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Workwear made from Trevira bioactive

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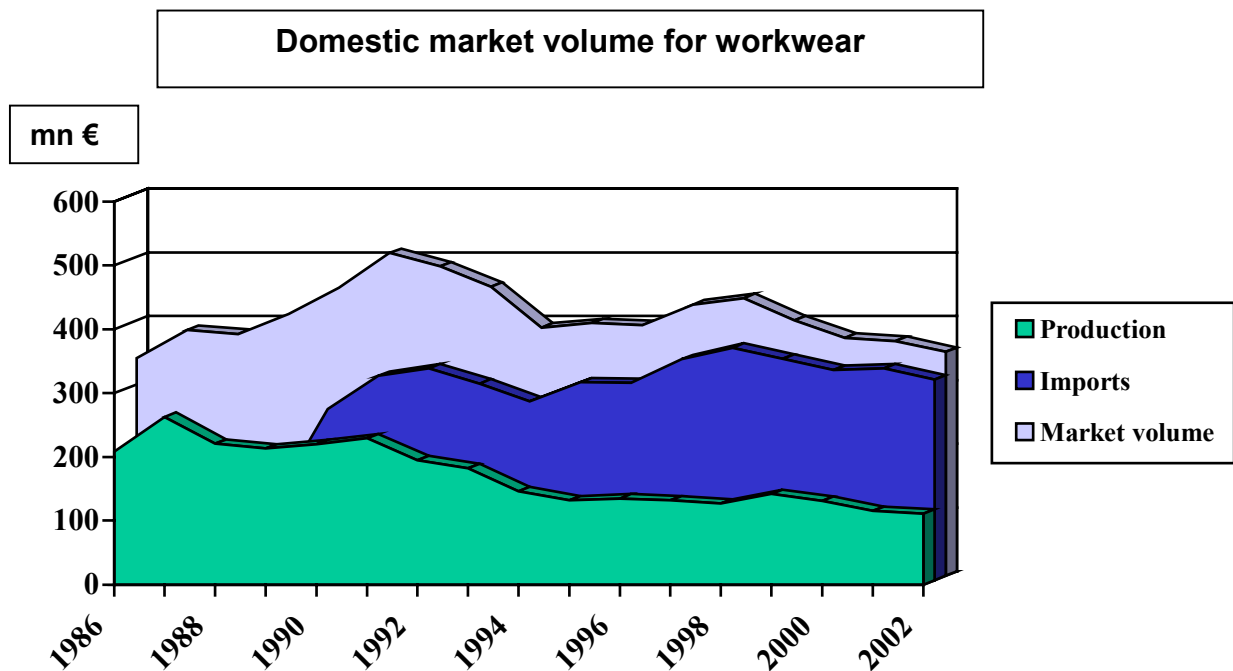
1. Introduction

In addition to classic consumer goods, textiles, too, are increasingly being produced in antimicrobial versions. The textile industry started with antimicrobial finishes for technical textiles. But some time ago now, the leisure and sportswear industry also discovered antimicrobial properties for itself. Most consumers are confused by the variety of different systems that can be used to achieve an antimicrobial effect. A clear distinction needs to be made between migrating additives and finishing agents anchored to the fabric surface such as Trevira bioactive, which is based on silver ion generators firmly integrated into the fiber.

Antimicrobial textiles are also attracting increasing interest from workwear manufacturers. In addition to considerably reducing unpleasant perspiration odors, Trevira bioactive has demonstrated in a hospital trial that it can significantly inhibit the growth of bacteria responsible for nosocomial infections in hospitals. This antibacterial action is also desirable in other sensitive sectors, such as food processing and manufacture, where particular attention must be paid to hygiene.

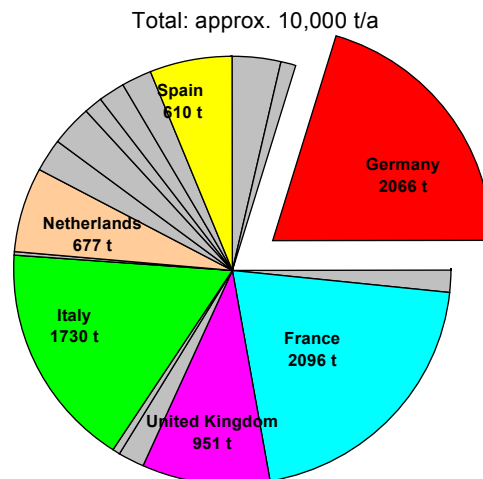
2. Market environment for workwear, taking Germany as an example

Over the last few years in Germany, there has been a significant trend towards workwear. This sector is less subject to fashion trends and seasonal variations, and is therefore far more predictable than the fashion industry for producers and distributors. Nevertheless, in this sector, too, despite a more or less constant domestic market volume, domestic production nearly halved between 1986 and 2002. This also means, of course, that imports doubled during the same period. The trend is even more pronounced in other important markets, such as the United Kingdom, where 8 out of 10 clothing items in the workwear sector come from Asia.



The only possible way of reversing this trend, as examples in other industries have shown, is to specialize in new functional textiles. Workwear in hygiene-sensitive areas, such as hospitals, offers good opportunities for this.

Hospital workwear in western Europe



The market for hospital workwear is approx. 10,000 t per annum. In addition to Germany and France, Italy and the United Kingdom play a not insignificant role.

This market is seen as having growth potential for antimicrobial textiles.

3. Mode of action of Trevira bioactive

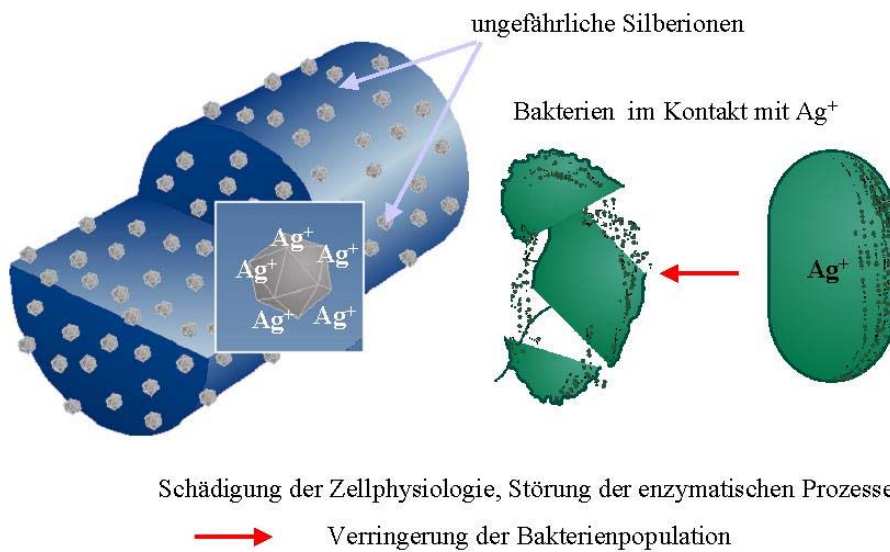
To achieve an antimicrobial effect, there are three basic systems:

The first system is a traditional finishing process, in which antimicrobial substances are applied to the surface of the textile. In the second system, the man-made fiber manufacturers incorporate these organic substances in the fibers. The third system is based on metal ions on a suitable carrier firmly bonded to the polymer matrix

The disadvantage of the first two systems is that the organic chemicals used are normally volatile. This means that they exert a vapor pressure and the person wearing the textile is literally surrounded by a cloud of disinfectant.

In the third system, on the other hand, there is no emission to the environment. The active ingredient is firmly embedded in the polymer and the effect is therefore permanent.

Wirkweise von Bioactive



Trevira bioactive staple fibers and filament yarns are produced by the latter method, using silver ions on an inorganic substrate. The silver ions migrate to the fiber surface and there, and only there, have an adverse effect on the vitality of the bacteria.

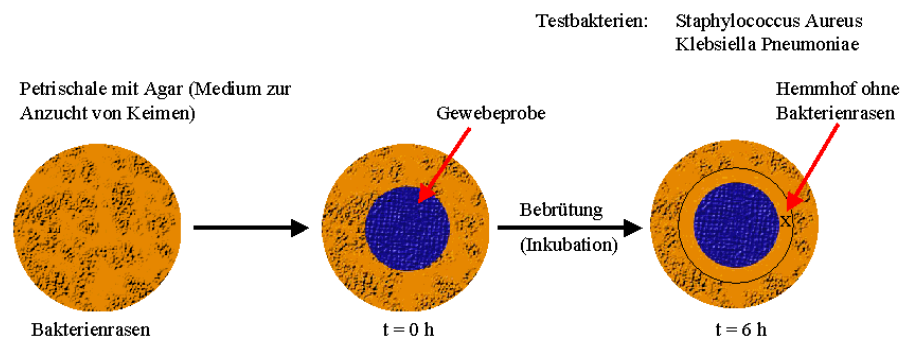
4. Test methods for antimicrobial efficacy

How can the efficacy of Trevira bioactive be tested? There are two different test systems, the agar diffusion test and the challenge test.

In the agar diffusion test, a Petri dish filled with agar is inoculated with test bacteria. Then the fabric sample is placed on the dish. After a period of 6 hours, the zone of inhibition that has formed is assessed. The width of the zone of inhibition is used as an index for antimicrobial efficacy.

Agar Diffusions Test

- Prinzip: Hemmung des Wachstums eines Bakterienrasens durch antimikrobielles Gewebe.

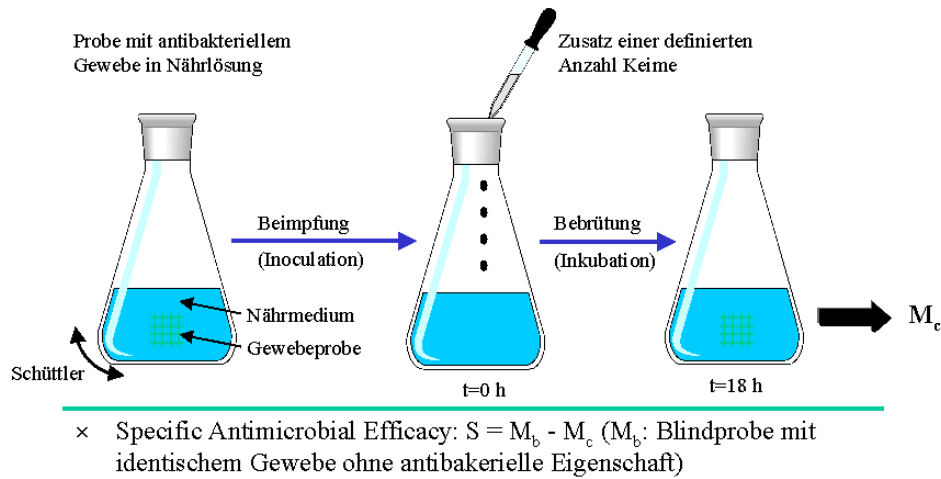


- Größe des Hemmhofs (x) ist ein Maß für die antimikrobielle Wirkung des Gewebes

This test method only works with diffusing chemicals. The active ingredient in Trevira bioactive does not diffuse but only acts on the fiber surface. For this reason, a modified version of the Japanese test JIS 1902 - 2002 is used.

Jis 1902 - 2002 Variante Hohenstein

- Hemmung des Wachstums von Bakterien in flüssigem Nährmedium



In this test, the antimicrobial sample is placed in a nutrient medium. Then the nutrient medium is inoculated with test bacteria. The test bacteria comprise a representative of the gram-positive bacteria, *Staphylococcus aureus*, and a representative of the gram-negative bacteria, *Klebsiella pneumoniae*. After an incubation period of 18 hours at 37°C, the bacterial count is determined. An unmodified reference sample is also subjected to the same test. The difference in measured bacterial count between the two test samples gives the specific antimicrobial efficacy.

5. Practical trial at the Humboldt Hospital in Berlin

The problem of nosocomial infections in hospitals has been known for years. In Germany, it is estimated that some 20,000 – 40,000 patients die every year as a result of these secondary infections. The bacteria frequently responsible for the spread of nosocomial infections are *Staphylococci* and *E-coli*.

These pathogenic agents can be transmitted via the skin (hands), through droplets (from the mouth and throat) and, last but not least, by textiles. The critical garments

in this respect are nurses' and orderlies' tunics and physicians' coats (especially the coat pockets).

What is expected from the use of Trevira bioactive in hospital workwear?

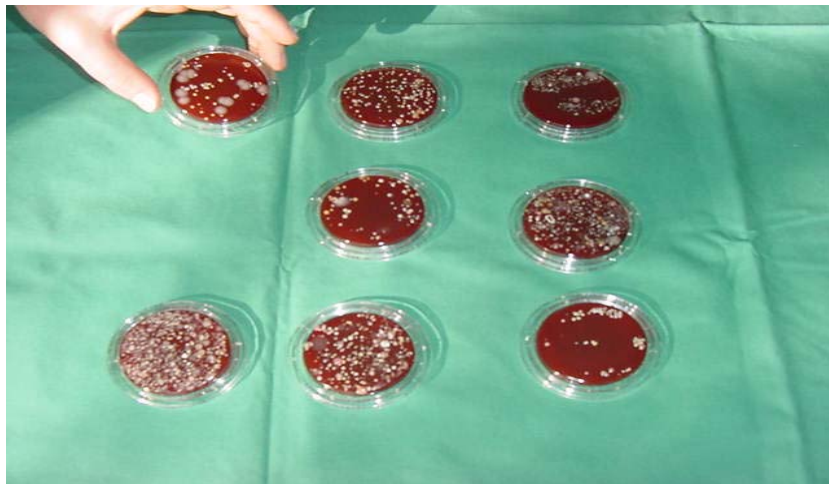
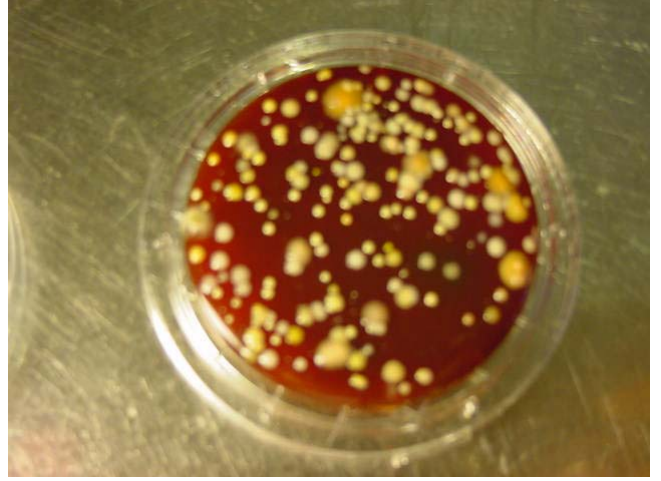
Certainly, a drastic reduction in bacteria to such a low level that the risk of infection by bacterial transmission can be considerably reduced.

To verify this, practical trials were carried out at the Humboldt Hospital in Berlin. For this purpose, tunics were made in two halves, each half from a different material. One half was produced from normal polyester and cotton, while the other half was made from a fabric consisting of Trevira bioactive blended with cotton.



At the critical points in the stomach area and pockets, several bacterial count determinations were carried out every day.

All bacteria were counted, i.e. both the number of environmental bacteria and the number of relevant nosocomial pathogens (Staphylococci and E-coli).



A clear result was obtained. While on the textiles with Trevira bioactive, the bacterial count was reduced by over 80% after 16 h, on the conventional polyester/cotton blend, a reduction of only about 25% was measured after the same time period.

6. Summary

In view of these impressive results in the practical trial, the use of antimicrobial materials in many textile applications is now feasible. Besides workwear throughout the health sector, possible applications might include areas in which particular attention must be paid to hygiene, such as food manufacture and processing. The only obstacle is the somewhat higher initial purchasing cost, which will meet with only limited acceptance by administrators of hospitals and other public institutions, in particular, even though it has clearly been demonstrated that antimicrobial textiles make a crucial contribution to better hygiene and so can actually achieve cost savings. This argument will, however, only carry weight if the system of flat-rate payments for each patient planned by the health insurance companies compels the hospitals to operate more economically. For in that case, every extra day that a patient occupies a hospital bed as a result of a nosocomial infection is a financial loss.

In the food sector, too, the market for antimicrobial workwear will open up, because Trevira bioactive can undoubtedly offer considerable benefits in terms of the HACCP concept (**H**azard **A**nalysis and **C**ritical **C**ontrol **P**oint), an internationally recognized preventive food safety system.