# TENCEL® in mattresses

THE NEW AGE FIBER

LENZING

# Contents:

- Sleep studies
- Skin compatibility
- Lenzing research on knitted mattress tickings:
  - Pilling behavior
  - Moisture management and physiological attributes
- Hygiene attributes
- Electrostatic behavior

# Independent scientific studies: Better sleep with TENCEL®

## Studies prove the TENCEL® functions

- 1) Comparison of the micro climate
  - Univ.-Prof. DDr. H.W. Juergens and Dr. K. Helbig, University Kiel, Germany
- 2) Sleep study 2007
  - The influence of textiles on well being and sleep quality, Univ.-Prof. Dr. Maximilian Moser, Johanneum Research, Institute of Non-Invasive Diagnosis, Austria
- 3) Sensitive skin 2008 – new study
  - „Deutscher Allergie- und Asthmabund“



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# Sleep studies:
# Comparison of different bed set-ups

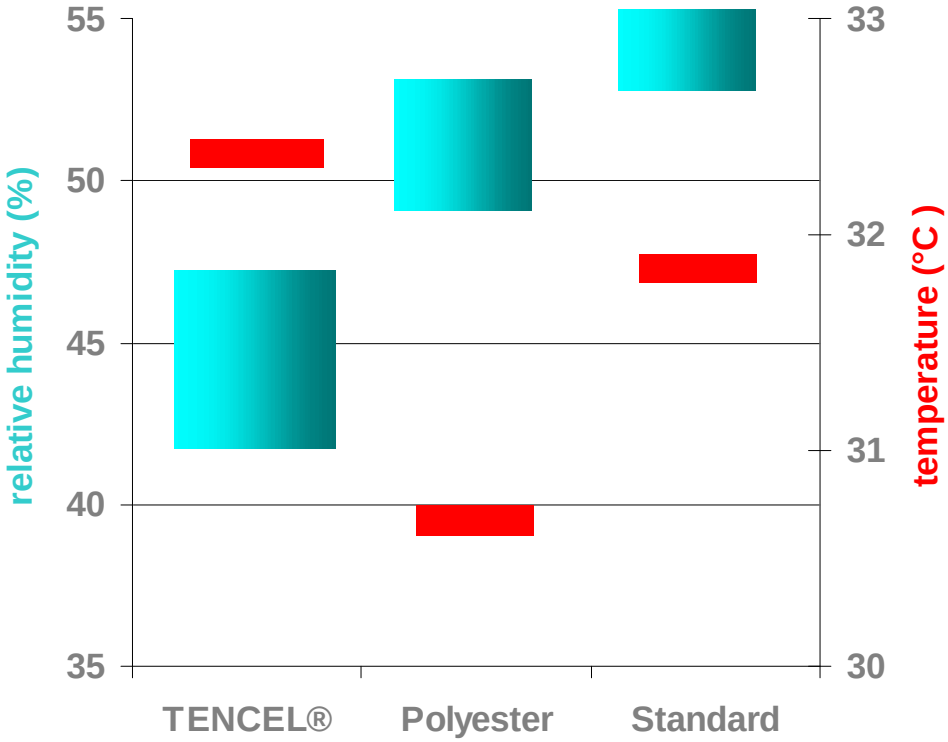
| | „standard“ | polyester | TENCEL® |
|---|---|---|---|
| **mattress ticking** | cotton | polyester | TENCEL® blend |
| **mattress filling** | polyester | polyester | TENCEL® blend |
| **bed sheets** | cotton | polyester | TENCEL® MICRO |
| **comforter - / pillow filling** | polyester | polyester | TENCEL® FILL |
| **shell fabrics** | cotton | polyester | TENCEL® MICRO |




# Study 1: Comparison of the micro climate

TENCEL® leads to a dry and warm climate in the sleeping cave

TENCEL®






Univ.Prof. DDr. H.W. Jürgens and Dr. K. Helbig, Universität Kiel, DE

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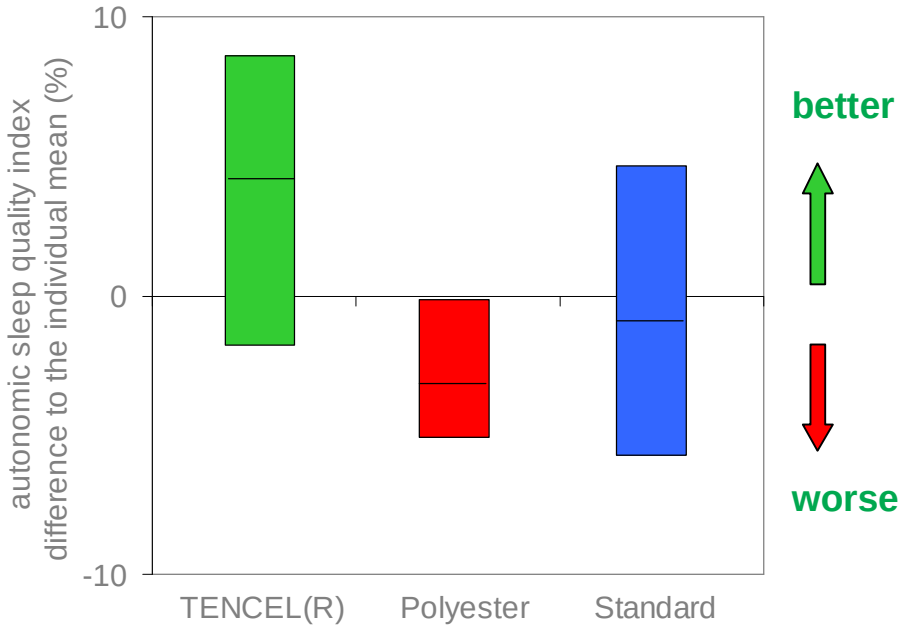
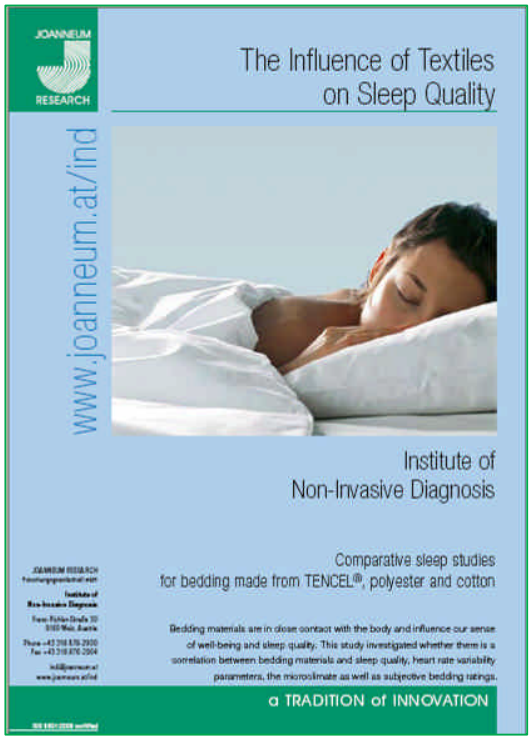
# Study 2: Comparison of the autonomic sleep quality index

TENCEL® gives significantly better sleep quality due to optimized thermoregulation.






Univ.Prof. Dr. M. Moser,Joanneum Research, Weiz , Austria

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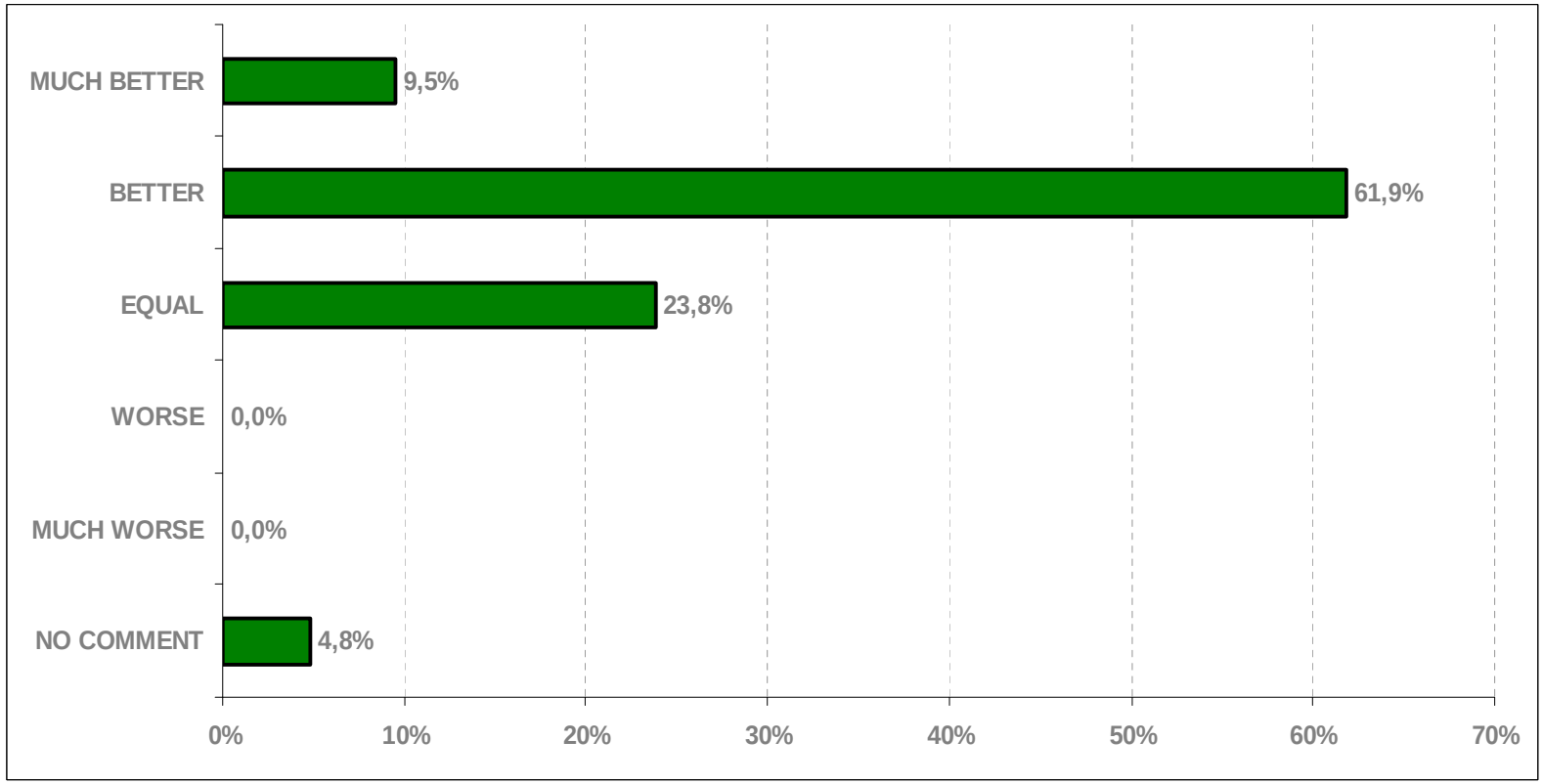
# Study 3: Sensitive skin study 2008

German allergy association (DAAB).




* “How is skin friendliness [of the TENCEL® product] compared to the usually preferred material?”

# Important aspects for Mattress

**Textile:**

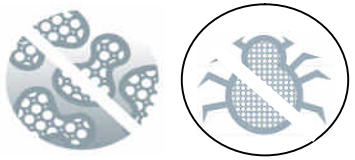
- Fabric hand
- Washability / Shrinkage
- Wet and dry pilling resistance

**Physiological performance:**

- Moisture Management
- Thermoregulation

**Hygiene**

Reduced/retarded growth of Fungi and dustmite



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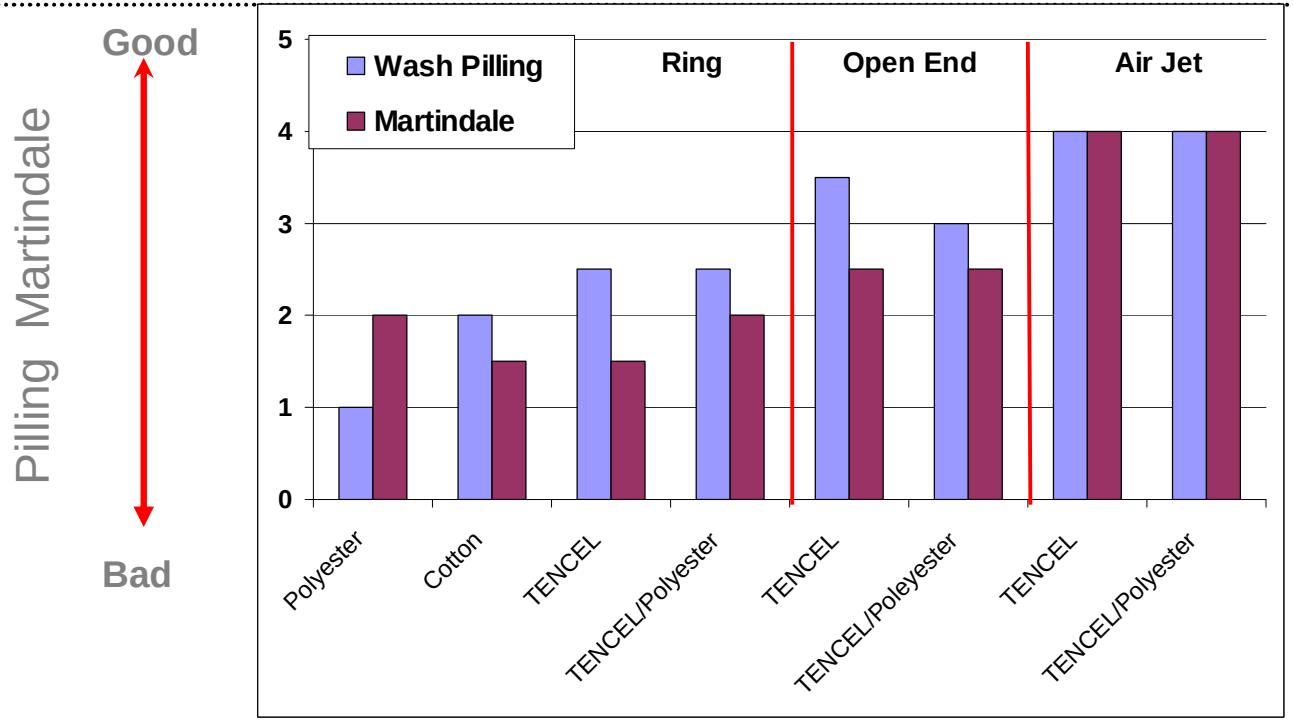
# Enhanced wet and dry pilling resistance in knitted mattress ticking

# TENCEL® Airjet spun yarn in mattress ticking

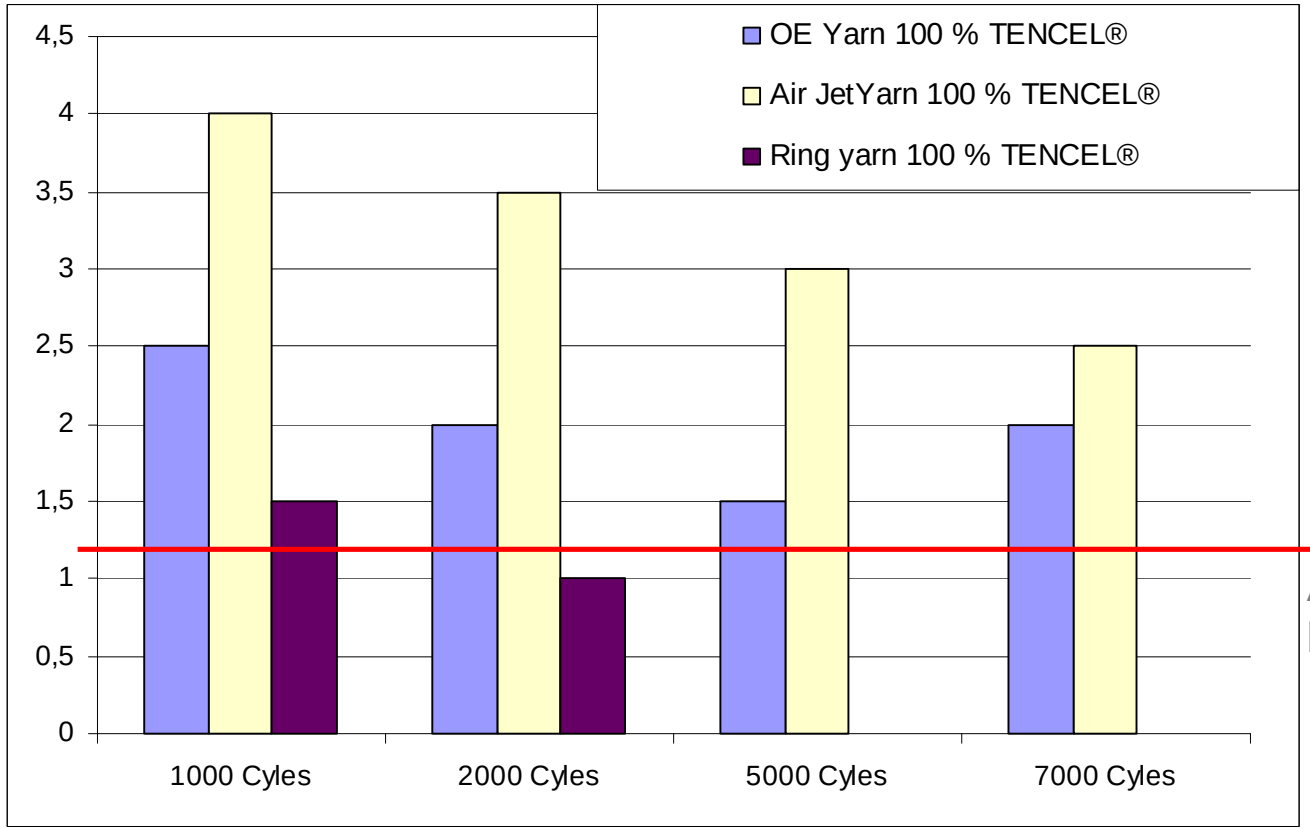



- Airjet yarns are a significant improvement of the dry and wet pilling behavior
- As smooth as Ring yarn.. Pills les than Open End yarn

# Higher pilling resistance possible

Good

Pilling Martindale




Average knitted ticking

Bad

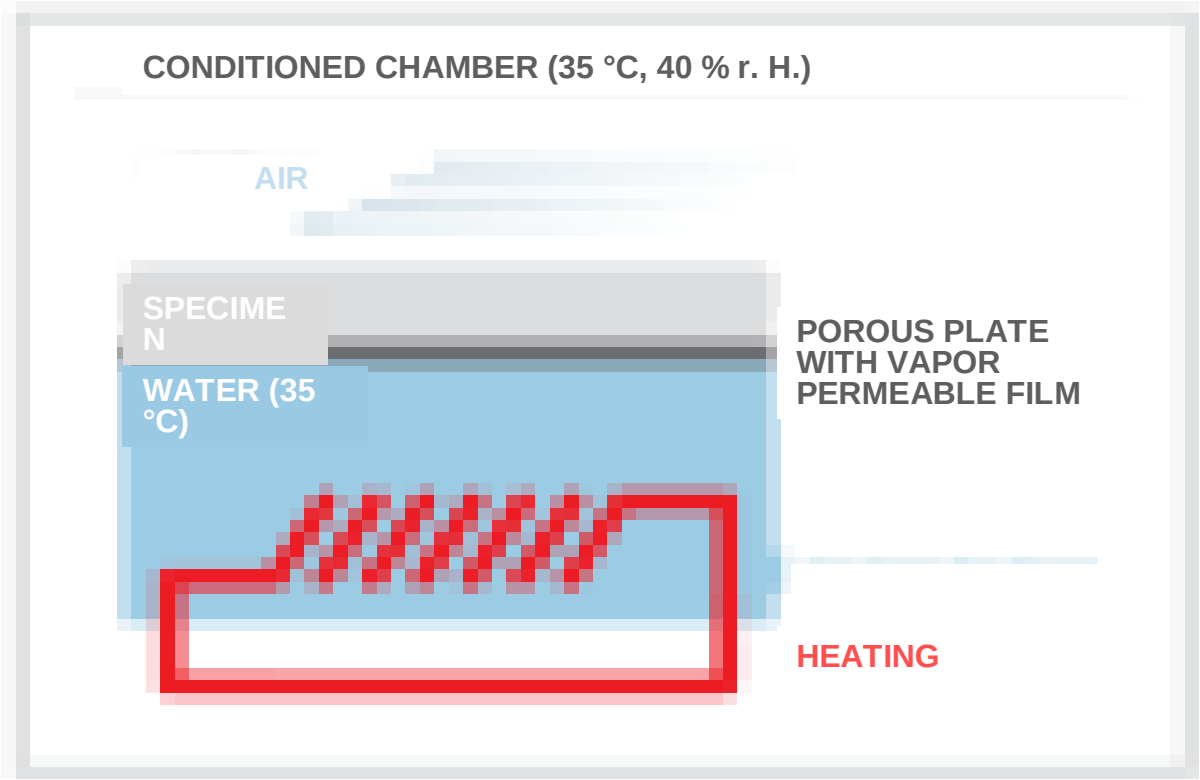
Mattress tickings with TENCEL® Airjet yarns can “survive” 7000 martindale pilling cycles

# Lenzing research on moisture management and physiological attributes

# Enhanced physiological performance

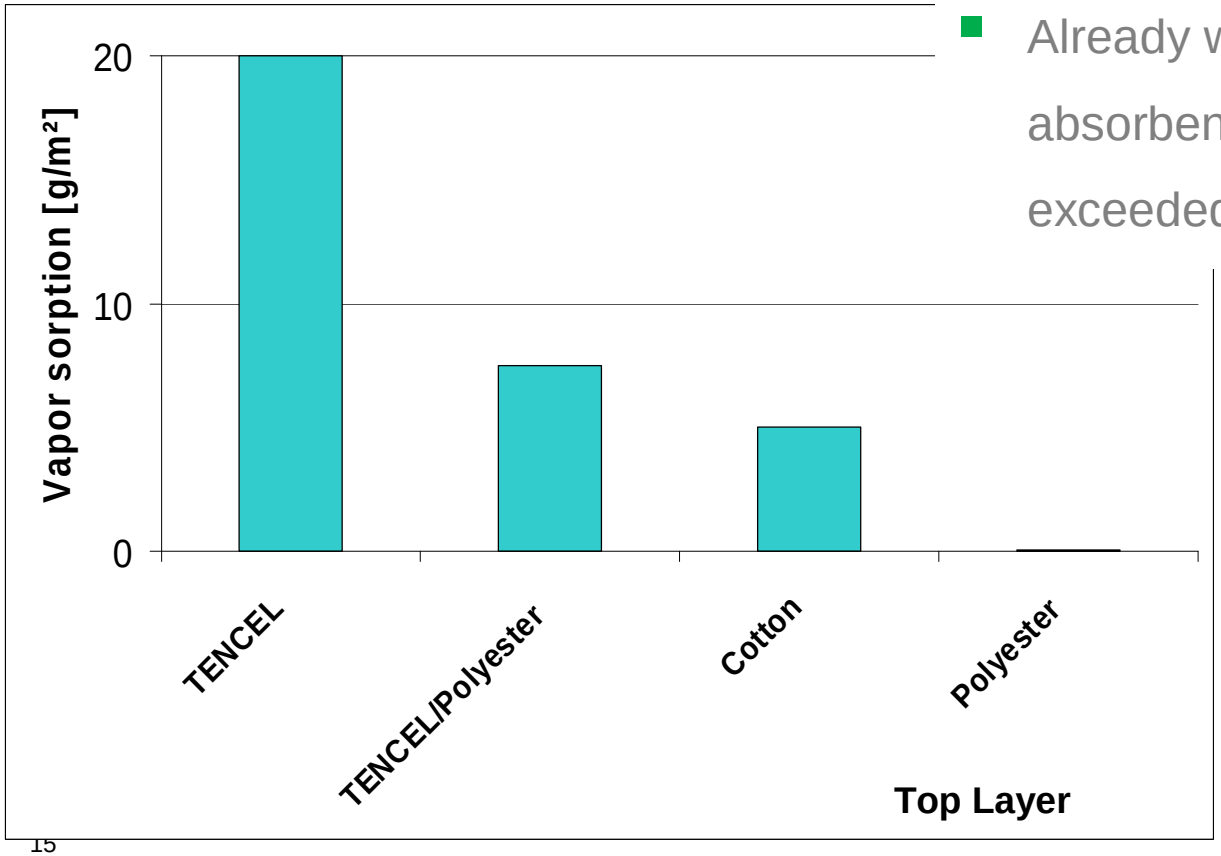
# Short time vapor absorbency (Fi)

European Standard ISO 11 092: 1993

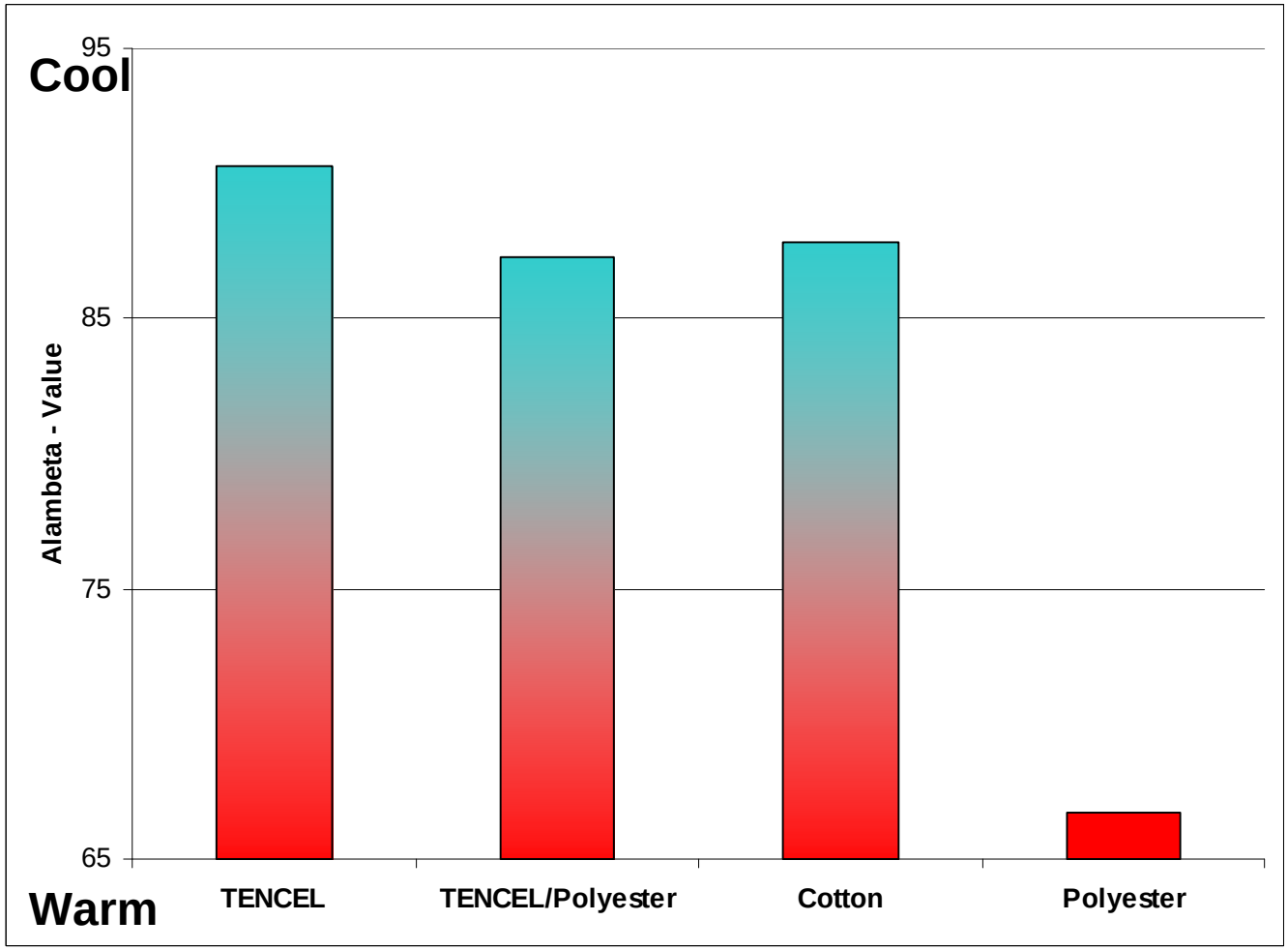


# Short time vapor absorbency ($F_i$)

- TENCEL® shows  4 fold water vapor sorption in comparison to cotton
- Already with 50% TENCEL® the absorbency of 100% cotton is exceeded



# Alambeta: Warm / Cool feeling




**TENCEL surface feels cooler**

# Water absorption and distribution in fibers

TENCEL® fibers are hydrophilic and hygroscopic and can absorb ~ 70% water. Water is absorbed and transported within the fiber.

Polyester fibers are not hygroscopic and not absorbing. Only 2-3 % water can be adsorbed at the surface.

TENCEL ®

Polyester

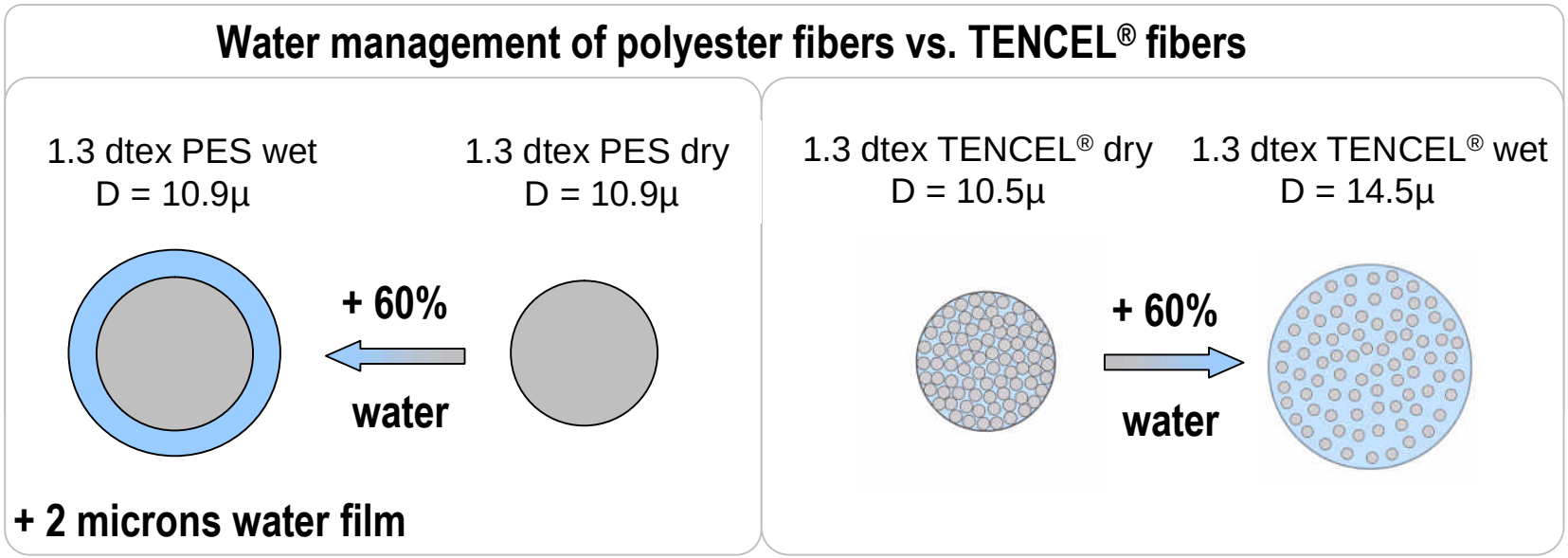
# TENCEL® strongly retards bacterial growth

Bacteria need high amounts of free water (high water activity) for their growth

TENCEL® can absorb high amounts of water inside its nano-fibrillar structure

The water activity on humid TENCEL® fibers is much lower than on synthetics

Therefore,  bacteria find very bad growth conditions on TENCEL®

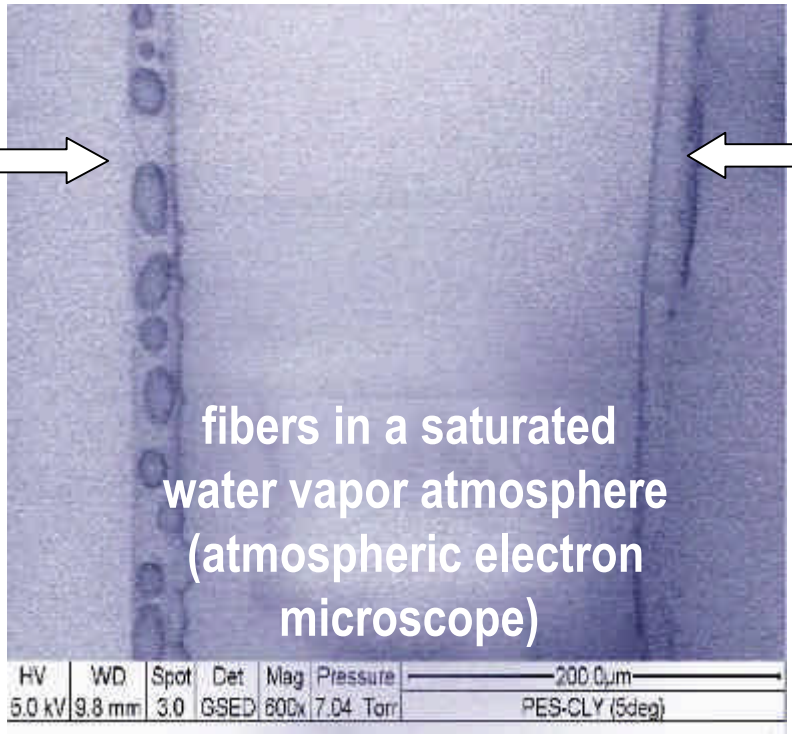


# Vapor condensation at saturated humid climate

Polyester Fiber

non absorbing

water adsorbed
ON surface



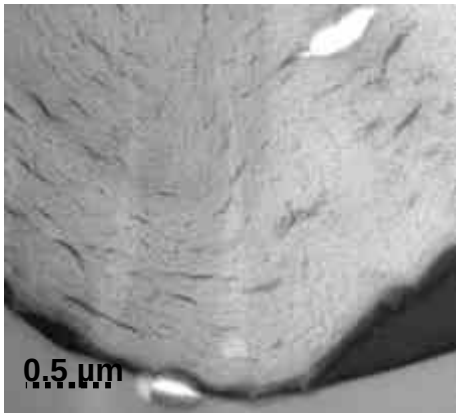

TENCEL® Fiber

water absorbent

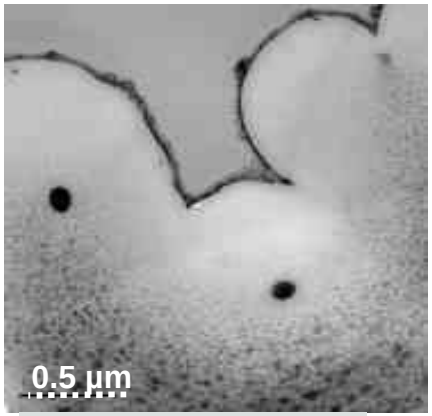
water absorbed
IN the fiber

Video: water vapor condensation on Polyester and TENCEL®

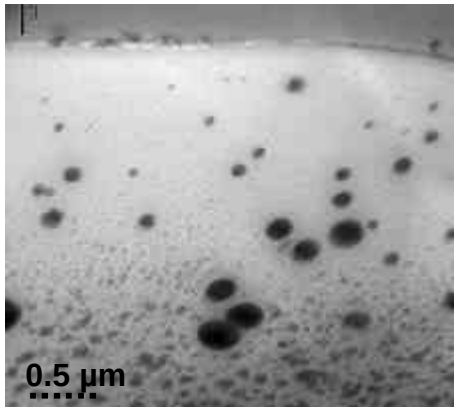
# Cross-sections of Cellulosic Fibers



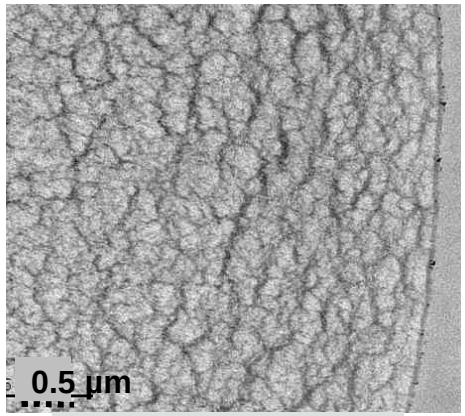

Cotton




LENZING Viscose®




LENZING Modal®

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Different size and distribution of pores in Cotton, viscose, Modal and TENCEL® lead to significant differences in the

- amount of absorbed water
- distribution of water over the fiber cross section



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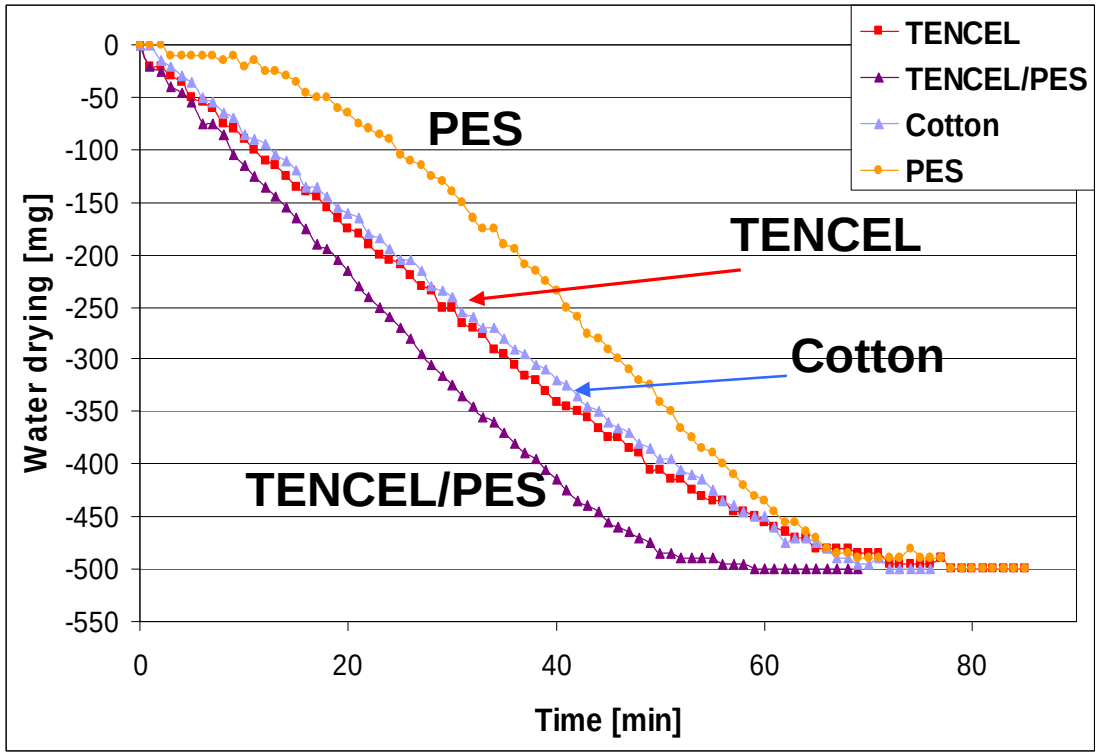
# Water transportation on fabric surface


**5 sec** **30 sec** **6 min**

# Drying rate




Video:
water vapor absorption (swelling) of TENCEL® in a blend with PES

- Drying rate depends on water migration speed
- TENCEL dries as fast as cotton
- TENCEL/PES combination dries faster

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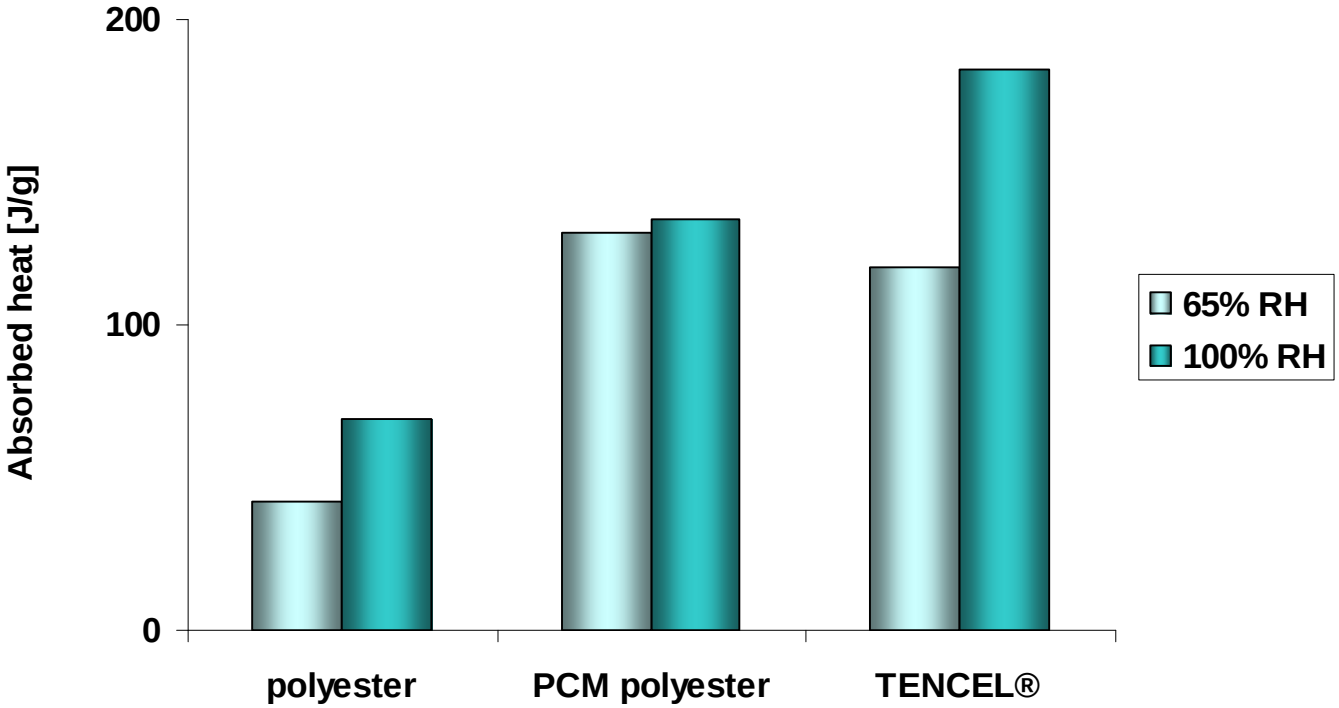
# Water management means temperature management




- At “Normal” humidity (room) vs. high humidity (bed), the water/cellulose system of TENCEL® has a high heat capacity
- At normal applications, TENCEL® matches the PCM-loaded synthetic fiber



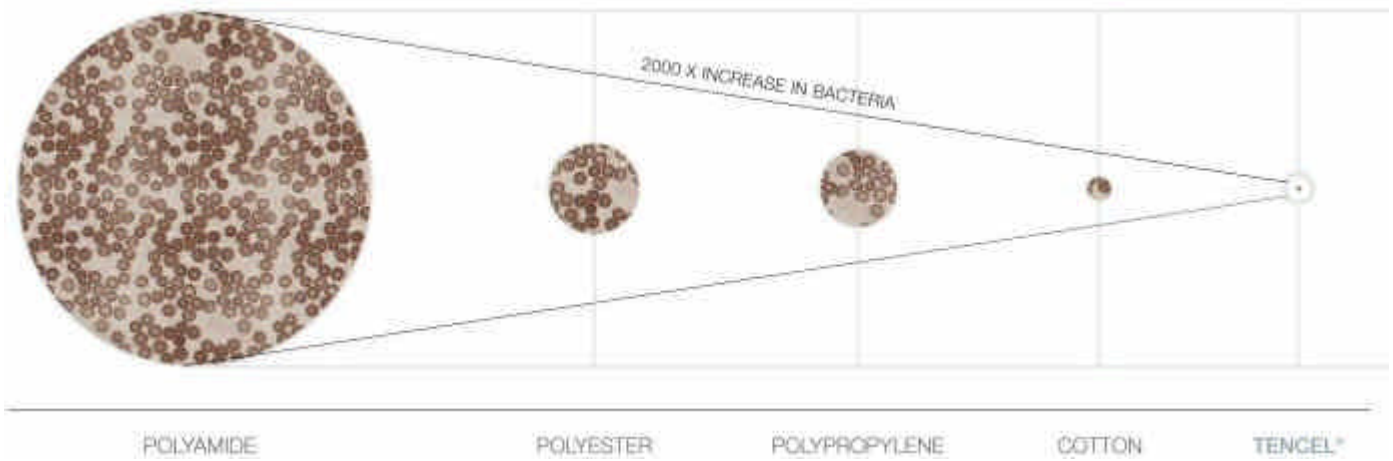
*PCM = Phase change material (e.g. Outlast ®)*

# Enhanced hygiene

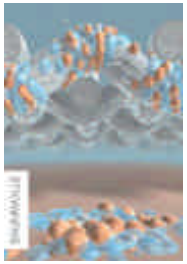
# Hygiene

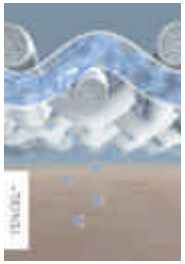
retarded bacterial growth without chemistry

no malodor



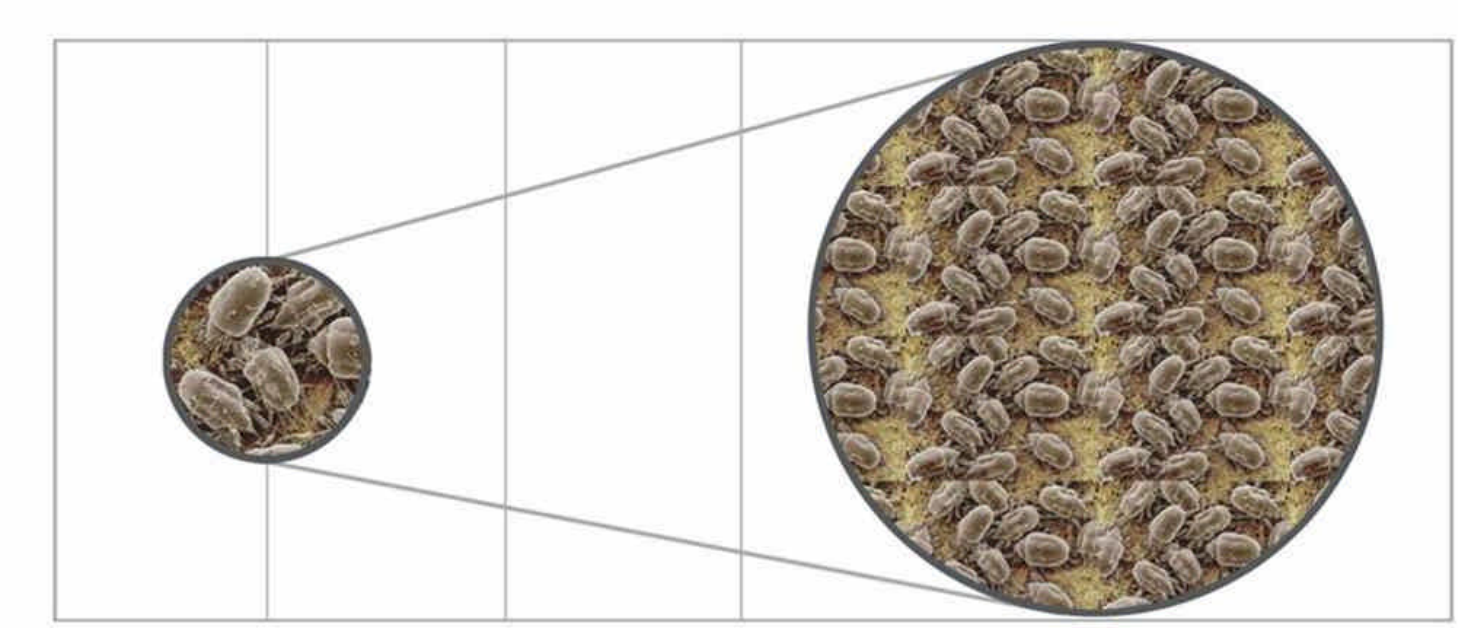

Laboratory study via modified challenge test (JIS L 1902 )
Univ.-Prof. Dr. B. Redl, Innsbruck University of Medicine, Austria, 2004





# Anti-dustmite activity

Tested according to the French Norm NF G39011 (2001)



TENCEL®  cotton standard

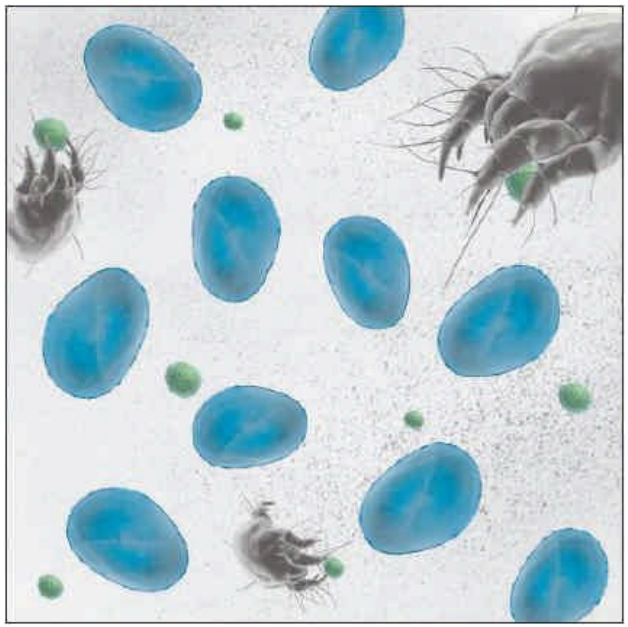
148*  dustmite number after 42 days  5880*

* Original number ofdustmites: 300  Ref: IFTH test report

# Hygiene

- All organisms need water to live !
- A dry environment retards the growth of micro organisms

**Polyester**



**TENCEL®**

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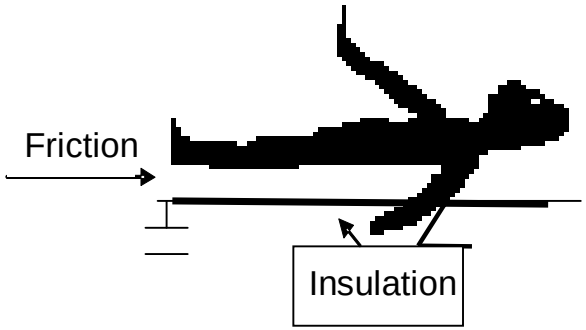
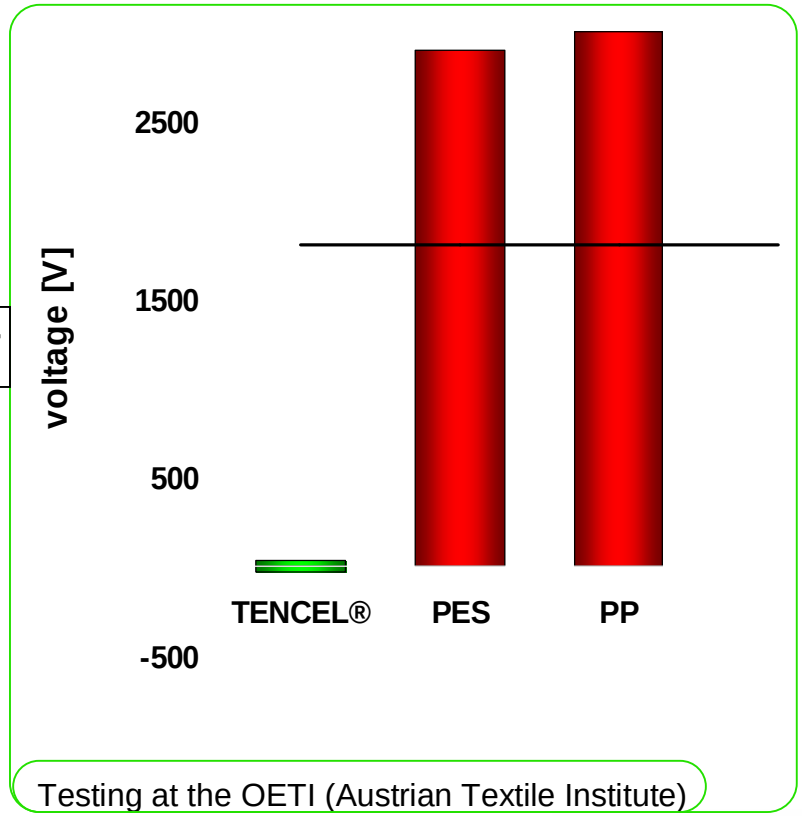
# Electrostatic behavior

Electrostatic charge of humans body after a friction experiment with textiles. TENCEL® shows neutral electrostatic properties.

**No electrostatic charge with TENCEL®!**




Voltmeter




Testing at the OETI (Austrian Textile Institute)



Testing at the OETI (Austrian Textile Institute) in order to DIN 66095

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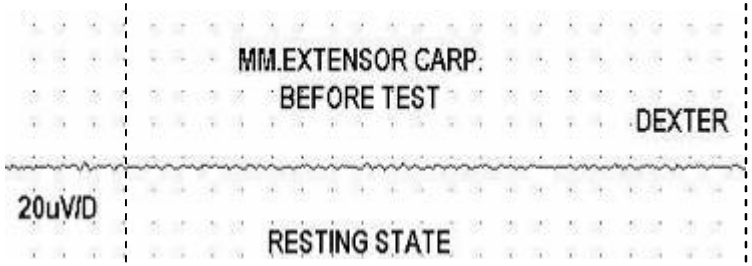
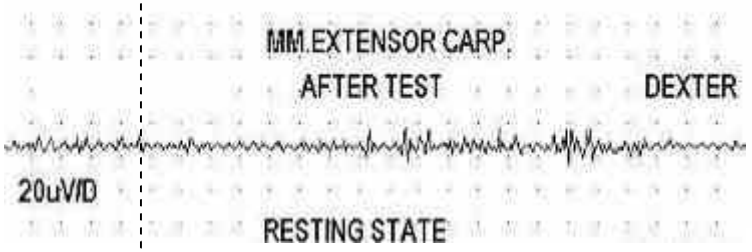
# Muscle activity measured by Electromyography

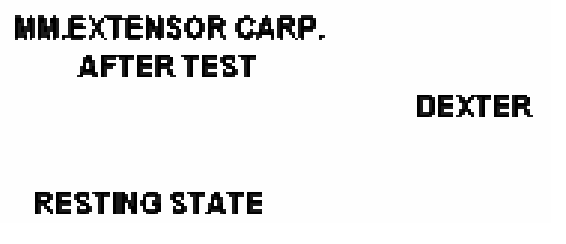
**before**





**after**




**polyester** **TENCEL®**

Dr. Malgorzata Zimniewska (Inst. of Natural Fibers, Poznan / PL)
Prof. Juliusz Huber (Medical University Poznan / PL)

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# Conclusion: TENCEL® enhances comfort and hygiene in all mattress components!

**Mattress ticking:**

Softer touch

Enhanced physiological performance

Reduced fungi growth

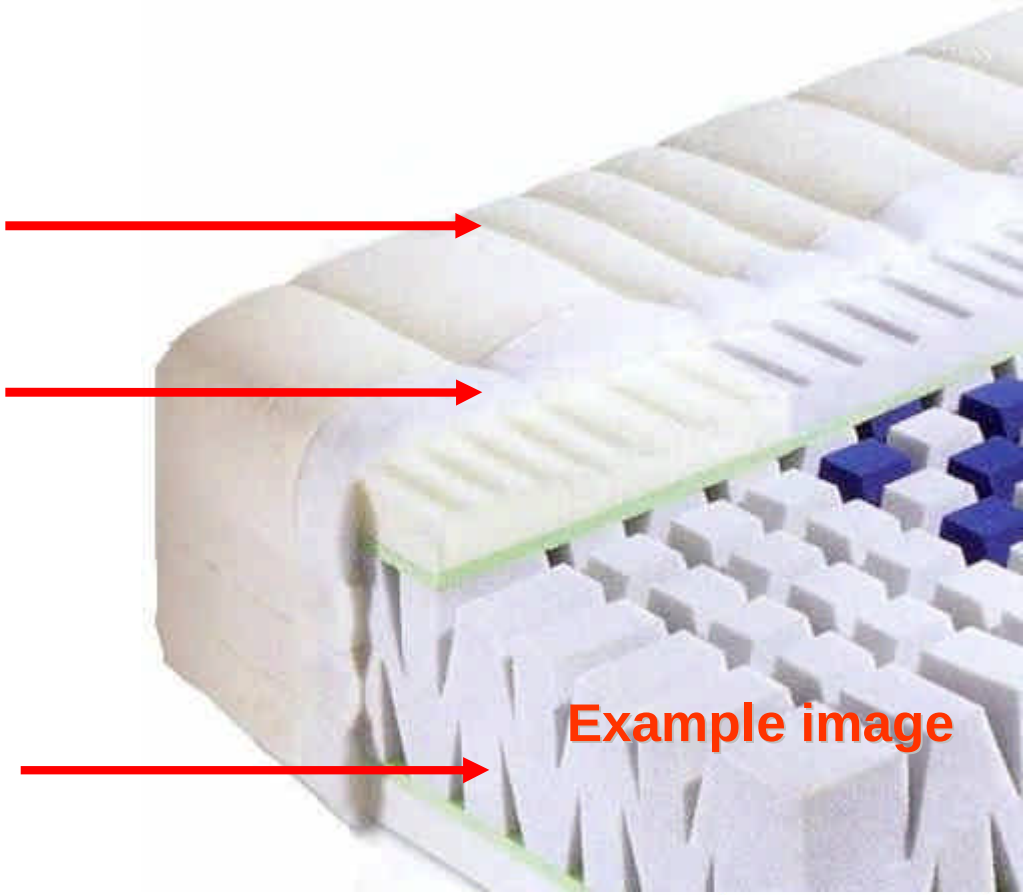
**Fiber wadding:**

enhanced humidity management

Reduced fungi and dustmite growth

**Mattress core:**

Reduced fungi and dustmite growth



# TENCEL® in mattress offers:

- Better humidity and temperature management
- Better hygiene
- Enhanced mattress comfort

## More quality with less chemistry

TENCEL®