



Reducing the Textile Environmental Footprint with TENCEL®

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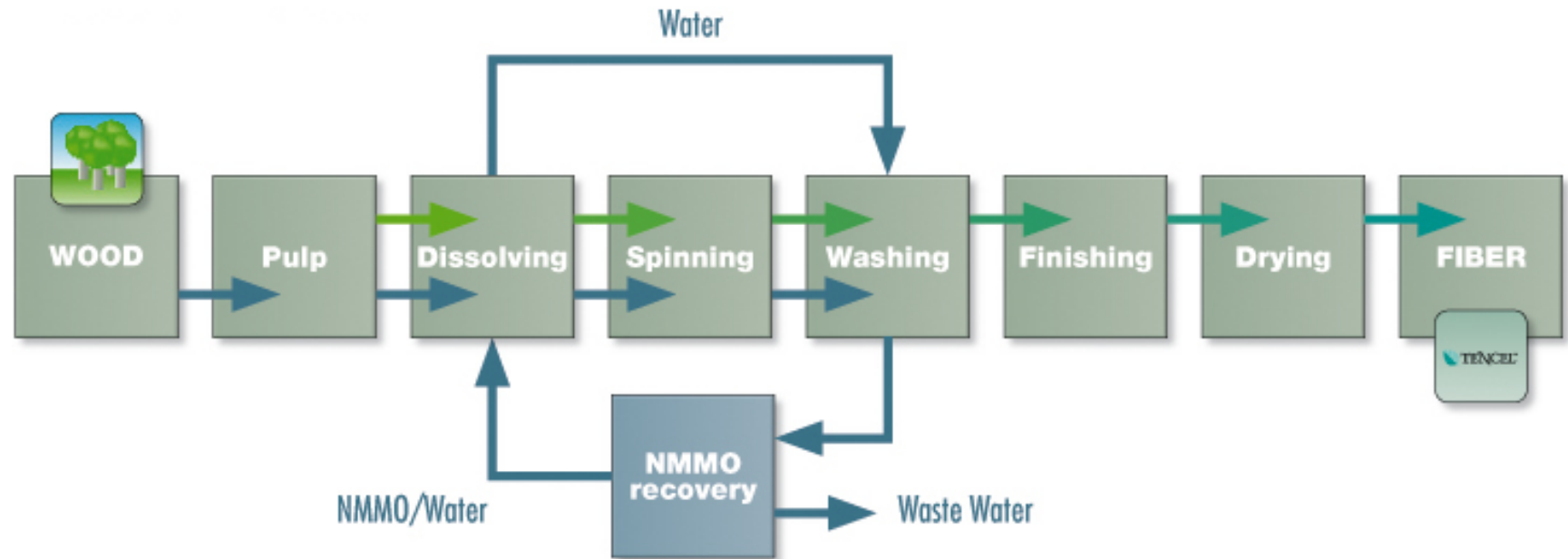
22nd International IFATCC Congress, Stresa, Italy



TENCEL® production - environmental

- Purest cellulosic fibre available; based on eucalyptus
- Wood pulp+water+solvent *in* ---- TENCEL® fiber+water+solvent *out*
- Solvent used is non-toxic (99.6% recycled)
- Full production in Mobile/US, Grimsby/UK, Heiligenkreuz/Austria
- Pilot plant in Lenzing/Austria

TENCEL® lyocell fiber production



LCA - Life cycle analysis of fibers

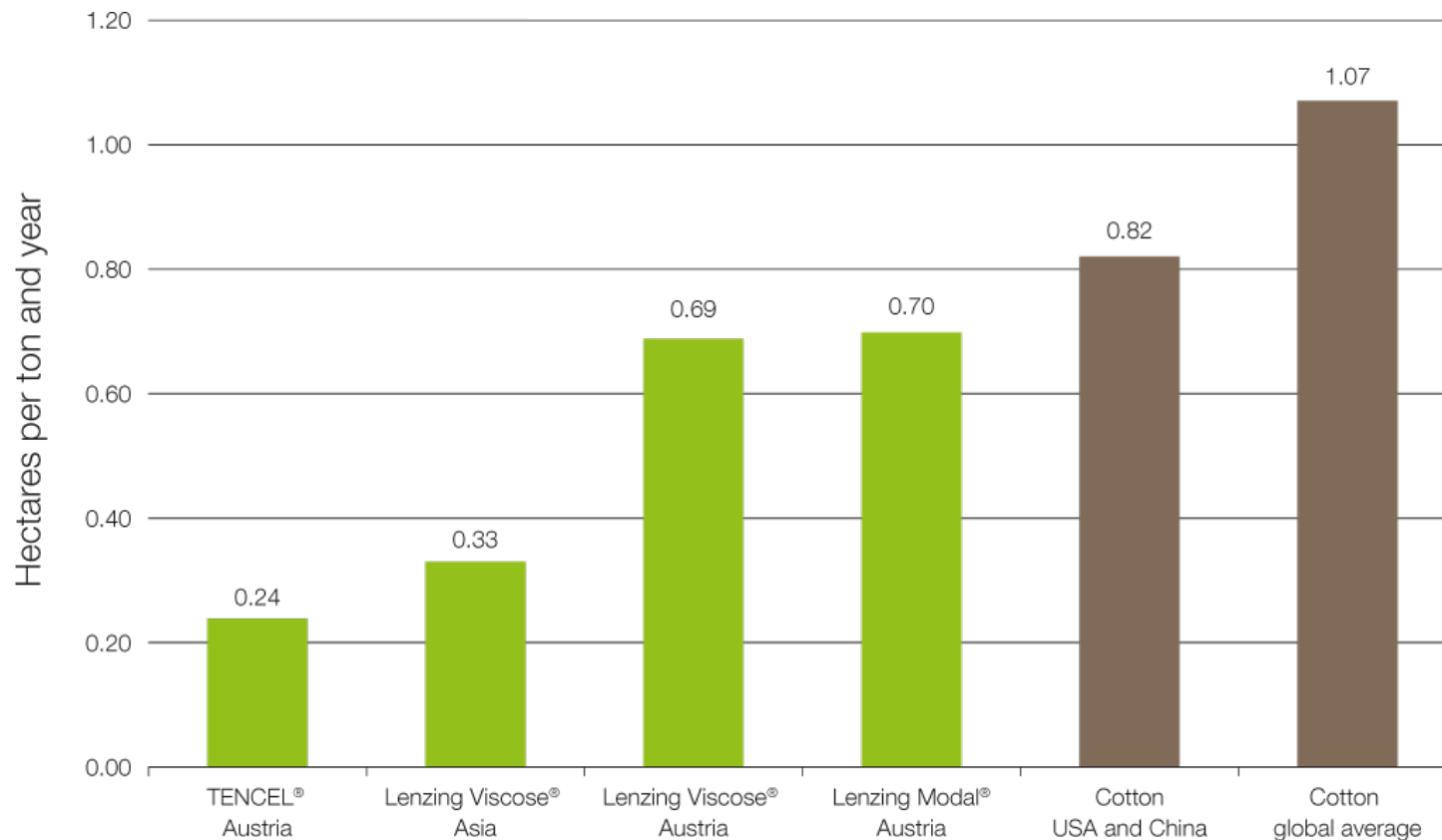
- Comprehensive evaluation of fibers
- Utrecht University, The Netherlands (Prof. M. Patel, Li Shen)
- Assessment of sustainability of Lenzing fibers in comparison to cotton, polyester and polypropylene.
- 11 environmentally relevant factors studied
- Peer studies confirm results

Result:

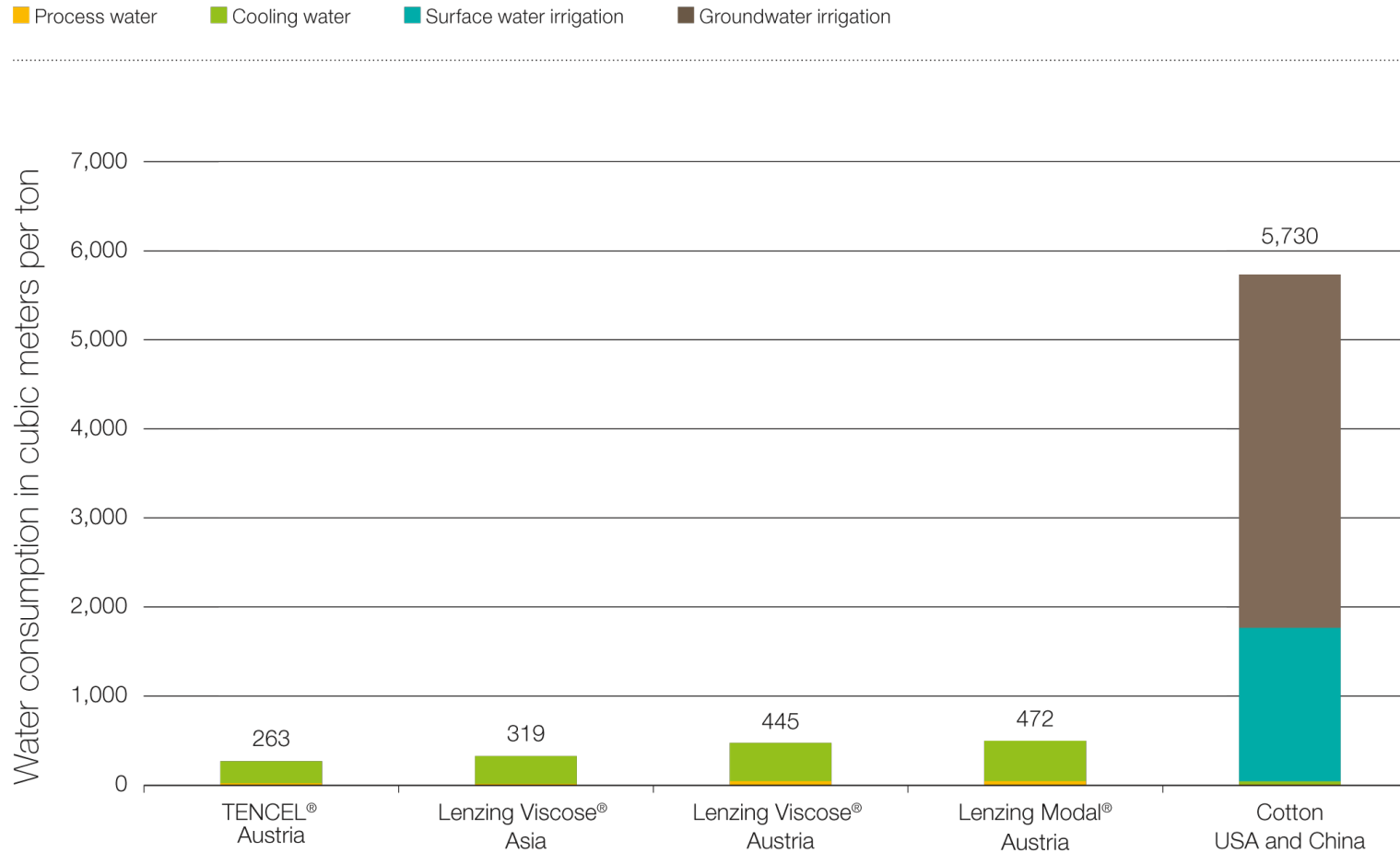
Environmental load of Lenzing fibers is significantly lower than that of cotton!

Up to 70 % less required acreage

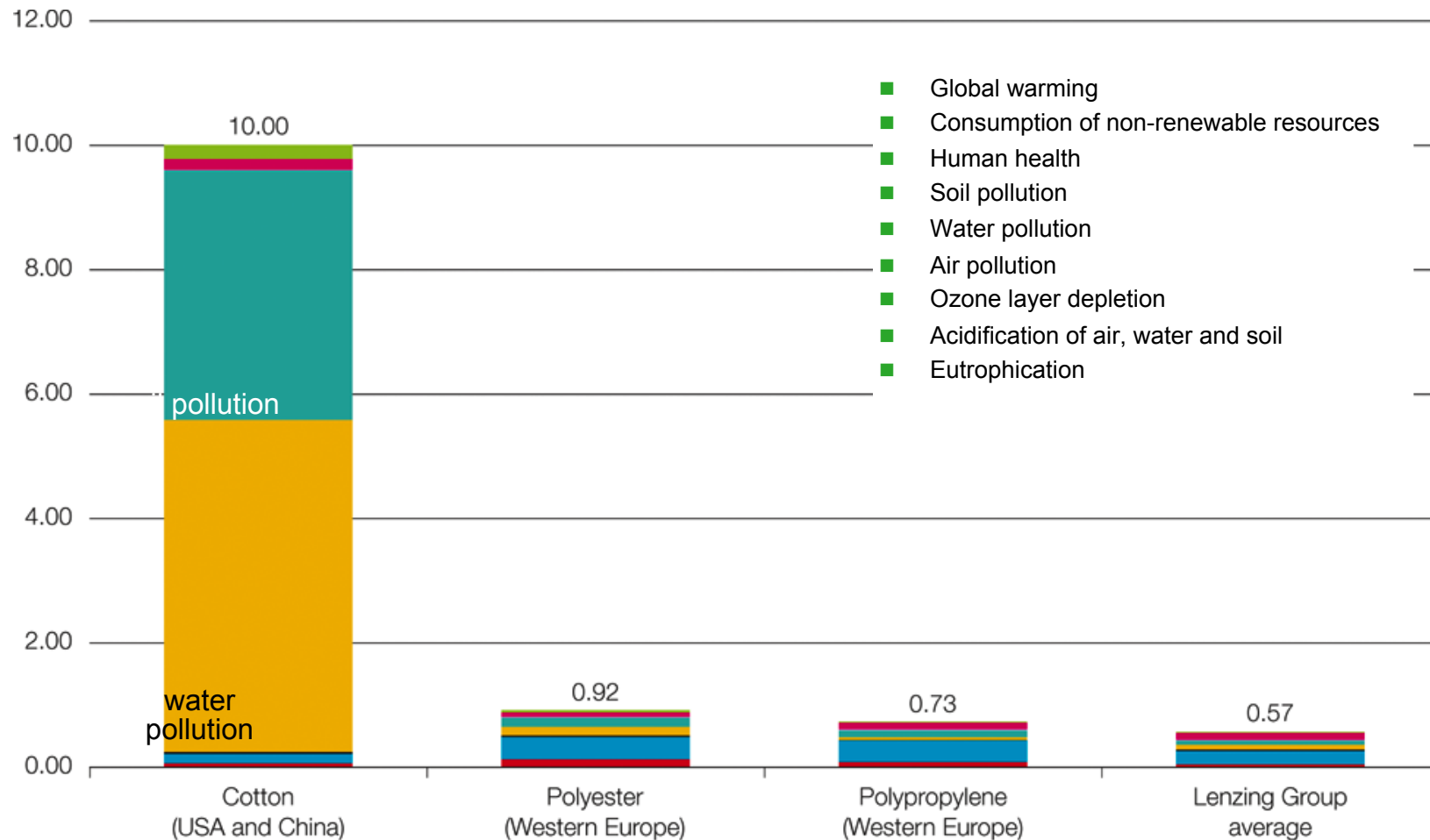
Required acreage for the production of 1 ton of fiber



Up to 20 times less water consumption



Life cycle analysis - relative environmental load per ton of fiber



Awards

- VÖNIX Sustainability Index
- CSR Ranking Austria 2008
- Eco-Label of the European Commission
- Responsible Care
- Panda-Award (WWF Austria)
- DIN CERTO
- R.I.O. Award 2006
- ÖKOTEX
- European Environmental Award
- Nordic Swan



Efficiency in Dyeing & Finishing

- TENCEL® is the purest cellulosic fiber with no contamination like cotton seeds, heavy metals, waxes or sulphur therefore
 - Little or no scouring is needed in knitted fabrics
 - No bleaching
 - No mercerising

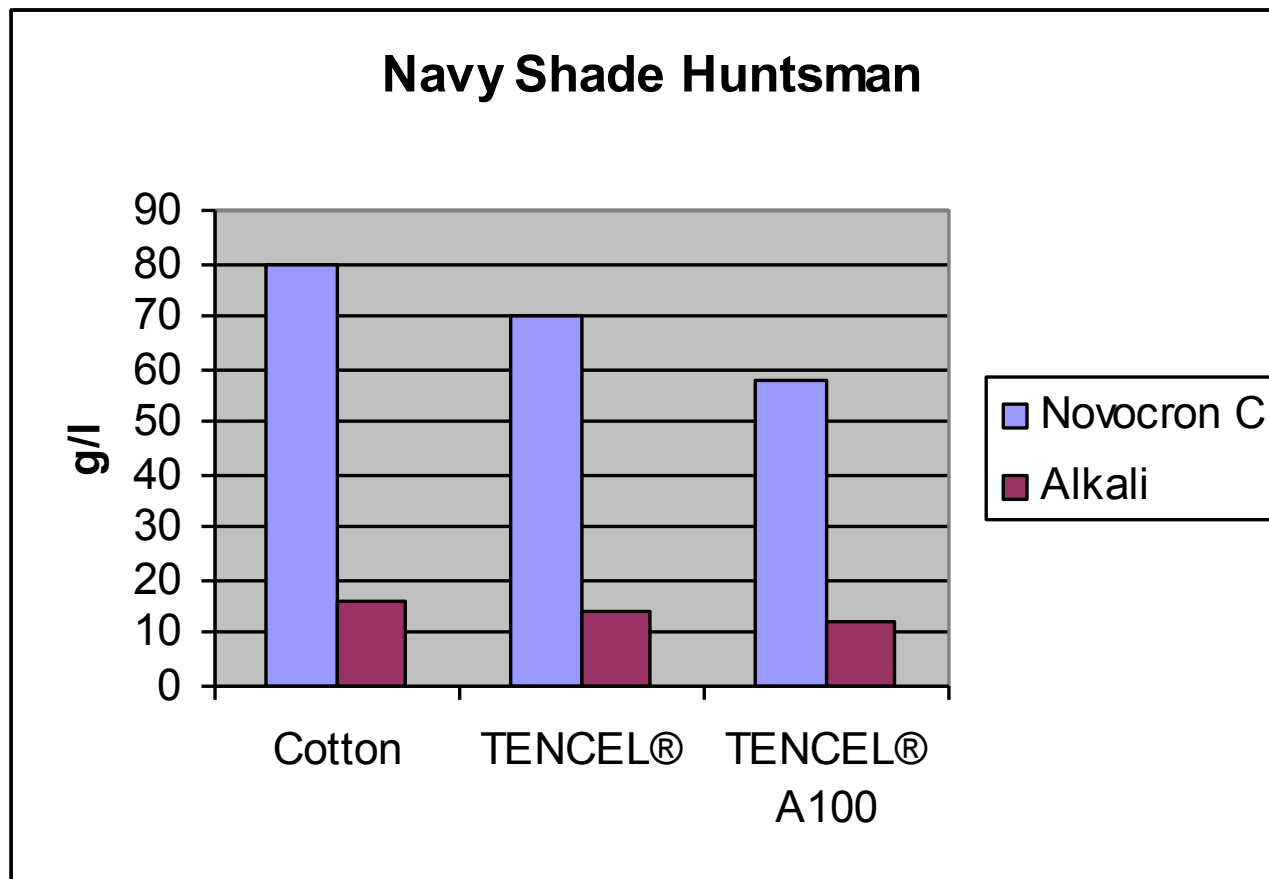
- TENCEL® shows very high dyeing efficiency allowing exceptional reduction of
 - Dyes
 - Salt
 - Alkaline
 - Water
 - Energy usage
 - Processing time

Cold Pad Batch Dyeing

Assess colour yield and alkali requirement

- Novocron C, Navy shade – Huntsman
- Comparisons made cotton versus Standard TENCEL[®] and TENCEL[®] A100

Cold Pad Batch



Cold Pad Batch - Summary

About 70% of the dye is required on TENCEL[®] compared with cotton for the same shade.

15% less alkali is needed

TENCEL[®] results in 45% of the amount of residual unfixed colour than is seen with cotton.

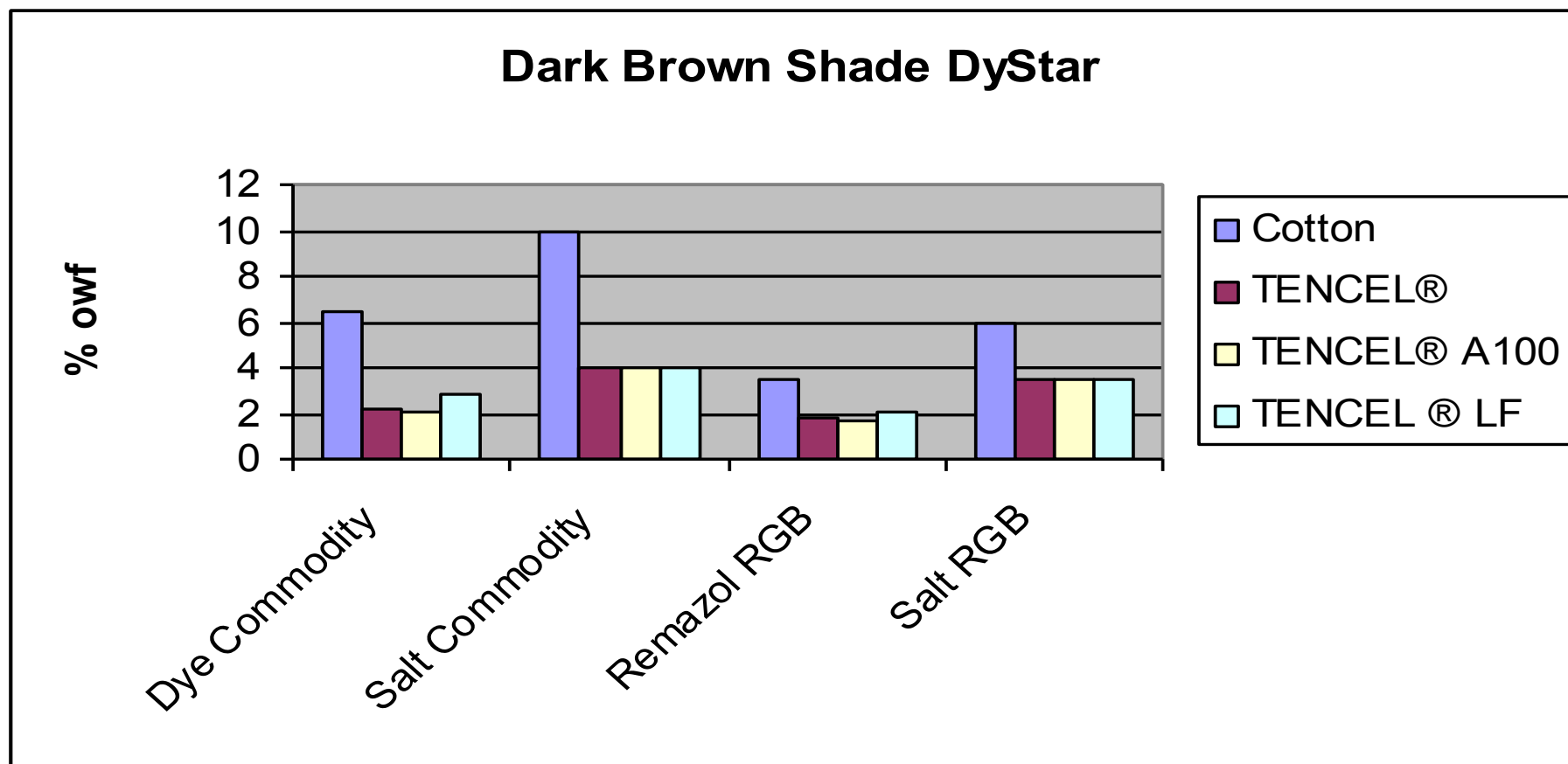
Exhaust Dyeing

Assess dye and salt requirements

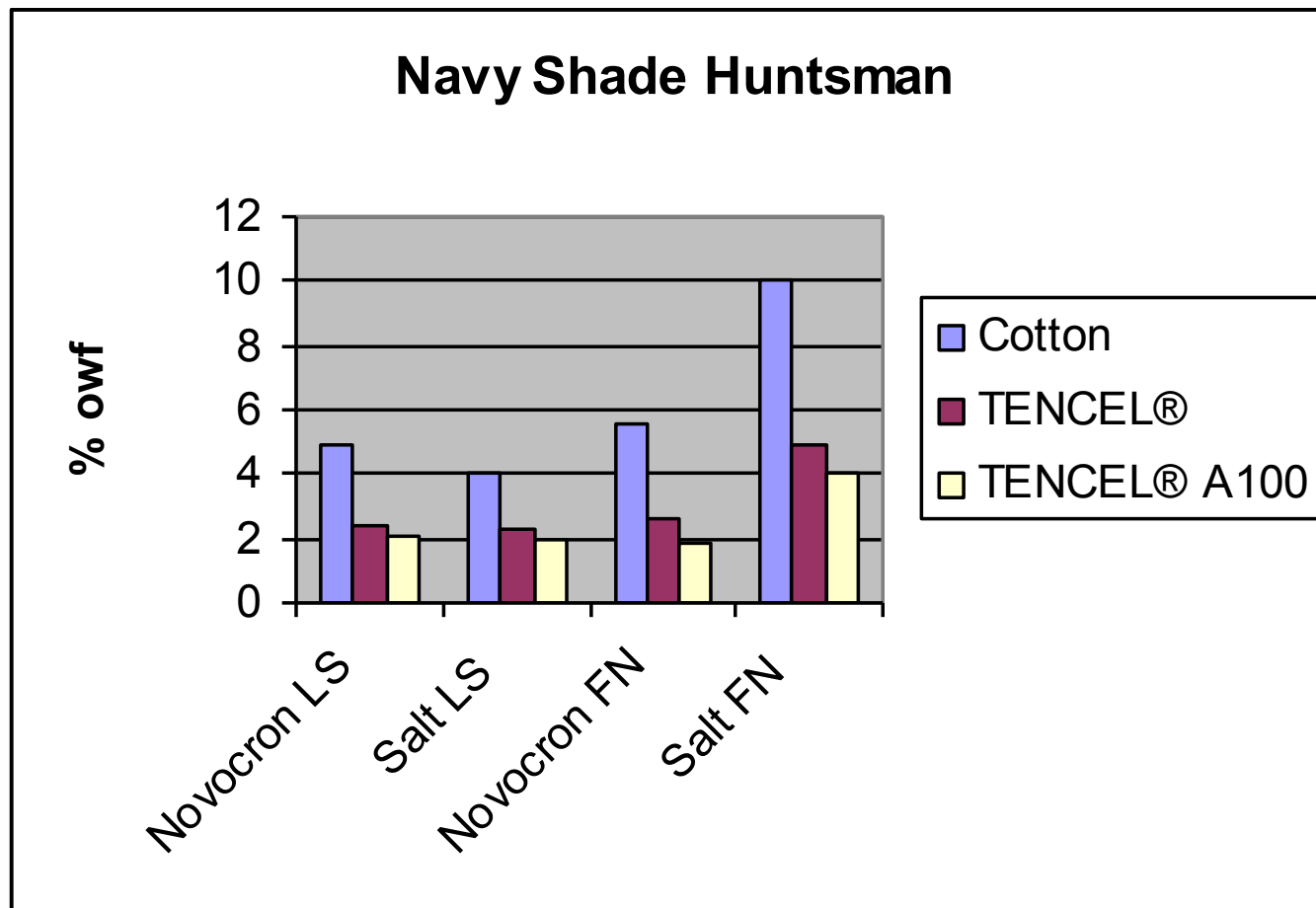
Compare TENCEL®, TENCEL® A100, TENCEL® LF and cotton

Commodity dyes, Remazol Ultra RGB & Levaifix CA (DyStar), Novocron LS and FN (Huntsman) and Synozol HB (Kisco)

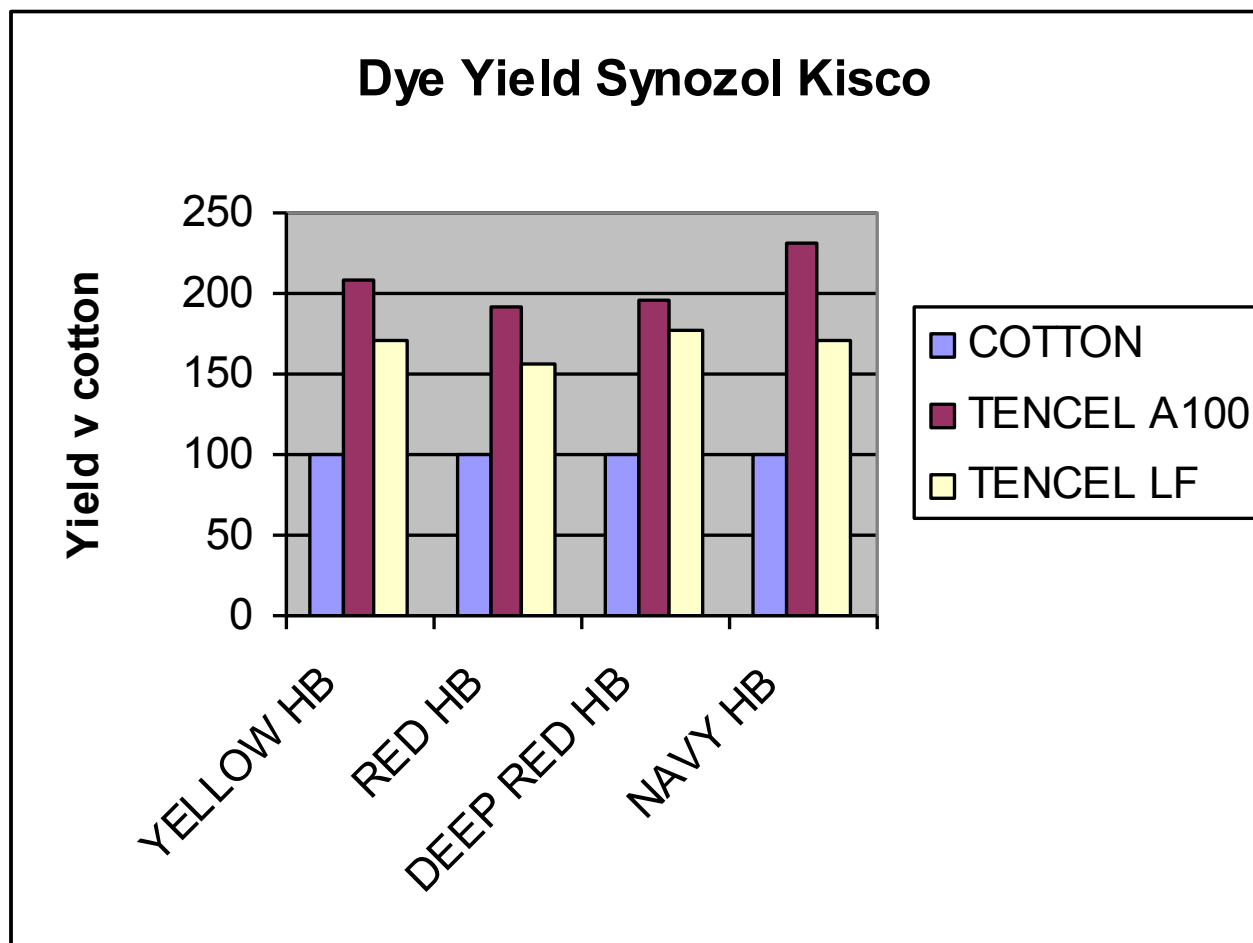
Exhaust Dyeing



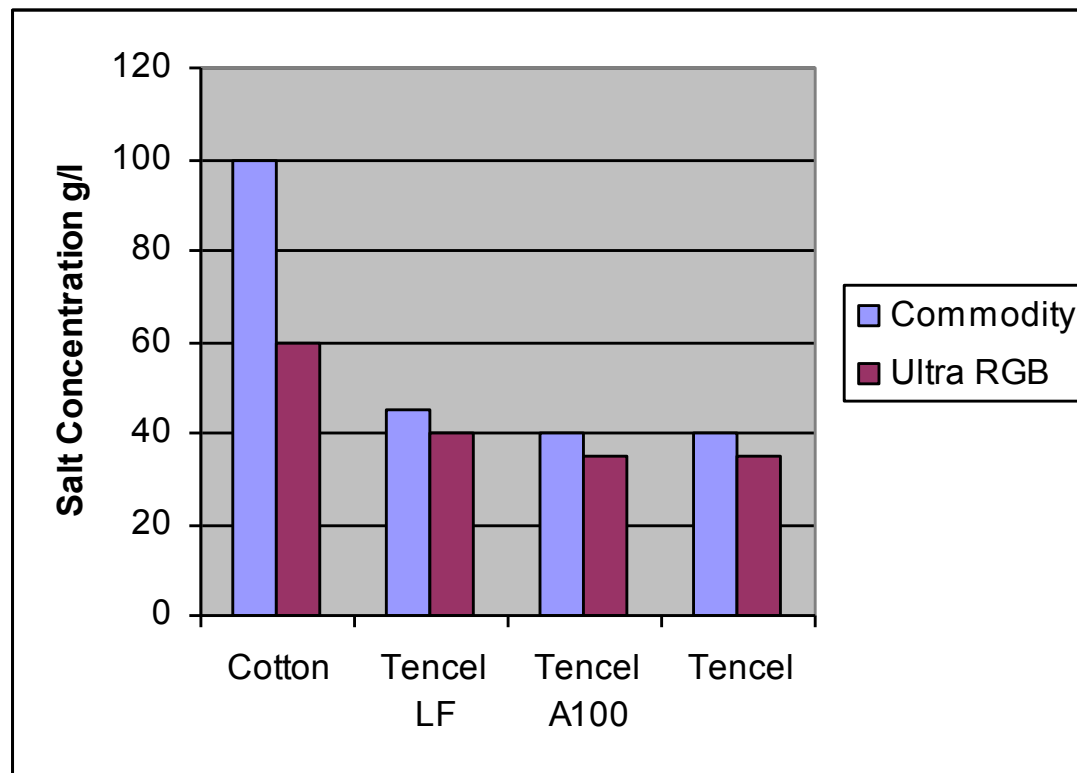
Exhaust Dyeing



Exhaust dyeing



Salt Usage



Comparison of Dye Wash off Behaviour



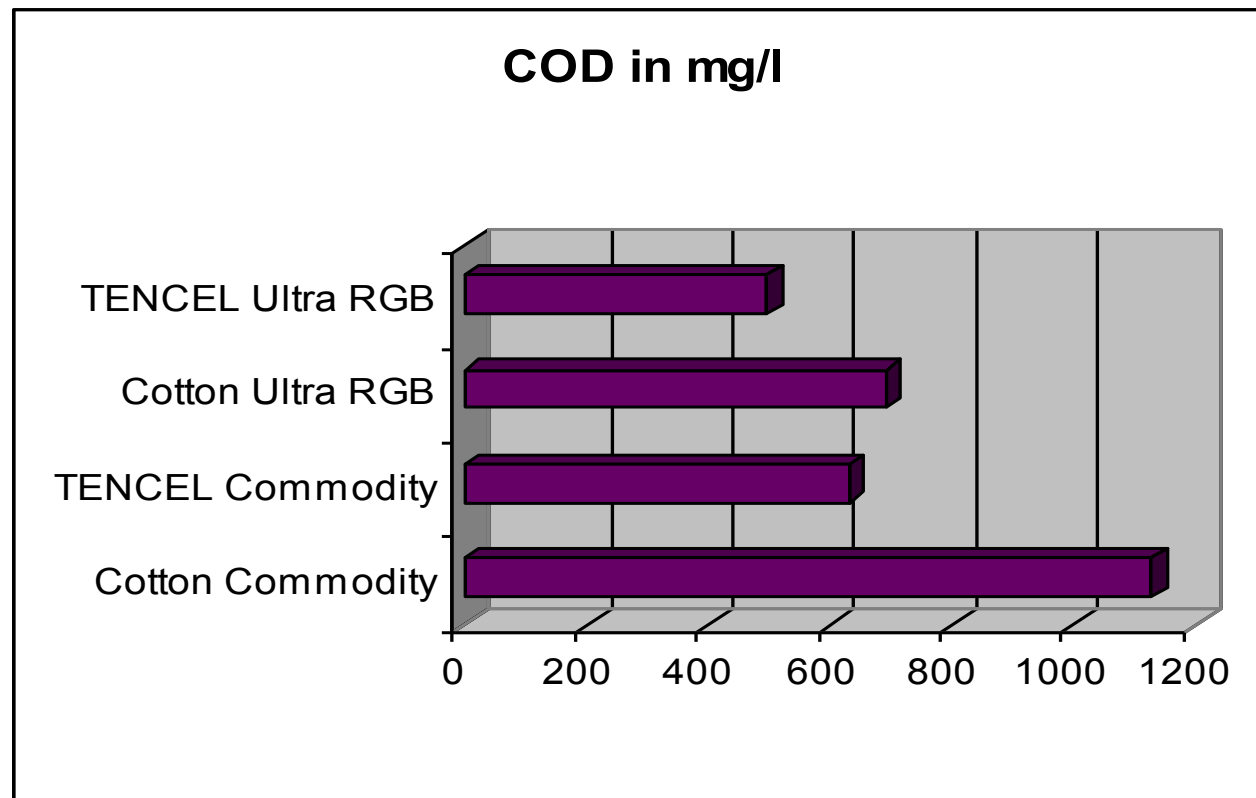
Baths represent:

Dye bath, 50°C, 50°C acid, 80°C, 98°C, 80°C , cold

TENCEL[®]
A100

Cotton

Reduced COD



Exhaust Dyeing Summary

- TENCEL® requires less than half of the amount of dye to achieve the same shade as cotton
- You need only half the amount of salt on TENCEL®
- Soda ash concentrations are also reduced by similar magnitude
- The use of lower dye levels coupled with higher fixation levels means less unfixed dye on TENCEL® compared with cotton.
- TENCEL® results in only 30% of the level of residual colour compared with cotton.
- TENCEL® A100 results in only 20% of the level of residual colour

Water, energy and chemical demand

Jet Dyed Navy - Shade Remazol RGB - DyStar

| | Cotton | TENCEL[®] A100 |
|-----------------------------------|---------------|--------------------------------|
| Process Time (mins) | 649 | 375 |
| Bath water (l) | 16400 | 10000 |
| Cooling Water (l) | 21060 | 4260 |
| Total Water (l) | 37460 | 14260 |
| Water / kg fabric (l) | 187.3 | 71.3 |
| Total Energy (MJ) | 3639 | 1819 |
| Energy / kg fabric (MJ) | 18.12 | 9.10 |
| Total Chemicals (kg) | 260 | 121 |
| Chemicals / kg fabric (kg) | 1.3 | 0.61 |
| Total Dye (kg) | 7.35 | 3.3 |
| Dye / kg fabric (kg) | 0.036 | 0.016 |

Garment Appearance – Multiple Wash



■ TENCEL A100

■ COTTON

Environmental Cost of a Black T-shirt

Fibre manufacture (based on 250g)

| | Cotton | TENCEL [®] | Cotton (Replacement) |
|---------------|--------|---------------------|-------------------------|
| Water (l) | 1430 | 66 | 4290 |
| Energy (MJ) | 10 | 11 | 30 |
| CO2 (kg) | 0.75 | 0.52 | 2.25 |
| Land Use (m2) | 3.4 | 0.52 | 10.2 |

Figures from LCA by Patel & Chen

Environmental Cost of a Black T-shirt

Fabric manufacture

Yarn spinning – TENCEL[®] has 20% less waste compared with cotton.

| | Cotton | TENCEL [®] | Cotton (Replacement) |
|--------------|--------|---------------------|-------------------------|
| Energy (MJ) | 4.5 | 1.8 | 13.5 |
| Water (l) | 47 | 18 | 141 |
| Chemical (g) | 320 | 150 | 960 |
| Dyestuff (g) | 20 | 12 | 60 |

Conclusions

In exhaust dyeing, when compared to cotton, TENCEL® A100 can be dyed using approximately:

- Half the amount of dye to achieve the same shade
- Half the amount of chemicals
- Half the amount of water
- Half the amount of energy

This is achieved because of very mild scouring/bleaching requirements, high dye fixation and thus less unfixed dye to remove from low salt dye liquors.

Acknowledgements

Peter Collishaw and Roland Schamberger, DyStar

Erwin Miosga and Mike Heaton, Huntsman Textile Effects

Richard Straughan, Kisco

Andrew Thompson, CHT



Thank you for your attention!

