

SILVER+[®]

www.silverplus.com

Rudolf-Info 5/07

**RUDOLF
CHEMIE**

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Speciality Chemicals
SILVERPLUS®
Version 2007-02-14



The **U**ltimate **H**ygienic
Finish for **T**extiles

COMPLIES
WITH
OEKO-TEX
STANDARD 100

SILVER+[®]

Application in a washing machine: Wash the textiles according to the care instructions. Then select an extra rinse programme (cold). Stir content of bag **thoroughly** into 250 ml cold water. Pour diluted product completely into the cleaned major rinsing box. Start rinsing. Spin-dry at 600 r.p.m. maximum.

Dosage: Sufficient for 5 kg load

Dispose of completely empty bags at reusable material collection. Take larger waste to collecting point for problematic materials.
Use before 12/2007.

Active ingredient: Silver chloride

Product is sensitive to light. Avoid contact with skin and eyes. Keep out of the reach of children. Store protected from frost.

Rudolf GmbH & Co. KG
Chemische Fabrik
Postfach 749
82532 Geretsried
Germany
Tel: +49 (0)8171-53-0

A concentrate based on silver ions
For use in washing machines
Test sample - not for sale
For long-lasting hygiene and
freshness of textiles, especially for
sports articles, socks, underwear,
bed linen, and much more

Speciality products for the textile industry

Rudolf GmbH & Co. KG
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Advantages of SILVERPLUS®

1. Hygiene and freshness for more textile comfort with Oeko-Tex Standard 100

Who is not familiar with it - textiles and shoes, especially when made of synthetics, start developing unpleasant odours after only a short period of use. Stop it once and for all with **SILVERPLUS®!** The best and most innovative solution to this problem.

Body moisture and warmth in textiles are the ideal biosphere for bacteria. Bacteria exploit the organic content of the body moisture generated. The degradation products of this exploitation are often associated with unpleasant odours. **SILVERPLUS®** silver ions from a virtually infinite reservoir counteract this odour formation.

SILVERPLUS® thus ensures hygiene and freshness. Additionally, **RUCO-BAC AGP** has been registered on the Oeko-Tex list (www.oeko-tex.com) and thus complies with Oeko-Tex Standard 100.



Page 1 of 1 page(s) of test report no. 619385 N of 2006-12-13



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82538 Geretsried

Fürth, 2006-12-13

Test report no. 619385 N

Testing of fabric samples for antimicrobial activity according to ASTM E-2149-01

Order no. AWE 011206 - FR
Arrival in lab: 2006-12-04; Period of analysis: 2006-12-04 - 2006-12-13
Head of microbiological department: Dr. Karin Laue-Schüler

General note: Copying this test report, partially, is permitted only in agreement with the contracted lab. This report consists of 1 page(s).
The test method signed with * is not listed in the attachment of the accreditation certificate.

Test results

Test method: ASTM E-2149-01*
Parameter: test strain: Staphylococcus aureus DSM 1104
incubation: 24 h at room temperature in 100 ml ¼ Ringer solution
weighted sample: 2 g

Remark: Variations of the test method are underlined (in accordance with client).

sample	initial titer [cfu/ml]	titer after 24 h [cfu/ml]	titer reduction [%]	titer increase [%]
CO fabric, finished with 5 g/l RUCO-BAC ACP	3,3x10 ⁸	< 10	99,9	
CO fabric, finished with 5 g/l RUCO-BAC ACP after 100 washes at 60 °C	3,3x10 ⁸	< 10	99,9	
CO terry good, finished with 5 g/l RUCO-BAC ACP	3,3x10 ⁸	< 10	99,9	
CO terry good, finished with 5 g/l RUCO-BAC ACP after 100 washes at 60 °C	3,3x10 ⁸	< 10	99,9	
CO control fabric, without antibacterial finish	2,9x10 ⁹	1,5x10 ⁴ *		417

Porst & Partner GmbH
Umweltanalytik • Warenprüfung • Ingenieurleistung

Head of analytical department



2. Outstanding resistance to washing and dry cleaning

Due to its microparticles **SILVERPLUS®** can be embedded in the textile in a resistant-to-washing and dry-cleaning manner without using binder or adhesive systems that diminish moisture transportation and handle.

SILVERPLUS® deposits in the yarn interstices and is permanently bonded by strong adhesive forces.

This procedure can be compared with the incorporation of soot pigments, which cannot be removed even after repeated wash cycles with commercial scouring agents.

The resistance to washing is usually outstanding, being above 100 coloured laundries at 60 °C with higher application quantities (> 4 - 5 g/l). This has been confirmed by an independent test institute.

germ stress after drying

Condition	Relative Germ Stress
w/o Silverplus	High
with Silverplus	Low

germ stress after washing

Condition	Relative Germ Stress
w/o Silverplus	High
with Silverplus	Low

germ stress after wearing

Condition	Relative Germ Stress
w/o Silverplus	High
with Silverplus	Low

3. Laundry gets hygienically clean even at 40 °C

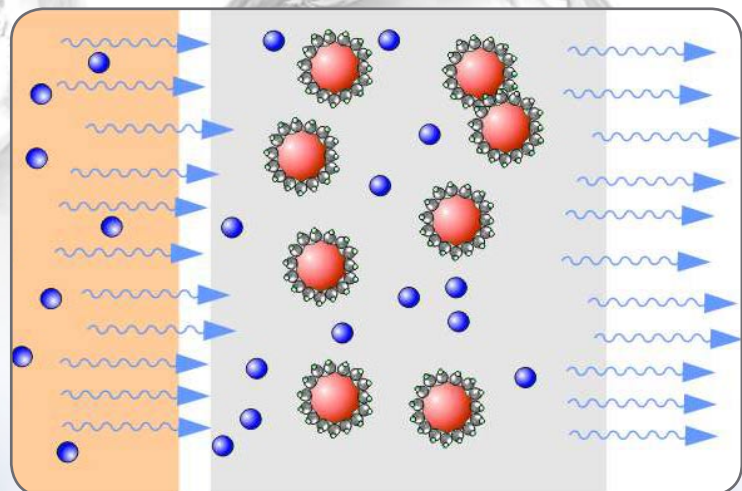
Many textiles can only be washed at 40 °C (amongst other things, textiles from viscose). However, at 40 °C, the washing machine is an ideal breeding ground for bacteria. Bacterial growth is optimally supported at this temperature, which becomes evident, above all, by the musty odour when drying laundry in poorly ventilated cellar rooms or in areas with high humidity. **SILVERPLUS®** confers hygiene and freshness to textiles at 40 °C. With only minor-soiled textiles, which would normally be washed at higher temperatures, washing at 40 °C is now sufficient. **SILVERPLUS®** supplies bacteria-free textiles. The consumer saves energy and money.

4. Synergism of hygiene management and optimised moisture transportation

In combination with moisture-transportation-improving, hydrophilic-rendering **RUDOLF** agents, such as

- **FERAN ICE**
- **FERAN ASR**
- **RUCO-PUR SLY**

further optimised functional properties regarding moisture management are conferred to textiles. Improved perspiration transportation with bacteria being synergistically removed by **SILVERPLUS®** on the textile instead of the skin.



perspiration-producing skin

*perspiration-absorbing textile with **SILVERPLUS®** protective system, optimum moisture evaporation on the textile face*

5. No influence on the natural balance of the skin

Many products with antimicrobial effects migrate from the textile onto the skin to then attack it. **SILVERPLUS®** develops its antimicrobial effects exclusively on the textile surface. The hygienic effect develops on the textile, leaving the skin fully functional. Thus textiles finished with **SILVERPLUS®** protect against the spreading of health-hazardous bacteria without attacking those having a positive effect on the skin.

6. No formation of bacteria resistance

Bacteria are directly controlled on the textile surface by antimicrobially active silver ions. The triple mechanism of silver ions prevents the possible formation of adapted bacteria. According to current observations, bacteria are not able to adapt to all three mechanisms to become resistant to silver.



FUNCTIONAL
WEAR

SHOES

UNDER-
WEAR



SOCKS



Further cost and technical application advantages

1. Easy application results in optimised costs/efficiency

Normally, the costs of finishing textiles are not caused by the finishing product, but by additional processing costs due to its application. Even though **SILVERPLUS®** belongs to the high-end finishing agents, the costs do not run away.

We recommend to use **SILVERPLUS®** at application quantities of 2 – 5 g/l (pad process) or 0.2 – 0.5 %, on weight of fabric (exhaust method), for the initial textile finish. **SILVERPLUS®** can be integrated in every finishing step; a separate run, as with many conventional antimicrobial systems, is not necessary. A sales-promotional, functional additional value is created.

SILVERPLUS® is - also from the economic point of view - profitable.



2. An additional, quality-diminishing binder system is not necessary

The use of a binder/adhesive system for heat-setting **SILVERPLUS®** in a resistant-to-washing and dry-cleaning manner is not necessary. Binder/adhesive systems, as offered for other silver-based product systems, have the following disadvantages:

- Most binder systems can only be applied by padding. The silver finish remains inapplicable to textiles that can only be finished by the exhaust method.
- Binder systems have to be additionally cured at higher temperatures. A change of the white shade or colour has to be taken into account.
- Binder systems require a separate run under curing conditions, which increases the production costs.

For obtaining a hygienic effect ordinary drying is sufficient to embed **SILVERPLUS®** in the fibre interstices. Depending on the combination with other finishing variants or process steps in dyeing or finishing, curing/setting temperatures can be used without effect losses.

Make use of the flexibility of **SILVERPLUS®**.

3. Good compatibility with other functional finishes

SILVERPLUS® can be beneficially combined with the following functional finishes:

Hydrophilic finishes

The existing or created hydrophilic properties of fabrics are not affected by **SILVERPLUS®**. **SILVERPLUS®** offers a perfect system in combination with optimised moisture transportation (**FERAN ICE**, **FERAN ASR** or **RUCO-PUR SLY**), further guaranteeing hygiene and freshness.

Hydrophobic finishes

In combination with water-, oil- and soil-repellent finishes (**RUCO-GUARD**, **BIONIC FINISH**) these textile surfaces are additionally protected against bacteria. The water and oil repellency are not affected.

Soft handle finish

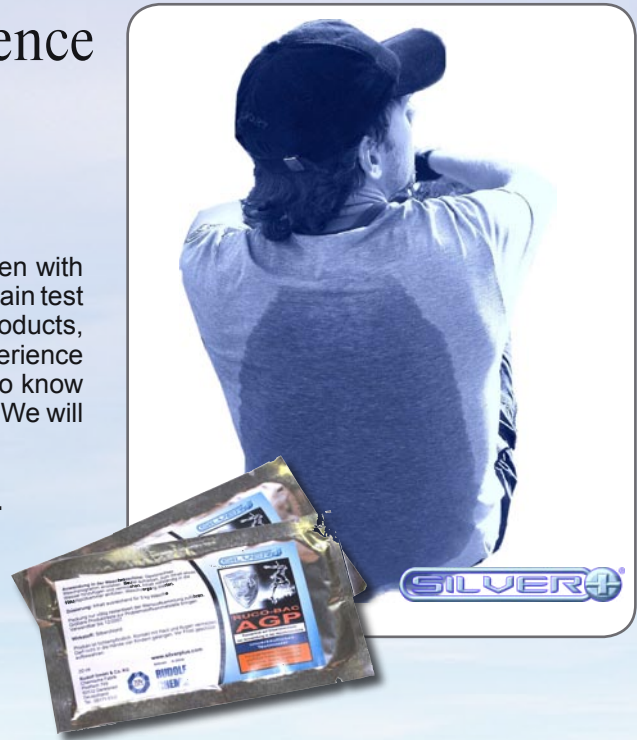
SILVERPLUS® is extremely suitable for a combination with softeners, such as **RUCOFIN** or **PERRUSTOL**, and does not at all impair the textile handle.

Test method versus experience

1. The best test method

Lab test methods more or less try to imitate reality, often with only mediocre success, but enormous expenditure. Certain test methods illustrate certain effective principles of the products, and others are completely unsuitable. Hence, the experience made during wearing is the best method by far to get to know the mode of action of **SILVERPLUS®**. **Test it yourself**. We will assist our partners.

Order a test pack of **SILVERPLUS®** at www.silverplus.com.



2. A suitable test method

The "Dynamic Shake Flask" test method according to the test standard ASTM-E2149-01 is the best method for demonstrating the antimicrobial effect of **SILVERPLUS®**. This test method imitates the wearing of textiles.

Test principle: The contact between antimicrobially finished textiles and bacteria in a bacterial suspension is ensured by thorough mechanical shaking. The antimicrobial active ingredient does hence not necessarily migrate out of the substrate. The full antimicrobial effect of **SILVERPLUS®** by means of free, antimicrobial silver ions is normally attained after a dwell time of 24 hours.

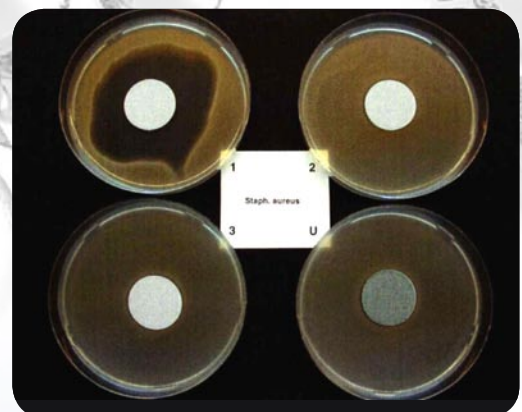


Dynamic Shake Flask Test (ASTM-E2149-01)

3. An unsuitable test method

SILVERPLUS® is a non-migrating, antimicrobial product, which means that it is effective on the textile and does not form inhibition zones according to the Agar Diffusion Plate Test (SN 195 920).

Test principle: The antimicrobial active ingredient moves out of the substrate (ideal case for migrating products) and forms an unpopulated zone (inhibition zone) in the environment. Only a migrating product shows an inhibition zone. Since **SILVERPLUS®** is not a migrating antimicrobial product, which is an advantage, this test method is unsuitable.



- 1 = Migrating product (inhibition zone)
- 2 = **SILVERPLUS®** (not migrating, no inhibition zone)
- 3 = Conventional product (not migrating, no inhibition zone)
- U = Untreated textile (grown with bacteria)

History



For centuries silver has been successfully used as a means against bacterial attack. In the past silver coins were placed in earthen vessels to preserve milk.

Today the inside of refrigerators is made of silver-containing coatings to meet hygienic requirements. Through silver, enamels and ceramics obtain an antimicrobial function too.

In the food sector silver is used as an additive, eg for sweet coatings or decorating chocolates. In medicine silver found usage a long time ago as a therapeutic agent in wound care or on medico-technical plastics.

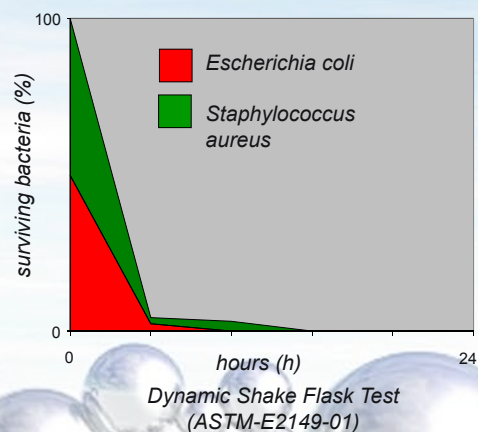
Did you know that space suits are metallised with silver?

Silver on textiles

Silver has so far been used as either a fine silver wire or vacuum-metallised on the fibre. **RUDOLF CHEMIE** follows a new, more efficient path and offers with **SILVERPLUS®** an agent for the top finish on all fibres and textiles.

The antimicrobial or hygienic finish based on silver prevents the uninhibited multiplication of bacteria on textile surfaces. The natural balance of the skin is not affected.

Already in the first two hours **SILVERPLUS®** shows an antimicrobial effect of 95 % (see chart: by means of escherichia coli and staphylococcus aureus).



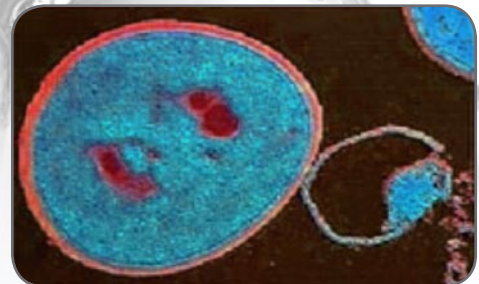
Hygiene and microorganisms

Microorganisms are life-forms of microscopic size (ca. 10^{-8} to 10^{-6} m), such as

- bacteria
- fungi

Bacteria especially lead to

- body odour due to bacterial degradation of perspiration
- infection and illness
- allergic reactions



Methicilline-resistant staphylococcus aureus (MRSA, resistant stem)

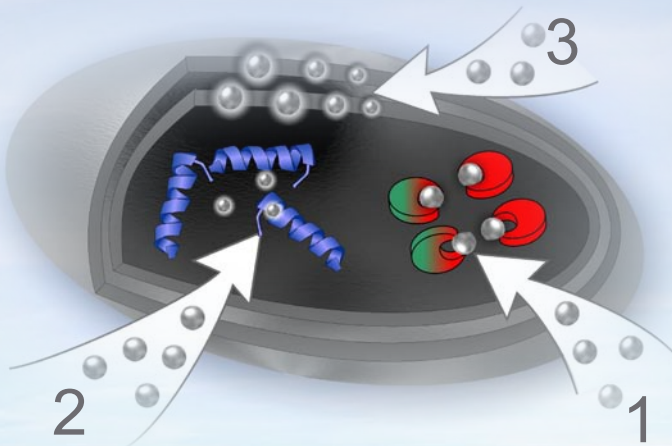
Microorganisms require certain prerequisites to be able to exist, such as food, temperature, moisture and large surface areas.

Hence, textiles worn next to the skin, such as underwear, socks and sports tricots are ideal biospheres for microorganisms. **SILVERPLUS®** causes the removal of these microorganisms, prevents them from colonising on textile surfaces and thus provides hygiene and freshness.

Antimicrobial effect of silver

Silver ions control bacteria by means of a triple mechanism:

1. Blocking oxygen-transporting enzymes
2. Inactivating sulphur-containing proteins of the bacteria
3. Locking the cell membrane

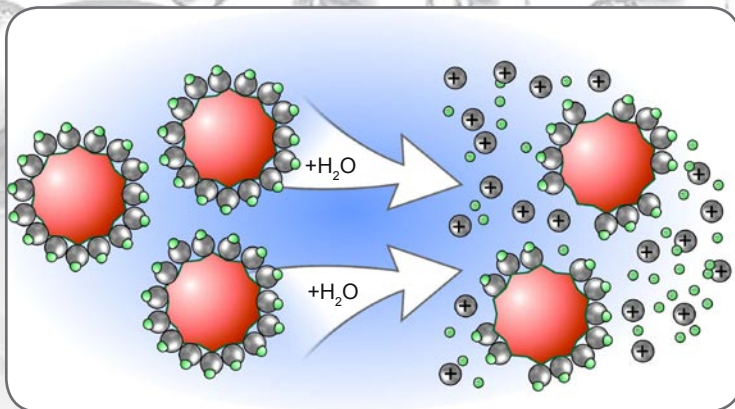


Bacteria are controlled by silver ions directly on the textile surface. The triple mechanism of silver ions prevents the potential formation of adapted bacteria. Bacteria cannot adapt to all three effective mechanisms to become resistant to silver.

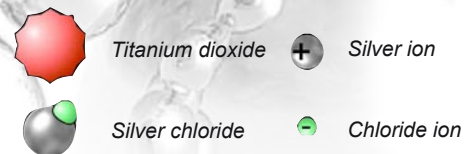
Triple mechanism of silver

How does SILVERPLUS® work?

Micro-structured titanium dioxide is the carrier of the active component silver chloride, on which **SILVERPLUS®** is based. In the case of moisture (eg perspiration) silver ions with antimicrobial (**flexible response**) effect are set free from a virtually infinite deposit.



Equilibrium of titanium oxide, silver chloride and silver ions with antimicrobial effect in moist medium (eg perspiration)



Due to its large active surface **SILVERPLUS®** is already effective in very small quantities. One gram of the micro-structured **SILVERPLUS®** has a superficial extent of ca. 600,000 cm². Already 1 ppb of mobile silver ions can inhibit bacterial cell growth significantly. Hence silver ions in **SILVERPLUS®** are more efficient by far than other antimicrobial products. This is reflected in the low application quantities of **SILVERPLUS®**.

Products based on SILVERPLUS®

1. RUCO-BAC AGP

Hygiene and freshness system
Durable to laundering for up to 100 wash cycles at 40 - 100 °C,
Complies with OEKO-TEX Standard 100

2. RUCO-BAC AGL

Hygiene and freshness system
Durable to laundering for up to 30 wash cycles at 40 - 100 °C

Examples from the press

K&L trusts RUCO-BAC AGP!

Now as freshness and hygienic finish in unisex socks with non-slip soles. **RUCO-BAC AGP** promotes the antimicrobial function of silver as "Wellness".



Freshness and hygienic finish with RUCO-BAC AGP for the armed forces

RUCO-BAC AGP makes life more comfortable, easier and safer - now even for the armed forces.

Ab sofort in allen Shops und im Webshop unter www.lhd-shop.de

T-Shirt mit Silberionen-Ausrüstung.
In den Farben oliv + sand.
In den Größen 4-9.

Antimikrobielle Funktion von Silber
Silberionen kontrollieren Bakterien mit einem Dreifach-Mechanismus:

1. Blockierung sauerstofftransportierender Enzyme
2. Inaktivierung schwefelhaltiger Proteine des Bakteriums
3. Verriegelung der Zellmembran

Wirkungsweise
Mikrostrukturiertes Titandioxid ist der Träger für die Aktivkomponente Silberchlorid. In Gegenwart von Feuchtigkeit (z. B. Körperschweiß) werden bei Bedarf antimikrobiell wirksame Silberionen aus einem Wirkstoff-depot freigesetzt.

Artikel-Nr.: 20030029_oliv
Artikel-Nr.: 20030028_sand

RUCO-BAC AGP, a symbiosis of the protective and curing element silver, and state-of-the-art technology, opens up completely new ways of textile application.

Wherever freshness and hygiene are particularly required or washing is not possible, **RUCO-BAC AGP** is used. This focus has been perceived by the LH Dienstbekleidungs GmbH (Cologne), the privatised clothing supplier of the armed forces.

The antimicrobial effect still is fully functional after more than 50 wash cycles at 60 °C. Since August 2006 **RUCO-BAC AGP** has been actively promoted as a hygienic product for the tropical shirt, in olive or sand, of the armed forces: **Small silver ions - big effect! T-shirt with silver ion finish.**

Visit also www.lhd-shop.de.

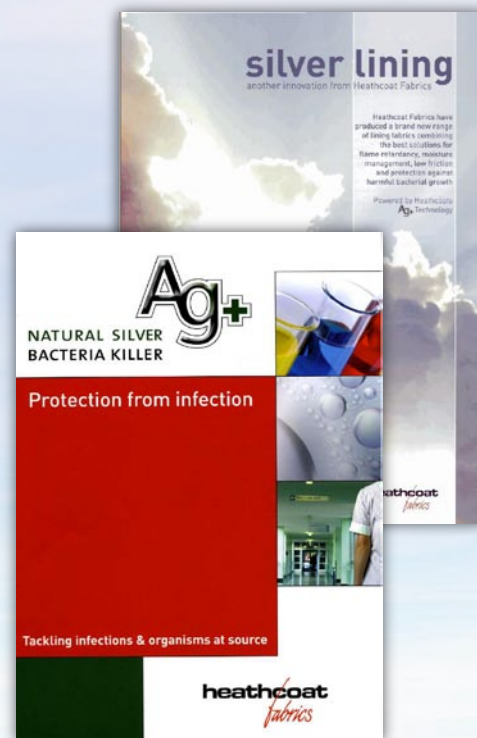
RUCO-BAC AGP on hospital clothes

Ag+, Natural Silver, Bacteria Killer - Protection from Infection“
 „Silver lining - another innovation from Heathcoat - powered by Heathcoat's Ag+ Technology“

RUCO-BAC AGP now on

- hospital clothes (protection from infection), ensuring health and hygiene.
- jackets/coats. The textile is protected by Ag+ (RUCO-BAC AGP) against bacterial degradation of held-back perspiration and the resulting development of odour (silver lining).

John Heathcoat & Co. Ltd. has an international reputation for innovation and quality, supplying a range of apparel and high technology technical textiles to diverse markets around the world. With nearly 200 years of success, Heathcoat recognises the importance of working with customers to deliver solutions that help their businesses prosper and grow. The ability to deliver unique product solutions is achieved not only through working closely with customers, understanding their requirements and developing real partnerships, but also through collaboration with leading suppliers.



For further news visit
www.silverplus.com



Here, you should find our product sample of
RUCO-BAC AGP; if it is missing,
 please order it
 at marketing@rudolf.de

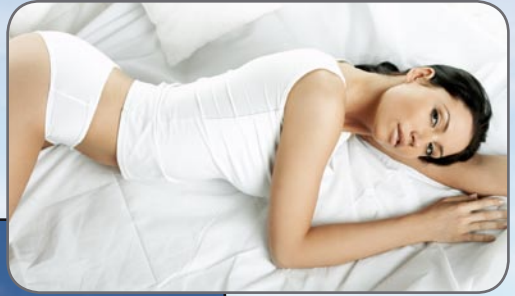
SILVERPLUS® - a brand to have confidence in

SILVERPLUS® is the major brand for functional freshness and hygienic finish with **RUDOLF** silver products. The brand comprises industrial initial finishes with highly concentrated products as well as professional care products including product formulations for home use.

SILVERPLUS®, the headliner of the brands **RUCO-BAC AGP** and **RUCO-BAC AGL**, is used in many textile articles. In co-operation with leading manufacturers of sports articles, socks, bed linen, shirts and underwear, **SILVERPLUS®** has been successfully introduced in the market. After completing a licence agreement, the **SILVERPLUS®** brand will be available to our industry partners free of charge.

Visit www.silverplus.com for more information.

Use bioicides safely. Always read the label and product information before use.



SILVERPLUS®

The hygiene and freshness label from RUDOLF

