Processing Techniques for knitted fabrics

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Nearchimica auxiliaries can help cut processing costs.
High Performance Chemicals for Pre-treatment of Knitted Fabrics in Cellulosic Fibres

NEARPON UCM

Wetting agent/detergent, stabiliser and sequestering agent all in one compound for alkaline bleaching with hydrogen peroxide

Properties and key benefits

All-in one product for simplified recipes

- less errors in metering
- time saving in dosing
- reduced stockholding

Consumption of hydrogen peroxide is optimised for bleaching with anti-catalytic action

- very good degree of whiteness; suitable for full white
- fibres consistently protected against chemical damage
- possible RAPID bleach at high temperature
Nearpon UCM

Titration of hydrogen peroxide in bleaching bath

Without stabiliser

0.5g/l Nearpon UCM
100% Cotton single jersey liquor ratio 6:1

A  Peroxide bleach
  2.0 – 3.0 g/l  Nearpon UCM
  3.0 – 4.0 ml/l Hydrogen peroxide
  3.0 – 3.5 ml/l caustic soda 30% liq.

B  Neutralising / afterclearing
  2.0  ml/l Nearchel ASB

C  Peroxide removal
  0.1–0.5 ml/l Neareduxol EX

D  Dyeing with reactive dyes

- Short pretreatment time, up to 50% quicker
- Minimum water and energy consumption – up to 70% reduction
- Single bath aftercleaning, neutralising, peroxide removal and dyeing
- Optimum results for dyeing, maximum process safety and reproducibility

Combined cooling/rinsing

° C
110
100
90
80
70
60
50
40
30

15 min at 105° C

Total time

A  L.R. 6:1
B
C
D

Possible (but not mandatory) to bleach at high temperature
Nearcand OP-LF - Four in One

Highly effective combination of detergent, sequestering agent, peroxide stabiliser and alkali for consistent discontinuous peroxide bleaching of cellulosic fibres and their blends.

PROBLEM

Heat-setting of knitted fabrics in viscose/elastane is necessary to ensure dimensional stability (length and width) and resistance to creasing. The baking of residual oils into the fibre and yellowing of the fibres at typical heat-setting conditions of 30–60 sec at 180–195 °C means that the fabric must be bleached before dyeing.

Excessive bleaching conditions can easily damage the bursting strength of viscose/elastane fabrics.

The following graphs indicate the degree of whiteness obtained with different bleaching recipes.
Bleaching of viscose/Lycra® knitted fabric

while maintaining bursting strength

<table>
<thead>
<tr>
<th></th>
<th>Degree of whiteness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70°C</td>
</tr>
<tr>
<td>1</td>
<td>5% H₂O₂ + 2% Nearcand OP-LF</td>
</tr>
<tr>
<td>2</td>
<td>1% Nearcand PC 15</td>
</tr>
<tr>
<td>3</td>
<td>3% Nearcand PC 15</td>
</tr>
<tr>
<td>4</td>
<td>1% Nearcand PC 15 + 2% Nearcand OP-LF</td>
</tr>
<tr>
<td>5</td>
<td>3% Nearcand PC 15 + 2% Nearcand OP-LF</td>
</tr>
<tr>
<td>6</td>
<td>1% Nearcand PC 15 + 2% soda ash</td>
</tr>
<tr>
<td>7</td>
<td>3% Nearcand PC 15 + 2% soda ash</td>
</tr>
</tbody>
</table>

In Bursting strength tests Viscose fabric bleached for 30 minutes at 70°C with: 3% Nearcand PC 15 2% Nearcand OP-LF did not lose any resistance, while fabric bleached at 98°C with hydrogen peroxide lost about 20% in bursting strength.
LUBRIFIL LAF

Save time and money in jet-dyeing cotton knits

For shades not requiring a pre-bleach to remove seeds or to achieve brightness, the anionic lubricant and emulsifying agent LUBRIFIL LAF can be used in an acid scour before dyeing with reactive dyes.
Shortened processing technique for knitted cotton using LUBRIFIL LAF in an acid scour

Save money

Save time
Comparison of processes

<table>
<thead>
<tr>
<th></th>
<th>Caustic soda scour</th>
<th>Lubrifil LAF scour</th>
<th>SAVING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>10.00</td>
<td>4.69</td>
<td>53%</td>
</tr>
<tr>
<td>Dyes</td>
<td>0.00</td>
<td>0.00</td>
<td>58%</td>
</tr>
<tr>
<td>Chemicals</td>
<td>17.49</td>
<td>7.39</td>
<td>42%</td>
</tr>
<tr>
<td>Effluent</td>
<td>4.63</td>
<td>2.69</td>
<td>39%</td>
</tr>
<tr>
<td>Water</td>
<td>10.76</td>
<td>6.55</td>
<td>27%</td>
</tr>
<tr>
<td>Steam</td>
<td>11.89</td>
<td>8.71</td>
<td>57%</td>
</tr>
<tr>
<td>Electricity</td>
<td>2.54</td>
<td>1.09</td>
<td></td>
</tr>
</tbody>
</table>

TIME (mins)  160  75  53%
BATCHES per week  40  87
Pre-setting Cotton and Viscose/Lycra ® with LUBRIFIL LAF

Where blends of cotton or viscose/elastane contain more than about 5 or 6% elastane, it will be very difficult to achieve satisfactory dimensional stability in the final garment (e.g. less than 5% shrinkage on washing) unless the fabric is pre-set before wet processing.

LUBRIFIL LAF is also the product we recommend in padding before pre-setting:

Pad the greige fabric in:
- LUBRIFIL LAF 20 g/l
- NEARPON BW-LF 5 g/l

Heat set for 30 - 60 seconds at 190° - 195° C (depending on type of elastane)

After heat setting the fabric will feel very soft and bulky compared to fabric heat-set without auxiliaries, and when put into water the knitting and spinning oils and charred colour are immediately rinsed out of the fabric. When the heat set fabric is loaded into the dyeing machine, a quick hot rinse is applied, then the fabric is scoured/bleached with Nearpon KR to complete the removal of silicone oil. Because the fabric already contains Lubrifil LAF, no further addition of anti-crease agent is necessary in the scouring/bleaching bath.
While we are talking about Elastane blends, let us discuss how preparation of these blends may be different.

All spinners of ELASTANE yarn apply SILICONE OILS and MAGNESIUM STEARATE to prevent the yarn sticking to itself wherever it crosses.

These must be removed before dyeing. So whenever we are processing ELASTANE blends, we always need a special detergent to remove the silicone oil, and we always need a sequestering agent to remove the magnesium stearate.
NEARPON KR NEW

- High performance detergent suitable for discontinuous & continuous processes;
- Emulsifies and washes off difficult-to-remove oils, including silicone oils from elastane fibres;
- Good stability to alkali and hard water;
- Leaves treated goods with excellent absorbency;
- High biodegradability (APEO free).

20 cS silicone oil stained with Sudan Red 462.

1.0 g/l Competitor’s detergent
1.0 g/l Nearpon KR New
## Analysis of metal impurities in cotton fibre of different origin

<table>
<thead>
<tr>
<th>Provenance</th>
<th>Ca ppm</th>
<th>Mg ppm</th>
<th>Fe ppm</th>
<th>Al ppm</th>
<th>Mn ppm</th>
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<tbody>
<tr>
<td>Sendhwa India</td>
<td>1000</td>
<td>600</td>
<td>125</td>
<td>45</td>
<td>5.9</td>
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<tr>
<td>Bailhongal India</td>
<td>1030</td>
<td>845</td>
<td>115</td>
<td>64</td>
<td>5.6</td>
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<tr>
<td>Jetpur India</td>
<td>580</td>
<td>585</td>
<td>84</td>
<td>65</td>
<td>3.9</td>
</tr>
<tr>
<td>Pandurna India</td>
<td>980</td>
<td>790</td>
<td>475</td>
<td>220</td>
<td>9.9</td>
</tr>
<tr>
<td>Izmir Turkey</td>
<td>905</td>
<td>890</td>
<td>22</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Hatay Turkey</td>
<td>725</td>
<td>640</td>
<td>24</td>
<td>17</td>
<td>3</td>
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<tr>
<td>Urfa Turkey</td>
<td>6290</td>
<td>1190</td>
<td>63</td>
<td>48</td>
<td>31</td>
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<tr>
<td>Tarsus Turkey</td>
<td>985</td>
<td>620</td>
<td>29</td>
<td>23</td>
<td>3</td>
</tr>
<tr>
<td>Paranah Brazil</td>
<td>2711</td>
<td>1119</td>
<td>313</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sao Paulo Brazil</td>
<td>944</td>
<td>863</td>
<td>72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peru</td>
<td>700</td>
<td>440</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Texas USA</td>
<td>810</td>
<td>365</td>
<td>75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>California USA</td>
<td>600</td>
<td>540</td>
<td>40</td>
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<td>Russia</td>
<td>1320</td>
<td>567</td>
<td>112</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Even 1 ppm of iron in dissolved form increases the rate of decomposition of hydrogen peroxide TENFOLD (X 10).
NEARCHEL SA

Special sequestering agent for iron and alkaline earth ions in strongly alkaline pre-treatment baths and oxidative bleaching. Complexes and disperses metal ions, disperses size and soil particles, giving best absorbency, whiteness and stain removal.

Method A
solution of FeCl₃ + solution of NaOH
then filter

Method B
solution of FeCl₃ + solution of NaOH + H₂O₂
then filter

With no addition of sequestering agent

With 2 g/l Nearchel SA

We can clearly demonstrate the superior sequestering and dispersing properties of the phosphonic acid used in formulating Nearchel SA for sequestering Fe⁺⁺⁺ IRON.
Disadvantages of alkaline earth impurities (Ca & Mg) in textile processing

- Dust in singeing
- Insoluble white powder deposits of carbonates, hydroxides, phosphates formed in alkali
- Insoluble silicate deposits in bleaching
- Lime soap stains
- Build-up of deposits on machines
- Peroxide stabilisers blocked by excess calcium – Mg ions precipitated – poor peroxide stability
- Insoluble yellowish-green salts formed with fluorescent brightening agents
- Emulsions of oils and greases are split by Ca and Mg
- Solubility of dyes impaired
- Form spots and stains with dyes
- Unlevel dyeing, changes in shade and reduced fastness
What happens if calcium and magnesium remain in the cotton during dyeing and/or during soaping?

Effect of calcium and magnesium ions on ISO Cold Water fastness of C.I. Reactive Red 120
cotton containing 1500 ppm Ca & Mg

Into dyeing machine at 10:1 liquor ratio

water will contain 150 ppm Ca & Mg

1 g of NEARCHEL 11/E chelates:

<table>
<thead>
<tr>
<th>pH</th>
<th>mg. CaCO₃</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>212</td>
</tr>
<tr>
<td>12</td>
<td>200</td>
</tr>
</tbody>
</table>

Theoretically therefore 0.75 g/l NEARCHEL 11/E at pH 12 should be used in that water to sequester the calcium and magnesium from the greige fabric (150/200 g/l).

Typical dosages of Nearchel 11/E are 0.5 – 1.5 g/l in exhaust preparation processes and 2 – 5 g/l in continuous processes.
Shortened processing

A traditional alkaline preparation
- uses high amounts of caustic soda, usually at 90°C+:
- scouring alone 4-8% o.w.f
- combined with bleaching 2-5% OWF

Caustic soda is non-specific
- much more than necessary is removed (=> high BOD)
- damage to and loss of cellulose

Caustic soda is corrosive and environmentally unfriendly:
- higher demands on the quality of machinery stainless steel
- neutralisation with acids is essential, problematical and time-consuming
- high rinse water consumption and salt load in effluent

Although alkaline scouring is effective and the cost of sodium hydroxide is low, the process is costly because it consumes large quantities of energy, water, and auxiliary agents. The potential for the environmental contamination and depletion of natural resources is also serious. The strict pH and temperature requirements for alkaline scouring are damaging to many fibres.
Bio-preparation with the bacterial alkaline pectinase **NEARCAND P-ECO** allows us to scour the cotton WITHOUT caustic soda. We therefore eliminate expensive and time-consuming rinsing and neutralisation processes. The specificity of enzymes and their mild reaction conditions mean:

- only the components that we want to remove are removed from the cotton
- damage to cellulose is eliminated or at least minimised, therefore the tensile strength / tear strength is not reduced
- process conditions are much less harmful to mill operators, hardware and the environment
Conventional alkaline scouring and dyeing process for dark shade with reactive dyes
1. For black and dark shades not requiring bleaching

Pectinase pre-treatment → Bio-polish (acid)
Reactive dyeing - Soaping

Pectinase pre-treatment:
- 0.5 g/l Nearpon BW-LF
- 1 – 1.5% Nearcand P-ECO
- 1% Nearchel 11 / E

OR: Pectinase pre-treatment - Reactive dyeing - Soaping
Bio-polish (acid or neutral)

Acid Bio-polish:
- 1% Nearstone DP 741Y08

OR: Combine Pectinase and Neutral Bio-polish - Dyeing - Soaping

Neutral Bio-polish
- 1-1.5% Nearstone BPL-N

Adjust to pH 8 – 8.5 with soda ash. Run 30 minutes at 50 – 55°C. Raise to 80°C for 5 minutes to render enzyme inert. Change bath and proceed with Bio-polishing.

at pH 5 – 5.5, at 40°C for 30 – 60 minutes. Raise to 80°C for 5 minutes to kill enzyme. Rinse.

at 50 – 55°C for 30 – 60 minutes, pH 5 – 8. Raise to 80°C for 5 minutes to kill enzyme. Rinse.
Time saving only by eliminating rinsing & neutralising

1-1.5% Nearpon BW-LF
1-1.5% Nearcand P-ECO
1% Nearchel 11 / E
1-2% Neargal LU-SRV
80 g/l Glaubers salt
>6% Reactive dyes

1
2
3

4 Alkali for fixation
5 X g/l acetic acid to neutralise
6 1 – 2 g/l Neariserve DP 746 Y08 soaping agent
Customers are already using a combined Pectinase scour and neutral cellulase biopolish

For brown, khaki, and similar dark shades with Reactive dyes not requiring bleach

Even more Time saving

1 0.75 – 1 g/l Nearpon BW-LF
   0.6 – 1.5 g/l Nearcand P-ECO
   0.3 – 1 g/l Nearstone BPL-N

2 1- 2 % Neargal LU-SRV
   80 g/l Glaubers salt

3 Add reactive dyes
4 Alkali for fixation
5 X g/l acetic acid to neutralise
6 1 – 2 g/l Riserve DP 746 Y08 soaping agent
Core neutralisation of caustic soda

We have already mentioned how difficult it is to remove and neutralise caustic soda from cotton. I believe many problems of poor reproducibility in dyeing with reactive dyes come from a failure to adequately neutralise caustic soda from bleaching, penetrated into the core of the cotton fibre.

Neutralising with weak acid
Buffer is formed e.g. sodium acetate acts as barrier

Neutralising with Nearchel AS/B
Nearchel AS/B reaches soda in interstices of fibre

Interference with dyeing
Yellowing on drying

Reproducible dyeing
No yellowing
2. For black and dark shades not requiring bleaching

Conventional NaOH scour - Bio-polish (acid) - Reactive dyeing - Soaping

Conventional scouring with caustic soda:

- 3 g/l caustic soda 36° Bé liquid
- 1 g/l Nearpon BW-LF
- 1 g/l Nearchel 11 / E
- 1 g/l Lubrifil LTN

Run 30 minutes at 95° C. Rinse at 60° C.
Rinse at 60° -70° C with addition of Nearchel AS/B and proceed with Bio-polishing.

OR:

Conventional NaOH scouring - Reactive dyeing – Soaping – Bio-polish (acid or neutral)

Acid Bio-polish:

- 1% Nearstone DP 741Y08

OR:

Neutral Bio-polish

- 1-1.5% Nearstone BPL-N

at pH 5 – 5.5, at 40° C for 30 – 60 minutes. Raise to 80° C for 5 minutes to kill/neutralise enzyme. Rinse.

at 40 – 45° C for 30 – 60 minutes, pH 5 – 8. Raise to 80° C for 5 minutes to kill/neutralise enzyme. Rinse.
NEARSTONE BPL-N is a NEUTRAL cellulase enzyme therefore dyeing with reactive dyes can be made in the same bath, saving water, energy, and time; or.....

bio-polishing can be made after dyeing with no effect on shade of acid-sensitive dyes.

It is also possible to combine with ECO-scour using NEARCAND P-ECO, pectinase.
Neutral Biopolish with NEARSTONE BPL-N and dyeing with reactive dyes at 80° C

1. Nearstone BPL-N 1%
2. Add alkali to fix dye and render enzyme inert
3. Add salt reactive dye Neargal LU-SRV Nearoxidol SBR

Time saving
Lint / Dust from Bio-polishing

A major disadvantage of bio-polishing knitted cotton fabrics is the accumulation of the cellulose fragments as lint or dust, particularly on the inside of tubular knit fabrics.

The formation of fibre dust

Lint filter of jet dyeing machine should be covered with nylon bolting cloth of 60 mesh
NEARPON SV
– anti-redemption agent

Higher Liquor ratio will help in better Bio-Polishing, but, will equally generate more lint/dust.
Use a Filter Sock (NYLON BOLTING CLOTH of 60 mesh) over the lint filter of the jet dyeing machine.
Incorporate 0.5 g/l NEARPON SV, a high activity dispersing agent / anti-redemption agent, together with enzyme in the bio polishing bath.
Add a further 0.5 g/l NEARPON SV together with your normal soaping agent (like NEARISERVE ECO RS) in the soaping bath after dyeing with reactive dyes

Lint/Dust is not prevented, but customers tell us that build-up of lint or dust is reduced by perhaps 50%
Washing off of reactive dyes

Unfixed dye to be removed during washing-off

Levelling Stage

Fixation Stage

% Exhaustion

% Fixation

Alkali Added
Exhaustion of 5% shade of reactive dyes at 5:1 liquor ratio as affected by salt

The graph shows the exhaustion that would be achieved with 3 typical reactive dyes using the concentration of salt remaining in the bath after 1, 2, 3 and 4 rinses.

Indicates salt concentration which would apply after 1, 2, 3 and 4 rinses.
### Common salt dilution at L.R. 8:1

Nominal working liquor ratio 8:1  
Effective liquor interchange 6:1 allowing for 200% liquor carry-over

<table>
<thead>
<tr>
<th>Original salt concentration (g/l)</th>
<th>Rinse 1</th>
<th>Rinse 2</th>
<th>Rinse 3</th>
<th>Rinse 4</th>
<th>Rinse 5</th>
<th>Rinse 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 g/l</td>
<td>5.0</td>
<td>1.25</td>
<td>0.31</td>
<td>0.08</td>
<td>0.02</td>
<td>-</td>
</tr>
<tr>
<td>30 g/l</td>
<td>7.5</td>
<td>1.88</td>
<td>0.47</td>
<td>0.12</td>
<td>0.03</td>
<td>0.01</td>
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<tr>
<td>40 g/l</td>
<td>10.0</td>
<td>2.5</td>
<td>0.63</td>
<td>0.16</td>
<td>0.04</td>
<td>0.01</td>
</tr>
<tr>
<td>50 g/l</td>
<td>12.5</td>
<td>3.13</td>
<td>0.78</td>
<td>0.2</td>
<td>0.05</td>
<td>0.01</td>
</tr>
<tr>
<td>60 g/l</td>
<td>15.0</td>
<td>3.75</td>
<td>0.94</td>
<td>0.24</td>
<td>0.06</td>
<td>0.02</td>
</tr>
<tr>
<td>70 g/l</td>
<td>17.5</td>
<td>4.38</td>
<td>1.1</td>
<td>0.28</td>
<td>0.07</td>
<td>0.02</td>
</tr>
<tr>
<td>80 g/l</td>
<td>20.0</td>
<td>5.0</td>
<td>1.25</td>
<td>0.31</td>
<td>0.08</td>
<td>0.02</td>
</tr>
<tr>
<td>90 g/l</td>
<td>22.5</td>
<td>5.63</td>
<td>1.41</td>
<td>0.35</td>
<td>0.09</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Residual salt concentration g/l
Thus, for example, at a liquor ratio of 8:1, with an effective liquor interchange of 6:1, if the original concentration of salt = 90 g/l it takes 3 rinses at 70º C to reduce salt concentration to 1.41 g/l.

Reactive dye manufacturers usually recommend that dyeings should be rinsed until salt concentration is 1 to 2 g/l before ‘soaping’.

Use of “colour-catcher” technology in the soaping agent allows soaping with higher concentrations of residual salt, therefore less rinsing water is necessary.
NEARISERVE ECO RS

1 Dye bath
2 Neutralisation at 70° C for 10 mins
3 NEARISERVE ECO RS @ 90° C 10 mins
4 Rinse at 80° C 10 min
5 Rinse at 70° C 10 min
6 Rinse at 70° C 10 min

1 Dye bath
2 Neutralisation at 70° C for 10 mins
3 NEARISERVE ECO RS @ 90° C 10 mins
4 Polyacrylate 2 g/l 90° C 10 mins
5 Polyacrylate 2 g/l 90° C 10 mins
6 Rinse at 80° C 10 min
7 Rinse at 80° C 10 min
8 Rinse at 70° C 10 min
NEARSOPHT PEARL SOFTENERS

Easy-to-handle softener concentrates in droplet form

NEARSOPHT JS-100
Special CATIONIC softening agent for cellulose, protein and synthetic fibres

NEARSOPHT NI
Non-yellowing non-ionic softening agent for cellulose, protein and synthetic fibres
Special finishes – oil & water repellent etc.

We can select from a range of **Naigard** fluorocarbon oil and water repellent finishes to give optimum performance on every fibre.
Naigard 6-SR

• For example
NAIGARD 6-SR Anti-Soil Finish against Household Stains
Coating finishes based on acrylic and polyurethane to produce many different durable effects

Glossy / shiny effects
Leather look / suede feel
Peach skin
Buttery softness
“Barbour”-type finish ..... 

......and many others

Talk to NEARCHIMICA about the full range of products we can supply