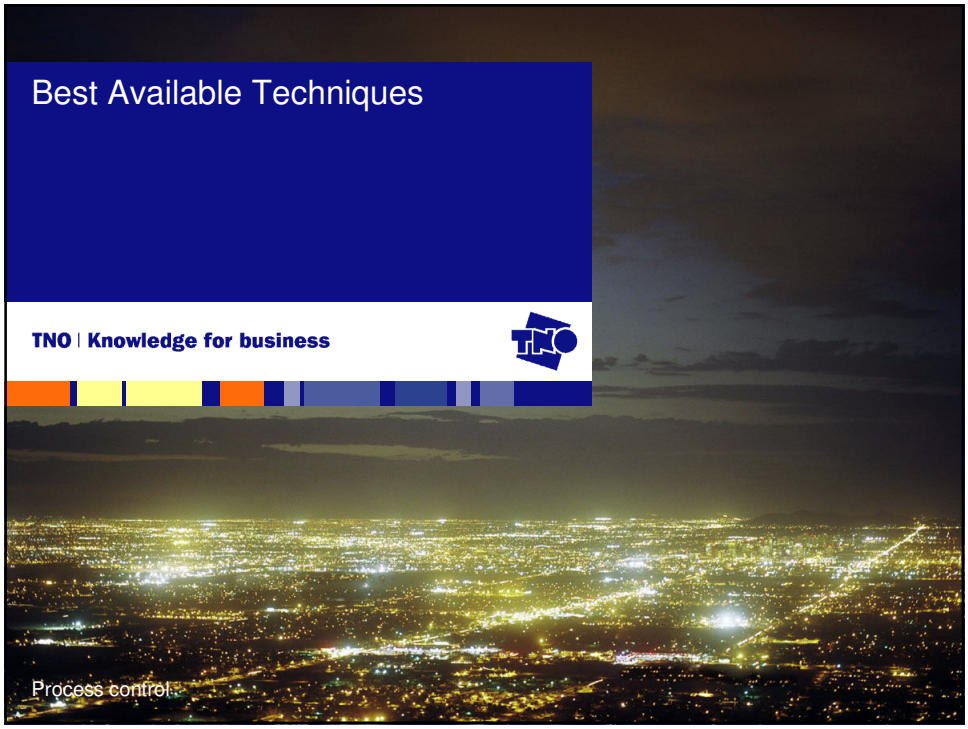
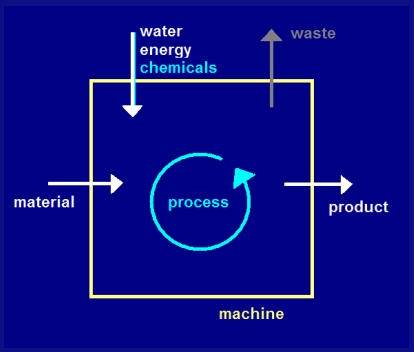


Best Available Techniques

- Source: IPPC document

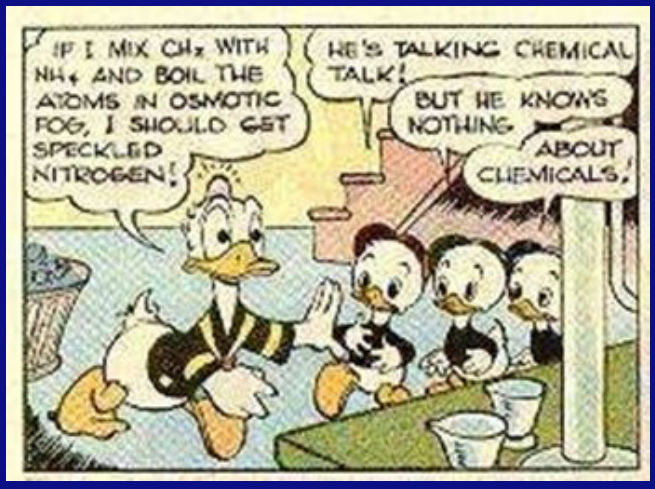
Content

- Sizing
- Bleaching (H_2O_2)
- Mercerising
- Enzyme treatment
- Dyes and auxiliaries
- Dyeing
- Finishing



- Analyse
- Avoid
- Control
- Optimise
- Re-use

Warning



Prewetting before sizing

- Increased quality:
  - homogeneous sizing effect
  - increased adhesion
  - reduced hairiness
- Reduced size load (20-50%)
- Sizing speed increase 22%
- Cost savings 27%

- Best results with medium to coarse yarns
- Possible for batches more than 5000 meter

Consider also Compact spinning (50% reduction of sizes)

Substitution of sodium hypochlorite by H_2O_2

Hypochlorite leads to chlorinated hydrocarbons (AOX)

Used for bleaching, cleaning dyeing machines and as stripping agent

Consider two-stage process if necessary:

1. hydrogen peroxide
2. sodium hypochlorite

Beware of:

- complexing agents as H_2O_2 stabilizers
- the use of optical brighteners

Reactivity of hydrogen peroxide (H_2O_2)

Oxygen species:

- O_2^{**}
- H_2O_2/HOO^-
- H_2O/OH^-
- HOO^*/O_2^{*-}
- OH^*/O^{*-}
- O_3/O_3^{*-}

Depends on:

- concentration of oxygen
- energy of activation
- reduction potential
- pH
- catalysts
- other reagents

Minimising complexing agents

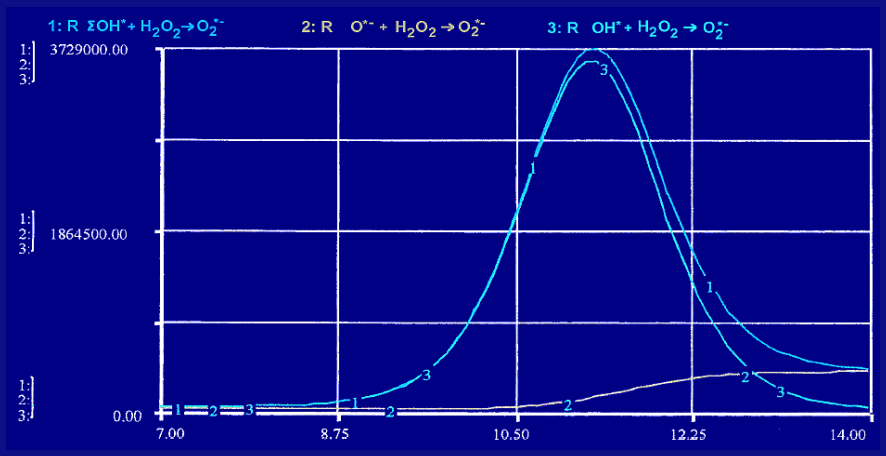
The problem:

- formation of OH* radicals increased by metals
- gives rise to ‘catalytic’ damage of fibres

The solution:

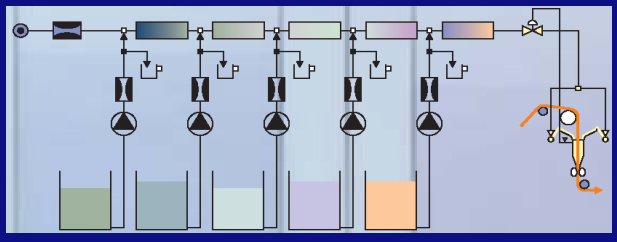
- softening of water
- acid deminiralisation/reductive treatment
- OH* radicals scavenged away by H_2O_2

H_2O_2 activity depends on pH



On line dosing for bleaching and finishing

Water quantity according to pick-up



Stabilizer NaOH softening agent sequestering agent H_2O_2

Oxidative universal size removal

- For commission finishers
- Above pH 13 H_2O_2 generates free radicals (O^{*-})

- Prerequisite: removal of uneven distributed catalyst (iron, copper)

Benefits:

- water & energy consumption,
- improved treatability of the effluent,
- attractive combination with peroxide bleaching

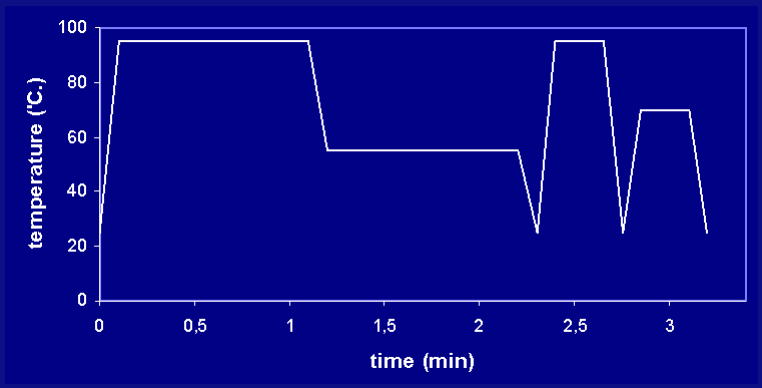
Enzymatic scouring (combined with bleaching)

- with pectinases
- operates under mild pH conditions
- with jet machines
- bleaching with reduced amount of chemicals

Enzymatic →	scouring	scouring & bleaching
Reduction in rinsing water consumption	20%	50%
Reduction in BOD-load	20%	40%
Reduction in COD-load	20%	40%

Environmental benefits

Combined enzymatic desizing and scouring



Scouring plus desizing integrated Rinse twice

Benefits of enzyme technology

- catalyse specific reactions ⟶ performance focus
- enantio selective
- low concentrations required
- biodegradable
- renewable
- re-usable
- acts at moderate temperatures
- enzyme systems are easily controlled
- enzyme action can be targeted
- integration of different enzyme processes
- less waste production

Drawbacks of enzyme technology

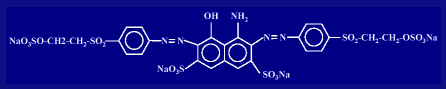
- limited application range concerning temp. and pH
- compatibility with other chemicals
- possibility of enzyme inhibition
- sometimes storage stability ⟶ dosage problems

Selection of dyes

Eco-toxicological assessment and classification
- hazard
- risk

with the help of a database.

High-fixation poly-functional reactive dyestuffs



High fixation and fastness:

- mono-functional: fixation rate 60%
- bi-functional: fixation rate 80%

Benefit:

- reduction of unused dyestuff in waste water

Savings:

- water (less need to wash off unfixed dye),
- energy (short process time)
- chemical (low-salt exhaust dyeing)

Selection of surfactants

Focus on: APEO and NPE

Used in:

- washing formulations
- scouring
- spinning lubricants

Environmental concerns:

- poor biodegradability
- toxicity (including metabolites)
- potential endocrine disruptors

Alternative: AE

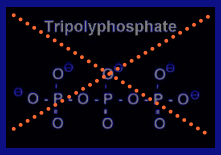
Selection of complexing agents

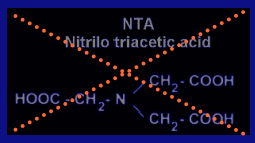
Polyphosphates, phosphonates and amino carboxylic acids

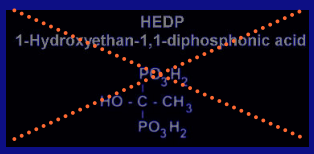
Used: to mask hardening alkaline-earth cations and transition-metal ions in pretreatment and dyeing

Environmental concerns:

- poor biodegradability/bioeliminability
- nitrogen and phosphorus content
- form stable complexes with metals



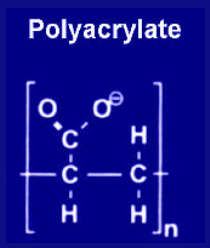


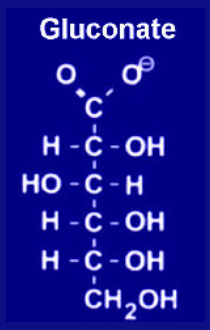


Selection of complexing agents (2)

Alternative:

- softening of fresh water,
- polycarboxylates,
- substituted polycarboxylic acids,
- hydroxy carboxylic acids





Selection of antifoaming agents

Mineral oil based with PAHs contaminants

Used: to avoid uneven dyeing because of excessive foaming
(also used in pretreatment, printing and finishing)

Environmental concerns:
- contribution to organic load of the final effluent
- reduction of VOC emissions during HT processes

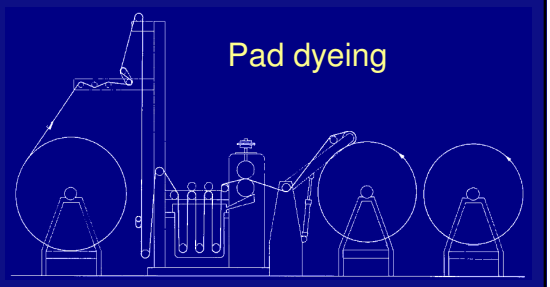
Alternative:
- products free of mineral oils which are bioeliminable

No detergents in afterwashing

- Detergents do not improve removal of hydrolised reactive dyestuff
- Increasing temperature does have an affect
  - more effective
  - increased fastness
- Heat recovery becomes necessary
- Reduction of H_2O_2 consumption

Dyeing machines

Machines:
- continuous dyeing
- batch dyeing
  - winch
  - jiggers
  - overflow
  - jet
  - beam dyeing



Additional:
- colour kitchens
- dosing and dispensing
- controllers

Cut-off between different batches

- Instead:
  - rinsing by overflow or
  - draining and refilling use

↓

- Separate streams for dyeing and rinsing

With this opportunities for:
- re-use,
- separate treatment and
- thermal energy recovery

Finishing

- Chemical finishes
  - optical
  - absorbent and soil release
  - softeners and abrasion-resistant
  - crease-resistant
  - physical stabilization

Sanfor

Finishing

- Physical
  - heatsetting
  - brushing and napping (raising)
  - softening
  - optical finishing
  - shearing
  - compacting

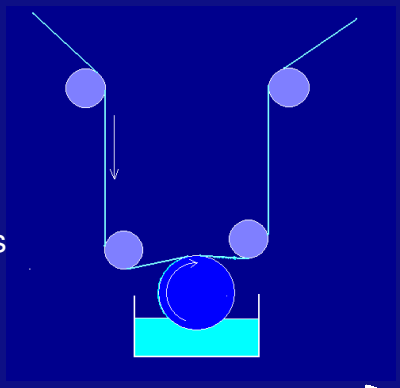
Rubber belt shrinking machine

Application of the finish

Consider the “Critical add on value” (CAV)

- exhaustion
- padding
- liquor transfer
  (through conveyor felt)
- finish printing
- semi-immersion systems
- minimal application techniques
  - foam
  - spray

Semi-immersion systems



Formadehyde-free easy care finishing

Problem:
- cross-linking can contain formaldehyde
- is thought to be carcinogenic

Alternative:
- formaldehyde-free products
  (like modified dimethyldihydroxyethylene urea)

Although:
- also hardly biodegradable
- odour-intensive
- higher price

Avoiding batch softening

Problem:
- softeners applied with exhaustion method in batch dyeing
- harmful cationic agents are lost with the bath

Alternative:
- application separately by pad mangles or by minimal application techniques

Side effect:
- re-use of dye bath