



Virus, bacteria & odor control for textiles

March 16, 2020

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TECH
INSIDE**



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.

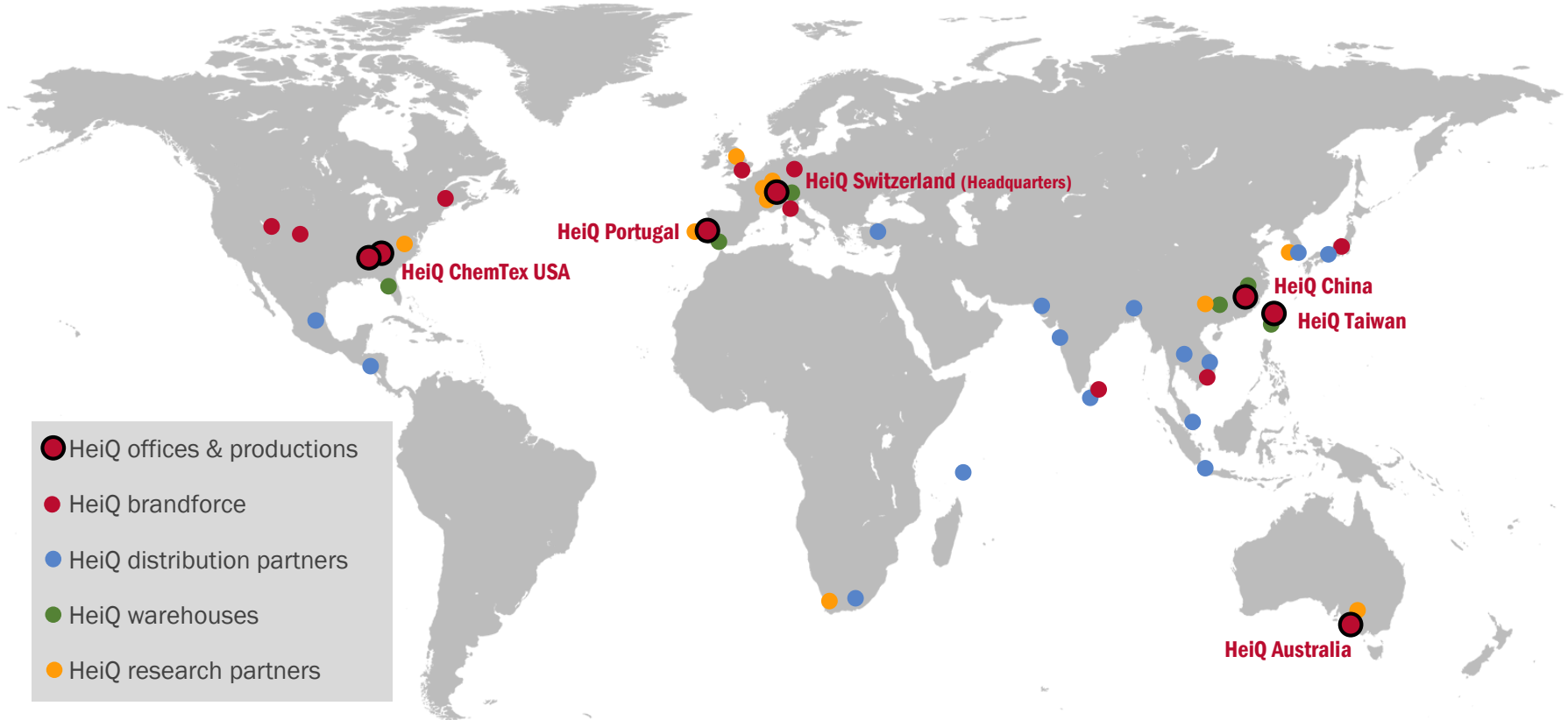
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[HeiQ corporate video](#)





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



Rapid
polyester dyeing:
Award-winning
HeiQ Clean Tech



50% less
insulation yet
100% warmth:
HeiQ XReflex

Destroys
Coronavirus in
seconds
HeiQ Viroblock

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

bluesign®

SYSTEM
PARTNER

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:



heiq it! – Fast fabric sampling tool [more...](#)

Partner mill recommendations

Local technical application services worldwide [more...](#)

Global supply chain solution provider

EHS & sustainability services [more...](#)

B2B2C Marketing services 

Consumer ingredient branding [more...](#)

International testing services [more...](#)

Legal compliance services [more...](#)

HeiQ Research and Development Lab



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



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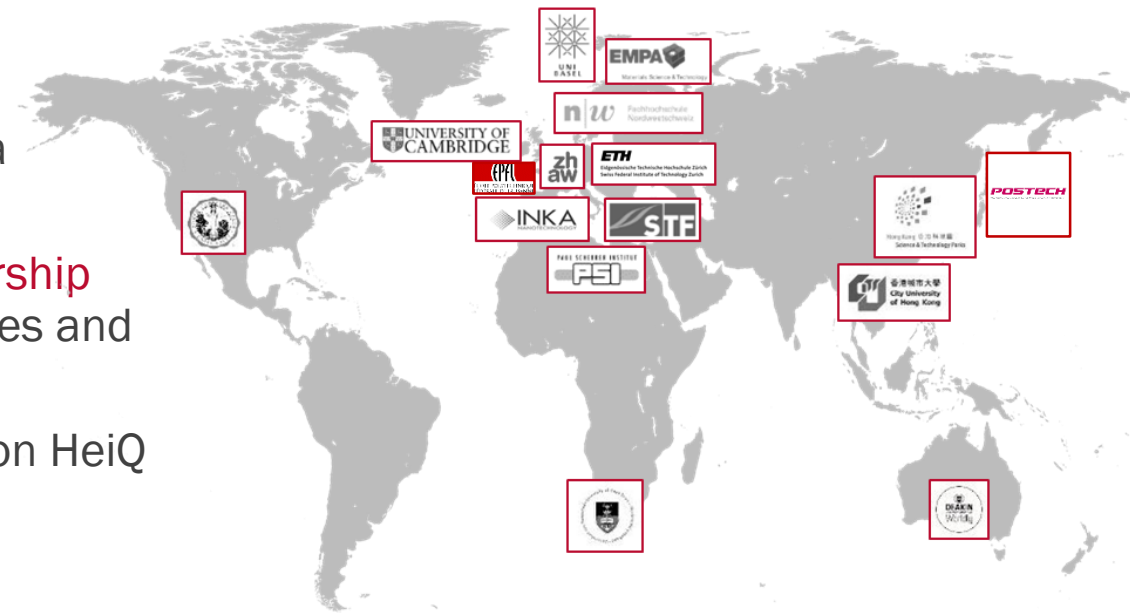
HeiQ research network

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





HeiQ key innovation families





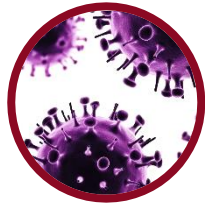
Antiviral and antimicrobial range





What is the issue?

Viruses

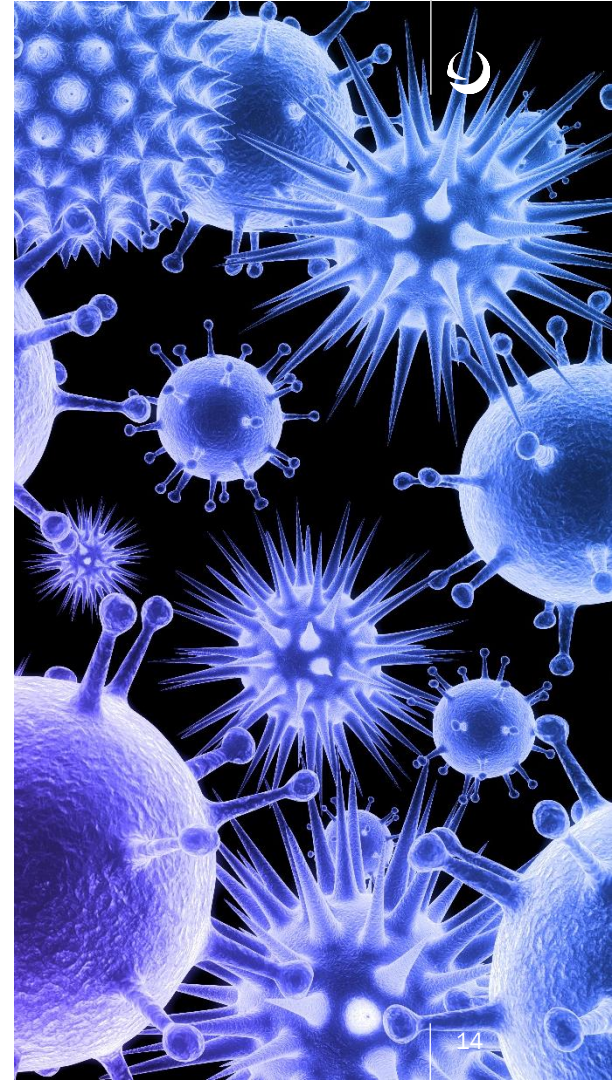


What is a virus?

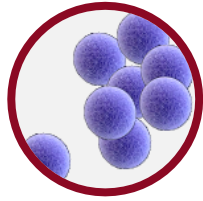
- Extremely small and infectious substances that reproduce by invading a living host cell. The host cell replicates and releases the new viruses which go on to infect other cells
- Viruses usually infect specific cell types and most viruses infect only a few species of plants or animals; some infect only humans

What is an enveloped virus?

- Many pathogenic viruses are **enveloped by a lipid** (fatty) membrane
- The lipid membrane protects the genetic material inside the virus and provides additional functions for cell attachment, morphogenesis and transmission
- Enveloped viruses represent more **than 60% of all existing viruses** and include major human pathogens
- Examples: **coronavirus**, human and avian influenzas, H5N1, Herpes, hepatitis, and AIDS



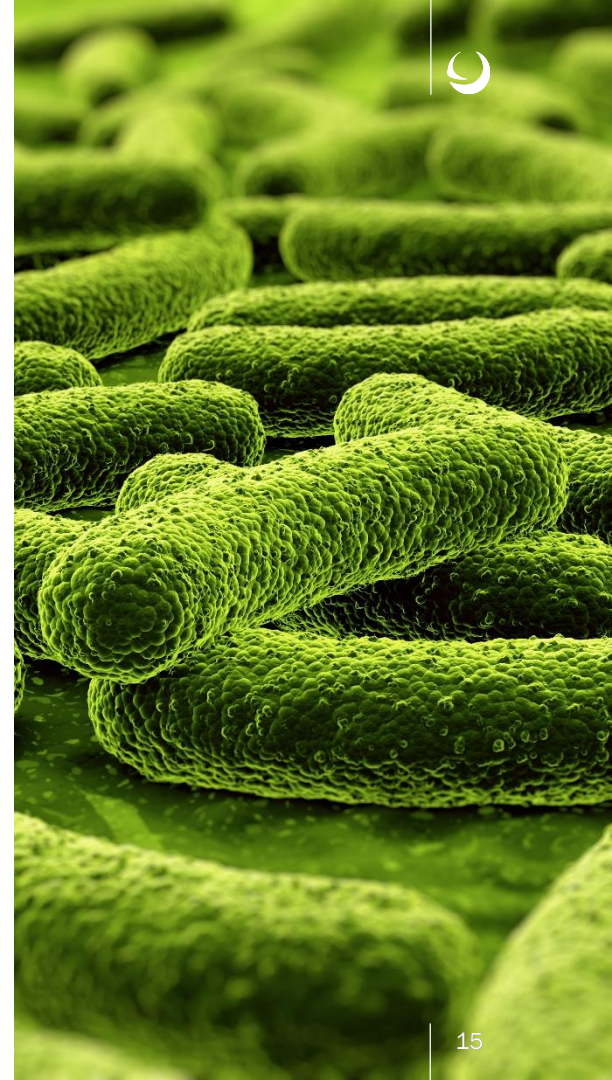
Bacteria



What are bacteria?

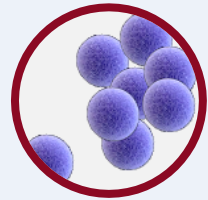
- Single cell organisms capable of rapidly reproducing by cell division
- A natural part of the environment, and present in large numbers inside and on the outside our bodies
- Most bacteria are harmless; however some bacteria can cause harmful disease
- Bacteria can be broadly classified as *gram positive* 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
<ul style="list-style-type: none">▪ <i>Staphylococcus aureus</i>▪ MRSA ("golden staph")▪ MSSA▪ <i>Listeria monocytogenes</i>▪ etc.	<ul style="list-style-type: none">▪ <i>Escherichia coli</i>▪ <i>Klebsiella pneumoniae</i>▪ <i>Salmonella typhimurium</i>▪ <i>Pseudomonas aeruginosa</i>▪ etc.





Textiles: a vector for viruses and bacteria



Bacteria

Bacteria need 4 conditions to survive & reproduce:



Warmth



Fat & protein
(from human sweat)

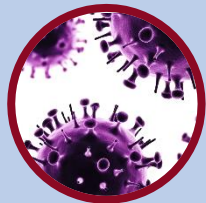


Moisture



Hosting
surface

Textiles provide
a large surface
area for
bacteria



Viruses

Viruses can persist on surfaces and remain infectious

E.g research has shown that the human **coronavirus (SARS-CoV)** can persist for up to 2 days on surgical gowns at room temperature.¹⁾

[1] Kampf, G., Todt, D., Pfaender, S. and Steinmann, E., 2020. Persistence of coronaviruses on inanimate surfaces and its inactivation with biocidal agents. Journal of Hospital Infection.



Infection & transmission

- Many **viruses and bacteria** are pathogens that can lead to severe sickness and mortality
- Thousands of deaths every year can result from **transmission of pathogenic viruses and bacteria** ¹⁾
- Viruses and bacteria can **remain active on textile surfaces from days to months** ^[2]

1) K.Sack "Hospital Infection Problem Persists", New York Times (April 13, 2010).

2) A.Kramer, I.Schwebke, G.Kampf (2006) "How long do nosocomial pathogens persist on inanimate surfaces? A systematic review", BMC Infectious Diseases, 6(130).

Table 1: Persistence of clinically relevant bacteria on dry inanimate surfaces. ²⁾

Type of bacterium	Duration of persistence (range)
<i>Klebsiella</i> spp.	2 hours to > 30 months
<i>Listeria</i> spp.	1 day – months
<i>Mycobacterium bovis</i>	> 2 months
<i>Mycobacterium tuberculosis</i>	1 day – 4 months
<i>Neisseria gonorrhoeae</i>	1 – 3 days
<i>Proteus vulgaris</i>	1 – 2 days
<i>Pseudomonas aeruginosa</i>	6 hours – 16 months; on dry floor: 5 weeks
<i>Salmonella typhi</i>	6 hours – 4 weeks
<i>Salmonella typhimurium</i>	10 days – 4.2 years
<i>Salmonella</i> spp.	1 day
<i>Serratia marcescens</i>	3 days – 2 months; on dry floor: 5 weeks
<i>Shigella</i> spp.	2 days – 5 months
<i>Staphylococcus aureus</i> , including MRSA	7 days – 7 months
<i>Streptococcus pneumoniae</i>	1 – 20 days
<i>Streptococcus pyogenes</i>	3 days – 6.5 months
<i>Vibrio cholerae</i>	1 – 7 days

Table 3: Persistence of clinically relevant viruses on dry inanimate surfaces. ²⁾

Type of virus	Duration of persistence (range)
HAV	2 hours – 60 days
HBV	> 1 week
HIV	> 7 days
Herpes simplex virus, type 1 and 2	4.5 hours – 8 weeks
Influenza virus	1 – 2 days
Norovirus and feline calici virus (FCV)	8 hours – 7 days
Papillomavirus 16	> 7 days
Papovavirus	8 days
Parvovirus	> 1 year
Poliovirus type 1	4 hours – < 8 days
Poliovirus type 2	1 day – 8 weeks
Pseudorabies virus	≥ 7 days
Respiratory syncytial virus	up to 6 hours
Rhinovirus	2 hours – 7 days
Rotavirus	6 – 60 days
Vacciniavirus	3 weeks – > 20 weeks

Textiles: a vector for viruses and bacteria

- Textiles from clothing, gowns, drapes and sheets provide an ideal surface for contamination with viruses and bacteria. Contaminated textiles can act as a surface for transmitting pathogens ^{1, 2, 3)}
- **Antiviral and antibacterial textiles can play a part in an overall strategy to address transmission of bacteria and viruses in sensitive environments**
- Preventing bacteria and viruses from contaminating textiles can play a role in minimizing opportunities for transmission ⁴⁾
- **Textiles treated with HeiQ Viroblock are designed to reduce virus and bacteria contamination of textile fabrics in sensitive environments**

1) A.Kramer, I.Schwebke, G.Kampf (2006) "How long do nosocomial pathogens persist on inanimate surfaces? A systematic review", BMC Infectious Diseases, 6(130).

2) A.Neely & M.Maley (2000) "Survival of Enterococci and Staphylococci on Hospital Fabrics and Plastic", Journal of Clinical Microbiology, 38, p.724-726.

3) RW.Sidwell, GJ.Dixon, E.McNeil (1966) "Quantitative Studies on Fabrics as Disseminators of Viruses. I. Persistence of Vaccinia Virus on Cotton and Wool Fabrics", Applied Microbiology, 14(1), p.55-59.

4) D.Höfer "The Role of Textiles in Chains of Infection", AMH Magazine, (April 2010).





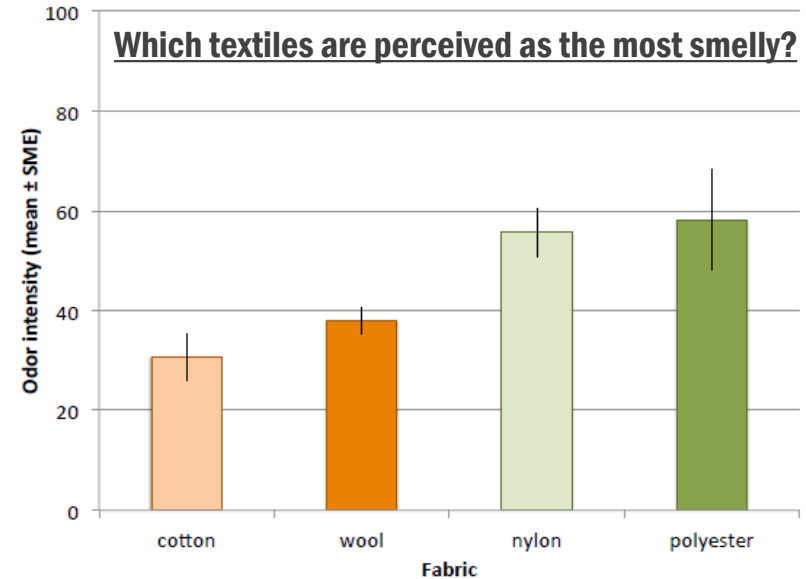
Bacteria is a reason for bad odor in textiles

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

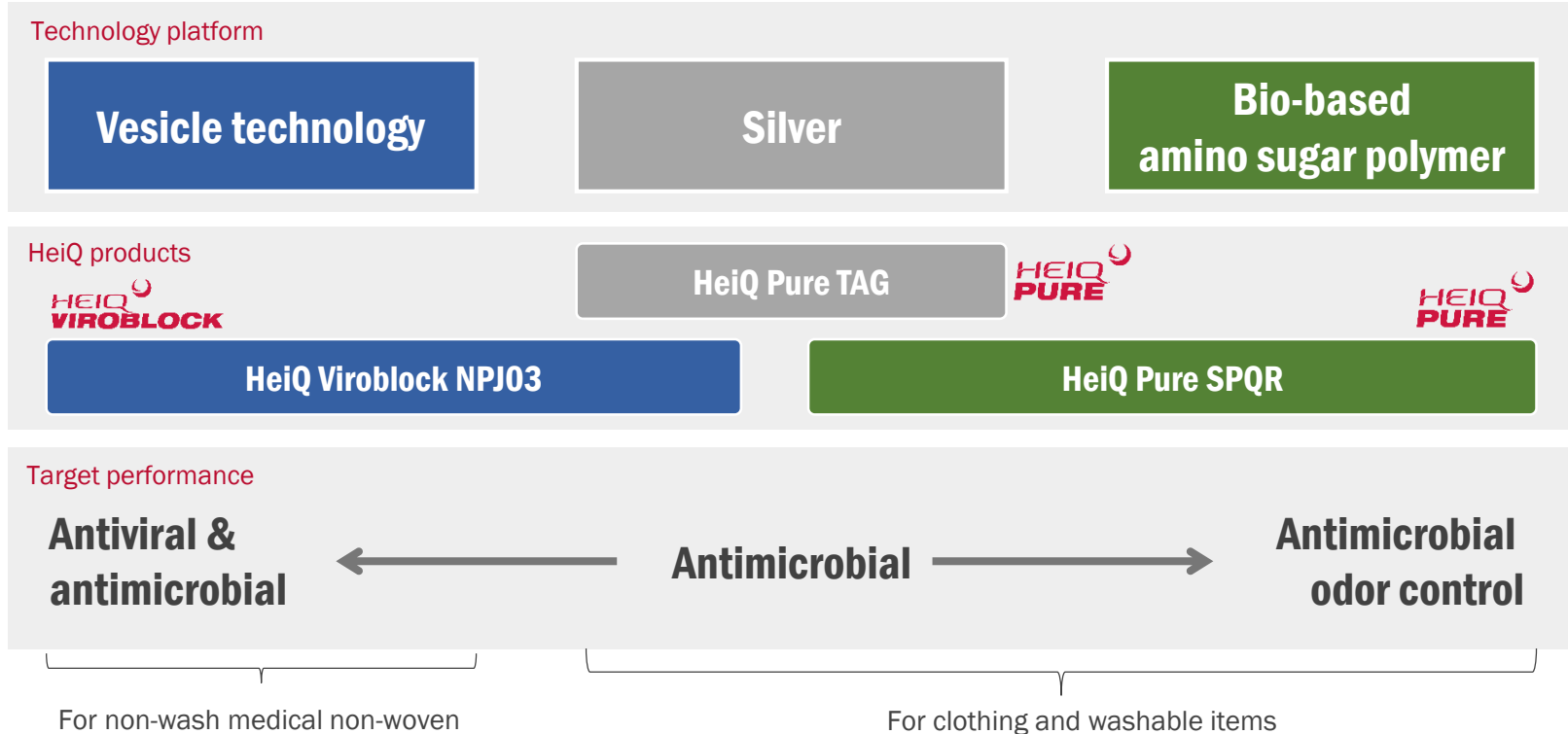
[1] McQueen, Rachel H., et al. "Retention of axillary odour on apparel fabrics." *Journal of the Textile Institute* 99.6 (2008): 515-523.



What is the solution?



HeiQ's three innovative technology platforms





HeiQ Viroblock NPJ03 – antiviral technology

- Effective against common harmful viruses such as **influenza** and **coronavirus**
- Combination of **innovative antibacterial silver** and **antiviral cholesterol depleting lipid vesicle technologies**
- **Kills bacteria and destroys viruses in minutes**
- Effective **protection against contamination and transmission** of viruses and bacteria that use textile as a hosting surface
- Harnesses the natural antiviral and antibacterial properties of silver
- Ideal for disposable non-woven medical garments, face masks, drapes, air filters, and other non-wash items

Technical USPs

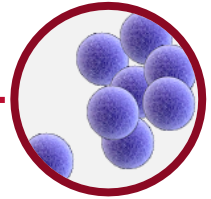
- ✓ **Non-dangerous good:** logistic and storage convenient
- ✓ Can be applied to **all types of fabrics** and non-wovens
- ✓ Standard continuous wet-processing applications (padding, kiss-roll etc.)
- ✓ Application 5% to 20% w.o.f.





HeiQ Pure TAG – based on recycled silver

- 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.



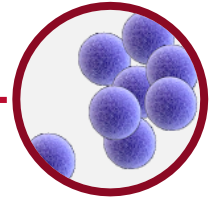


HeiQ Pure SPQR – hybrid efficiency

- 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

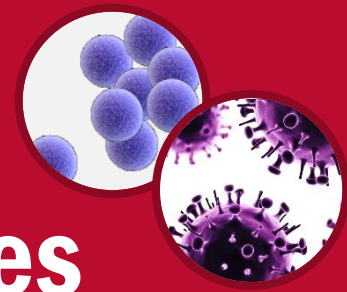
- ✓ **Non-dangerous good:** logistics and storage convenient
- ✓ **Best product for exhaust application** (e.g. seamless garments for sport)
- ✓ Excellent wash durability
- ✓ Flexible application by padding or **exhaust**
- ✓ **Super bath-stable**
- ✓ Application 4% to 6% w.o.f.



 Based on silver salt from recycled silver source



HEIQ[®] **VIROBLOCK**



Vesicle & silver technologies

Highly efficient antiviral and antibacterial effect



Protection against viruses and bacteria

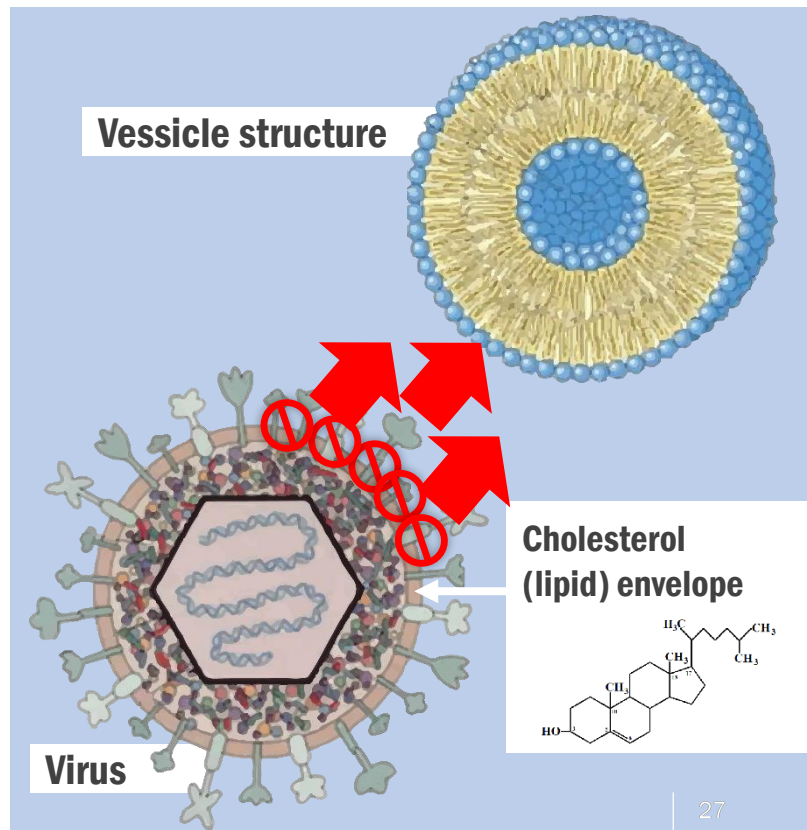
- HeiQ Viroblock provides textiles with effective protection against contamination and transmission of viruses and bacteria
- A unique combination of two leading HeiQ technologies:
 - **HeiQ vesicle technology** targets lipid-enveloped viruses providing rapid virus destruction
 - **HeiQ silver technology** targets both bacteria and viruses kills and inhibits replication

Virus examples (enveloped type):	Bacteria examples:
<ul style="list-style-type: none"> ▪ Coronavirus (SARS-CoV, Covid-19, etc) ▪ H1N1 ▪ H5N1 ▪ HIV ▪ RSV ▪ Herpes Simplex ▪ Sendai ▪ etc. 	<ul style="list-style-type: none"> ▪ Staphylococcus aureus ▪ MRSA ("golden staph") ▪ MSSA ▪ Listeria monocytogenes ▪ Escherichia coli ▪ Klebsiella pneumoniae ▪ Salmonella typhimurium ▪ Pseudomonas aeruginosa ▪ Candida albicans (yeast)



HeiQ Viroblock – Vesicle component

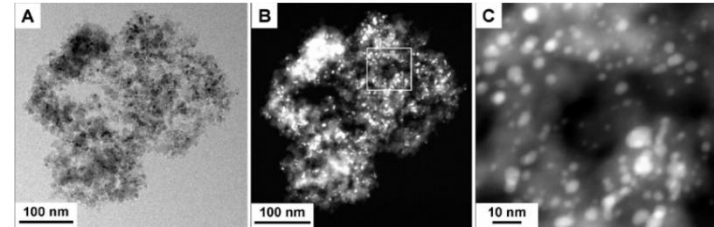
- HeiQ Viroblock vesicle technology functions by directly targeting the lipid envelope (membrane) surrounding the virus
- The vesicle structures **rapidly deplete cholesterol** from the viral envelope exposing and **destroying the virus**
- The vesicles destroys the viruses through a physical contact mechanism **in seconds**





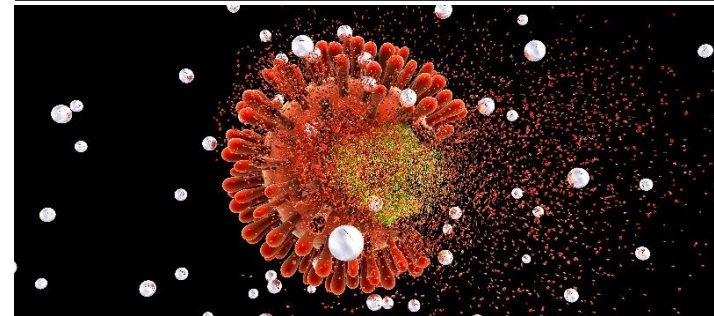
HeiQ Viroblock – Silver component

- Small silver particles are potent “antimicrobial and antiviral agents” due to high surface area to volume ratio and unique chemical and physical properties ⁵⁾
- Small silver particles are effective against viruses, effectively eliminating them following short exposure of isolated viruses to silver ⁵⁾
- Silver interacts with the sulfur-bearing moieties of viruses and can form complexes with electron donor groups leading to inhibition of post-entry stages of infection through blocking of viral proteins
- HeiQ small silver particles contribute to a broad-spectrum of anti-viral mechanisms that are not prone to inducing resistance



6)

A) Transmission electron micrograph showing an amorphous silicon dioxide aggregate particle (gray structure) together with numerous supported silver metal particles (dark spots). (B) Scanning transmission electron micrograph of the structure shown in panel A, providing better contrast between the silica structure (gray) and the silver metal particles (bright spots). (C) Higher magnification of the region in panel B enclosed in a box. The silver metal particles are typically between 1 and 10 nm in diameter.

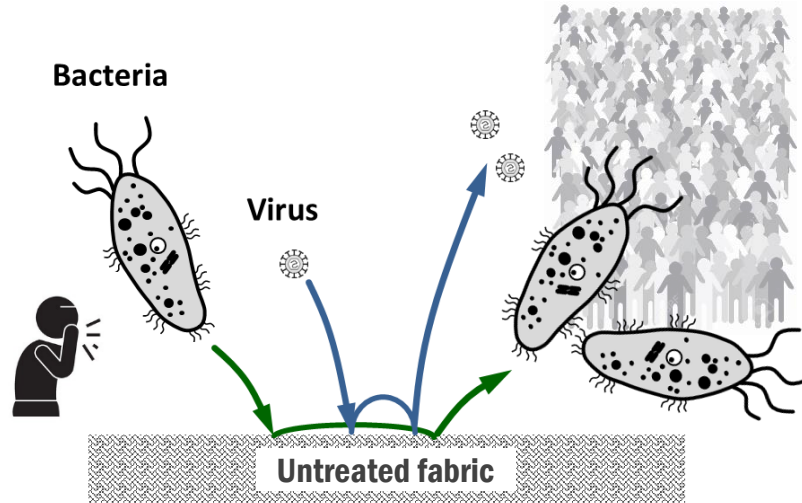


5) Stefania Galdiero et. al. (2011) “Silver Nanoparticles as Potential Antiviral Agents”, molecules 2011, 16, 8894-8918.

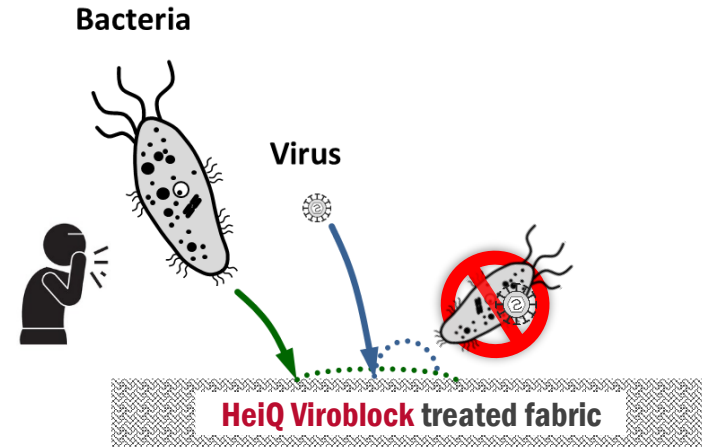
6) Egger et. al., 2009. Antimicrobial properties of a novel silver-silica nanocomposite material. Appl. Environ. Microbiol., 75(9), pp.2973-2976.



How does it work?



- Textiles provide an ideal surface for harboring viruses and bacteria
- Over the time, viruses and bacteria be re-transmitted from the textile (eg. contact with other surfaces)

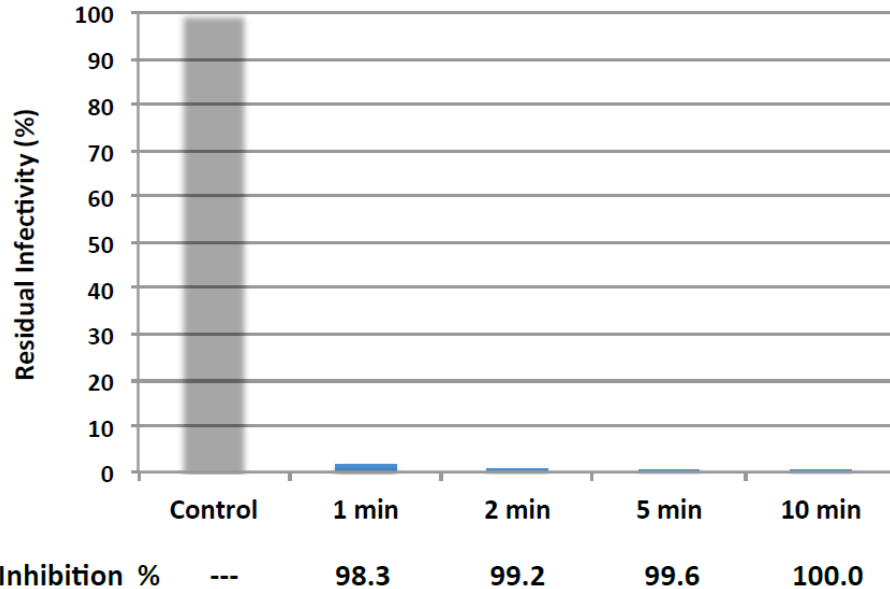
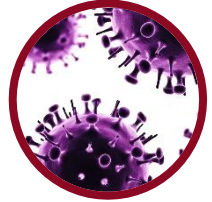


- Textiles treated with HeiQ Viroblock actively inhibit viruses and kill bacteria upon contact
- By keeping the textile free of viable viruses and bacteria **HeiQ Viroblock treated textiles help to minimize the potential for re-transmission of pathogens from textiles**



Sendai virus time series

- Non-woven fabric treated with HeiQ Viroblock NPJ03
- Residual virus infectivity tested according to a modified ISO 20743 method (Sendai virus)

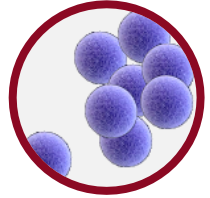


- Rapid anti-viral effect demonstrated within 2 to 5 minutes**



Staphylococcus aureus time series

- Polyester fabric treated with HeiQ Viroblock NPJ03
- Time series effectiveness based on modified ISO 20743 test method



Kill rate for *Staphylococcus aureus* over time

sample # 326-1-1	contact time [min]	0	15	20	30	60
cfu control		4.35×10^5				5.17×10^5
cfu sample			6.63×10^4	2.23×10^3	6.93×10^2	$\leq 9.9 \times 10^1$
log reduction			0.8	2.3	2.8	3.6
% reduction			84.74%	99.49%	99.84%	99.98%

The theoretical limit of detection is 100 CFU

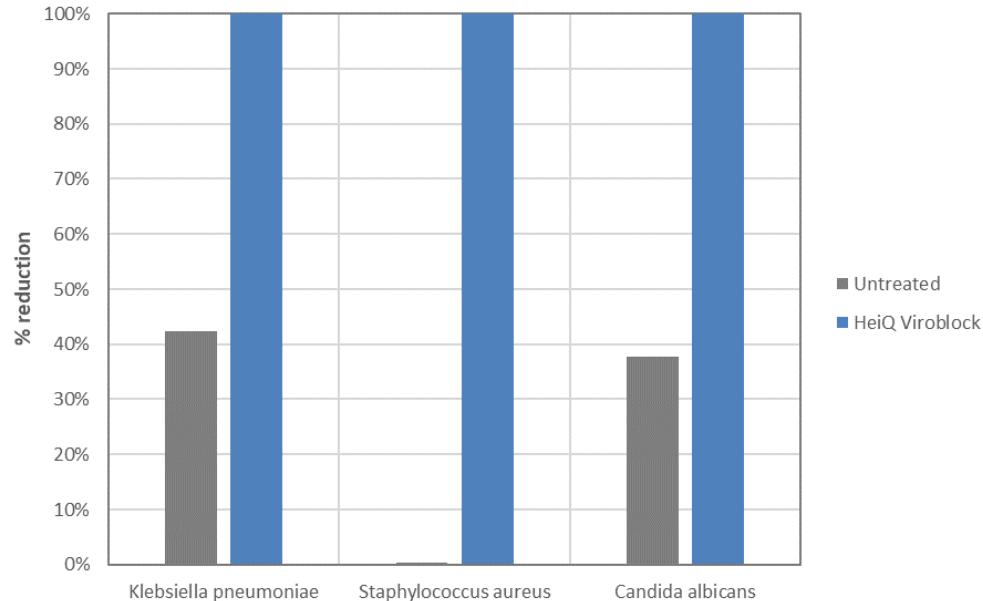
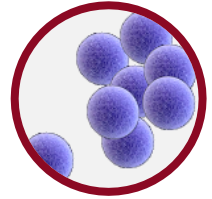
The time series study showed **>99% effect** against ***Staphylococcus aureus*** within 20 min

- **Rapid anti-bacterial effect demonstrated within 20 to 30 minutes**



Antimicrobial effect on bacteria and yeast

- Non-woven fabric treated with HeiQ Viroblock NPJ03
- Antimicrobial activity tested according to a ISO 20743



- **Broad spectrum activity against gram negative and gram positive bacteria (and yeast)**

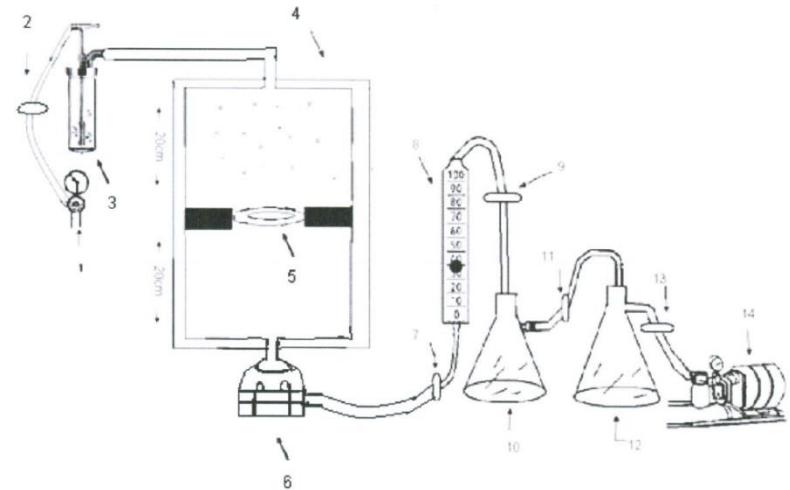


HeiQ Viroblock aerosol challenge testing

Aerosol challenge test (antiviral effect)

Method

- Test mask mounted and sealed within a test chamber
- A nebulizer delivers an aerosol of the target virus inoculum to the upstream side of the mask
- A vacuum draws air through the mask
- A collection dish placed below the mask downstream collects aerosol droplets that pass through the mask sample
- The reduction in infectivity with and without mask is calculated as an indicator of effectiveness



Key

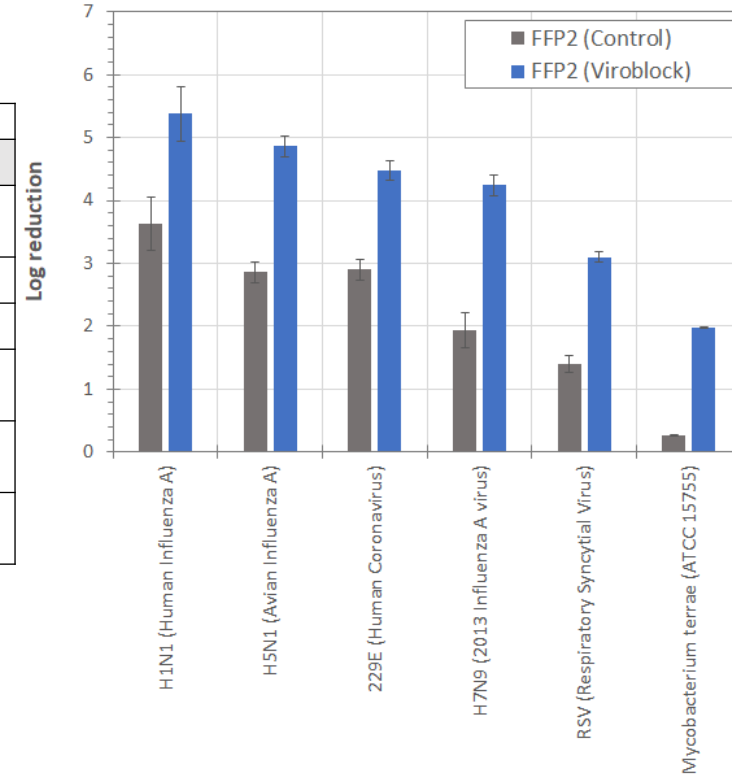
- | | | |
|-----------------------------|--------------------------------|-----------------|
| 1. High pressure air source | 7. Filter #2 | 13. Filter #5 |
| 2. Filter #1 | 8. Calibrated Flowmeter, L/min | 14. Vacuum pump |
| 3. Nebulizer | 9. Filter #3 | |
| 4. Mask chamber | 10. 4L Vacuum flask #1 | |
| 5. Test material location | 11. Filter #4 | |
| 6. Anderson Impactor | 12. 4L Vacuum flask #2 | |



Aerosol challenge test (antiviral effect)

- FFP2 face masks (untreated control vs HeiQ Viroblock treated)

Study ID	Agent	Log reduction		% reduction	
		Control	Viroblock	Control	Viroblock
798-110	H1N1 (Human Influenza A)	3.63	5.38	99.9766%	99.9996%
798-111	H5N1 (Avian Influenza A)	2.86	4.86	99.862%	99.999%
798-112	229E (Human Coronavirus)	2.90	4.48	99.874%	99.997%
798-114	H7N9 (2013 Influenza A virus)	1.93	4.24	98.825%	99.994%
798-115	RSV (Respiratory Syncytial Virus)	1.40	3.10	96.02%	99.92%
798-116	Mycobacterium terrae (ATCC 15755)	0.26	1.98	45.05%	98.95%

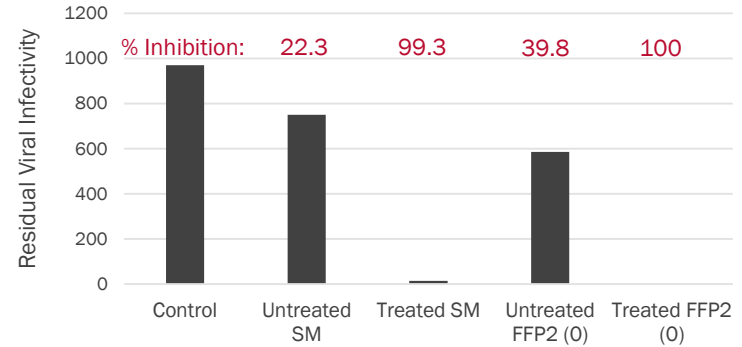


- HeiQ Viroblock NPJ03 (Viroblock) treated FFP2 mask shows **dramatically (>10 times) improved reduction** in virus infectivity
- Effective against key virus types: H1N1, H5N1, H7N9, Coronavirus, and RSV

Antiviral efficacy test (ISO 18184)

Determination of antiviral activity of textile products

- ISO 18184¹⁾ measures the property to give the morphological change or structural damage to the surface protein of virus
- A reference cloth used to verify the stability of the test virus on a textile fabric
- Infectivity titre of virus is measured with the number of infectious viral particles present per unit volume in a cell lysate or in a solution



96 wells microplate for TCID50 method

Please consult your local testing laboratories to carry out ISO18184 tests if needed

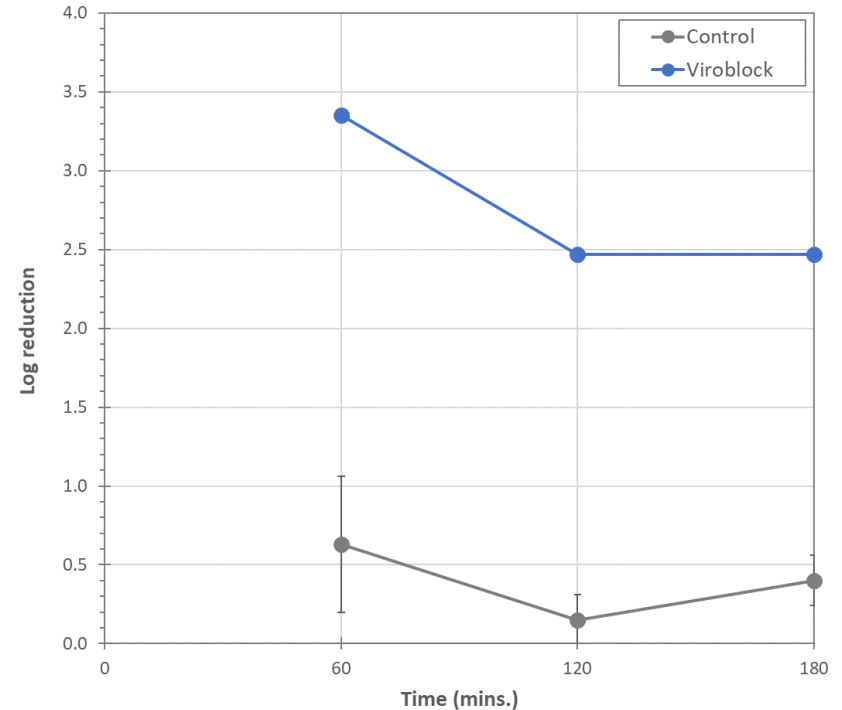


Misting study results

- Cotton fabric (Untreated control vs HeiQ Viroblock treated)
- Exposure to Human influenza A (H1N1)

Study	Agent	Time (mins)	Control	Viroblock
798-119	H1N1 (Human Influenza A)	60	0.63	3.35
		120	0.15	2.47
		180	0.40	2.47

- **HeiQ Viroblock treated fabric shows dramatically improved reduction (>100 times) in virus infectivity over a 3 hour period**





FFP2 control facemask vs FFP2 treated HeiQ Viroblock



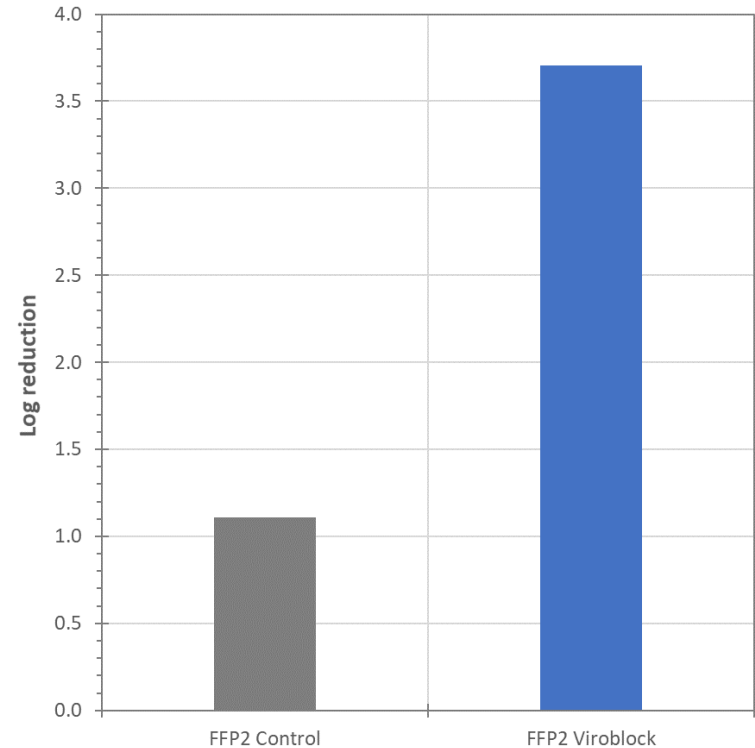


Misting study results

- FFP2 face masks (untreated control vs HeiQ Viroblock treated)

Study	Agent	FFP2 Control	FFP2 HeiQ Viroblock
798-126	H1N1 (Human Influenza A)	1.11	3.71

- HeiQ Viroblock treated FFP2 mask shows **dramatically (>100 times) improved reduction** in virus infectivity (mist contact)





Face mask performance comparison

- FFP3 masks have a higher resistance to breathing than FFP2 masks leading to higher metabolic cost. Higher resistance can lead to greater fatigue and exertion for prolonged periods of mask wearing. ^{1, 2)}
- FFP2 mask material treated with HeiQ Viroblock showed similar virus reduction to FFP3 mask material** ³⁾
- Masks treated with HeiQ Viroblock provide significantly **greater protection against surface contamination** of the mask material ⁴⁾

Mask type	Metabolic cost (W/m2) ¹	Max breathing resistance (Pa) ²	Log reduction (H1N1 human influenza)			
			Aerosol protection ³		Surface protection ⁴	
			Control	HeiQ Viroblock	Control	HeiQ Viroblock
FFP2	20	70		5.22	1.11	3.71
FFP3	40	100	5.11			

[1] Roberge, R.J., Kim, J.H. and Coca, A., 2012. Protective facemask impact on human thermoregulation: an overview. Annals of occupational hygiene, 56(1), pp.102-112.

[2] Senić, Ž., Ilić, M., Radojković, A., Rajić, D. And Karkalić, R., Efficiency of Respiratory Protection Devices Against Bird Flu Virus. 4th International Conference on Defensive Technologies, OTEH 2011, 2011 Oct 6-7th.

[3] Viroblock, Aerosol study 798-121

[4] Viroblock, Misting study 798-126



Droplet breakthrough

- A cough can release around 100,000 droplets into the air ¹⁾
- A scenario of a mask exposed to all 100,000 droplets yields different resulting numbers of viable virus droplets passing through:

Mask	Log reduction [2]	% reduction	Viable droplets passing through mask
FFP2 control	3.63	99.9766%	>23
FFP2 & HeiQ Viroblock	5.38	99.9996%	<1



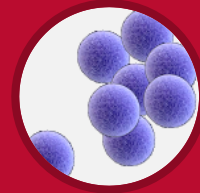
- **HeiQ Viroblock treatment enhances the level of virus protection for masks by >10 times**

1) Gerone, P.J., Couch, R.B., Keefer, G.V., Douglas, R.G., Derrenbacher, E.B. and Knight, V., 1966. Assessment of experimental and natural viral aerosols. Bacteriological reviews, 30(3), p.576.

[2] Viroblock, Aerosol study 798-110



HEIQ[®]
PURE



Recycled silver & bio-based amino sugar polymer

Antimicrobial odor control

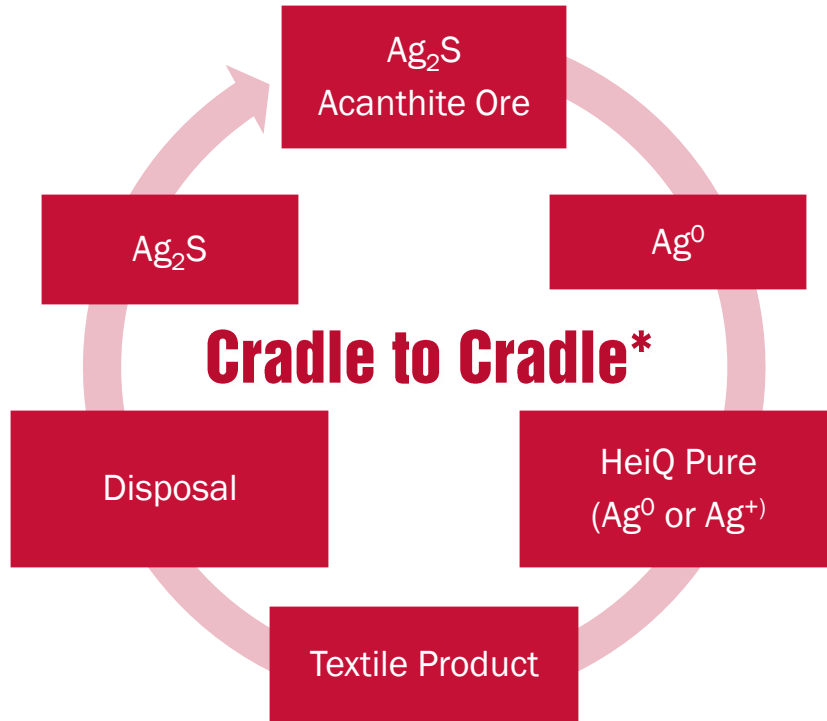


Silver salt based on recycled silver

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

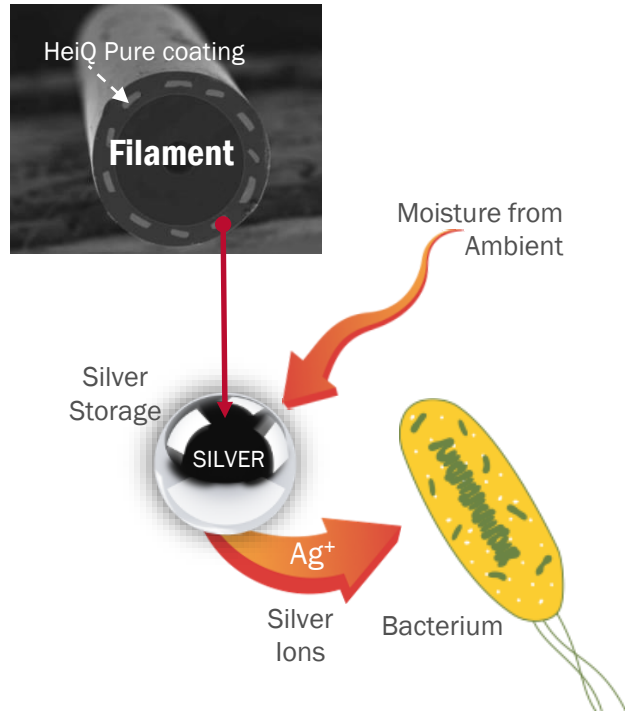
3) Damm, C. et al., Soft materials, 2006, 3:71-88

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.



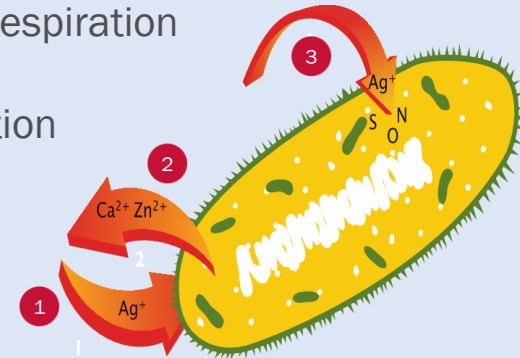
HeiQ Pure – Mode of Action



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

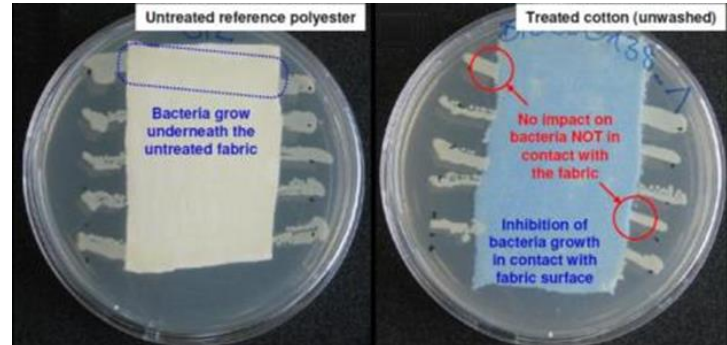
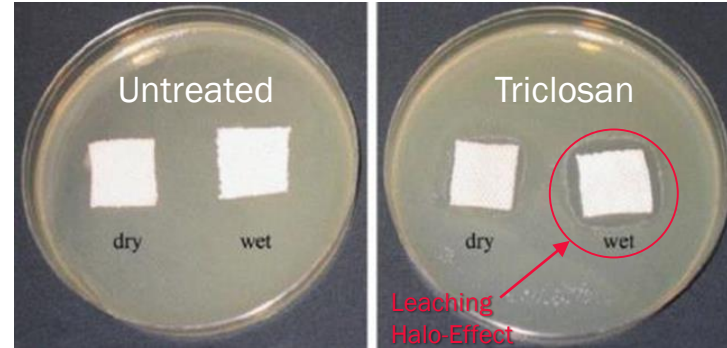




Safe to the Skin

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



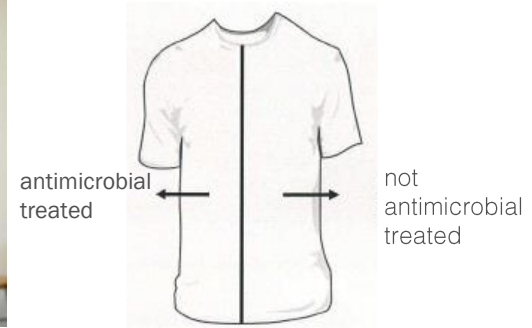
Silver & skin flora – Study performed by Hohenstein

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

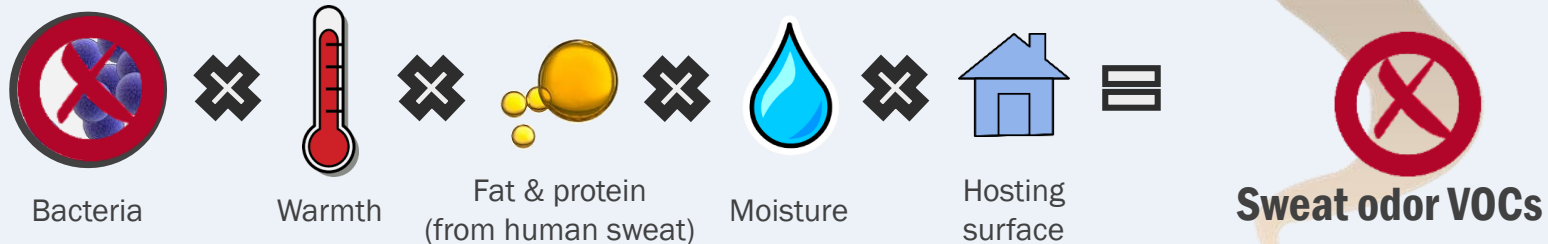


Sweat odor: Did you know?

- Sweat does not smell
- Gram-positive bacteria, eg. *Staphylococcus Aureus* found on skin, produce 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

HeiQ Pure SPQR tackles in two actions

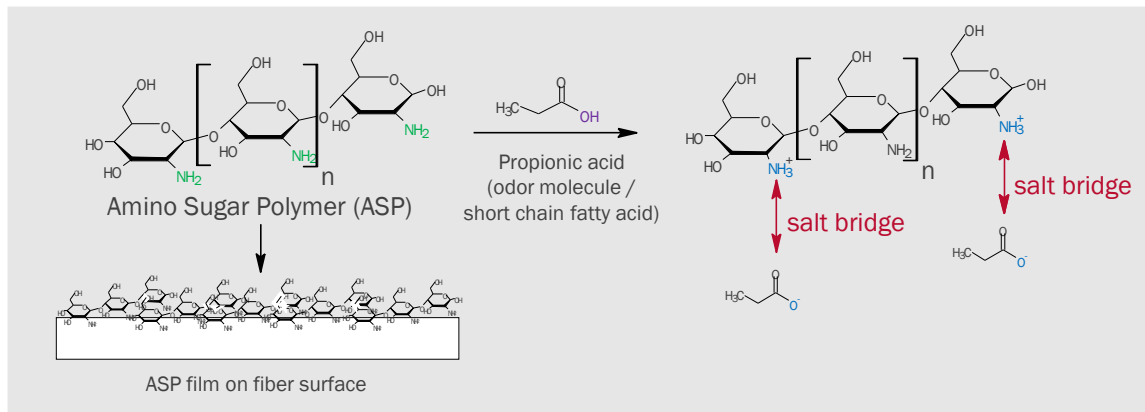


*Butanoic acid

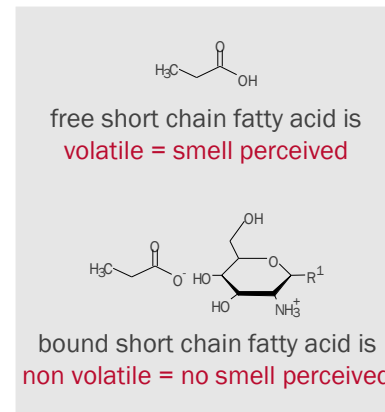


Detailed mode of action of the Amino Sugar Polymer

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 Viroblock and 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)

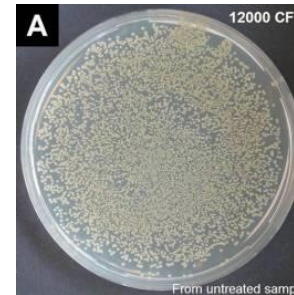


Bacteriostatic efficacy test (ISO 20743)

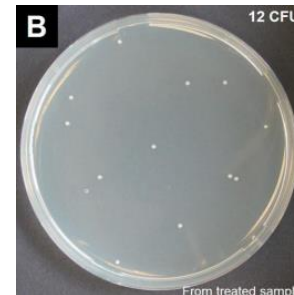
Quantitative test method for the determination of bacteriostatic activity on textiles including nonwovens



- 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

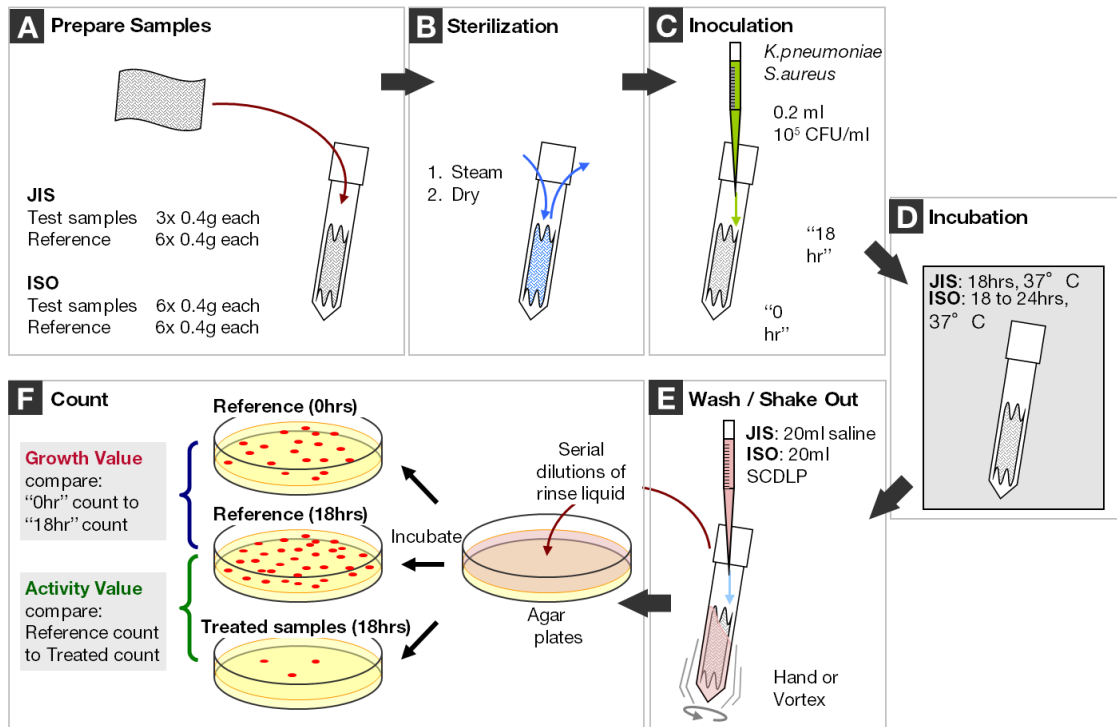


Treated with
HeiQ Pure TAG

*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

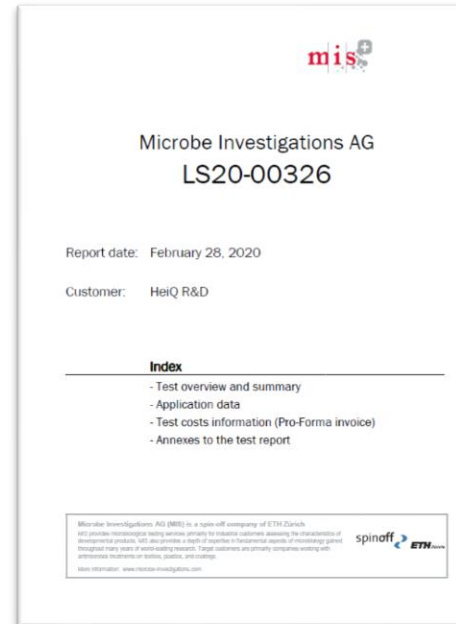


Antimicrobial Testing

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)

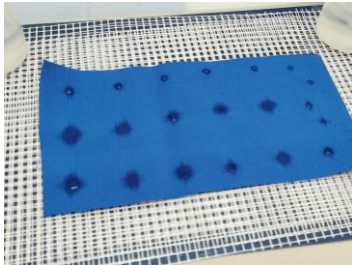
Control	Initial	After 18 h
Log cfu	4.4 St.Dev.: 0.1	7.2 St.Dev.: 0.1
Sub-Samples	1-1	2-1
Log cfu Sample (staph) [none]	2.0 St.Dev.: 0.0	2.0 St.Dev.: 0.0
Percent reduction Sample (staph) [%]	99.9994	99.9994
Log reduction Sample (staph) [none]	5.2	5.2
Performance style Sample (staph)	Detailed (VG/G/M/P)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



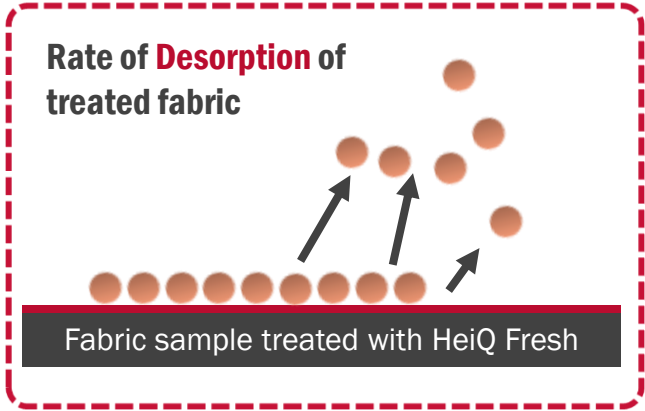


Odor emission test (adapted ISO 17299-2)

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

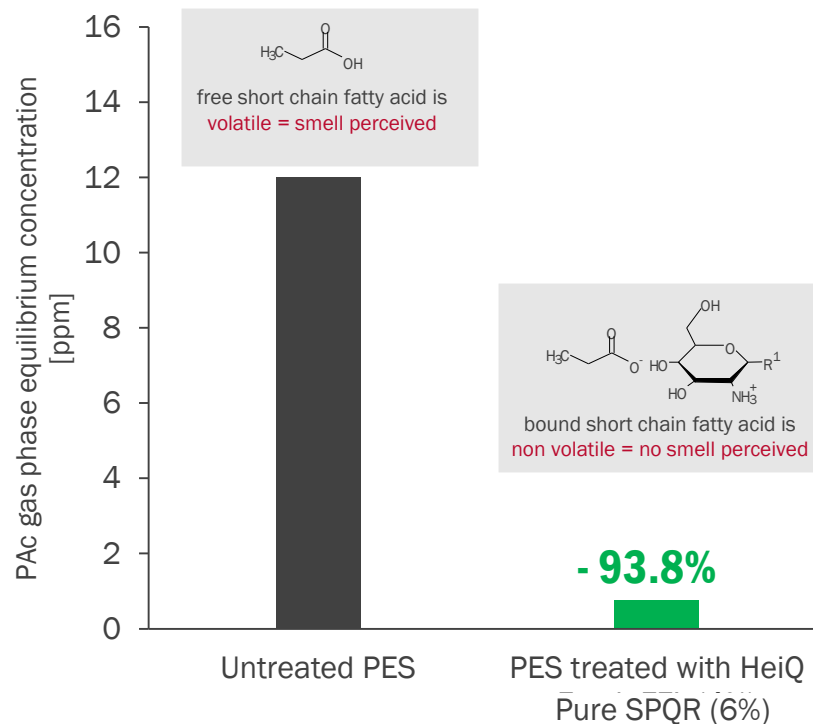


*QA = Quality Assurance test method (at cost if used for QC purpose)



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 Viroblock and HeiQ Pure be used?



HeiQ Viroblock application areas

All fiber types

Non-wovens

- HeiQ Viroblock NPJ03 is ideal for non-woven products:
 - Face masks
 - Air filters
 - Medical non-wovens (eg. surgical gowns, scrubs, drapes, curtains etc.)





HeiQ Viroblock's unique selling points

- HeiQ Viroblock treated textiles help to **reduce the risk of viral and bacterial persistence on dry inanimate surfaces**, thereby lowering the potential for transmission
- HeiQ Viroblock confers **antiviral & antibacterial effect to textiles**
- HeiQ Viroblock is a **Swiss** technology
- HeiQ Viroblock technologies effectiveness has been **tried and tested as active** against viruses that commonly affect human health.



Every few years, epidemics breakout globally or regionally causing disruption to lifes, sometimes leading to social distress, financial market crashes and economic downturn.

Photo: Commuters wearing protective masks in a MTR station in Hong Kong on the 5th day after first confirmed case of novel coronavirus (Covid-19) in Hong Kong.

Photo from CNBC, Paul Yeung | Bloomberg

HeiQ Viroblock ingredient brand and hangtag



HeiQ Viroblock logo



SWISS TECH INSIDE logo
Sewn-in label

HeiQ Viroblock 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** needs to be submitted for HeiQ's review.
 - Acceptable tests for HeiQ Pure treated fabrics: **ISO 18184**.
 - Third-party laboratory tests are accepted. HeiQ does not offer ISO 18184 test.
- **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!)

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



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 - 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 Viroblock and HeiQ Pure



Regulations & labels

All HeiQ Pure & HeiQ Viroblock products are thoroughly tested for **Safety, Sustainability** and **Environment**

- Harmless to skin and body
- Uses a minimum of active ingredient, best in industry class

The family contains products and actives 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





Differentiate. Innovate.

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