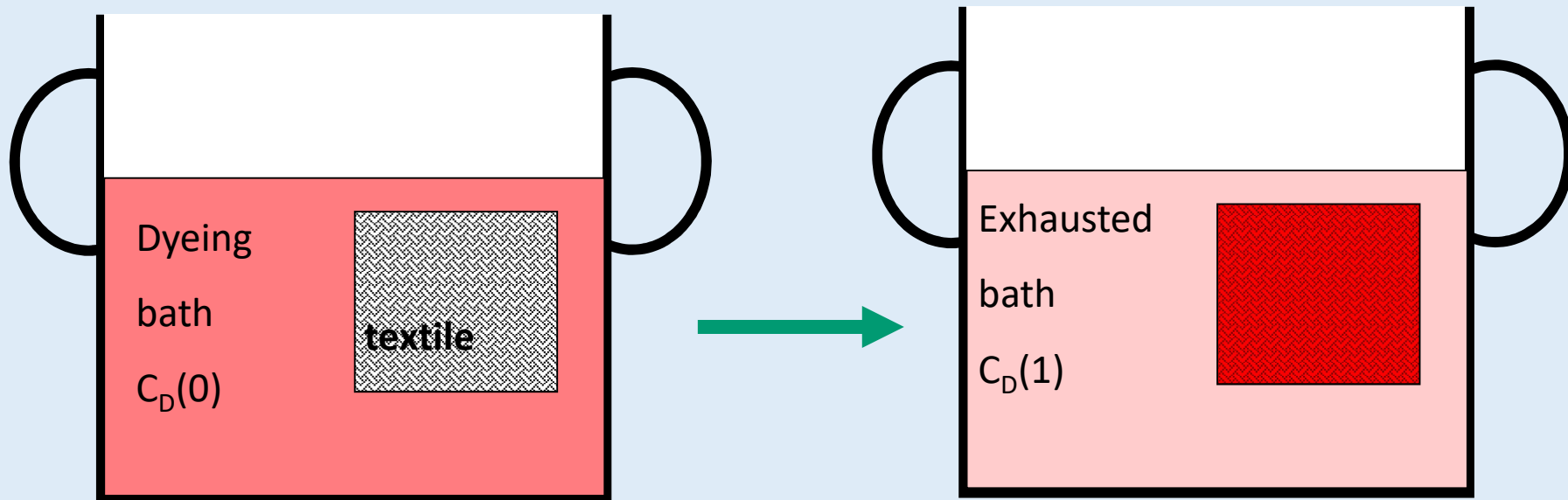


Dyeing

Exhaustion dyeing

Dyestuff sorbs to the fabric from the liquor

Description: discontinual, spontaneous process



Exhaustion:

$$\%E = \frac{C_D(0) - C_D(1)}{C_D(0)} \cdot 100\%$$

Dyeing

Basic terms – Liquor ratio

- Ratio between weight of fibers and the volume of liquor
- Sample: 1:50
- *Shorter liquor ratio = cheaper but not so even*

Liquor ratio	Volume of liquor for dyeing 1 kg of fibers
1:5	5 liters
1:10	10 liters
1:50	50 liters

Dyeing

Basic terms - Dye %

dye % of weight of fibers (% o.w.f.)

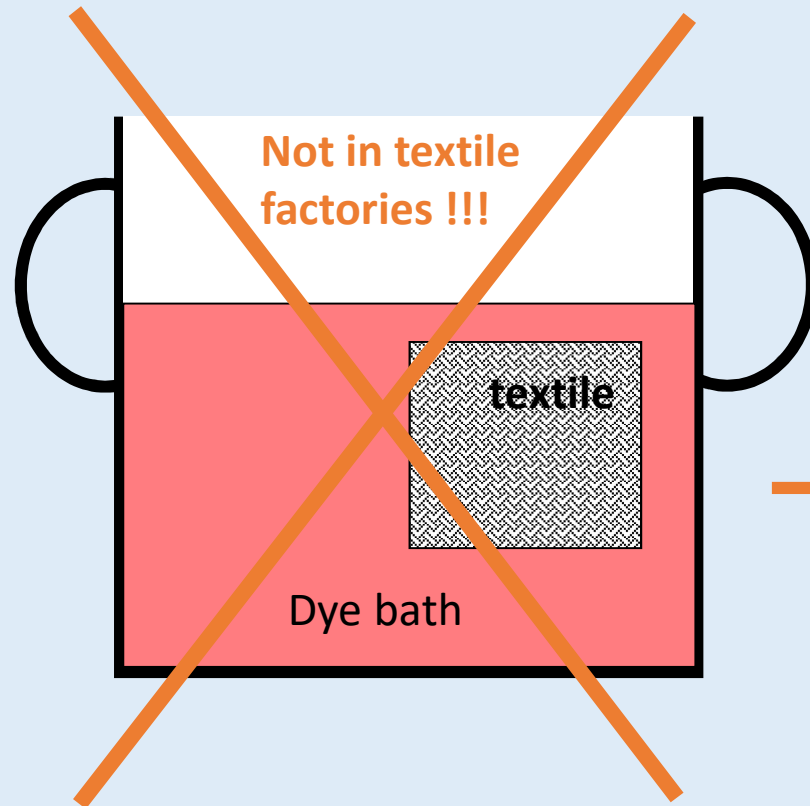
- Quantity of dye in dyeing bath
- % of weight of fibers

- Light shades 0.3-0.5%
- Middle shades 1-1.5%
- Dark shades about 3%

Dye %	Weight of dye for dyeing of 1 kg (1000g) of fibers
0.5%	5g
1 %	10 g
2%	20 g

Dyeing

Exhaustion technology



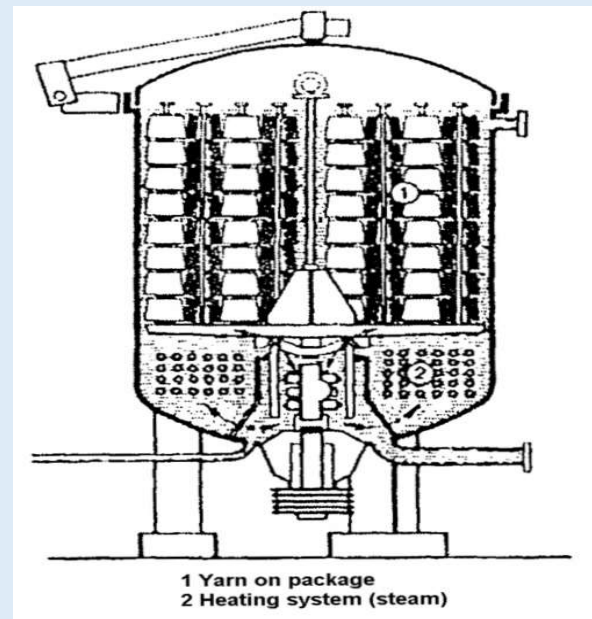
Replacing:

- shorter (better) liquor ratio
- bigger quantity of textiles (up to 1000 kg)
- controlled heating
- intensive flow in dye bath
- controlled dosage in timing of chemical dosage in bath
- observation of process
- easy rinsing (washing off) after dyeing

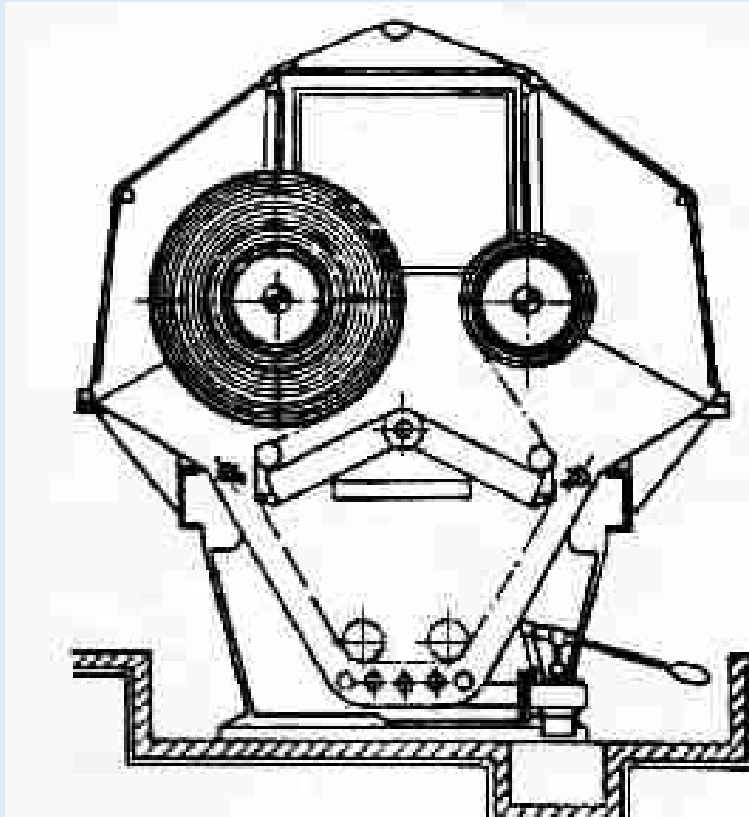
In the pot is worse Liquor Ratio (1:30 – optimal for pots), hands stirring, manual manipulation, low productivity, levelness problems ...Low effectivity and reproduction!

Dyeing

Dyeing apparatuses – textile stay, bath runs



Dyeing



Textile runs, water stays

jigger is easy dyeing machine for discontinual dyeing, washing and finishing of textiles



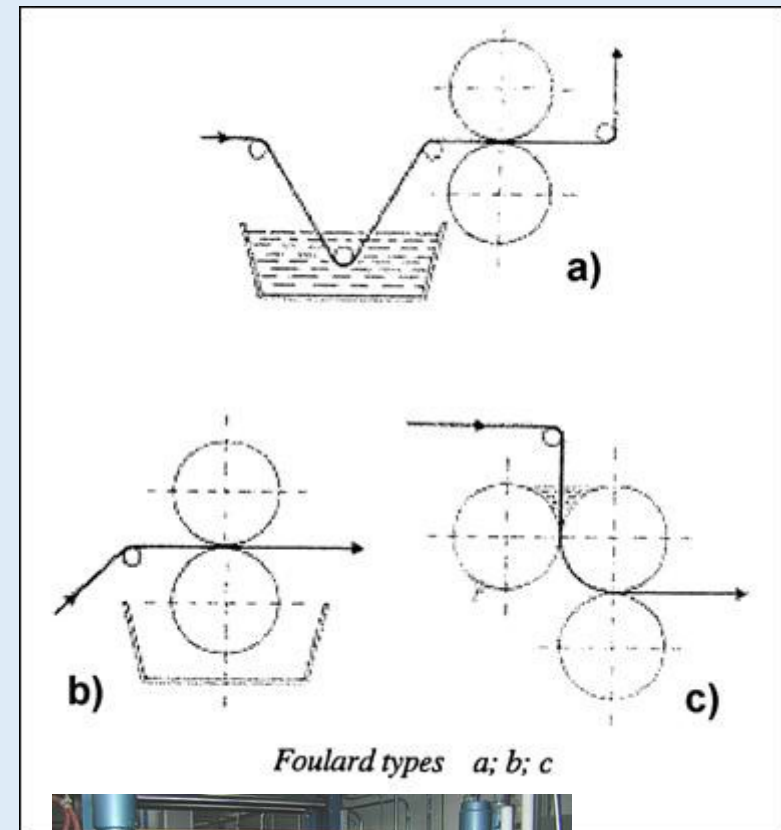
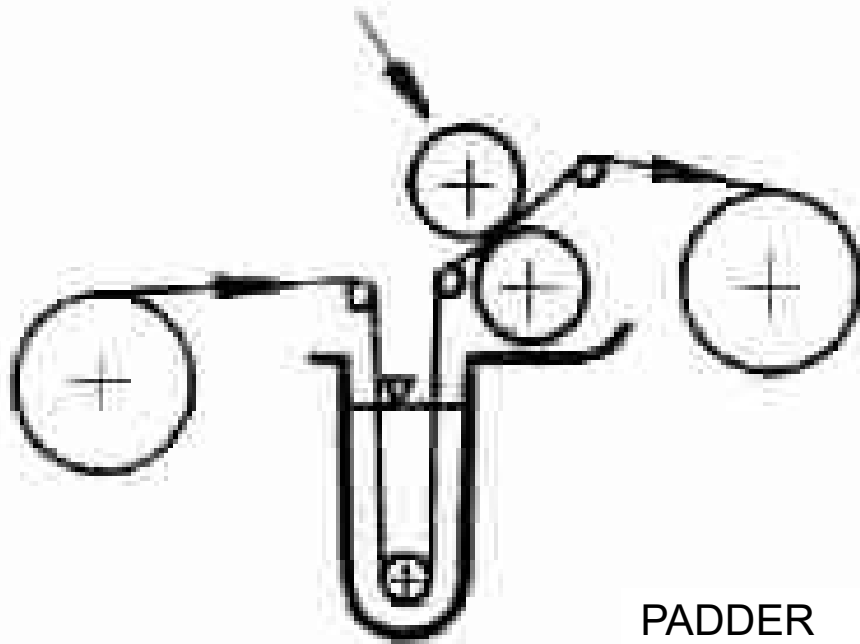
JIGGER

Dyeing

Padding technology

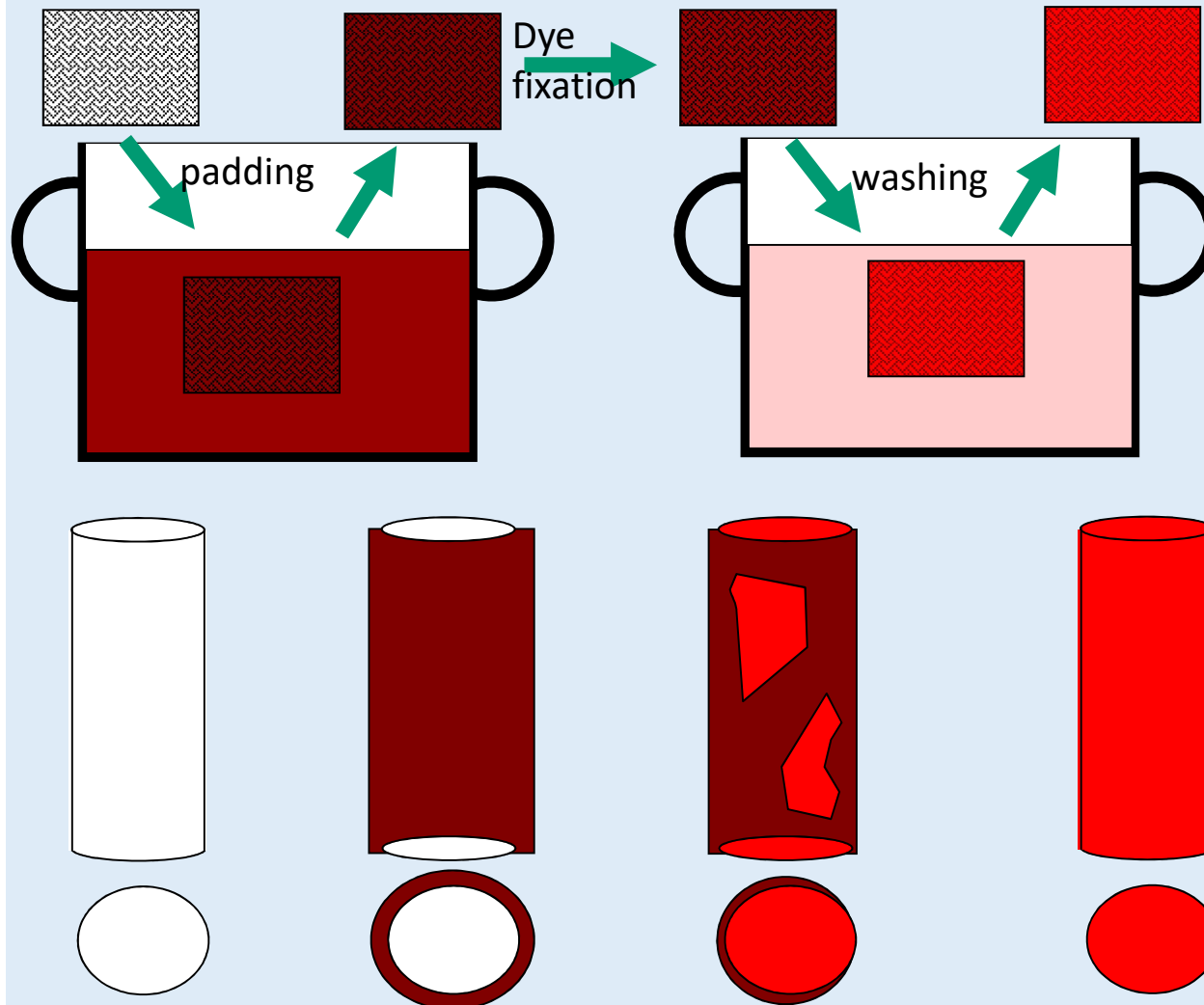
Padding machine (=Foulard)

– mechanical squeezing (dewatering)



Dyeing

Padding technology



1. Impregnation

2. Padding

3. Fixation

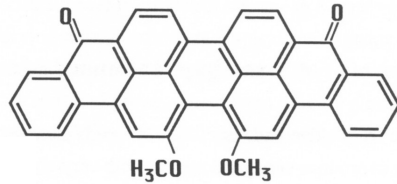
- Increase of dye diffusion

- Starting of chemical reactions (reactive dyes)

4. Washing off

Dyeing

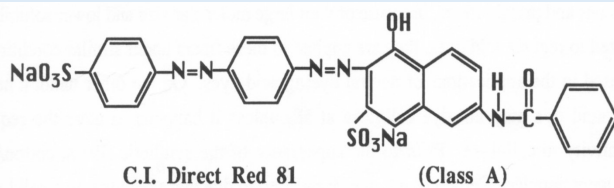
Dyes for Cellulose – Comparison



Vat

C.I. Vat Green 1 Dyeing Method: IN (also IW, and IK)

Very stable dyes, chemically „aromatic character“, unsurpassed lightfastness and technological fastnesses (bleaching). Inhomogenous range (no trichromatic dyeing), different dyeing conditions for groups. Poor diffusion rates, low temporary solubility. Limited mobility.



C.I. Direct Red 81

(Class A)

Soluble dyes, low washing fastness, homogenous range, tinctorially strong. Wet fastnesses can be improved by aftertreatment. Bonded with weak bonds to fiber resulting in poor wet fastnesses.

Direct

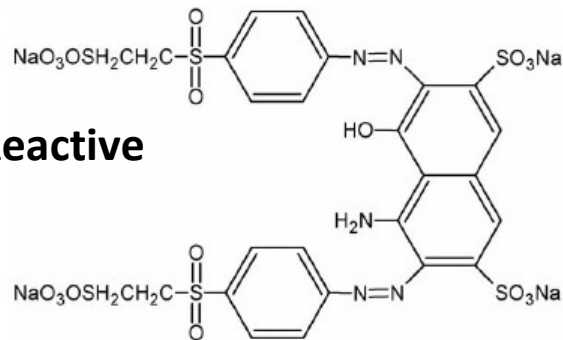


Fig. 1. Structure of Reactive Black 5.

Soluble dyes with a reactive group. The reactive group enables a strong covalent bond between fiber and dye resulting in good wet fastnesses. The fast developing dyeing range, homogenous. Enables trichromatic dyeing.

Reactive

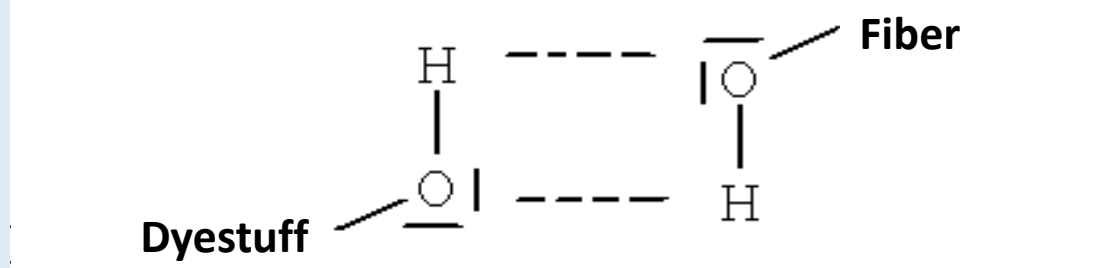
Dyeing

Comparison of reactive dyes with other dyes for cotton

Dye property	direct	reactive	vat
Price	average price	cheap	more expensive
Application	easy	difficult	difficult
Fastnesses to washing	worse	excellent	excellent
Fastness to light	average	average	excellent
Brilliantness of shades	average	excellent	worse

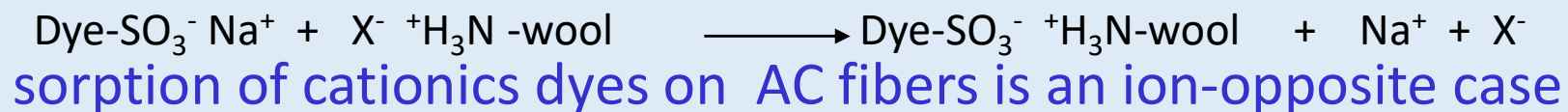
Dyeing

Cellulose dyeing = Substantive sorption mechanism:
sorption on cellulose chains by physical intermolecular forces:
weak but numerous **van der Waals forces** and **H-bonds**



Wool dyeing - ionic exchange, ionic chemical bond + van der Waals-
forces

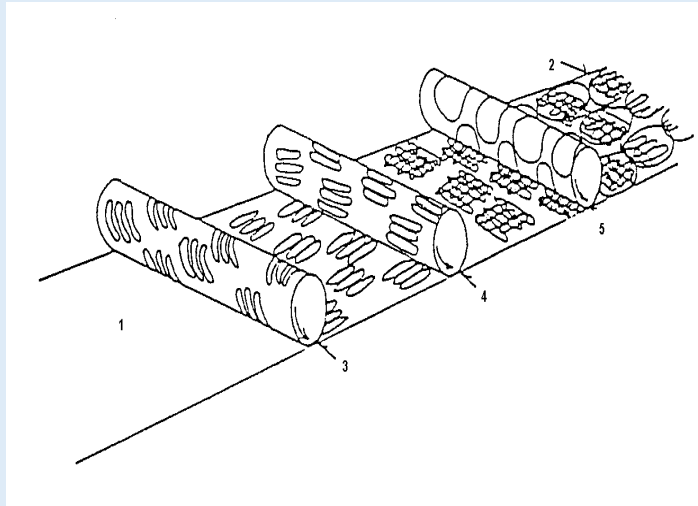
Electrostatic ↓ forces



Dyeing of synthetic fibers by disperse dyes – solubility of dye in
the fiber polymer- van der Waals forces and H-bonds

Textile printing

Textile printing is the process of applying colour to fabric in definite patterns or designs. In properly printed fabrics the colour is bonded with the fiber, so as to resist washing and friction. Textile printing is related to dyeing but, whereas in dyeing proper the whole fabric is uniformly covered with one colour, in printing one or more colours are applied to it in certain parts only, and in sharply defined patterns



Screen printing



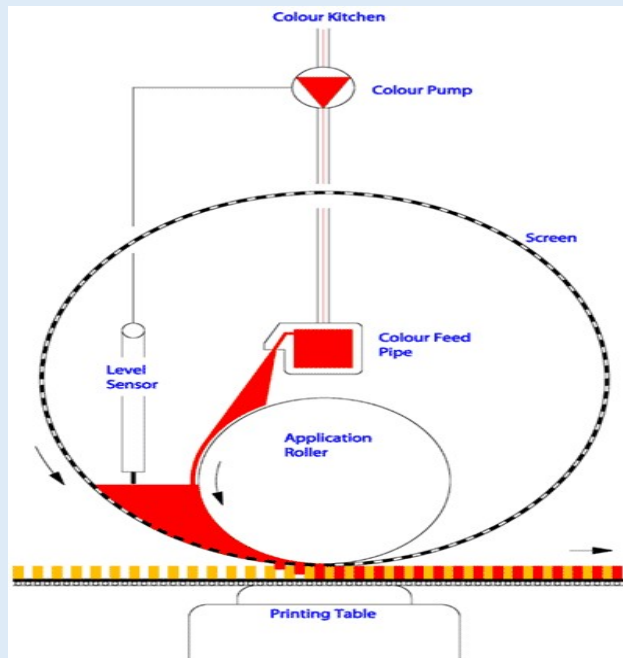
Textile printing

Screen printing

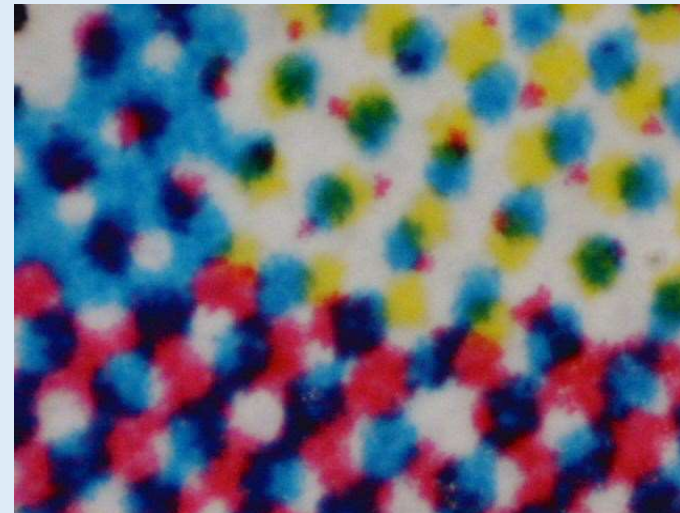
is by far the most used technology today.

Two types exist: rotary screen printing and flat (bed) screen printing.

A blade squeezes the printing paste through openings in the screen onto the fabric.



Digital textile printing



Finishing - introduction

Examples:

Easy-care - finish generally applied to cellulose and cellulose blends fabrics. The most technically correct description would be “Cellulosic anti-swelling” or “Cellulosic cross linking” finishes. Normally a high dry crease recovery angle is preferred because the appearance of the dry textile is more important than the wet one.

Sanforization – It is a method of stretching, shrinking and fixing the woven cloth, to reduce the shrinkage which would otherwise occur after washing

Flame retardant finish – Flame retardants are chemicals are applied to fabrics to inhibit or suppress the combustion process. They interfere with combustion at various stages of the process e.g. during heating, decomposition, ignition of flame spread.

Antistatic finish – prevents dust from clinging to the fabric. Increase of electrical conductivity

Water-repellent finish - ater-repellent finishes are surface finishes imparting some degree of resistance to water but are more comfortable to wear because the fabric pores remain open. Such finishes include wax and resin

Fastness of coloration

List of basic fastness

The most observed fastnesses are:

Light fastness – the sample is illuminated by intensive light, the rate of changes of tested shade is compared with blue scale. The scale has 8 samples of dyed by dyes with different light fastnesses.

Rubbing fastness – the sample is rubbed by white textile (dry or wet) and transition of dye on white textile is observed.

fastness to perspiration – the sample is wetted by synthetic perspiration. The transition of dye on accompanying sample in condition of human body perspiration (37°C) for 4 hours is observed.

Washing fastness – home washing is simulated. The transition of dye on accompanying sample is observed.

+ about 40 other fastness tests !!!!

Fastness of coloration

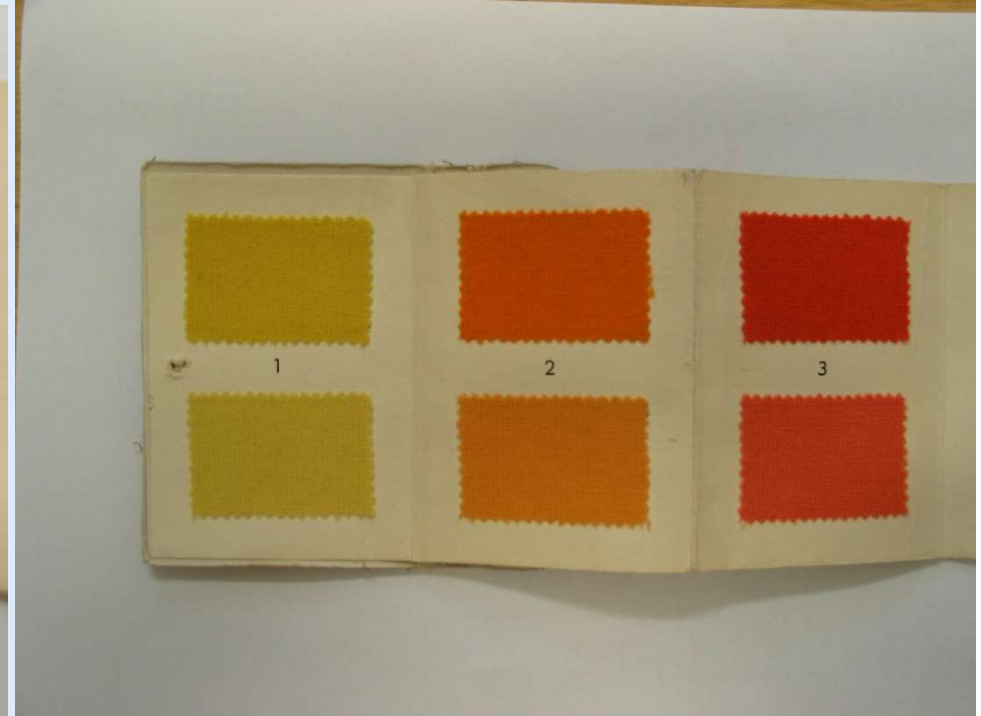
Deep of shade

Color standards: internationally defined in all colors (basic: **1/1** – standard deep of shade)

To quantification of lighter shades: $1/3$, $1/6$, $1/12$, $1/25$

or deeper shades: $2/1$

+ special standard for black colors



Fastness of coloration

fastness evaluation – grey scale

Evaluation: change of color of the original color sample (color change) and the color of originally white sample (color transfer - staining)

Two possible principles: measurement of color difference (not so common) and using of color-difference standards „gray scales“ (standard evaluation)

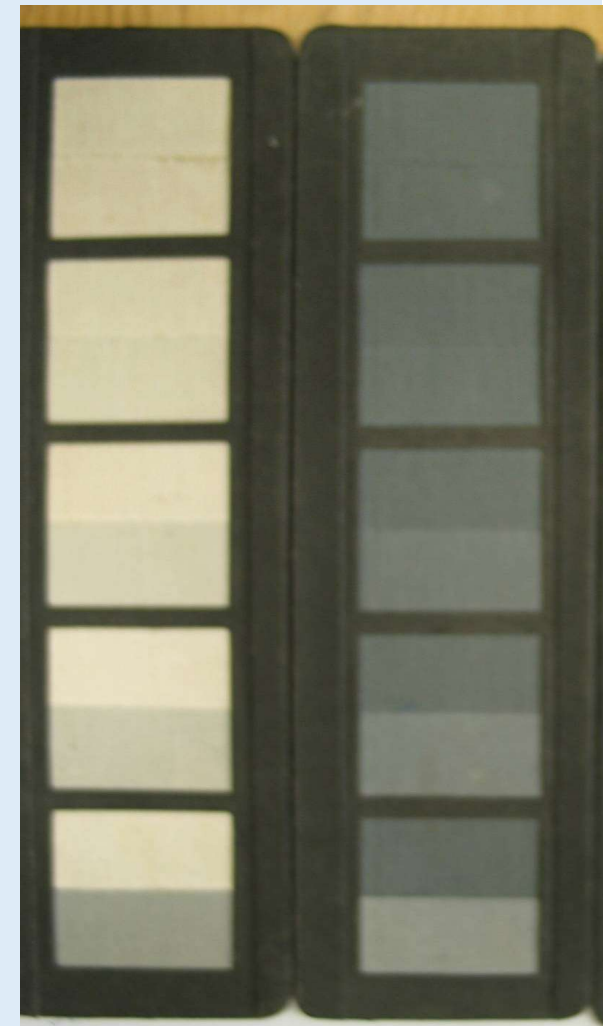
Grey scale: 2 !! One for „color change „ testing and the second one for the „staining“

In both scales: 5 ... Excellent result, 1 ... Wrong result

comparison of results
only at right illumination...

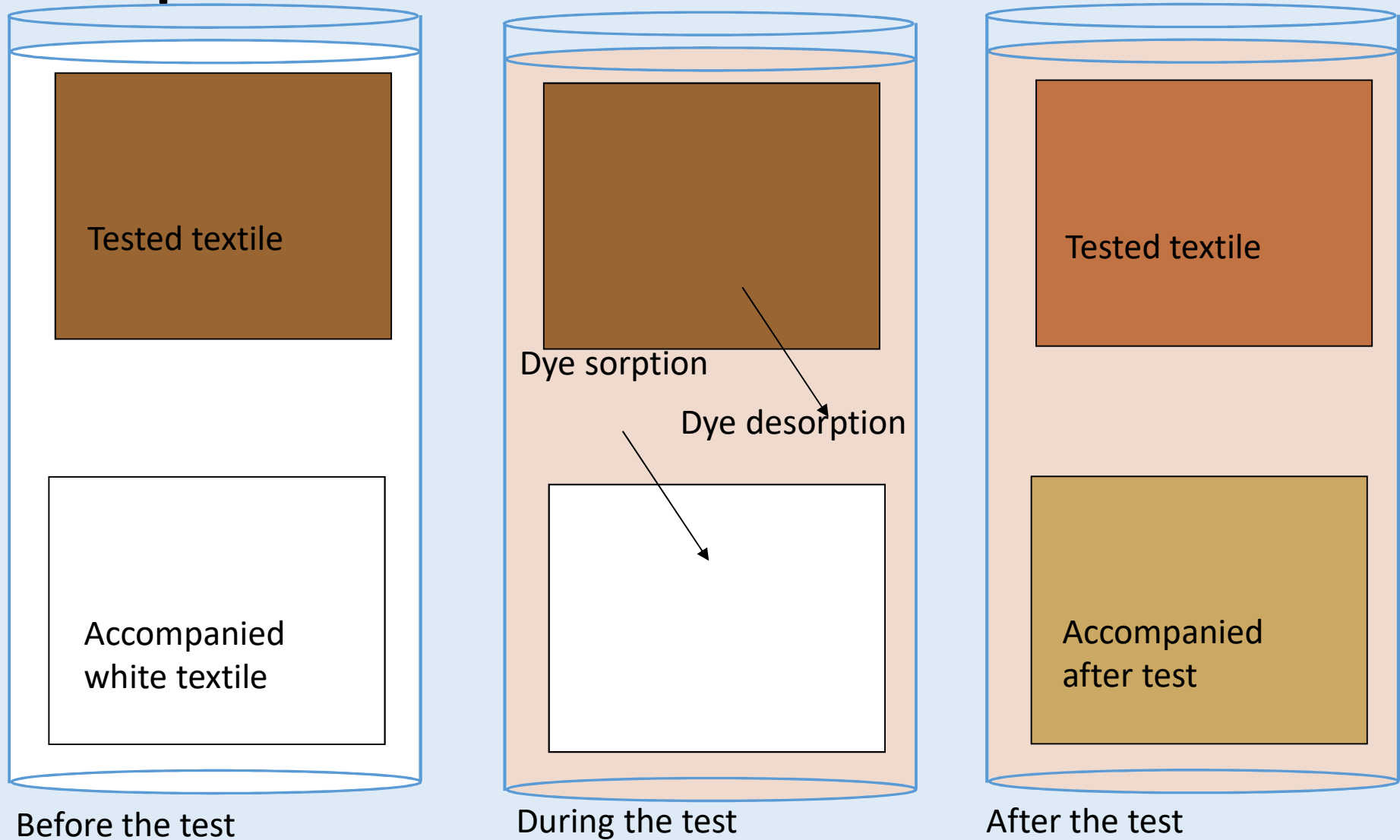


For staining For color change



Fastness of coloration

Principle of wet fastness



Fastness of coloration

Combined sample for washing test

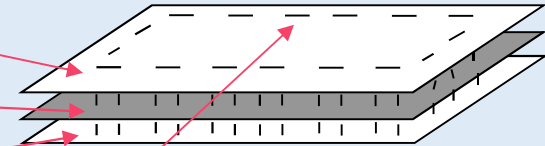
„Sandwich“ – typical size 10x4 cm.

First accompanied / supporting textile (from the same fibers as the tested sample), defined in standard

Tested textile

Second accompanied / supporting textile is choose to absorb higher quantity of dye from the bath. defined in standard

Sawed together at the sides of combined sample.

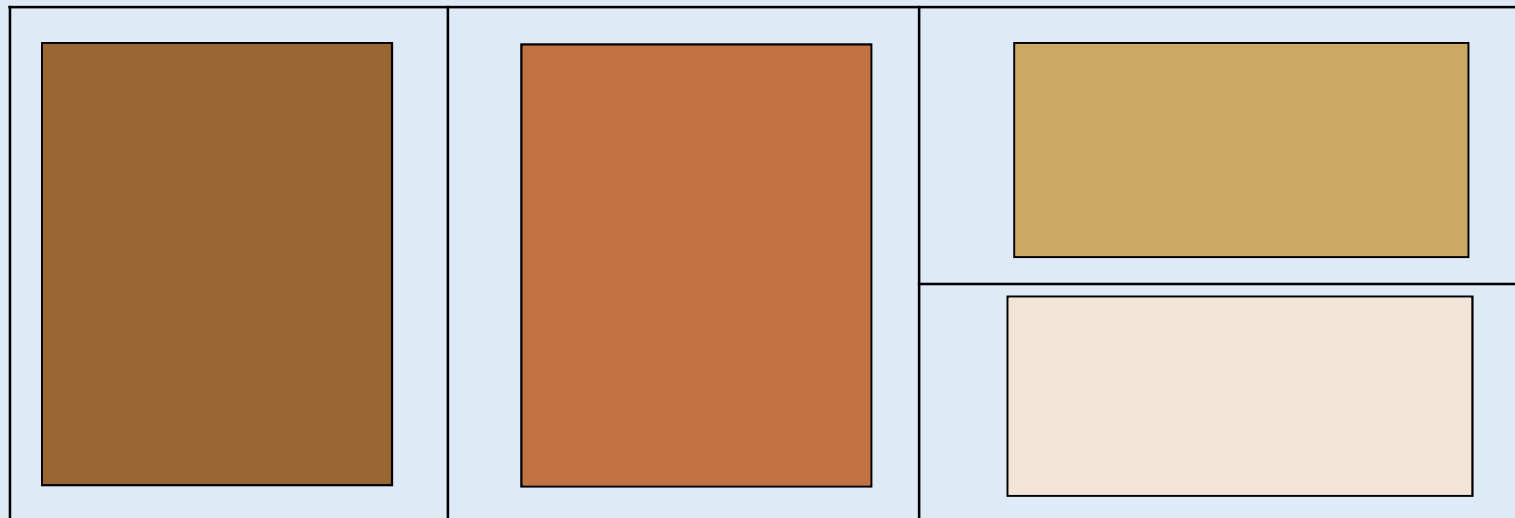


Fastness of coloration

Adjusting of samples

Description: 3R / 1-2G / 4-5

Original tested sample (brawn)	After the fastness test (result according the gray scale: 3R (R ... Reddish)	Staining to fabric from the same fibers. (1-2 G... greener)
		Staining to fabric from the other fibers . (4-5 ... in the same shade)



Fastness of coloration

fastness to perspiration

Principle: Simulation of contact of tested color textile with the white sample.

In live praxes: Sweated textiles on the body are wet and in close contact at the body temperature for long time

Method: The procedure is set by technical test standard. The fastnesses in alkali and acid perspiration are tested together obviously.

Steps:

Wet the combined samples by synthetic perspiration (Synthetic perspiration: according the standard...)

Put it inside to perspirometer and carry it in heat insulation package for 4 hours at 37°C

Dry samples and evaluate its by grey scales



Fastness of coloration

fastness to washing

Described in technical standards: used accompanied textiles, used temperatures, used pH, used chemicals...

accompanied textiles according table:



1st accompanied fabric	2nd accompanied fabric	
	For tests A a B	For tests C,D a E
Cotton	Wool	viscose
Wool	Cotton	-
viscose	Wool	Cotton
polyamid	Wool or Cotton	Cotton
polyester	Wool or Cotton	Cotton

Fastness of coloration

Blue scale

8 grades = 8 wool samples with different color fastness
Blue scale will be irradiated together with tested samples








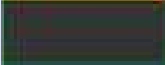





Color changes are observed in defined times according the standard



Lighfastness standard	Realative time of color change
1	1
2	2
3	4
4	8
5	16
6	64
7	128
8	256

Fastness of coloration

Typical description of fastness in a paterncard

Colour Sample	Name of Colour	C.I. No	Light	Water retting	Washing	Perspiration		Rubbing		Iron
						Acid	Alkaline	Dry	Wet	
	Direct Yellow DV-120	D.Y 12	3-4	2	1-2	2	2-3	3	1	3-4
	Direct Yellow DV-121	D.Y 50	6	4-5	3-4	4	3	4	3-4	4-5
	Direct Orange DV-122	D.O 39	4-5	4	4-5	5	5	4-5	3-4	4-5
	Direct Brown DV-126	D.B 2	2-3	4	2-4	4	3-4	3	2	4
	Direct Red DV-124	D.R 23	4-5	4-5	4-5	4-5	4-5	4	3	4-5
	Direct Black DV-128	D.B 38	3	3-4	3	3-4	3-4	3	1-2	3-4
	Direct Blue DV-132	D.B 15	2	2-3	2-3	4	3-4	4	2-3	4
	Direct Blue DV-134	D.B 86	5	2-3	2-3	2-3	4	3	2	3-4
	Direct Blue DV-136	D.G 1	2	3-4	3-4	2	3	3-4	2-3	4-5
	Direct Red DV-140	D.R 28	2	3-4	3-4	2	3	3-4	2-3	4-5
	Direct Red DV-142	D.R 31	2	3	2-3	4	4	4	2	4-5

