Successful dyeing of polyester/elastane blends with Dispersol® and Palanil® dyes

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Successful dyeing of polyester/elastane blends with Dispersol and Palanil dyes
Elastane fibres are:

- widely used to improve fit and comfort of underwear, sportswear and outerwear
- formed from a synthetic polymer containing at least 85% by weight of segmented polyurethane
- generally based on polyether soft segments
- hydrophobic and open-structured with high affinity for disperse dyes
Polyester/Elastane Dyeing Problems

Dyeing polyester/elastane at 130 °C

Permanent drawing of elastane fibre

Loss of stretch recovery power

Elastane fibres have higher affinity for disperse dyes than do polyester fibres

Heavy staining of elastane fibres

Poor colour fastness of dyed polyester/elastane fabrics

Careful choice of

• preparation chemicals
• dyes
• dyeing process
• machinery with minimum tension

is essential for producing high quality dyed fabrics
Lufibrol MSD can be omitted if soft water is used.

Stability of removed silicone oils emulsion is highest at pH 3-4.

Elastane yarns are lubricated with a protective film of 2-5% silicone oil for efficient fabric construction.

Efficient removal of silicone oils before dyeing is important to:

- reduce disperse dye stain on elastane fibres
- reduce risk of spotting and staining during dyeing
- reduce smoking during finishing
- reduce migration of disperse dyes during storage of dyed fabrics
- Kieralon MFB, used at acid pH, is an efficient scouring system for oil removal.
Disperse dyes dyed on polyester/elastane blends will.....

...... preferentially dye the elastane fibre

70 °C  80 °C  90 °C  100 °C  110 °C  120 °C  130 °C  30 min at 130 °C

Polyester

Elastane

• disperse dyes build-up preferentially on elastane in a dyebath containing both polyester and elastane fibres

...... migrate slowly from elastane to polyester

Migration test:
30 minutes at 130 °C, pH 4.5

before migration after migration migrated dye

• very little dye migrates from elastane to polyester after 30 minutes at 130 °C in blank dye bath

...... stain heavily in washing tests

M&S C4A (50 °C), rinsed only dyeings

Dispersol Yellow Brown C-VS 300
Dispersol Red C-VS 300
Dispersol Navy C-VS 300

S.D.C. MULTIFIBRE TEST FABRIC

Elastane

Secondary cellulose acetate (Durene), Bleached unmercerised cotton, Nylon 6.6, Polyester (Terylene), Acrylic (Courtelle), Wool worsted

• disperse dyes on elastane have poor wet fastness
**Disperse Dye Stain on Elastane Fibres**

**Reduction clearing** of dyed polyester/elastane fabrics under alkaline conditions is essential to:

- optimise the wet fastness
- improve the storage fastness
- optimise the shade stability to post heat setting

**Disperse dyes** vary greatly in ease of removal from elastane

<table>
<thead>
<tr>
<th>Disperse dye</th>
<th>Before reduction clearing</th>
<th>After reduction clearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispersol Yellow C-VS 300</td>
<td><img src="image1" alt="Yellow" /></td>
<td><img src="image2" alt="Yellow" /></td>
</tr>
<tr>
<td>Palanil Yellow E-3G 200</td>
<td><img src="image3" alt="Yellow" /></td>
<td><img src="image4" alt="Yellow" /></td>
</tr>
<tr>
<td>Dispersol Crimson SF</td>
<td><img src="image5" alt="Red" /></td>
<td><img src="image6" alt="Red" /></td>
</tr>
<tr>
<td>Dispersol Red C-VS 300</td>
<td><img src="image7" alt="Red" /></td>
<td><img src="image8" alt="Red" /></td>
</tr>
<tr>
<td>Dispersol Blue XF</td>
<td><img src="image9" alt="Blue" /></td>
<td><img src="image10" alt="Blue" /></td>
</tr>
<tr>
<td>Palanil Dark Blue 3RT-CF</td>
<td><img src="image11" alt="Blue" /></td>
<td><img src="image12" alt="Blue" /></td>
</tr>
</tbody>
</table>

**Reduction Clear**

- 3-4 g/l Hydrosulfite Conc. BASF
- 4-8 ml/l caustic soda 38° Bé
- 0.5 g/l Cyclanon® PE-J et 20 minutes at 80 °C

**Dye Selection** should aim to produce, after reduction clearing:

- little or no disperse dye on elastane (ideal)
- disperse dye stain on-tone with polyester dyeing (second best)
Dyeing temperature should take into account:

- source and stability of elastane yarns
- construction of the fabric
- dyeing machinery available
- colour fastness needed

Dyeing polyester/elastane fabrics at reduced dyeing temperatures (e.g. 115 °C) will minimise loss of stretch recovery power, but will result in:

- reduced colour fastness
- reduced shade reproducibility and more shading additions
- poor coverage of polyester yarn variations (increased barré)
- reduced colour yield
- danger of shade change on post heat setting

Dyeing temperature for polyester/elastane is often a compromise
1. Dyeing at 115 °C

Controlled coloration of polyester/elastane blends with good shade reproducibility at 115 °C is possible with:

Palanil E dyes ➞ pale to medium shades
Dispersol C-VS dyes ➞ medium to heavy shades

1.1 Controlled Coloration

On-tone build-up ......

<table>
<thead>
<tr>
<th>Temperature</th>
<th>70 °C</th>
<th>80 °C</th>
<th>90 °C</th>
<th>100 °C</th>
<th>110 °C</th>
<th>115 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 min</td>
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<tr>
<td>45 min</td>
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<td></td>
</tr>
</tbody>
</table>

Recipe 1

- 0.11 % Palanil Yellow E-3G 200
- 0.11 % Palanil Red E-BF 200
- 0.08 % Palanil Blue E-R 150

Recipe 2

- 1.69 % Dispersol Yellow Brown C-VSE
- 0.21 % Dispersol Red C-VS 300
- 0.67 % Palanil Dark Blue 3RT-CF

...... and stability to heat setting ......

<table>
<thead>
<tr>
<th></th>
<th>Recipe 1</th>
<th>Recipe 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔE</td>
<td>0.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Strength</td>
<td>113%</td>
<td>102%</td>
</tr>
<tr>
<td>Hue</td>
<td>0.5 redder</td>
<td>0.2 yellower</td>
</tr>
</tbody>
</table>

* colour measurements on the above dyeings

...... all lead to:

Best achievable Right-First-Time performance
1.2 Colour fastness

Good washing to 50 °C washing and to perspiration can be achieved by efficient reduction clearing of all shades after dyeing (see pages 10 and 11 for full application details)

### C06/B2S (50 °C)

**Secondary cellulose acetate (Dicel)**
- Olive
- Navy
- Black
- Cherry

**S.D.C. MULTIFIBRE TEST FABRIC**
- Bleached unmercerised cotton
- Nylon 6.6
- Polyester (Terylene)
- Acrylic (Courtelle)
- Wool worsted

**Dye Formulations**
- **Olive**
  - 0.23 % Palanil Yellow E-3G 200
  - 0.12 % Palanil Red E-BF 200
  - 0.10 % Palanil Blue E-R 150
- **Navy**
  - 0.02 % Dispersol Yellow C-VS 300
  - 0.29 % Dispersol Yellow Brown C-VSE
  - 1.38 % Palanil Dark Blue 3RT-CF
- **Black**
  - 0.06 % Dispersol Yellow Brown C-VSE
  - 2.16 % Dispersol Black C-VSE
- **Cherry**
  - 0.47 % Dispersol Yellow Brown C-VSE
  - 0.39 % Dispersol Red C-VS 300
  - 0.02 % Palanil Dark Blue 3RT-CF

*All dyeings heat-set at 190 °C for 30 seconds after reduction clearing.*

### Alkaline Perspiration (E04)

**Secondary cellulose acetate (Dicel)**
- Olive
- Navy
- Black
- Cherry

**S.D.C. MULTIFIBRE TEST FABRIC**
- Bleached unmercerised cotton
- Nylon 6.6
- Polyester (Terylene)
- Acrylic (Courtelle)
- Wool worsted
1.3 Dyeing/clearing Processes

Pale/medium shades ➞ Palanil E dyes

- Yellow E-3G
- Red E-BF
- Brilliant Blue BG-CF
- Blue E-R

40 °C: 30 - 60 minutes
70 °C: 0
115 °C: 3-4 g/l Hydrosulfite Conc. BASF
20 minutes
80 °C

1-4 g/l Setamol® BL
1 g/l Palatex® PC
1-2 g/l Palegal® LP
pH 4 - 5 with Eulysin® S or acetic acid

3-4 g/l Hydrosulfite Conc. BASF
4-8 ml/l caustic soda 38° Bé
0.5 g/l Cyclanom® PE-Jet
Compact Elastane - Dyeing at 115 °C

Medium/heavy shades ➢ Dispersol C-VS dyes

- Yellow C-VS
- Yellow Brown C-VSE
- Black C-VSE/Black C-GE
- Green C-VS
- Navy C-VSE
- Palanil Dark Blue 3RT-CF
- Royal C-VS
- Blue C-VSA
- Violet C-VS
- Royal C-VS
- Red C-VS
- Red C-4G
- Navy C-VSE
- Black C-VSE/Black C-GE

Temperatures:
- 40 °C
- 70 °C
- 115 °C
- 80 °C
- 20 minutes
- 30 - 60 minutes

Chemicals:
- 1-4 g/l Setamol® BL
- 1 g/l Palatex® PC
- 1-2 g/l Palegal® LP
- pH 4 - 5 with Eulysin® S or acetic acid
- 3-4 g/l Hydrosulfite Conc. BASF
- 4-8 ml/l caustic soda 38° Bé
- 0.5 g/l Cyclanon® PE-Jet
- 1 g/l Palatex® PC
## 2. Dyeing at 125-130 °C

Controlled Coloration of polyester/elastane blends with good shade reproducibility and optimum wet fastness at 125-130 °C with:

- **Palanil E**: pale shades
- **Dispersol C-VS**: medium/heavy shades
- **Dispersol XF, SF**: heavy shades with highest wash fastness

### 2.1 Controlled Coloration

**On-tone build-up ......**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>70 °C</th>
<th>80 °C</th>
<th>90 °C</th>
<th>100 °C</th>
<th>110 °C</th>
<th>120 °C</th>
<th>130 °C</th>
<th>15 min</th>
<th>30 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recipe 1</td>
<td><img src="image1" alt="Recipe 1 Color Swatches" /></td>
<td><img src="image2" alt="Recipe 1 Color Swatches" /></td>
<td><img src="image3" alt="Recipe 1 Color Swatches" /></td>
<td><img src="image4" alt="Recipe 1 Color Swatches" /></td>
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<td><img src="image6" alt="Recipe 1 Color Swatches" /></td>
<td><img src="image7" alt="Recipe 1 Color Swatches" /></td>
<td><img src="image8" alt="Recipe 1 Color Swatches" /></td>
<td><img src="image9" alt="Recipe 1 Color Swatches" /></td>
</tr>
<tr>
<td>Recipe 2</td>
<td><img src="image1" alt="Recipe 2 Color Swatches" /></td>
<td><img src="image2" alt="Recipe 2 Color Swatches" /></td>
<td><img src="image3" alt="Recipe 2 Color Swatches" /></td>
<td><img src="image4" alt="Recipe 2 Color Swatches" /></td>
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<td><img src="image9" alt="Recipe 2 Color Swatches" /></td>
</tr>
<tr>
<td>Recipe 3</td>
<td><img src="image1" alt="Recipe 3 Color Swatches" /></td>
<td><img src="image2" alt="Recipe 3 Color Swatches" /></td>
<td><img src="image3" alt="Recipe 3 Color Swatches" /></td>
<td><img src="image4" alt="Recipe 3 Color Swatches" /></td>
<td><img src="image5" alt="Recipe 3 Color Swatches" /></td>
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<td><img src="image7" alt="Recipe 3 Color Swatches" /></td>
<td><img src="image8" alt="Recipe 3 Color Swatches" /></td>
<td><img src="image9" alt="Recipe 3 Color Swatches" /></td>
</tr>
</tbody>
</table>

**Recipe 1**
- 0.11 % Palanil Yellow E-3G 200
- 0.11 % Palanil Red E-BF 200
- 0.08 % Palanil Blue E-R 150

**Recipe 2**
- 1.69 % Dispersol Yellow Brown C-VSE
- 0.21 % Dispersol Red C-VS 300
- 0.67 % Palanil Dark Blue 3RT-CF

**Recipe 3**
- 3.43 % Dispersol Yellow Brown XF
- 0.54 % Dispersol Rubine XFN
- 0.77 % Dispersol Navy XF
...... with good time/temperature robustness ......

<table>
<thead>
<tr>
<th>Recipe 1</th>
<th>Recipe 2</th>
<th>Recipe 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>125 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 minutes</td>
<td>98% 0.9 yellower</td>
<td>91% 0.4 yellower</td>
</tr>
<tr>
<td>30 minutes</td>
<td>99% 0.4 yellower</td>
<td>95% 0.01 redder</td>
</tr>
<tr>
<td>45 minutes</td>
<td>100% 0.3 redder</td>
<td>97% 0.04 redder</td>
</tr>
<tr>
<td>130 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100% 0.5 yellower</td>
<td>94% 0.2 yellower</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Control</td>
</tr>
<tr>
<td>103% 0.1 redder</td>
<td>100% 0.02 yellower</td>
<td></td>
</tr>
<tr>
<td>135 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>103% 0.3 yellower</td>
<td>102% 0.4 redder</td>
</tr>
<tr>
<td></td>
<td>108% 0.5 redder</td>
<td>101% 0.02 redder</td>
</tr>
<tr>
<td></td>
<td>112% 0.4 redder</td>
<td>103% 0.3 redder</td>
</tr>
</tbody>
</table>

...... and stability to heat setting ......

|          |          |          |
|          |          |          |
|          |          |          |
|          |          |          |

Best achievable Right-First-Time performance
2.2 Colour Fastness

Optimum wet fastness can be achieved by efficient reduction clearing of all shades after dyeing (see pages 15, 16 and 17 for full application details)

**C06/B2S (50 °C)**

- Olive
- Navy
- Navy 2
- Black
- Black 2
- Cherry
- Cherry 2

**Alkaline Perspiration (E04)**

- Olive
- Navy
- Navy 2
- Black
- Black 2
- Cherry
- Cherry 2

<table>
<thead>
<tr>
<th>Colour</th>
<th>Olive</th>
<th>Navy</th>
<th>Navy 2</th>
<th>Black</th>
<th>Black 2</th>
<th>Cherry</th>
<th>Cherry 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olive</td>
<td>0.23 % Palanil Yellow E-3G 200</td>
<td>0.02 % Dispersol Yellow C-VS 300</td>
<td>0.30 % Dispersol Yellow Brown XF</td>
<td>0.06 % Dispersol Yellow Brown C-VSE</td>
<td>0.15 % Dispersol Yellow Brown XF</td>
<td>0.47 % Dispersol Yellow Brown C-VSE</td>
<td>0.92 % Dispersol Yellow Brown XF</td>
</tr>
<tr>
<td></td>
<td>0.12 % Palanil Red E-BF 200</td>
<td>0.29 % Dispersol Yellow Brown C-VSE</td>
<td>0.14 % Dispersol Rubine XFN</td>
<td>2.16 % Dispersol Black C-VSE</td>
<td>3.43 % Dispersol Black XF</td>
<td>0.39 % Dispersol Red C-VS 300</td>
<td>0.54 % Dispersol Rubine XFN</td>
</tr>
<tr>
<td></td>
<td>0.10 % Palanil Blue E-R 150</td>
<td>1.38 % Palanil Dark Blue 3RT-CF</td>
<td>1.54 % Dispersol Navy XF</td>
<td></td>
<td></td>
<td>0.02 % Palanil Dark Blue 3RT-CF</td>
<td>0.16 % Dispersol Crimson SF</td>
</tr>
</tbody>
</table>

All dyeings heat-set at 190 °C for 30 seconds after reduction clearing.
2.3 Dyeing/clearing procedures

Pale shades ➤ Palanil E dyes

Yellow E-3G

Red E-BF

Brilliant Blue BG-CF

Blue E-R

Disperse dyes

125 - 130 °C
15 - 30 minutes

70 °C

1-4 g/l Setamol® BL
1 g/l Palatex® PC
pH 4 - 5 with
Eulysin® S or acetic acid

80 °C
20 minutes

3-4 g/l Hydrosulfite Conc. BASF
4-8 ml/l caustic soda 38° Be
0.5 g/l Cyclanon® PE-Jet
Compact Elastane - Dyeing at 125-130 °C

Medium/heavy shades ➞ Dispersol C-VS dyes

1-4 g/l Setamol® BL
1 g/l Palatex® PC
pH 4 - 5 with Eulysin® S or acetic acid

3-4 g/l Hydrosulfite Conc. BASF
4-8 ml/l caustic soda 38° Bé
0.5 g/l Cyclanon® PE-Jet

125 - 130 °C
15 - 30 minutes

70 °C
20 minutes

40 °C

Disperse dyes

1 g/l Palatex® PC
pH 4 - 5 with Eulysin® S or acetic acid
Compact Elastane - Dyeing at 125-130 °C

Heavy shades with highest wash fastness ➞ Dispersol XF, SF dyes

- 1-4 g/l Setamolfi® BL
- 1 g/l Palatex® PC
- pH 4 - 5 with Eulysin® S or acetic acid

125 - 130 °C

15 - 30 minutes

1 g/l Palatex® PC

70 °C

40 °C

disperse dyes

3-4 g/l Hydrosulfite Conc. BASF
4-8 ml/l caustic soda 38° Bé
0.5 g/l Cyclanon® PE-Jet

20 minutes

Yellow Brown XF

Crimson SF

Black XF

Navy XF

Rubine XFN

Turquoise XF

Blue XF

Flavine XF

Crimson SF
Compact Elastane - Top Tips

For successful dyeing of polyester/elastane fabrics

- lowest dyeing temperature which produces level, well penetrated dyeings
- low tension dyeing machinery
- select dyes and chemicals for Controlled Coloration
- efficient pre-scouring to remove silicone oils
- efficient reduction clearing
- lowest post heat-setting temperature which produces stable fabrics