



Anitmicrobial & odor control

17. March 2020

**SWISS
TECH
INSIDE**

HeiQ Pure TAG
HeiQ Pure SPQR



Differentiate. Innovate.

HeiQ is a three-in-one company:
Scientific research,
Specialty materials manufacturing
& Consumer ingredient branding.

Our purpose is to improve the lives
of billions of people by perfecting
an every day product: Textiles.

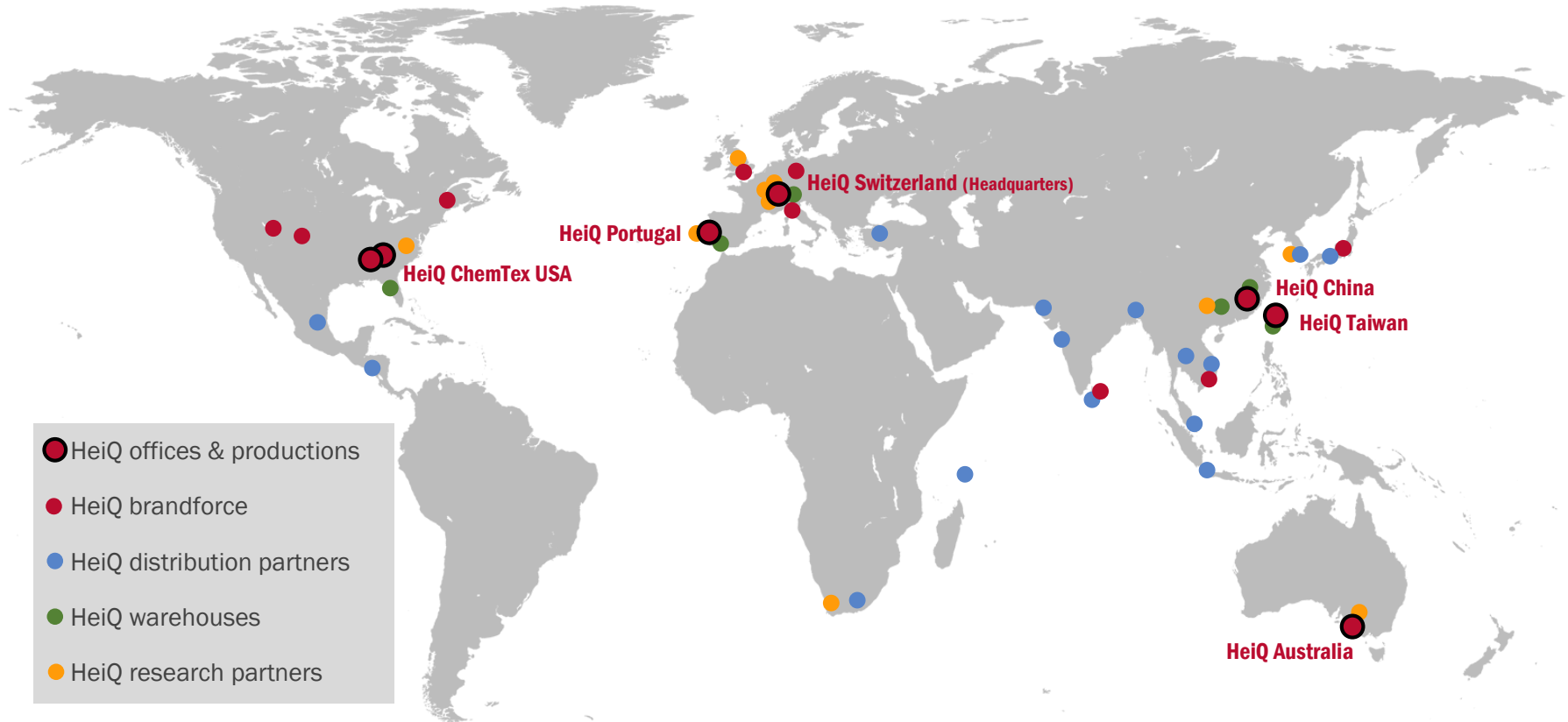
SWISS
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[HeiQ corporate video](#)





HeiQ global network



Sustainability is at the core of our business.

For HeiQ, sustainability encompasses not only economic, environmental and social principles, but also product quality. Our purpose is to help make **textiles better.**

PFC-free
water repellent:
HeiQ Eco Dry



Destroys
Coronavirus in
seconds
HeiQ Viroblock

50% less
insulation yet
100% warmth:
HeiQ XReflex

Rapid
polyester dyeing:
Award-winning
HeiQ Clean Tech



Silver-free
bio-based odor
control:
HeiQ Fresh FFL



HeiQ is bluesign
partner since
2011

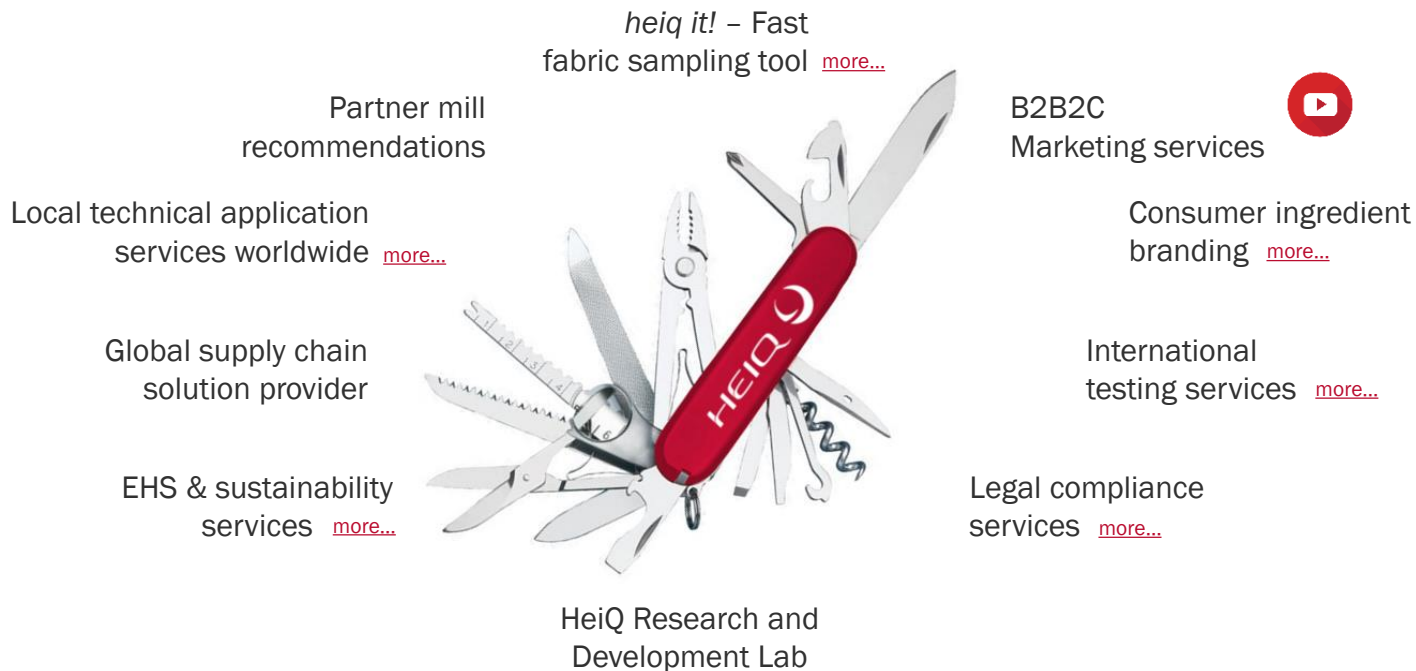
OEKO-TEX®
CONFIDENCE IN TEXTILES

Oeko-tex conform
products



HeiQ: All-in-one support

Aligned with your brand, HeiQ helps you realize the added value of innovations and provides the tailored tools and services you need for impact:





Innovation partner of over 200 brands – Examples:

Sports & outdoor



Intimate & hosiery



Fashion & athleisure



Home fashion



Footwear



Workwear



HeiQ development laboratories

Zürich, Switzerland & Concord, North Carolina USA

- State-of-the-art textile testing & development laboratories
- Our dedicated team of textile chemists offers product development, customized solutions & testing services



Laboratory capabilities

- Chemical reactions
- Polymer synthesis
- Chemical formulations
- Particle milling
- Analytics
- QC
- Recipe development
- Textile application
- Textile testing
- Membrane testing
- Antimicrobial testing
- VOC testing
- Pilot plant textile application
- *heiQ it!* fabric library





17 major recognitions in 15 years

2020	Swiss Venture Club / Credit Suisse award
2019	Swiss Environmental Award
2018	Finalist E&Y Entrepreneur of the Year
2017	Top 30 Swiss Growth Champions
2016	Swiss Technology Fund Award
2015	Swiss Top 10 McKinsey Venture Graduate
2013	Finalist Swiss of the Year
2011	European Environmental Press Award
2010	Swiss Technology Award
2010	Swiss Equity Fair Winner
2009	Finalist E&Y Entrepreneur Of the Year
2008	KTI Technology Entrepreneur
2007	McKinsey / ETH Venture Prize
2007	Venture Leaders Award
2006	W.A. DeVigier Foundation Award
2006	IMD Startup Award
2005	Siska-Heuberger Prize



KTI/CTI

DIE FÖRDERAGENTUR FÜR INNOVATION
L'AGENCE POUR LA PROMOTION DE L'INNOVATION
L'AGENZIA PER LA PROMOZIONE DELL'INNOVAZIONE
THE INNOVATION PROMOTION AGENCY



venturelab

HeiQ scientific board

Martin Loessner Prof. Dr.	ETH Zürich Switzerland	Microbiology & food sciences
Clemens Holzer Univ. Prof. Dipl. Eng. Dr. mont.	Montanuniversitaet Leoben Austria	Polymer science & processing
Hyung Gyu Park Prof. Dr.	POSTECH South Korea	Nanotechnology & process engineering
Thierry Pelet Dr.	EPFL Lausanne Switzerland	Molecular biology & virology
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Paul Collins Assoc. Prof. Dr.	Deakin University Australia	Engineering & sports physiology
Alessandra Sutti Assoc. Prof. Dr.	Deakin University Australia	Biomaterials & materials science





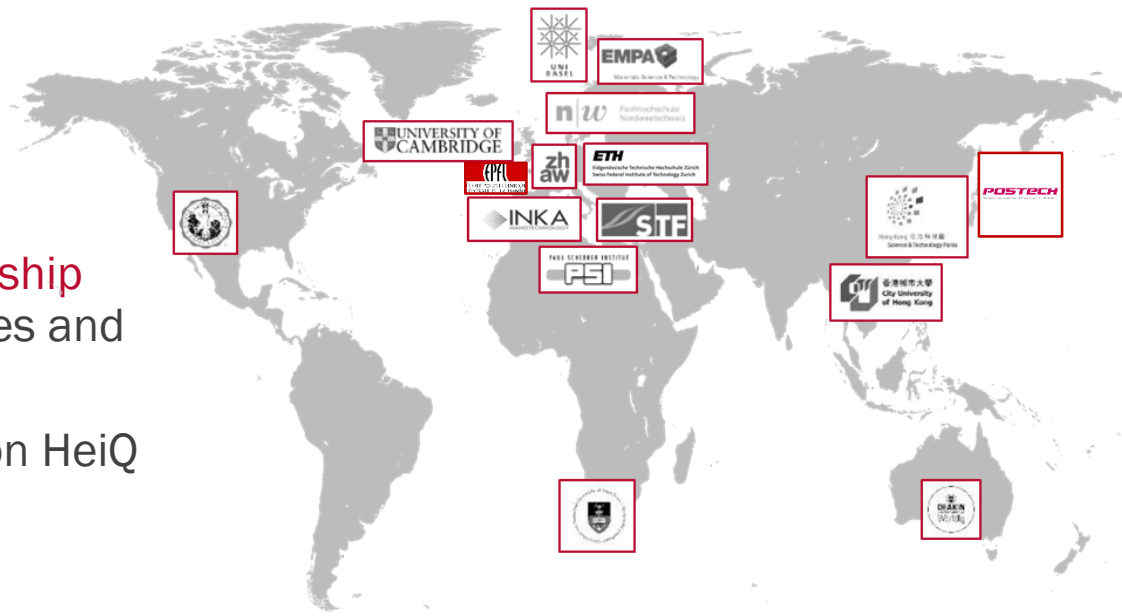
HeiQ research network

HeiQ internal product development team of 12 chemists

HeiQ achieves its research objectives primarily through a **boundless research network**

HeiQ **sparks engaged partnership** with researchers at universities and institutes around the world

Today dozens of PhD's work on HeiQ projects





Scan to learn more

HEIQ FRESH
SUSTAINABLE
ODOR CONTROL

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Scan to learn more

HEIQ ECO DRY
ECO-FRIENDLY
WATER-REPELLENT

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HEIQ SMART TEMP
INTELLIGENT
THERMOREGULATION

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HEIQ PURE
ANTIMICROBIAL
ODOR CONTROL

SWISS
TECH
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HEIQ REAL SILK
A TOUCH OF LUXURY

SWISS
TECH
INSIDE

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HEIQ CLEAN TECH
THE ECO-FRIENDLY WAY

SWISS
TECH
INSIDE

Scan to learn more

HEIQ SUN BLOCK
UV PROTECTION

SWISS
TECH
INSIDE

Scan to learn more

HEIQ GLIDE
FREEDOM TO MOVE

SWISS
TECH
INSIDE

Scan to learn more

HEIQ XREFLEX
WARMTH REFLECTED

Same warmth, 50% lighter*

SWISS
TECH
INSIDE

Scan to learn more

HEIQ VIROBLOCK
ANTIVIRAL PROTECTION

SWISS
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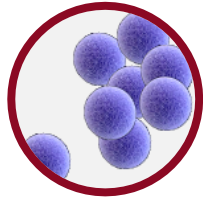
Antiviral and antimicrobial range





What is the issue?

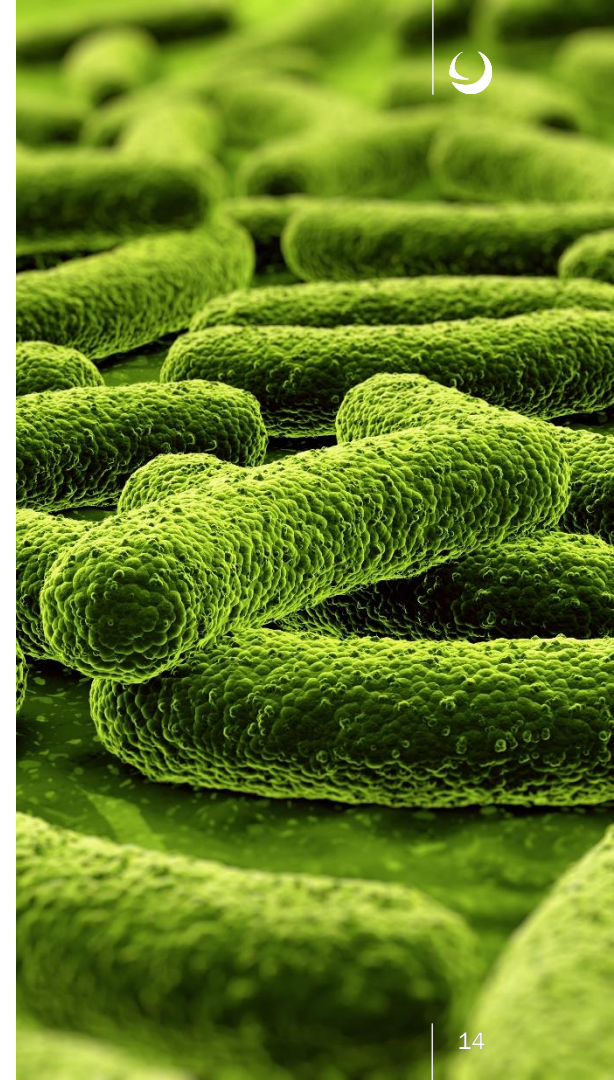
Bacteria



What are bacteria?

- Single cell organisms capable of rapidly reproducing by cell division
- A natural part of the environment, and present in large numbers inside and on the outside our bodies
- Most bacteria are harmless; however some bacteria can cause harmful disease
- Bacteria can be broadly classified as *gram positive* or *gram negative* depending on the structure of the cell wall
- Gram positive bacteria are primarily responsible for body odors:

Gram positive bacteria	Gram negative bacteria
▪ <i>Staphylococcus aureus</i> ▪ MRSA ("golden staph") ▪ MSSA ▪ <i>Listeria monocytogenes</i> ▪ etc.	▪ <i>Escherichia coli</i> ▪ <i>Klebsiella pneumoniae</i> ▪ <i>Salmonella typhimurium</i> ▪ <i>Pseudomonas aeruginosa</i> ▪ etc.





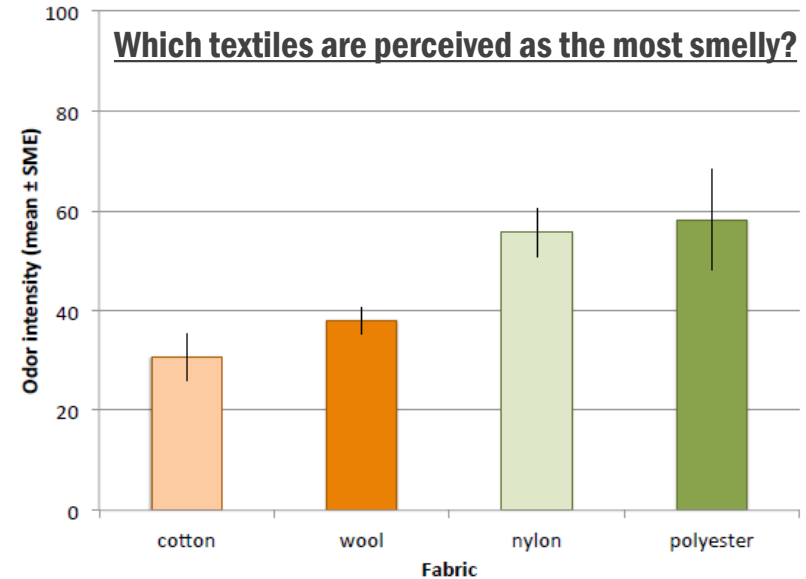
Bacteria is a reason for bad odor in textiles

Synthetic fibers are generally perceived to be much smellier than natural fibers

By sweating we transport nutrients like lipids and sugars into textiles on which **bacteria** can feed and rapidly grow by **doubling every 20 minutes**

Bacteria cause **bad odors** and **discomfort**

The **odor development** is particularly strong on **synthetic textiles**, already after few hours



Wear trial at University of Alberta¹

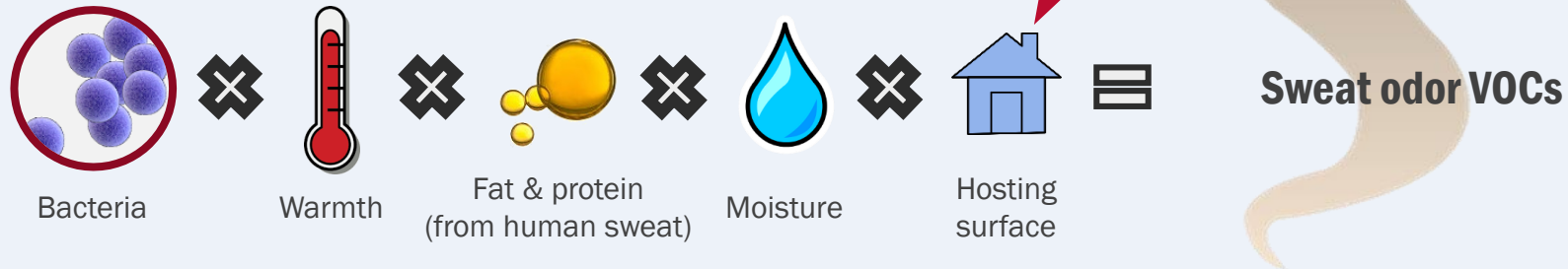
[1] McQueen, Rachel H., et al. "Retention of axillary odour on apparel fabrics." *Journal of the Textile Institute* 99.6 (2008): 515-523.



Sweat odor: Did you know?

- Sweat does not smell
- Gram-positive bacteria, eg. *Staphylococcus Aureus* found on skin, cause the bad smell
- By sweating we transport **moisture** and **nutrients** into **textiles** which feed the **bacteria**
- Bacteria break down fat and protein into a **smelly acids (VOCs)** similar to rancid butter*

Sweat odors need 5 precursors to emerge:



*Butanoic acid



What is the solution?



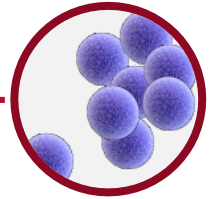
HeiQ's antimicrobial and odor control technology platforms

Technology platform	Vesicle technology	Silver-based	Bio-based amino sugar polymer chemisorption	Modified zeolite permanent absorption
Target performance	Antiviral & antimicrobial	Antimicrobial odor control	Non-antimicrobial odor control	
HeiQ products				
HeiQ Viroblock NPJ03				
HeiQ Pure TAG				
HeiQ Pure SPQR				
 HeiQ Fresh FFL				
 HeiQ Fresh HAX				



HeiQ Pure TAG – best technical profile

- Inhibiting the growth of **all bacteria** on textiles
- Non-leaching antimicrobial agent
- Especially suitable for **protective textiles**
- Highly **resistant to washing** and dry cleaning
- Harness the natural properties of silver, based on silver salt from **recycled silver source**
- Bluesign approved, ZDHC, Oekotex Class 1-4 EPA registered



Technical USPs

- ✓ Non-ionic = **best compatibility** with most textile finishings
- ✓ **2 year storage stability**
- ✓ No shade influence
- ✓ No impact on the hand
- ✓ No foaming behavior, suitable on jets
- ✓ High bath stability
- ✓ Application 0.5% to 1.5% w.o.f.



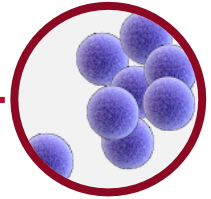


HeiQ Pure SPQR – hybrid efficiency

- Excellent **dual-action** properties: **antimicrobial** and **odor absorbing**
- Contains >60% **bio-based** amino sugar polymer (ASP) and silver salt based on **recycled silver**
- ASP binds odors emitted from the body & refreshes at every wash, **prevents permastink**
- Especially suitable for textiles worn next to the skin
- Bluesign approved, ZDHC, Oekotex Class 1-4 EPA registered, USDA bio-preferred certified

Technical USPs

- ✓ **Non-dangerous good:** logistics and storage convenient
- ✓ **Best product for exhaust application** (e.g. seamless garments for sport)
- ✓ Excellent wash durability
- ✓ Flexible application by padding or **exhaust**
- ✓ **Super bath-stable**
- ✓ Application 4% to 6% w.o.f.

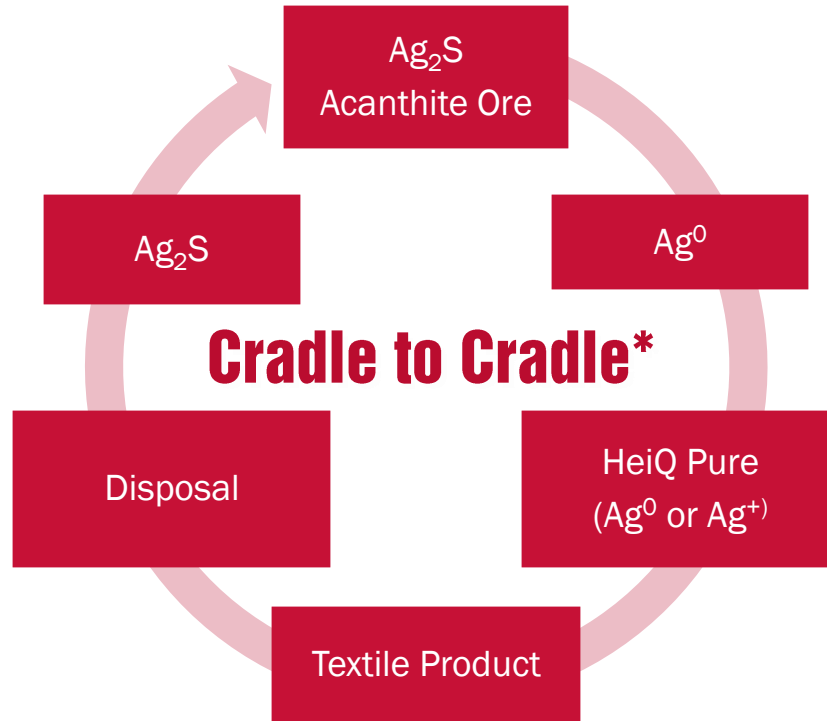




Silver salt based on recycled silver

Harness the natural antimicrobial properties of silver.

Silver – the sustainable technology



Unique qualities of silver:

- No human & skin toxicity ¹⁾
- Effective in very low concentrations ²⁾
- Low risk for bacteria resistance ³⁾
- Immediately de-activated in waste water treatment plant & effluent sludge/land-fill ⁴⁾

1) US Environmental Protection Agency, R.E.D, 1991

2) Gilchrist T, et al., Biomaterials, 1991, 12: 76-78

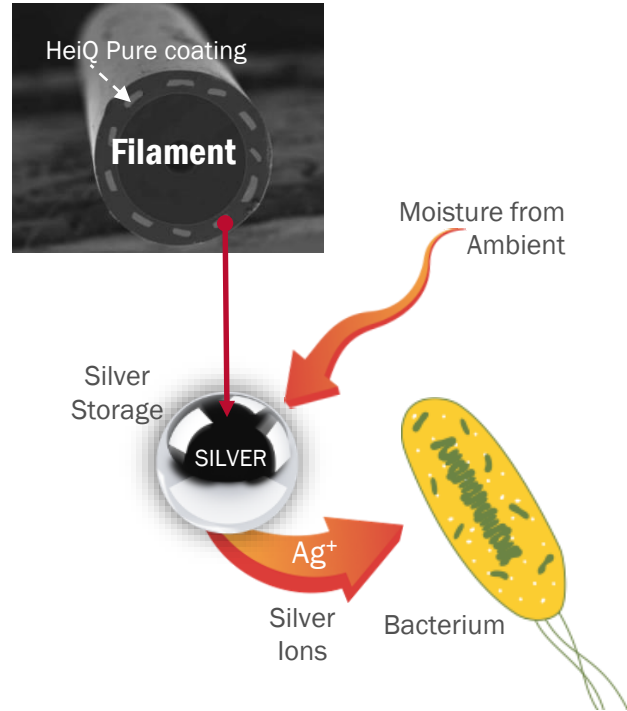
3) Damm, C. et al., Soft materials, 2006, 3:71-88

4) Kägi, R. et al., Environmental Science, & Technology, 2011

*Cradle to Cradle is a holistic economic, industrial, social framework that seeks to create products that are efficient but also essentially waste free.



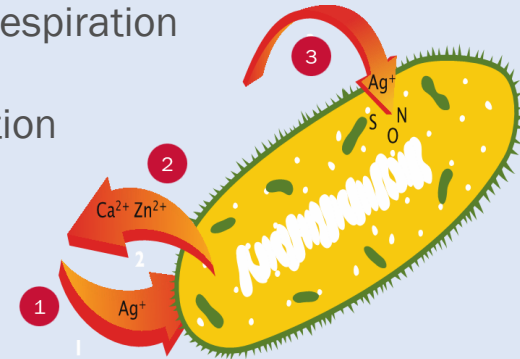
HeiQ Pure – Mode of Action



The silver ions generated from **HeiQ Pure** stops bacterial growth and odor development

→ Very low likelihood of resistance building¹

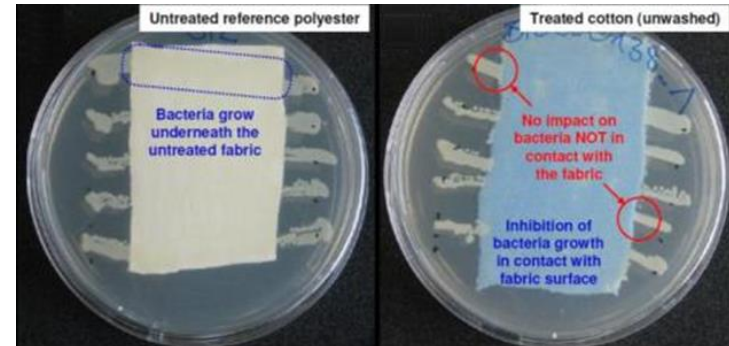
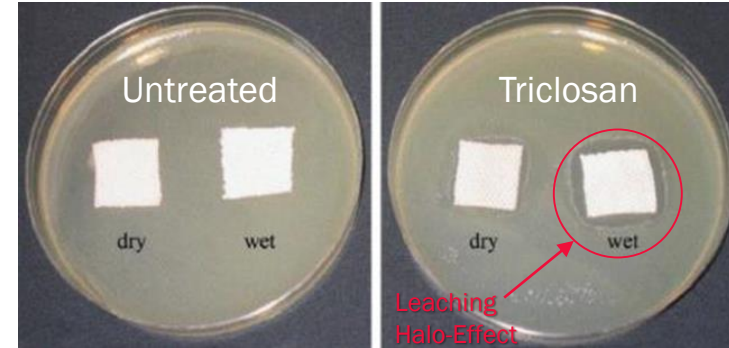
- 1 Perforates the cell membrane
- 2 Interferes with respiration
- 3 Stops reproduction



Safe to the Skin

Leaching technologies like Triclosan migrate out of the textile and potentially onto the skin; a “halo” of an inhibition zone is detectable. They should not be used close to skin.

Non-leaching technologies like silver do not migrate away from the textile; the bacteria can grow in the immediate proximity of a treated textile; there is no migration of bioactive silver onto the skin



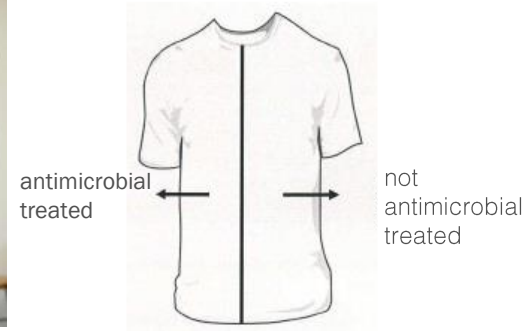
Silver & skin flora – Study performed by Hohenstein

Hohenstein researchers carried out field study into the **effect of silver treated clothing on skin flora** and **microclimate**

A total of 60 healthy volunteers took part in this trial for a period of 6 weeks

Trials show that the **natural skin flora** are **unaffected** even after long periods of wear

As conclusion, in this field study the skin flora and microclimate of healthy skin remained unaffected by the silver treated t-shirts that were worn next to the skin





Amino sugar polymer: Bio-based odor adsorber

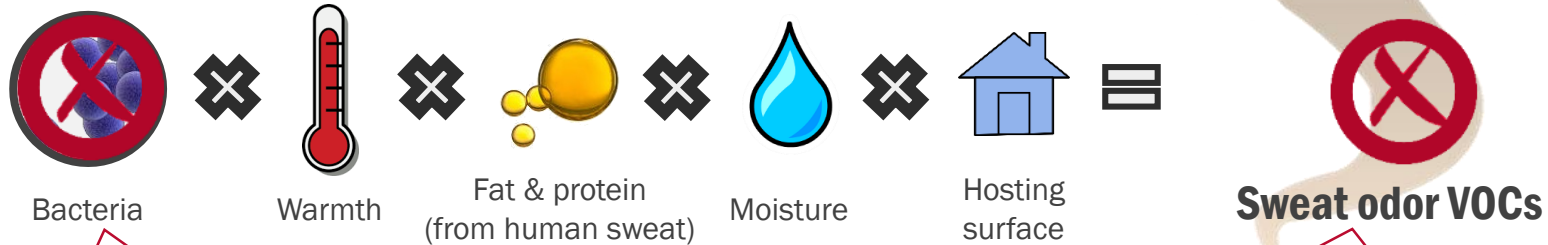
A key ingredient in HeiQ's best odor control technology:
HeiQ Pure SPQR



HeiQ Pure SPQR – hybrid odor control, dual effect

Sweat odors need 5 precursors to emerge

HeiQ Pure SPQR tackles in two actions



Silver-ions (released from silver salt) effectively inhibit the growth of bacteria and stop them from processing odorless sweat into body odor

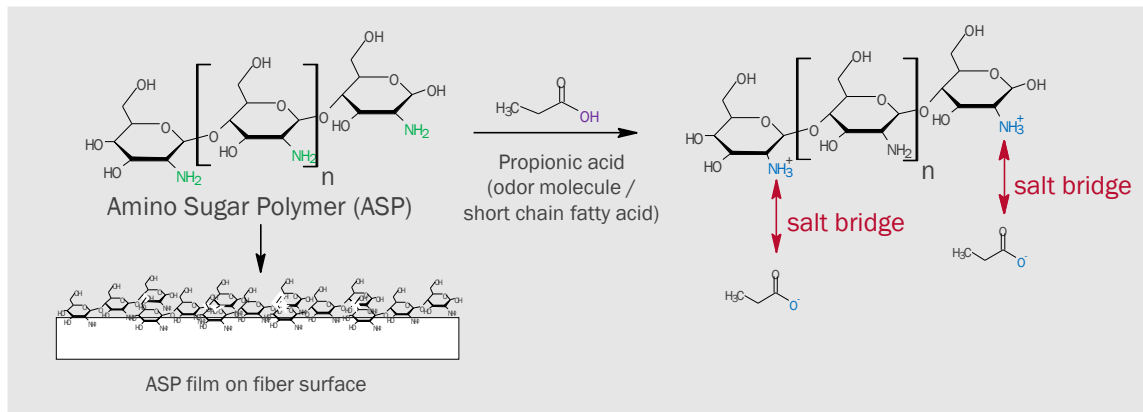
Action 1: Tackle odor at source

Amino Sugar Polymers (ASPs) have an opposite charge compared to body odor VOCs, by chemisorption they bind VOCs and form a salt, which is dissolved during washing. Odor control function is **regenerated** in every wash, **no permastink**.

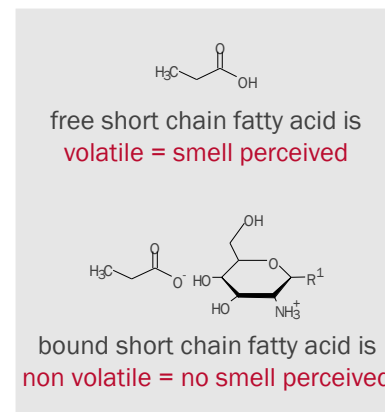
Action 2: Capture the odor VOC

Detailed mode of action of the Amino Sugar Polymer

Binding of odor molecules via salt bridge (chemisorption mechanism):



Effect on odor molecule:



- The amino groups (-NH₂) chemisorb short chain fatty acids (-COOH) and form a salt bridge (-NH₃⁺ / -COO⁻) resulting in mineralization of odor molecules¹
- Action is directly between odor molecules and the amino sugar polymer. NOT an antimicrobial mechanism²

[1] M. V. Shamov, S. Yu. Bratskaya, and V. A. Avramenko, Interface Science 249, 316–321 (2002)

[2] L. John R. Foster, Julian Butt, Biotechnology Letters (2011) 33:417–421



How can HeiQ Pure be tested?



HeiQ Yogurt Bac test – Qualitative method

Fast and simple test for quick proof of concept

Procedure:

Adding diluted sterile UHT (Ultra High Temperature) milk and non-pathogenic blended (Yogurt/bifidus) bacteria sample onto fabric (incubation: 15 hours at 40°C)

Evaluation:

pH-measurement for control purposes:

Fail ✗

pH < 5.5 (lactic acid present)

Pass ✓

pH > 6.5 (no noteworthy amount of lactic acid)

Qualitative olfactory evaluation:

Fail ✗

Odor present

Pass ✓

Odor not present



*QC = Quality Control test method (at cost)

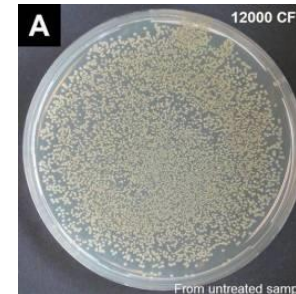


Bacteriostatic efficacy test (ISO 20743)

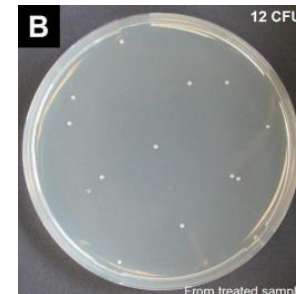
Quantitative test method for the determination of bacteriostatic activity on textiles including nonwovens



- This test method is applicable to **all textile products** including material for apparel, home textiles, cloth, wadding, thread etc.
- **Widely accepted** method for textile samples
- Specified organism:
Staphylococcus aureus
Klebsiella pneumoniae



Untreated

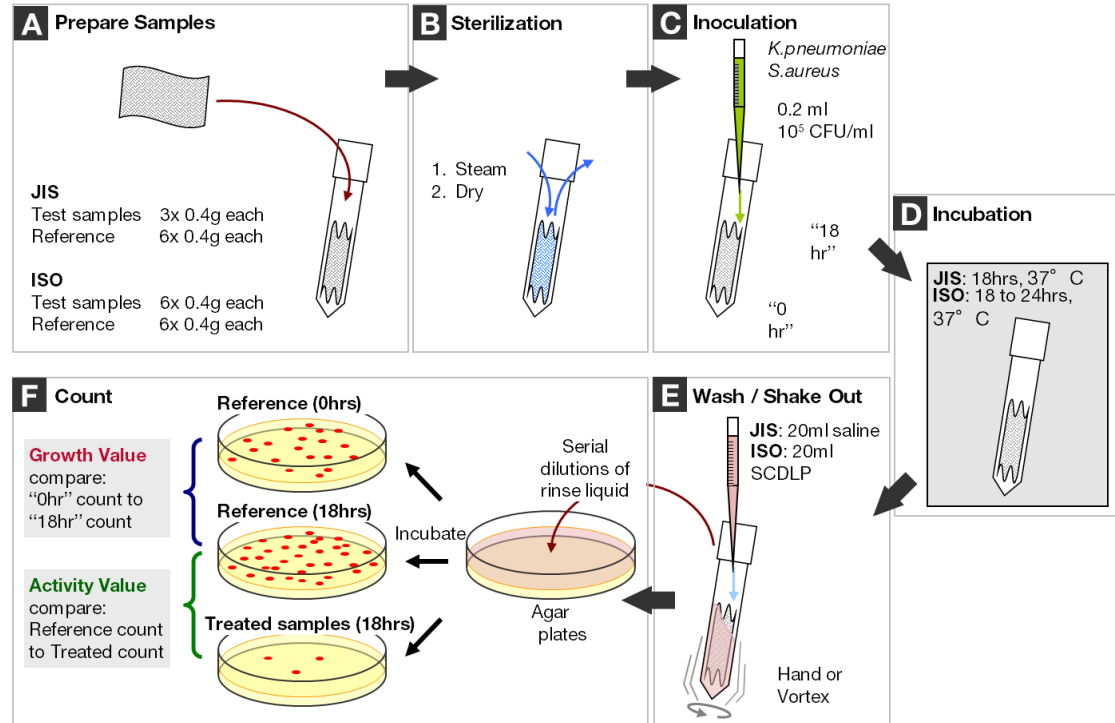


Treated with
HeiQ Pure TAG

*QA = Quality Assurance test method (at cost if used for QC purpose)



Testing Method – ISO 20743



ISO 20743 results

- HeiQ Pure TAG treated samples of PES and CO both show 99,999% antimicrobial activity versus Staphylococcus aureus and versus Klebsiella pneumoniae

Microbe Investigations AG

Report: LS20-00326

Customer Order-ID: Pure MD

Date: February 28, 2020

Antimicrobial Testing

Recipe	Sample number	
Product	1	2
HeiQ R&D [g/l]	400	222
ISO 6330 parameters	1-1	2-1
Tabellarischer Bericht	0	0
Drying conditions		

ISO 20743: Staphylococcus aureus (ATCC 6538P)

Control	Initial	After 18 h
Log cfu	4.4 St.Dev.: 0.1	7.2 St.Dev.: 0.1
Sub-Samples	1-1	2-1
Log cfu Sample (staph) [none]	2.0 St.Dev.: 0.0	2.0 St.Dev.: 0.0
Percent reduction Sample (staph) [%]	99.9994	99.9994
Log reduction Sample (staph) [none]	5.2	5.2
Performance style Sample (staph)	Detailed (VG/G/M/P)	Detailed (VG/G/M/P)
Activity Sample (staph)	Excellent	Excellent

Microbe Investigations AG LS20-00326

Report date: February 28, 2020

Customer: HeiQ R&D

Index

- Test overview and summary
- Application data
- Test costs information (Pro-Forma invoice)
- Annexes to the test report

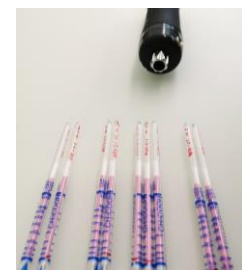
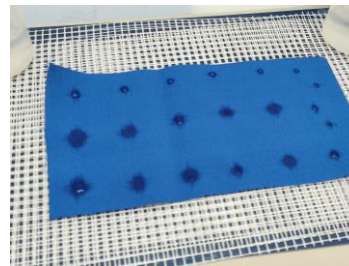
Microbe Investigations AG (MIS) is a spin-off company of E.ON Energy Research Center (ERC).
MIS provides microbiological testing services primarily for industrial customers assessing the characteristics of development products. MIS also provides a depth of expertise in biotechnological aspects of microbiology gained throughout many years of world-leading research. Target customers are primarily companies working with comprehensive treatment of testing, quality, and safety.

More information: www.microbe-investigations.com

spinoff 

Odor emission test (adapted ISO 17299-2)

Test method for measuring VOC emission from sweaty textile apparel

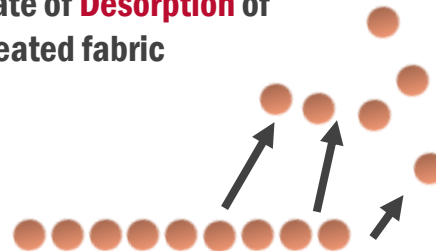


ISO 17299-2

Adapted ISO 17299-2

Type of VOC	Ammonia	Diluted propionic acid (=main odiferous metabolite in human sweat) → Artificial body odor solution (ABOS)
Inoculation	VOC is inoculated into the air (in the bag)	VOC is inoculated directly on textile to simulate the absorption of the sweat
Measurement of	Adsorption	Desorption

Rate of **Desorption** of treated fabric

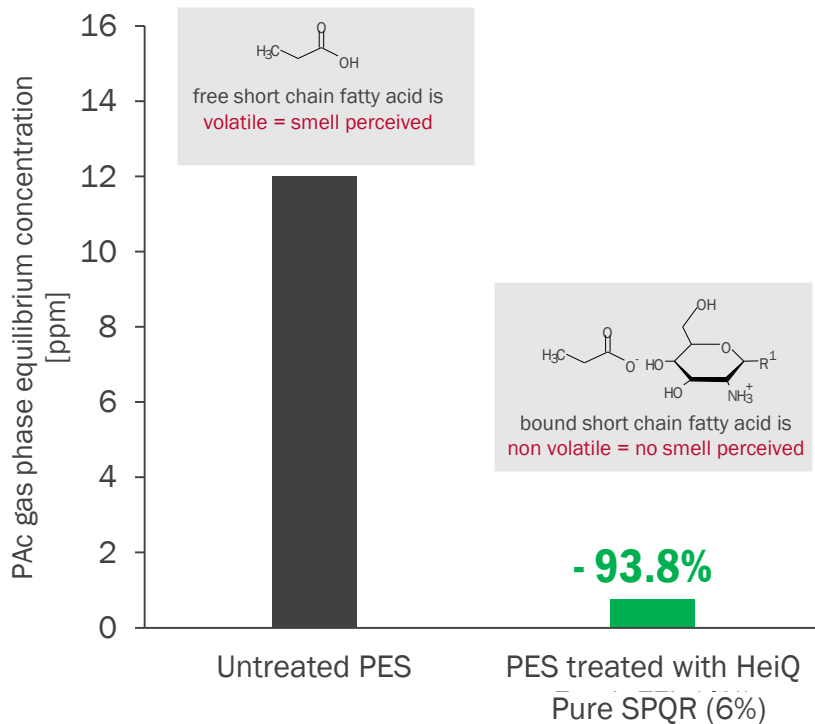


Fabric sample treated with HeiQ Fresh

*QA = Quality Assurance test method (at cost if used for QC purpose)

Amino sugar polymer sweat odor capturing effect

- The perception of sweat mimicking odors is drastically reduced as Amino sugar polymer is able to **mineralize** the most prominent **odor forming molecules** originating from sweat components (**short chain fatty acid**, e.g. propionic acid), by forming a **salt bridge** between the amino group of the amino sugar polymer and the carboxylic acid of the odorous molecule
- **The volatility is strongly reduced**
- The mode of action does not affect the microbe flora





Where can HeiQ Pure be used?

HeiQ Pure application areas

Garments

- Underwear, sports apparel, hiking shirts, fleece, socks, linings, footwear and gloves
- Casual and business wear
- Home textiles, such as towels and bed linens
- Ideal for next-to-skin products
- Applicable to all fabric types
- Uniforms in clinical and care facilities



HeiQ Pure ingredient brand and hangtag



HeiQ Pure logo



SWISS TECH INSIDE logo
Sewn-in label

HeiQ Pure hangtag



Requirements to use HeiQ Ingredient Brand elements:

- Fabric testing: The HeiQ treated fabric has to be tested prior to the hangtag application.
A **test report number** needs to be submitted for HeiQ's review.
 - Acceptable tests for HeiQ Pure treated fabrics: **ISO 20743, JIS L 1902:2002, AATCC 100.**
 - Tests are changed at cost. Third-party laboratory tests are accepted.
- **Trademark license agreement:** Use of the hangtags requires adherence to HeiQ's standard license agreement. Providing the brand company name and contact person is mandatory.
- **Strict product label claim approval by HeiQ required** (no direct or implied healthcare claims allowed!)



Regulatory coverage of HeiQ Pure



Regulations & labels

All HeiQ Fresh products are thoroughly tested for **Safety**, **Sustainability** and **Environment**

- Proven harmless to skin and body¹
- No impact on waste water treatment plants²
- Uses a minimum of active ingredient, best in industry class

The family contains products compliant with EU BPR, EU REACH, US FIFRA, JP METI, JP SEK, CN IECSC, TK BPR, bluesign approved and OEKO-TEX® conform

Check with HeiQ which product can be utilized in your target market



[1] University of Pavia, Report on Human Patch Test, 2007

[2] Tex-a-Tec/, Toxicity of silver powder and HeiQ Pure TF textile finish in municipal wastewater treatments, 2008



Differentiate. Innovate.

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