

# Silver Leaching

A Report on  
Silver in Sportswear





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Svenskt Vatten

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**Graphic design:** Ordförandet AB

**Issue:** 1 November 2018

**ISSN no:** 1651-6893

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# Summary

Silver Leaching is a report on silver in sportswear. Our intention with this report is to highlight the problems created by silver for our environment and water cycle. We wish to highlight above all the leaching of silver which takes place when washing this clothing and which will in the long run affect life in our lakes and seas.

Silver is used in items such as sportswear because of its antibacterial properties. What many of us do not know is that silver is classified as a biocide; that is to say, a toxin. In the long run the silver found in the water cycle can pose a significant threat to the wealth of life in the sediments of our lakes and seas. Sediment-dwelling creatures and organisms play a crucial role in the biological networks created by nature.

A large problem with silver in sportswear is that the silver leaches out on washing the clothing. That is to say, the silver “breaks free”, meaning that it ends up in wastewater and finally in the water cycle. Companies which market odour-reducing treatment sometimes claim that no leaching takes place during washing. However, the Swedish Water & Wastewater Association (Svenskt Vatten) has carried out washes in a laboratory setting and can demonstrate that leaching takes place in all silver treatments on sportswear. Between 31 and 90 per cent, with a median value of 72 per cent of the silver had leached out after ten washes. The worst case was a pair of tights which had been treated with Polygiene and bought at [fitnessbutik.se](http://fitnessbutik.se), and contained only one tenth of the silver content after ten washes. The remainder – 90 per cent – had leached into the wastewater.

In the light of these results, Svenskt Vatten is issuing new washing instructions for clothing containing silver. Sportswear such as socks and jumpers containing silver ought not to be washed in a standard washing machine. Instead they ought to be washed by hand. The water ought to be collected in a container used for that purpose alone, and then treated as environmentally hazardous waste. See more information about the new washing instructions further down in this report. The washing instructions are intended to illustrate the leaching of toxins that is taking place. Our message is that it is always better to buy clothing which does not contain silver. And we would like to see even more chain stores and clothes labels in the industry acting responsibly and phasing out their silver-treated articles. Starting today.

Another effect of the use of silver in society is the rise in antimicrobial resistance (AMR). A study by Susanne Sütterlin, a researcher and specialist doctor in clinical microbiology at Uppsala University, showed that silver seemed able to reduce the level of sensitivity/resistance to antibiotics.

We have also looked at the way this so-called anti-odour clothing is labelled. According to current EU legislation – the Biocidal Products Regulation 528/2012, the labelling should show whether an article contains a biocide; that is to say, a substance classified as a toxin. The word “biocide” or “biocidal product” ought to be stated. Moreover, the labelling should also state which biocide; that is to say, which toxic substance, has been used to treat the garment.

## Summary:

- Clothing treated with silver may pose a threat to sediment-dwelling creatures and organisms in our lakes and seas. So-called sediment-dwelling organisms are more sensitive than we have previously thought.
- The spread of silver in the environment may be contributing to the rise in antimicrobial resistance (AMR).

- We are aware today that the antibacterial silver leaching from treated textiles is the largest known source of silver in our treatment plants, at the same time that the amount of silver entering the treatment plants must be reduced by more than half if the water cycle is to be sustainable in the long run.
- Antibacterial silver in clothing leaches out in the wash and always increases the amount of silver ending up in the treatment plants – this clothing is therefore taking the trend in the entirely wrong direction.
- After ten washes the amount of silver leached from the silver-treated clothing is 31–90 per cent. The median lies at 72 per cent, according to the laboratory analysis commissioned by Svenskt Vatten. This means that two thirds of the silver have leached out after ten washes.
- A total of fifteen garments were tested in laboratory conditions. All of these were labelled in some way as anti-odour (for example, “prevents bad odours”, “for lasting freshness”, “anti-odour”). Nine out of fifteen contained silver, according to the laboratory analysis. Of these nine, eight were treated with Polygiene, a patented treatment using silver chloride supplied by the Swedish company Polygiene AB.
- The clothing brands are sloppy with their labelling. According to EU regulations, each so-called anti-odour garment should have a label clearly stating which biocide has been used to treat it. Several clothing brands are poor in this respect.
- The retail stores fail to inform consumers about which toxic substances are present in the clothing. They should by law provide answers to any questions they receive from consumers on this issue within 45 days. When we asked them, several were unable to state which active biocides were used to treat their anti-odour sportswear.
- Bluesign, which is an environmental standard, accepts the presence of silver in its clothing despite the fact that according to our laboratory analysis it leaches silver into the water cycle.

#### **Svenskt Vatten’s requirements:**

- The spread of antibacterial silver in the environment must stop.
- The industry must begin to phase out all clothing and textile articles that have been treated with silver. Starting today.
- Manufacturers must be much better at labelling their clothing correctly. The labelling shall clearly state that the garment has been treated with a biocide.
- Svenskt Vatten will report stores whose labelling is inadequate to the Swedish Chemicals Agency. These include Adidas, Addnature and Fitnessbutiken.se.
- Sweden ought to encourage the EU to introduce requirements that ensure clearer labelling. For example, one absolute requirement should be that biocide-treated articles sold on the Internet are clearly labelled on both the website and the garment that arrives in the post.
- Consumers ought to avoid buying “anti-odour” clothing if they are unsure whether or not these contain silver. Always ask in the store.
- Svenskt Vatten would like to know why clothing treated with silver meets with Bluesign’s approval. What consideration does Bluesign give to the fact that a significant part of the antibacterial biocide is washed out and ends up in our waters and the water cycle?

# 1. Introduction

Sportswear that does not smell of sweat is a business concept. Quite simply, people want to be able to work out and sweat without smelling bad. For a long time now many products have been available on the market that are promoted on the basis of their odour-reducing properties, even though the effectivity of these is a subject of dispute. It sounds like a good, innocuous idea. But in actual fact it is deeply problematic.

Antibacterial silver is dangerous to both the environment and health. The substance is classified as a biocide, and is thus regarded as a toxin. In ion form it is highly dangerous to bacteria and aquatic organisms. It is therefore of the utmost importance that silver is not spread in the natural environment unnecessarily. Silver is an element and is therefore not degradable but rather is enriched in the environment over time. It is also a so-called reactive substance, which means it reacts with other substances. The risk is therefore great that toxic silver ions are released in water and in to the sediments of the bottom of our lakes and coastal waters.

Today silver is one of the substances that must be reduced in the wastewater to the treatment plant. It is therefore of key importance that the total use of silver in society is reduced. Silver-treated sportswear ought to be taken off the shelves.

## **The use of silver**

It has long been known that silver kills bacteria. Its antibacterial properties have, for instance, been used in silver cans to avoid bacteria in drinks. In recent years it has become common for a large number of consumer products to be treated with silver. This applies, for instance, to furniture. Antibacterial treatments are used in industry and the public sector as well. One example of this is the doors in catering kitchens and the food industry, which are sometimes covered with an antibacterial coating.

Several years ago the Swedish Environmental Protection Agency published a compilation of all the screenings made by the Agency in their search for biocides; that is to say, toxic substances in nature and the environment. Silver came top of the list of biocides in nature.

Table 1. The five most commonly found biocides in the environment.

Biocid	"Rate of discovery"
Silver	76 %
Triklosan	59 %
Formaldehyde	56 %
Methyl paraben	45 %
Irgarol	43 %

Source: Swedish Environmental Protection Agency report 6634

In 2015 the Swedish Chemicals Agency tested the effect of antibacterial treatment. Two out of three products tested had no antibacterial effect after ten washes. "Our study shows that the antibacterial treatment of textile articles have no effect in most cases. It's almost a stroke of luck if you happen to buy a garment which is still serves that function after several washes," said Ulrike Frank, scientific officer at the Swedish Chemicals Agency in a press release regarding the results.



Once antibacterial silver in items such as sportswear reaches the treatment plants it will always increase the amount of silver in the natural environment. This means, therefore, that the current trend is going in entirely the wrong direction.

### ***Anti-odour – a business concept***

Clothing that does not smell of sweat is a business concept in itself. There are a number of companies on the market for odour control. Most solutions are based on different kinds of antibacterial technology where silver often plays a crucial role. The Swiss company Sanitized is a global giant which has been in existence since 1935. The company supplies antibacterial treatments for products in a number of areas including clothing. The technology it uses contains silver in most cases.

HeiQ is another Swiss chemical company offering different treatments for textile articles, such as HeiQ Fresch Tech, which is marketed with the description “long-lasting odour control”. According to the company, this treatment is used on 300 million garments every year. The Swedish company Polygiene was founded in 2006, and its turnover last year was just over SEK 75 million. Its clients include internationally renowned brands. Polygiene states that a total of 140 clothing brands use their odour-reducing technology.

There are also other solutions. The company Antimicrobial Copper uses technology based on copper which is primarily applied to hard surfaces – not clothing, in other words. In certain cases Haglöfs use a treatment that does not contain silver, in which case they use instead technology based on recycled coffee grounds. The grounds are dried and crushed in the size of nanoparticles which are incorporated into the material fibres. These contain no silver.

### ***Is silver harmful to the environment?***

Silver is an element which in ion form is highly dangerous to both bacteria and aquatic organisms. It is an element classified as a biocide, and is thus regarded as a toxin.

That this substance is an element does not mean that it is harmless. On the contrary, there are several examples of elements that are dangerous to both the environment and to health and life. Cadmium and lead and mercury are examples of such elements. What defines whether silver is dangerous is, above all, which form it takes. Silver can occur in different reactive compounds such as silver nitrate, silver chloride and silver sulphide. In ion form it is highly toxic.

When washing sportswear a certain amount of silver always leaches out, as is shown by our analyses (see below). Much of this silver is captured in treatment plants. Up to 90 per cent of the silver is successfully separated by the treatment plants. This is of course highly significant and important with respect to the environment. The fact that “only” one tenth continues on its way into our lakes and seas may not sound like much. But bearing in mind the toxic properties of silver and the fact that it never degrades and is therefore constantly building up in the natural environment is far from acceptable.

In the long run, silver may above all do damage to the organisms living in the sediments of our lakes and seas (benthic organisms). These include spawn, eggs, bacteria, crustaceans and bristle worms. “It is the sediment-dwelling organisms that will be the most vulnerable aquatic organisms, which is confirmed by the test data we have access to,” says Christoffer Österwall from the Swedish Chemicals Agency .

It is therefore not primarily fish and other creatures in the water that might be affected by the silver we spread, but considerably smaller organisms. That in itself constitutes a real worry. Edda Hahlbeck, environmental risk assessor at the Swedish Chemicals Agency, has this to say: “We have access to studies carried out by our applicant companies within the framework of evaluation under the Biocidal Products Regulation. These studies show that sediment-dwelling organisms are more sensitive than previously thought. In the past we have not looked at the most relevant method of ingestion, which is via food. In other words, organisms that eat food or sediment contaminated with silver are the most sensitive. This is because silver readily binds

to particulate matter in the water, which gradually sinks down to the lake or sea bottom sediments. There are measurements showing that silver is enriched in this way in the sediment so that it amounts to concentrations from several thousand to hundreds of thousands of times higher than in the water.”

Just how the abundance of life in the sediments of our lake and sea is exactly affected by silver we don't know. However, what we do know, and have already said, is that silver has the property to kill living organisms. The long-term effects on aquatic life are hard to foresee, and it is therefore crucial that silver does not end up in our waters.

Another effect of the use of silver in society is more widespread antimicrobial resistance (AMR). A study carried out by Susanne Sütterlin, a researcher and specialist doctor in clinical microbiology at Uppsala University, showed that silver seemed able to lower sensitivity/resistance to antibiotics. The silver-resistant genes were found mainly in bacteria isolated by researchers from the human body involving individuals living in Sweden. The Swedish Chemicals Agency has pointed to other health risks too: “There are also studies ... indicating that silver nanoparticles can affect the development and physiological function of the nervous system”.<sup>1</sup>

In 2015 the Swedish Chemicals Agency published a report entitled “Kemikalier i textilier – Riskor för människors hälsa och miljö”. In this report the Agency laid particular emphasis on the connection between antibacterial biocides and antibiotic resistance: “The development of bacterial resistance to antibiotics is a very serious issue for human health, and all unnecessary use of biocides ought therefore to be avoided.”

### ***Is the silver used in sportswear a problem?***

Yes. That is the short answer to the question of whether silver in sportswear is a problem.

Polygiene is one of the companies offering a treatment containing silver chloride for clothing and textiles. That is the treatment that cropped up most often in the randomly chosen items of sportswear that underwent our laboratory tests. That is reason, therefore, to look more closely at the company's information and marketing material. Polygiene claim that that the treatment they offer can withstand harsher mechanical treatment and washes in higher temperatures. Our tests show, however, that Polygiene also leaches silver in a standard 40°C machine wash. None of the garments treated with Polygiene leach a zero amount of silver. On the contrary, the fact is that in one case 90 per cent of the silver is washed out after only ten washes.

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<sup>1</sup> “Kemikalier i textilier – Risker för människors hälsa och miljö”

The company believe that their silver poses no danger to the environment. But even the silver that leaches from Polygiene-treated clothing and does not collect in the treatment plants ends up in our water and the sediments of our lakes and seas. Polygiene claim that their silver does not harm aquatic organisms since it reacts with sulphur to form silver sulphide, which has a more solid structure and thus poses no danger. This claim is not without substance. It is true that silver ions can bind with sulphur. But a compound of this kind can also react with other substances and be “broken up” – in other words, it is reactive. One illustration of this is provided by the German Environment Agency: “... the formation of  $\text{Ag}_2\text{S}$  is an equilibrium response. Therefore, reactive  $\text{Ag}^+$ -ions will occur in solution. Depending on the environmental conditions  $\text{Ag}_2\text{O}$  and  $\text{Ag}_2\text{S}_2\text{O}_4$  will be formed at the surface of  $\text{Ag}_2\text{S}$ . As these compounds are more soluble than  $\text{Ag}_2\text{S}$ , this will cause an increased concentration of  $\text{Ag}^+$  in the solution.” The implication of this is that silver sulphide is reactive as well.

In short, a treatment such as Polygiene also contributes to the amount of silver collecting in the sediments of our lakes and seas, where in the long run it will constitute a threat to all living organisms in the oh-so-vital bottom sediments in our lakes and seas.

Other silver treatments contain nanoparticles. Nanosilver too has been especially singled out as a risk in the spread of antimicrobial resistance (AMR).

The industry needs to be far more proactive. What is needed is more clearly defined aims and knowledge in order to help customers choose products that don't contain hazardous substances. The solution is for the store/chain to acquire sufficient knowledge so that right from the time of purchase it phases out the substances that should not enter the water cycle.

## 2. Wash analysis

Svenskt Vatten commissioned Swerea to carry out an analysis of sportswear labelled “odour-free” or similar. A total of fifteen items of sportswear and products were included in the analysis.

The silver was tested before and after each of ten washes. The garments were washed in 40°C using 40 grams of washing detergent (Via Color), according to the dosage instructions on the packaging. The analysis of the silver was carried out using ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry) after leaching. After ten washes all nine garments had leached silver. Swerea reported that: “In every case where the silver content was established before washing, a reduction in content was measured after the wash, which indicates that it had leached out of the garment and been washed away in the wash water.”

- Nine of the fifteen garments were shown to contain silver.
- The original content of silver in most of the clothing treated was between 7.3 and 15.4 mg/kg.
- One athletic sock contained 686 mg per kg. After ten washes, 31 per cent had been washed out, which meant that 210 mg per kilo of wash water had disappeared down the drain.
- After ten washes, 31–90 per cent of the silver had leached out.

Table 2. Silver content in mg per kilo textile articles.

Garment/brand	Unwashed	10 washes	Per cent silver washed out
Tights/MxDc Sport	1	0.1	90 %
Hotpants/Dcore	7.3	1.8	75 %
Vest/Dcore	11.7	2.2	81 %
Sock/Sky Run	686	476	31 %
Sun shades/Buff	15.4	4.3	72 %
Bandana/Buff	7.8	3.7	53 %
T-shirt/Haglöfs	2.8	1.3	54 %
T-shirt/Adidas	8.6	2.4	72 %
Knee brace/POC	7.9	1.2	85 %

Silver in sportswear largely disappears after only a few washes. This is the finding of an entirely new analysis carried out by Swerea on behalf of Svenskt Vatten. Fifteen items of sportswear and products were analysed and washed. Nine of these contained silver.

### **The silver released by one individual**

Our analysis gives us a clear picture of how much of the silver disappears when the garments are washed. What does this mean at individual level? How much silver in the water cycle has been contributed by one person? Let’s do some simple calculations.

According to our analysis, the median of the silver leached after ten washes was no less than 72 per cent. This means that almost three quarters of the silver was washed away after only ten washes. Let’s say that one person has two or three garments that weigh 500 grams when taken together. That person uses the garments regularly and washes them ten times a year. This means they contribute 3.1 mg silver to the water cycle in

one year – just from washing these garments. The median in our analysis is 6.2 and the garments weighed 500 grams; that is to say, 3.1 mg silver.

One interesting benchmark is to measure the silver content in the sludge in the treatment plants. Approximately 90 per cent of the silver entering the treatment plant becomes stuck here. The median value relates to the treatment plants and is certified by REVAQ certification scheme as being 1.8 mg Ag/kg TS. Each person produces 22 kg sludge TS per person and year =>  $1.8 \times 22 = 40$  mg Ag/per person and year; that is to say, each person quite simply increases their personal contribution of silver to the natural environment by almost 10 per cent by washing only two or three garments. The person who happens to have bought a pair of socks leaching 21 mg Ag is suddenly adding 50 per cent more silver to the water cycle.

## 3. Labelling

All countries in the EU have to meet clear requirements on how articles containing biocides shall be labelled. This applies, in other words, to items such as sportswear containing silver intended to reduce odour. The labelling shall be clear, in Swedish, easy to read, and remain attached during use. According to the Swedish Chemicals Agency report “Regler för biocidbehandlade varor” (April 2018), it shall include the following:<sup>2</sup>

- information stating that the article contains a biocidal product
- the name of the active substance
- the purpose of the treatment, such as the addition of silver to remove bad odour
- relevant instructions for use and any precautionary measures, such as a particular action to be taken by the person wearing the article in order to protect human health or the environment
- the name of the nanomaterial, if such is found in the article.

### ***The response from the stores regarding biocide treatment***

The dealer, or party selling the article, also has a duty to inform the consumer about which biocide treatment has been used on the article, should the consumer request it. This information shall be supplied within 45 days, and the duty to inform is stated in article 58 of the EU Biocidal Products Regulation.

Having received the information from the laboratory analysis on which garments and products were treated with silver, we contacted the dealers to see whether they were fulfilling their obligation to inform consumers about which biocide treatment had been used on their article.

The companies whom we contacted and which sell biocide-treated articles were: Fitnessbutiken.se, Zalando.se, Athleteshop.se, Addnature.se and Adidas.se. All of these apart from Adidas.se, which did not respond at all, sent a quick answer by email within 45 days.

This was how we put our question: “Hi. I bought the following products ... Have they been subjected to any kind of biocide treatment? If so, which? And for what purpose?”

This is the answer we received by email from Zalando, for example, when we asked about a pair of socks labelled “Metal: 2%”: “The metal contained in this material provides one of the many properties found in these socks. Unfortunately I cannot find the answer to what the metal actually does. Zalando is a retailer of this product which is supplied by the manufacturer, X Socks. Unfortunately, all we have is the information provided in the product description on our website. Also, our customer services are not located near our warehouse, which means I’m afraid I cannot check the product in person. I apologise if I have not been able to give you the answer you were expecting on this occasion.”

Fitnessbutiken gave the correct answer and specified the biocide, and wrote: “Polygiene is a Swedish company that uses silver chloride to help clothing manufacturers combat and minimise the increase in bacteria, above all in polyester.”

Three stores provided answers such as: “Silver has a natural antibacterial property” or that they are simply “treated to combat odour and extend their shelf life”. They did not describe which biocide treatment had been used on the garments and thus did not fulfil the requirements regarding information to the consumer.

Adidas.se gave no response at all (despite several emails).

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<sup>2</sup> kemi.se

## 4. Acts and regulations

The EU Biocidal Products Regulation 528/2012, which came into force in 2013, contains regulations on biocidal products and biocide-treated articles. The Regulation applies in all member countries regardless of national legislation. Silver and all chemical compounds that release silver or silver ions are regarded as a biocidal product that requires authorisation if they are intended to have an antibacterial function. Biocide-treated articles may no longer be sold within the EU if the active substances they contain are not authorised and if the articles are not labelled as a biocidal product.

Silver is a biocide. In this report we have concentrated solely on different silver compounds, but there are other biocides too, such as triclosan, triclocarban, zinc pyrithione and permethrin, which have also been used for the antibacterial treatment of textile articles (triclosan has been banned in textiles over the past few years).

### ***What is a biocide?***

Biocides are pesticides which are used for such purposes as treating textiles and articles. The word biocide comes from the Latin, and means life-killer. Biocide-treated articles are all substances, compounds or articles which are treated with or which deliberately contain one or more biocidal products.

### ***Does Sweden as a member country of the EU have any influence over the legislation on biocides?***

Sweden has a particular influence on issues concerning silver because it is one of the reviewing member countries for silver as part of the review programme. It is the Swedish Chemicals Agency that is the competent authority regarding and chairing the review on silver and the implementation of the Biocidal Products Regulation. After the Swedish Chemicals Agency has submitted its report, a review process takes place within the EU whereby the other member countries submit their views on the report.

As part of a previous government assignment (within the framework of A Non-Toxic Environment), the Swedish Chemicals Agency has presented an overview of hazardous substances that can be found in textile articles, together with a proposal on how such substances can be regulated within the EU. This overview was not an exhaustive one, and one conclusion has been that there may well be a number of substances that have not yet been identified and therefore not reported. The potential risks associated with the exposure of humans and the environment to these were not covered by the previous assignment.

### ***Does this mean that the EU will ban certain silver compounds?***

The aim is not to ban silver compounds but to evaluate the risks associated with biocide use in certain areas for which applications have been submitted. Which areas of use will be subject to risk reduction measures is as yet unclear, because the decision-making process for the first four silver substances is still ongoing

### ***What is being done at national level to reduce the use of biocides such as silver in clothing?***

Dialogue in Sweden with the retail industry has begun, and many Swedish companies have voluntarily removed from their range those articles that have undergone antibacterial treatment. Promotions and greater supervision also serve to increase our knowledge about the risks posed by biocide-treated articles to the environment and health.



During 2019 the Swedish Chemicals Agency will run a cooperation project with Sweden's municipalities, which will focus on the information to be provided on hazardous substances in articles. This will include a check on the way companies in Sweden label biocide-treated articles and on their duty to inform regarding certain hazardous substances in articles. These substances are listed in the so-called Candidate List. Legislation in this area is provided in the form of the EU Biocidal Products Regulation and the Chemicals Regulation REACH.

The municipalities will check articles in the retail industry, while the Swedish Chemicals Agency will focus on manufacturers, importers and major chains. At the same time in 2019, an EU-wide project focusing on biocide-treated articles will get underway. The results of the inspections made by the Swedish Chemicals Agency and the municipalities will be reported to the EU project.

### ***Who is responsible for a biocide-treated article?***

A body which imports a biocide-treated article such as an item of sportswear into the EU or which manufactures the article within the EU is responsible for ensuring that the article is not dangerous to human health or the environment and that the labelling complies with the EU Biocidal Products Regulation.

### ***Does the body selling the biocide-treated (silver) article assume any responsibility?***

The seller of the article must check that the labelling requirements have been fulfilled. They may not, therefore, sell a treated article that has no label or has been incorrectly labelled. If "antibacterial" or similar is stated on the label, the seller shall investigate whether the article contains a biocide and, if so, which biocide. It must then be labelled. The purpose of the labelling is to inform the consumer whether the garment contains biologically active substances that could affect their health or the environment.

### ***Is treating sportswear with silver legal?***

Up to now the treatment of textiles using certain biocides has been legal, but many of these biocides are under review in the EU. The articles of primary concern are those aimed at consumers and especially children, and the aim is to reduce the use of antibacterial substances in society wherever it is simply unnecessary. The increased use of biocides has also led to a growing concern that bacteria will develop resistance to the antibacterial substances, and that this in turn could affect the development of antimicrobial resistance (AMR). The development of bacterial resistance against antibiotics is a very serious issue for human health, and all unnecessary use of biocides ought therefore to be avoided. We know that when an antibacterial substance is released into the environment on a constant basis and in moderate concentrations, this can create perfect conditions for bacteria to develop resistance against the substance. Sweden is especially keen to see EU legislation developed so as to limit the risks associated with biocides in textile articles.

### ***How do you recognise or identify a garment that has been treated with the biocide silver?***

The wording on the label of the garment or article may say "treated to reduce odour", "anti-odour treated", "anti-odour", "treatment for bacterial growth prevention and odour stop", "antimicrobial", "for lasting freshness" or "combats odour".



***Could it say “antibacterial” or something similar without the article containing a biocide such as silver?***

Yes, many companies have replaced biocide-treated products in their sales range with more environmentally friendly alternatives. In our survey, for example, Haglöfs had a T-shirt which had been subjected to an anti-odour treatment made from coffee grounds. Another example is merino wool in sportswear, which is marketed as being antibacterial. Lanolin such as that found in merino wool has a natural antibacterial function.

***Who is to provide proof of the benefits and effects of biocide treatment using silver?***

According to the EU Biocidal Products Regulation and marketing legislation, claims about biocidal properties may not be stated if its effectivity has not been proven and demonstrated. A manufacturer which intends to release a treated article on the market and claim it has certain biocidal properties must be able to back up such claims. If it has no benefit or effect, taking the risks to health and the environment that can often arise in the case of biocides is unnecessary.

The whole area of providing proof of effectivity is relatively untested and most unclear in the opinion of the Swedish Chemicals Agency, and it addressed on a case-by-case basis.

***Are there reasons for using silver in clothing?***

The benefit of clothing treated with silver is subject to much debate. The Swedish Chemicals Agency believes it is completely unnecessary. There are bacteria everywhere, and there are many bacteria we need. Antibacterial treatment may be needed in environments such as hospitals, but in those cases disinfectants are used which are more effective.

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- “Regeringen måste förbjuda silver i kläder”, article in Ny Teknik 21/05/2012 “Silver i kläder fullständigt onödigt”, article in Ny Teknik 26/05/2017 lamidoors.com/se/produkter/
- polygiene.com
- bluesign.com
- oeko-tex.com

## WASHING INSTRUCTIONS ..... ***FOR SPORTSWEAR***

TREATED WITH SILVER



.....

Sportswear are often treated with silver to kill bacteria and remove bad odours. What many people do not know is that antibacterial silver is toxic. Every time you wash the clothes, silver leaks out and collects in the water. In the long term, it constitutes a considerable threat to organisms in our lakes and seas.

Avoid clothing that has been treated with silver. Then you do not have to worry about the wash water and you will contribute to a cleaner environment.

.....

Sweden should have fresh drinking water, clean lakes and oceans.  
*Washing instructions for sportswear treated with silver* is a recommendation from  
The Swedish Water & Wastewater Association.



\* No, of course you shouldn't really turn in your wash water.  
Just avoid buying clothes treated with silver.

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Uppdragsgivare <b>Svenskt Vatten AB</b> <b>Box 14057</b> <b>167 14 BROMMA</b>	Uppdragsgivarens ref. nr.  Kontaktperson <b>Anders Finnson</b>
	Vårt ref. nr. <b>5180387_rev1</b>

**Avsikt**

Undersökning av hur tvätt urlakar silver ur textila plagg och produkter. Silver används som biocid i vissa material

**Provmaterial**

1-15	Femton olika provmaterial inköpta under april 2018 och där det i de flesta fall fanns något påståenden om att materialet motverkar dålig lukt eller är anti-odörbehandlat.  Se bilaga 2 för detaljerad beskrivning av provmaterial
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Provmaterialen erhöles från uppdragsgivaren 2018-05-03

Provningsdatum: 2018-05-08 --23

**Sammanfattning**

Silver analyserades i materialen före tvätt och efter 10 tvättar. 9 provmaterial innehöll silver. Tvätt har skett i 40 grader med vanligt förekommande hushållstvättmedel utan TAED eller blekmedel. I samtliga fall där silver påvisades innan tvätt uppmättes en nedgång i halterna efter tvätt vilket tyder på att de lakas ur plaggen och följer med tvättvattnet. Det kan inte uteslutas att vissa av textilierna kan vara behandlade med andra biocidsubstanser än silver som analyserats i denna studie.

**Utförande och resultat**

**Vattentvätt och torkning** utfördes enligt SS-EN ISO 6330:2012

Tvättprogram:

4N (40 °C)

Tvättmedel: Via Color, enligt kundens önskemål

Dosering: 40 g/tvätt, enligt doseringsanvisning på paketet.

Antal tvättar: 10

Total godsmängd (fyllnadsgods och provmaterial): 2 kg

Fyllnadsgods: 100 % polyester

Torkning:

Materialen torkades efter tvätt 3, 7 & 10

Torksätt A, hängtorkning

Datum för tvätt: 2018-05-15 -- 17

Denna rapport får endast återges i sin helhet, om inte utfärdande laboratorium i förväg skriftligen godkänt annat.  
Allmänna leveransbestämmelser för Swerea IVF tillämpas och finns tillgängliga på [www.swereaivf.se](http://www.swereaivf.se) eller beställs från Swerea IVF.

**Provvuttag.** Vid analyserna har provmaterial klippts från plaggen/textilierna. Plagg som består av olika delar och/eller material har någon del/material valt för analys baserat på mest trolig behandling med biocid.

**Analys av silverinnehåll** (ej ackrediterad metod) utfördes med ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry) efter lakning. 1,00 g av materialet har lakats under svag värmning i 22 ml kungsvatten (koncentrerad saltsyra och koncentrerad salpetersyra i förhållande 1:1) under två dygn. Innan analys har lösningen späts till 50 ml med destillerat vatten. Vid analysen har två våglängder används, 328,068 nm resp. 338,289 nm. Resultatet från 328 nm redovisas medan analysen vid 338 nm har verifierat frånvaro av spektrala interferenser.

Analysgränsen har satts till 0,1 mg/kg. Lägre halter kan mätas, men denna halt är den lägsta som verifierats med hjälp av utbytesförsök på kända halter i reella prover.

Vid analysen av silverinnehållet på ICP-OES har proverna före och efter tvätt analyserats i samma körning och mot samma standardkurva. Proverna har analyserats material för material i följden tvättat/otvättat/tvättat/otvättat för att minimera påverkan av instrumentdrift. Om ett prov uppvisade höga halter silver har ett blankt prov körts innan nästa prov för att förhindra eventuell kontaminering från tidigare prov.

Metoden med lakning i kungsvatten bryter inte ner fibrerna fullständigt och kan därför inte betraktas som en total uppslutning. Allt silver som finns exponerat på fibrernas ytor och därmed har biologisk aktivitet kan lakas ut, men silver som förekommer helt oexponerat inuti syntetfibrer kan ha begränsat utbyte i metoden.

De metoder som finns för total uppslutning av textilt material är baserade på avsevärt mindre provvuttag (0,1-0,2 g) med påföljande homogenitetsproblematik. De är dessutom baserade på enbart oxiderande syra (salpetersyra) och för att hålla silver stabilt i lösning krävs ett överskott av kloridjoner som förskjuter jämvikten av silver mot lösligt  $\text{AgCl}_2$ . Överskottet måste vara så stort att  $\text{AgCl}$  inte bildas, vilket uppfylls i kungsvatten även efter spädning enligt ovan. Detta är bakgrunden till valet av metodik i denna undersökning.

**Tabell 1.** Silverhalt i mg/kg textil.

Provmaterial	Otvättat	10 tvättar	% silver som tvättats ut
1	1	0,1	90 %
2	7,3	1,8	75 %
3	11,7	2,2	81 %
4	686	476	31 %
5	15,4	4,3	72 %
6	7,8	3,7	53 %
9	2,8	1,3	54 %
10	8,6	2,4	72 %
11	7,9	1,2	85 %



Samtliga resultat gäller endast för de provade materialen.

**Kommentar:**

- 9 av de 15 proverna innehöll silver.
- Ursprunghalten av silver varierade mellan 1 och 686 mg/kg textil.
- Den högsta halten silver uppmättes i strumporna, där metall var medstickat i det gråa materialet, se bilaga 2.
- Efter 10 tvättar hade 31-90 % silver läckt ut från textilierna av uppmätt ursprung.
- De flesta silverbehandlade kläderna hade en ursprungshalt mellan 7,3 – 15,4 mg/kg.
- En funktionsstrumpa innehöll betydligt högre silverhalter än övriga prov 686 mg/kg. Efter 10 tvättar hade 31 % tvättats ut, vilket innebär att 210 mg silver per kg textil försvunnit.
- 2 provmaterial påvisade inga halter av silver varken innan eller efter tvätt.
- 4 provmaterial påvisade inga halter av silver innan tvätt, men spårhalter kunde uppmätas i provmaterialen efter tvätt. Troligen beror detta på kontaminering av andra provmaterial i tvättprocessen.
- Analyserna kan inte ge svar på i vilken form silver är applicerat till textilierna (exempelvis i nanoform, i olika salter, som trådar osv.).
- Plaggen kan vara behandlade med andra och/eller ytterligare biocider, detta kan ej verifieras av utförda analyserna.

**Bilagor**

Bilaga 1, Samtliga värden från silveranalysen

Bilaga 2, Detaljerad beskrivning av provmaterial

Mölnadal, 2018-05-29

Swerea IVF

Analys och certifiering



Carina Berglund  
Teknisk Granskare



Elisabeth Olsson  
Handläggare

**Bilaga 1, Samtliga värden från silveranalysen:**

Prov	Otvättad (mg silver/kg textil)	10 tvättar (mg silver/kg textil)	% silver som tvättats ut	mg silver / kg textil som tvättats ut
1	1	0,1	90	0,9
2	7,3	1,8	75	5,5
3	11,7	2,19	81	9,5
4	686	476	31	210
5	15,4	4,3	72	11,1
6	7,8	3,7	53	4,1
7	< 0,1	0,5	-	-
8	< 0,1	0,1	-	-
9	2,8	1,3	54	1,5
10	8,6	2,4	72	6,2
11	7,9	1,2	85	6,7
12	< 0,1	< 0,1	-	-
13	< 0,1	< 0,1	-	-
14	< 0,1	0,3	-	-
15	< 0,1	0,2	-	-

## Bilaga 2, detaljerad beskrivning av provmaterial.







Bild	Prov nr	Vara/produkt	Märke	Material	Butik/Nätbutik	Biocid/marknadsföring enligt information från Svenskt Vatten AB	Analyserad detalj / Provuttag
	1	Ladies Compression High Tights. Färg: Svarta	MxDc Sport	80 % Nylon, 20 % Spandex	Fitnessbutiken.se	"Polygeinebehandlade träningsights"	Material från grenen
	2	Cross Hatpants Färg: grämelerade	Deore	90% Polyester, 10 % Elastan	Fitnessbutiken.se	"Polygiene anti-odör teknologi"	Material från grenen
	3	Movement Tank Färg: turkos	Deore	100 % Polyester	Fitnessbutiken.se	"Anti-odör polygiene behandlad"i	Material från armhålan



Bild	Prov nr	Vara/product	Märke	Material	Butik/Nätbutik	Biocid/marknadsföring enligt information från Svenskt Vatten AB	Analyserad detalj / Provttag
 	4	Sky Run Träningssockor Färg: Grå/grön/vit		75 % Nylon, 12 % Polypropylen, 8 % Polyester, 3 % Elastan, 2% Metall <sup>1</sup>	Zalando.se	Bionic <sup>2</sup>	Material från tån, både grönt, grått och vitt
	5	Headband med solskydd Färg: vit/märkt Buff	Buff	60 % Polyester, 40 % PU	Athletshop.se	"Polygiene® treatment for bacterial growth prevention and odor stop"	Det vita materialet

<sup>1</sup> Information från hangtag, avläst av Swerea IVF




Bild	Prov nr	Vara/produkt	Märke	Material	Butik/Nätbutik	Biocid/marknadsföring enligt information från Svenskt Vatten AB	Analyserad detalj / Provuttag
	6	Bandana Star Wars Färger: Star Wars mönster	Buf	100 % polyester	Athleteshop.se	"Behandlades med Polygiene"	Material svart/flerfärgat (50/50)
	7	Golfkeps Callaway	Callaway	100 % Bomull (?)	XXL.se butik och näthandel	"Antibakteriellt behandlad"	Material från kantband insida/ytteryg (50/50)
	8	Värmedress med huva Färg: svart	Everlast	PVC?	XXL.se Finns butik	"Antibakteriellt behandlad som förhindrar lukt"	Material från byxorna




Bild	Prov nr	Vara/produkt	Märke	Material	Butik/Nätbutik	Biocid/marknadsföring enligt information från Svenskt Vatten AB	Analyserad detalj / Provuttag
	9	Haglöfs sport t-shirt Färg: turkos	Haglöfs	100 % recycled polyester	Addnature.se Finns butik	"Behandlade för att motverka dålig lukt med hjälp av Polygiene®, en naturlig silversaltsteknik."	Material från ärmen (båda färgerna, 50/50)
	10	Techfit base t-shirt Färg: röd	Adidas	?	Adidas.se Finns butik	"Odörmotverkande Polygiene, som bygger på silversalt (silverklorid) gjort av återvunnet silver"	Material från ärmen (perforerat tyg)
	11	POC knäskydd Färg: svarta	POC	Div Neopren, PU, PES, mm	Addnature.se Intressant POC stort svenskt skid- och sportföretag	"Anti-odör-behandlad med Polygiene"	Insidan





Bild	Prov nr	Vara/product	Märke	Material	Butik/Nätbutik	Biocid/marknadsföring enligt information från Svenskt Vatten AB	Analyserad detalj / Provuttag
	12	Nike Pro T-shirt Färg: brun	Nike Pro	85 % polyester, 15 % Elastan	Intersport	"Contains antimicrobial biocide; Zinc Pyriithone to help reduce fabric odour"	Material från ärmen
	13	Seamless Bra Top Pigeon Färg: blågrön	Filippa K	94 % Polyamid, 6 % Elastan	Filippa K	"Made from breathable, anti-bacterial and odour-free fabric." Ingen märkning på plagget eller i butik.	Material resärtyg (50/50)
	14	Reebok Burnout Tee (t-shirt) Färg: korvblå	Reebok	48 % Polyester, 48 % Viskos, 4 % Elastan	Intersport	"antibakteriellt behandlad för att undvika oönskad odör"	Material från ärmen

Bild	Prov nr	Vara/produkt	Märke	Material	Butik/Nätbutik	Biocid/marknadsföring enligt information från Svenskt Vatten AB	Analyserad detalj / Provuftag
	15	Haglöfs Glee Tee Men (t-shirt) Färg: marinblå	Haglöfs	100 % Polyester	Haglöfs butik	"antiliukbehandling från återvunnen kaffesump som via en patenterad process förts in i tygets fibrer"	Material från ärmen



# Information provided by the Swedish Chemicals Agency on the labelling of biocide-treated articles — a checklist

**Company**

**Article:**

Labelling requirements	Yes/No	Comment
A statement that the treated article contains a biocidal product.		The word “biocide” or “biocidal product” or similar shall be used
In justified cases, the biocidal property of the treated article shall be specified.		E.g. “odour-free” or “antibacterial”. In justified cases, this means according to the guidance <sup>1</sup> that the labelling may make claims about the biocidal property only where there are facts that back up such claims.
The names of all the active substances in the biocidal products.		This applies only to the active substances that contribute to the biocidal properties stated in the claim on the label.
The names of all the nanomaterials included in the biocidal product or biocidal products, followed by the word “nano” in brackets.		
All relevant instructions for use, including all precautionary measures that must be taken because of the biocidal products either used to treat the article or contained in the article.		E.g. “dry in open air”, “avoid unnecessary washing”. The absence of instructions for use is not necessarily a drawback. It may be difficult to assess when these are relevant. In the case of some substances authorisation is contingent on there being certain instructions for use (this does not apply to silver; silver is still being evaluated under the Review Programme).
If sold in Sweden, Labelling in Swedish. The same applies if sold in any other EU members state, i.e. the labelling has to be in an official language in the Member State where the product is sold.		

Some other aspects to consider:

- The labelling shall be clear, easy to read and suitably durable (this must be assessed on a case-by-case basis)
- The labelling may be printed on the packaging or provided in the instructions for use where necessary because of the size and function of the treated article.
- The labelling need not be provided on the website in order to comply with legislation, but we recommend that it is provided there anyway because it helps the consumer to make informed choices.
- Note that the labelling regulations apply only to products placed on the market (made available initially within the EU; this applies to the individual article) after 1 September 2013.

<sup>1</sup> Commission note for guidance on treated articles at:  
<https://circabc.europa.eu/w/browse/d7363efd-d8fb-43e6-8036-5bcc5e87bf22>



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ISSN nr 1651-6893

Svenskt Vatten M146

2018-11



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