“Waterless Dyeing of Denim”

Real World Experiences from the Introduction of Breviol® Technology
HISTORY – IT ALL STARTED WITH HENKEL

1876
Henkel

1879
Adolf Theodor Böhme
(Later: Dr. Th. Böhme)

1906 – 1935
Heinrich Böhme
(Later: Böhme Fettkocherei)

1941 – 1986
Pulcra (Latin) pure (both physically and spiritually), clean

1999 – 2007
Cognis

2007 – 2008
Foundation & independence of Pulcra group

2010
01. April takeover
Dr. Th. Böhme production facility in Geretsried and today’s headquarters

2015
5th anniversary in Geretsried

2017
10th anniversary Pulcra Group

Pulcra: (latin) pure
(both physically and spiritually), clean
Headquartered is in Geretsried, Germany, Pulcra Chemicals operates production facilities, service centers, and sales offices in thirteen countries to provide comprehensive service for its customers around the world.
Pulcra Chemicals started working on reduced water usage for the indigo dyeing process in 2009 and introduced our initial Breviol® product for water saving in 2011 for indigo dyeing. Our line of Breviol® denim products have grown and some of these products are now part of our sustainable line of products for the industries we serve.

One of the core values of this Technology is protecting our Planet, focused on creating solutions that minimize the impact to our environment in terms of Water Contamination and Water Treatment.
SUSTAINABILITY AT PULCRA

SUSTAINABILITY: IN LINE WITH TOMORROW

The Pulcra Chemicals product line fully complies with Europe’s newest chemical requirements (REACH). We register our products according to textile eco-standards and criteria including OKEOTEX, GOTS, and bluesign®. Pulcra Chemicals is committed to the Zero Discharge of Hazardous Chemicals (ZDHC) and fulfills important requirements to make the production with our chemicals safe and clean.
Need to Reduce Water Usage in Denim Processing

One study which we have seen estimated that the global denim production was around 5.8 billion meters of fabric per year. The actual global production may be larger than this but about 50% of this production will have dyed yarns. The potential water savings for dyeing this amount of yarn is substantial. One continuous indigo dyeing range can use between 50 – 100 million liters of water annually in the washing process after dyeing. If we can reduce the amount of water usage by 50% - 90% the water reduction would be a substantial amount. This is an achievable goal and one our industry needs to work on.

Additional Water Usage Information from Denim Producers and Brands

• The life cycle of one pair of jeans can have an average water usage of 3,781 liter of water. This amount includes the growing of cotton, production of jeans and the home washing of jeans.

• The water usage to produce one pair of jeans is 6 – 8% of this total or 236 – 303 liters of water.

• Levi Strauss has stated they will save 50 billion liters of water in their Water<Less programs by 2020.
Introduction of Breviol® Denim Technology

Both indigo and sulfur dyes have no reactive groups to attached to the cotton yarn so both indigo and sulfur dyes are only semi-wash durable using a chemical reductive process followed by an oxidative process. The normal dyeing procedures for denim allow a substantial amount of dye to be removed during the washing process and additional dye is removed in subsequent garment washing and finishing processes. The amount of dye wash off is normally 15 – 25%. The final customer for the denim garments will normally see more dye wash off from their normal home washing cycles.

Our current line of Breviol® denim technology products are used in either the indigo or sulfur dyeing processes. Each product is similar in that they reduce the amount of water which is used after the dyeing process to remove the unfixed dyes which would normally go the waste water treatment facilities. The benefits of this technology can be summarized in nine categories.
The Core Principles of our Breviol® Denim Technology are:

- Reducing Water Usage
- Less Contamination of Unfixed Dyes
- Clearer & Cleaner Waste Water Going to Water Treatment Plants
- Water Savings During the Entire Process
- Economy of Energy + Water + Dyestuffs + Waste Water Treatment
- Management of Resources \(\rightarrow\) Much Cleaner Process

**WATER MANAGEMENT**

- Water Savings
- Impact on Water Treatment

**LESS CONTAMINATION**

- Less Unfixed Dye

**REDUCTION OF ENERGY**

- Lower Energy Consumption

Eco-friendly process
Benefits of Using Breviol® Denim Technology

- Reduced Water Usage for Washing Dyed Yarns to Remove Unfixed Dyes
- Reduce BOD / COD Loading Going to the Waste Water Treatment Facilities
- Reduced Dye Coloration of the Waste Water
- Reduced Sulfur Dye Contamination of Indigo Dye in a Sulfur Bottom Process
- Improved Ring Dyeing Effects of Indigo Dye During the Sulfur Bottom Dyeing Process
- Improved Dye Fastness Properties & Ability to Produce Darker Dye Shades
- Improved Sulfur Black Denim Process
- Reduced Sulfur & Indigo Dye Usage to Match the Same Shade to Reduce Dyestuff Costs
- Ability to Provide a Cost Neutral Dyeing Process When Using Breviol® Technology
SUSTAINABILITY – BREVIOL® DENIM TECHNOLOGY

WASTE WATER DISCHARGE WITH AND WITHOUT BREVIOL® DENIM TECHNOLOGY

Drain Water to Waste Water Treatment Plant During BREVIOL® DENIM TECHNOLOGY for Indigo dyeing at a 3.8% Level o.w.y.

Drain Water to Waste Water Treatment Plant During Normal Indigo Dyeing at a 1.9% Indigo Dye Level o.w.y.
## Analysis Waste Water Collector

<table>
<thead>
<tr>
<th>Waste Water</th>
<th>PH</th>
<th>BOD Specific (mg/L)</th>
<th>COD Specific (mg/L)</th>
<th>Colour Grades PT-CO</th>
<th>Flow (m³/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dyeing Process Caustification + Indigo Dyeing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Standard Process 2.04% Indigo o.w.y.</td>
<td>12.13</td>
<td>3780.00</td>
<td>5780.00</td>
<td>12100.00</td>
<td>5.4</td>
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<tr>
<td>2 BREVIOL® DENIM TECHNOLOGY Process 2.04% Indigo o.w.y.</td>
<td>13.47</td>
<td>740.00</td>
<td>2540.00</td>
<td>1140.00</td>
<td>4.4</td>
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<tr>
<td><strong>Dyeing Process Pre-Wetting + Indigo Dyeing</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3 Standard Process 2.3% Indigo o.w.y.</td>
<td>9.78</td>
<td>2600.00</td>
<td>3200.00</td>
<td>19350.00</td>
<td>5.4</td>
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<tr>
<td>4 BREVIOL® DENIM TECHNOLOGY Process 2.3% Indigo o.w.y.</td>
<td>10.02</td>
<td>1360.00</td>
<td>2360.00</td>
<td>1980.00</td>
<td>4.4</td>
</tr>
<tr>
<td>5 BREVIOL® DENIM TECHNOLOGY Process 3.58% Indigo o.w.y.</td>
<td>10.95</td>
<td>1220.00</td>
<td>2800.00</td>
<td>2260.00</td>
<td>4.4</td>
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<tr>
<td>6 BREVIOL® DENIM TECHNOLOGY Process 5.76% Indigo o.w.y.</td>
<td>10.98</td>
<td>1980.00</td>
<td>3640.00</td>
<td>3500.00</td>
<td>4.4</td>
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</table>
BREVIOL® DENIM TECHNOLOGY WITH INDIGO DYES
Waste Water Sample Pure Indigo (4%)

Waste Water Sample using Normal Process

Waste Water Sample using Breviol® Technology
BREVIOL® DENIM TECHNOLOGY

In the Following Slides You Will See Examples of Production Processes for:

- INDIGO DYEING
- SULFUR BOTTOM & INDIGO TOP DYEING
- BLACK SULFUR DYEING
- SULFUR OVER DYEING OF INDIGO OR SULFUR DYED FABRICS
- EXAMPLES OF BOTH ROPE AND SLASHER DYEING PROCESSES
### Number of finished meters of fabric in dye set

<table>
<thead>
<tr>
<th></th>
<th>20,000</th>
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### Length of yarn dye set

<table>
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<tr>
<th></th>
<th>25,000</th>
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</thead>
</table>

### Average speed meter/min

<table>
<thead>
<tr>
<th></th>
<th>X</th>
</tr>
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</table>

### Minutes/dye set

<table>
<thead>
<tr>
<th></th>
<th>25,000/X</th>
</tr>
</thead>
</table>

## TRADITIONAL PROCESS

<table>
<thead>
<tr>
<th>Process</th>
<th>Scour</th>
<th>Rinse</th>
<th>Rinse</th>
<th>Rinse</th>
<th>Rinse</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Rinse</th>
<th>Rinse</th>
<th>Rinse</th>
<th>Rinse</th>
<th>Softener</th>
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</thead>
<tbody>
<tr>
<td>Volume</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>BYPASS</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

### H₂O Consumption Liters/min

<table>
<thead>
<tr>
<th>Process</th>
<th>Scour</th>
<th>Rinse</th>
<th>Static</th>
<th>BYPASS</th>
<th>BYPASS</th>
<th>BYPASS</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>Indigo</th>
<th>BREVIOL</th>
<th>Static</th>
<th>BYPASS</th>
<th>BYPASS</th>
<th>Softener</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>BYPASS</td>
<td>BYPASS</td>
<td>BYPASS</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>A</td>
<td>A</td>
<td>BYPASS</td>
<td>BYPASS</td>
<td>D</td>
</tr>
</tbody>
</table>

### H₂O Consumption Liters/min

| Process | ByC.11 | ByC.11 | BYPASS | BYPASS | BYPASS | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | C.11   | C.11   | C.11   | BYPASS | E.11 |

Water Savings 80% meter to meter comparison
**BREVIOl® INDIGO WATERLESS PROCESS**

*With CATIONIZING BOTTOM*

90 – 95% WATER SAVINGS

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**Head Tank Feeding**

BrevioI® : X g/lt

With Securon Acid

pH: 4-4.5

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**Indigo Dips**

X%

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**Dry Cans**

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**Filling with**

Water at 80° C

**No Fresh Water Feeding**
BREVIO® SULFUR BOTTOM AND INDIGO TOP ROPE DYEING WATERLESS PROCESS

Yellow Sulfur Bottom: X g/L & Auxiliaries
pH: 12.78
Temperature: 75°C

Head Tank Feeding:
Brevio®: X g/L
Securon Acid: X g/L
pH: 2.5 – 2.8
Dosing

INDIGO DIPS
2.05%

Box:
Brevio®: X g/L
Securon Acid: X g/L
pH: 4-4.5
Temperature: 65 °C

Water
Temperature: 65°C
No Fresh Water Feeding

Head Tank Feeding:
Brevio®: X g/L
Securon Acid: X g/L
pH: 2.5 – 2.8
Dosing

Pass

Rope Bottom W1 W2 W3 W4 Pass Pass  I1 I2 I3 I4 I5 I6 I7 I8 I9 20 Brevio® W1 W2 W3 Belfasin Dry Cans Coiler

Box:
Brevio®: X g/L
Securon Acid: X g/L
pH: 4-4.5
Temperature: 65 °C

Water
Temperature: 65°C
No Fresh Water Feeding
BREVIOL® SULFUR BOTTOM AND INDIGO TOP SLASHER DYEING
WATERLESS PROCESS WITH INDIGO DYE REDUCTION

BOTTOM:
Black Sulfur Dye: X %
Activant & Wetting Agent
pH: 12.8
Temperature: 80°C

Head Tank Feeding:
Breviol®: X g/L
Securon Acid: X g/L
pH: 2.5-3.0
Dosing

INDIGO DIPS
4.4%
(20% Reduction)

Cold Rinse

Box:
Breviol®: X g/L
Securon Acid: X g/L
pH: 4-4.5
Temperature: 65 °C

Water
Temperature: 65°C
No Fresh Water Feeding

Beam Bottom W1 W2 W3 11 I2 I3 I4 I5 I6 I7 I8 I9 20 Breviol® W1 W2 Sizing Box 1 Sizing Box 2 Beam

Dosing
NORMAL PROCESS / BREVIOL® PROCESS

Waste Water from Indigo Wash Water Discharge after BREVIOL® PROCESS

Waste Water from Indigo Wash Water Discharge after NORMAL PROCESS

SIZING BOX from BREVIOL® PROCESS
No Black or Blue Color Contamination
**BREVIOL® SULFUR BLACK WATERLESS ROPE DYEING PROCESS**

**Feeding Caustic Soda & Auxiliaries**

**Head Tank Feeding:**
- BREVIOL®: X g/L
- Securon Acid: X g/L
- pH: 1
- Dosing Head Tank

**Water Temperature:** 65°C
- No Fresh Water Feeding

**Feeding Black Sulfur Dye:**
- X g/L

**Box:**
- BREVIOL®: X g/L
- Securon Acid: X g/L
- pH: 4-4.5
- Temperature: 65°C

**Rope Bottom W1    W2    W3    SOFT.    Dry Cans    Coiler**

**Water Temperature:** 65°C
- No Fresh Water Feeding

**Mercerizing 24° Be**

**Pass Pass Pass Pass**
BREVIOL® SULFUR BLACK SLASHER DYEING WATERLESS PROCESS WITH SULFUR DYE REDUCTION

Head Tank Feeding

Black Sulfur Dye: 25% Reduction
Activant & Wetting Agent: Caustic Soda to pH:13
Temperature: 80°C

MERC./CAUST.

Beam Scour W1 W2 W3 I1 I2 I3 I4 I5 I6 I7 I8 I9 20 BREVIOL® W1 W2 PASS Sizing Box 1 Sizing Box 2 BEAM

Cold Rinse

Box: Breviol®: X g/L
Securon Acid: pH: 4-4.5
Temperature: 65°C

Water
Temp: 65°C
No Fresh Water Feeding

DRY CANS

DRY CANS
SLASHER DYEING PROCESS USING BREVIOL® TECHNOLOGY

Sample of Waste Water Collected at Waste Drain after 15,000 Meters of Dyed Yarn

Sizing Box after 15,000 Meters of Dyed Yarn
WATERLESS SULFUR OVERDYING PROCESS

SULFUR OVERDYING

BREVIOL® HEAD TANK FEEDING

STEAM / WITHOUT STEAM

COLD WATER RINSING

60-65°C

BREVIOL® + ACID APPLICATION

BYPASS WITHOUT WASHING
OVERDYEING WITH STEAMER
BLUE-BLACK (OVERDYED)
# OVERDYEING WITH STEAMER
BLACK-BLACK (OVERDYE)

<table>
<thead>
<tr>
<th>RINSE WASH</th>
<th>30 MIN. STONE WASH</th>
<th>20 MIN. PEROXIDE BLEACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Breviol® Process</td>
<td>Normal Process</td>
<td></td>
</tr>
</tbody>
</table>
OVERDYING WITHOUT STEAMER
DRY-WET RUBBING FASTNESS
ADDITIONAL ARGUMENTS

Breviol® will Prevent Bleeding / Reduction of Sulfur Dyestuff into Indigo Dyebath During Bottoming Process

DEGRADATION OF NORMAL SULFUR BOTTOM DYE BECAUSE OF REDUCTION

1. FIVE IMMERSIONS IN HYDRO / CAUSTIC SODA

CONSTANCY OF SULPHUR BOTTOM DYE WITH BREVIOI® DENIM TECHNOLOGY

3. BREVIOI® PROCESS

4. BREVIOI® PROCESS + FIVE IMMERSIONS IN HYDRO / CAUSTIC SODA
Breviol® Technology Helps Prevent Indigo Back Staining

Filling Yarn Backstaining after 28° Be Mercerizing

No Backstaining with Breviol® Process After 28° Be Mercerizing
Normal Sulfur Bottom and Indigo Topping Dyeing Process
Breviol® Technology to Provide a Ring Dyeing Effect

Breviol® Denim Technology

Steps → Sulfur dye → Indigo dye

Yarn → → → Rings
# EXAMPLE OF A COST CALCULATION

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>UNIT</th>
<th>NORMAL PROCESS</th>
<th>BREVOL (W+L) PROCESS</th>
<th>Difference by amount</th>
<th>Difference by %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Dying Machine</td>
<td>Rope</td>
<td>Rope</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Warp Line</td>
<td>line</td>
<td>2.0</td>
<td>2.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Need of Dying Machine</td>
<td>mm</td>
<td>26.0</td>
<td>20.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cut Length (Double Warp) 24 ropes inch</td>
<td>meter</td>
<td>100,000.00</td>
<td>100,000.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyeing Time</td>
<td>hour</td>
<td>6.7</td>
<td>6.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Warp Length</td>
<td>meter</td>
<td>20,000.00</td>
<td>20,000.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Yarn Number</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td></td>
<td></td>
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<tr>
<td>Total Yarn Ends</td>
<td>ends</td>
<td>4,680.00</td>
<td>4,680.00</td>
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<tr>
<td>Warp Weight</td>
<td>g/m²</td>
<td>345.7</td>
<td>345.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rope Weight</td>
<td>g/m²</td>
<td>693.5</td>
<td>693.5</td>
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<tr>
<td>Total Yarn Consumption</td>
<td>h/kg</td>
<td>6154.8</td>
<td>6154.8</td>
<td></td>
<td></td>
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<tr>
<td>Dyeing Percentage</td>
<td>%</td>
<td>3.4</td>
<td>2.8</td>
<td></td>
<td></td>
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<tr>
<td>Dyeing PH</td>
<td>pH</td>
<td>12.0</td>
<td>12.0</td>
<td></td>
<td></td>
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<tr>
<td>Dye Loss</td>
<td>%</td>
<td>8.7</td>
<td>8.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Yarns</td>
<td>8.0</td>
<td>8.0</td>
<td>8.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Wash Boxes</td>
<td>6.0</td>
<td>6.0</td>
<td>6.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume of Each Wash Box for Filling</td>
<td>l</td>
<td>1,200.00</td>
<td>1,200.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume of Total Wash Boxes for Filling</td>
<td>l</td>
<td>7,200.00</td>
<td>1,200.00</td>
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<td></td>
</tr>
<tr>
<td>Total Fresh Water Feeding</td>
<td>l</td>
<td>20,000.00</td>
<td>3,333.33</td>
<td></td>
<td>83.33%</td>
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<tr>
<td>Fresh Water Consumption for Washing-Feed</td>
<td>l</td>
<td>22,233.34</td>
<td>11,111.67</td>
<td></td>
<td></td>
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<tr>
<td>Fresh Water Consumption for Washing-Total</td>
<td>l</td>
<td>33,433.33</td>
<td>11,111.67</td>
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<td></td>
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<tr>
<td>Uniform Water Consumption</td>
<td>l/kg</td>
<td>20.3</td>
<td>14.94</td>
<td></td>
<td>8.36%</td>
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<tr>
<td>Unit Price of Water Used per l</td>
<td>l</td>
<td>0.0010</td>
<td>0.0010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Cost of Water Used for Each List</td>
<td>l</td>
<td>1,400.00</td>
<td>1,377.67</td>
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<td></td>
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<tr>
<td>Unit Cost of Water Used on the 1m Warp</td>
<td>l</td>
<td>0.0050</td>
<td>0.0023</td>
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<td></td>
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<tr>
<td>Unit Cost of Water Used on the 1m Fabric</td>
<td>l</td>
<td>0.0090</td>
<td>0.0045</td>
<td></td>
<td></td>
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<tr>
<td>Indigo Consumption - Powder</td>
<td>kg</td>
<td>235.1</td>
<td>196.3</td>
<td></td>
<td>0.43%</td>
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<tr>
<td>Indigo Consumption - Liquid (10%)</td>
<td>kg</td>
<td>195.0</td>
<td>195.0</td>
<td></td>
<td>0.10%</td>
</tr>
<tr>
<td>Unit Price of Indigo - Liquid (10%)</td>
<td>l</td>
<td>1.8</td>
<td>1.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Indigo-Liq Cost for Each List</td>
<td>l</td>
<td>2233.50</td>
<td>394.14</td>
<td>-76.66%</td>
<td></td>
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<tr>
<td>Unit Cost of Liquid Indigo on the 1m Warp</td>
<td>l</td>
<td>0.112</td>
<td>0.022</td>
<td>-80%</td>
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<tr>
<td>Unit Cost of Liquid Indigo on the 1m Fabric</td>
<td>l</td>
<td>0.114</td>
<td>0.025</td>
<td>-79%</td>
<td></td>
</tr>
<tr>
<td>Acid/Alkali Consumption for Final Neutralisation</td>
<td>l/kg</td>
<td>562.00</td>
<td>84.00</td>
<td></td>
<td></td>
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<tr>
<td>Unit Price of Acid (formic)</td>
<td>l/kg</td>
<td>0.37</td>
<td>0.17</td>
<td>-51.31%</td>
<td></td>
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<tr>
<td>Acid Formic Cost for Each List</td>
<td>l</td>
<td>27.54</td>
<td>14.28</td>
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<tr>
<td>Unit Cost of Acid (formic) on the 1m Warp</td>
<td>l</td>
<td>0.001</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit Cost of Acid (formic) on the 1m Fabric</td>
<td>l</td>
<td>0.002</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Acid Cost (Water+Indigo+Acid) for Each List</td>
<td>l</td>
<td>3667.00</td>
<td>3952.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit Cost of Acid (formic) on the 1m Warp</td>
<td>l</td>
<td>0.183</td>
<td>0.104</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit Cost of Acid (formic) on the 1m Fabric</td>
<td>l</td>
<td>0.28</td>
<td>0.134</td>
<td>-53.00%</td>
<td></td>
</tr>
</tbody>
</table>

## TOTAL BALANCE ON THE FINISHED FABRIC

| $/meter | 0.287 | 0.269 | -0.018 | -6.39% |

---

### PARAMETERS

<table>
<thead>
<tr>
<th>UNIT</th>
<th>NORMAL PROCESS</th>
<th>BREVOL (W+L) PROCESS</th>
<th>Difference by amount</th>
<th>Difference by %</th>
</tr>
</thead>
</table>

---

1. Application Amount of Brevol
2. Special Chemical Consumption for WALES Pro
3. Unit Price of Extra Chemical
4. Total Cost of Extra Chemical for Each List
5. Unit Cost of Extra Chemical on the 1m Warp
6. Unit Cost of Extra Chemical on the 1m Fabric
7. Extra Acid/Formic Consumption for WALES Pro
8. Unit Price of Acid Formic
9. Total Cost of Acid/Formic for Each List
10. Unit Cost of Extra Chemical on the 1m Warp
11. Unit Cost of Extra Chemical on the 1m Fabric
12. Total Waste-Water - Daily
13. Consumption of Sulphuric Acid
14. Price of Sulphuric Acid
15. Average Cost of Sulphuric Acid for W.Water Treatment - Daily
16. Average Cost of Sulphuric Acid for W.Water Treatment - Monthly
17. Average Cost of Other W.Water Treatment Chemicals - Daily
18. Average Cost of Other W.Water Treatment Chemicals - Monthly
19. Total Cost of Waste Water Treatment Chemicals
20. Average Monthly Production
21. Unit Cost for Waste-Water Treatment Chemicals
22. Total Step Cost (Water+Indigo+Acid) for Each List
23. Unit Cost of Extra Chemicals Process
24. Unit Cost of Chemicals Process
25. Total Cost of Comparative Chemicals for 1m Warp
26. Unit Cost of Comparative Chemicals for 1m Fabric
27. Total Waste-Water Cost Treatment Chemicals

---

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8. Unit Price of Acid Formic
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11. Unit Cost of Extra Chemical on the 1m Fabric
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13. Consumption of Sulphuric Acid
14. Price of Sulphuric Acid
15. Average Cost of Sulphuric Acid for W.Water Treatment - Daily
16. Average Cost of Sulphuric Acid for W.Water Treatment - Monthly
17. Average Cost of Other W.Water Treatment Chemicals - Daily
18. Average Cost of Other W.Water Treatment Chemicals - Monthly
19. Total Cost of Waste Water Treatment Chemicals
20. Average Monthly Production
21. Unit Cost for Waste-Water Treatment Chemicals
22. Total Step Cost (Water+Indigo+Acid) for Each List
23. Unit Cost of Extra Chemicals Process
24. Unit Cost of Chemicals Process
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26. Unit Cost of Comparative Chemicals for 1m Fabric
27. Total Waste-Water Cost Treatment Chemicals
### What Did We Accomplish?

<table>
<thead>
<tr>
<th>Sulfur Black Process</th>
<th>20 - 50% Water Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigo Dyestuff Savings</td>
<td>20 - 25%</td>
</tr>
<tr>
<td>Sulfur Dyestuff Savings</td>
<td>20 - 30%</td>
</tr>
<tr>
<td>Pure Indigo Process</td>
<td>20 - 30%</td>
</tr>
<tr>
<td>Sulfur Bottom + Indigo Top Process</td>
<td>70 - 90% Water Savings</td>
</tr>
<tr>
<td>Sulfur Black Process</td>
<td>40 - 50% Water Savings</td>
</tr>
</tbody>
</table>
Breviol® Denim Technology Accomplishments

- Water Savings
- Less Waste Water Contaminates to Treat Including Water Color
- Provided Reduced Indigo and Sulfur Dye Usage & Cost Savings
- Less & Even Zero Dye Bleeding During Rebeaming, Sizing & Finishing Processes
- Provide an Ecological Overdyeing Process with / without a Steamer
- Reduce Fabric Back Staining
- Produced Special Ring Dyeing Effects
- Provide a Cost Neutral or Cost Savings Process when Using the Breviol® Denim Technology