



Washing nanotextiles: can nanosilver escape from clothes?

New research demonstrates how nanoparticles of silver in antibacterial socks and other fabrics may be released into the environment by washing. The study suggests that the release of silver from the textiles depends to a large extent on the way the silver has been incorporated into the fabric and that producers have possibilities for minimising release.

Nanosilver is already in fairly widespread use, with hundreds of products containing silver nanoparticles already available worldwide. It has antimicrobial properties which mean it can be used in clothing, cosmetics and wound dressing. Environmental release is of concern as the particles can dissolve; dissolved silver has been found to be one of the most toxic substances to microorganisms¹. While a recent modeling study² estimated that nanosilver contributes less than 15 per cent to the total silver released into the environment, there is still little information available about the levels of silver nanoparticles released.

An obvious way of releasing nanosilver is by washing clothes that contain the particles. The new Swiss study explores how nanosilver embedded in different fabrics behaves under conditions similar to those during washing, providing some of the first insights into factors that increase the likelihood of these particles escaping into the environment.

The researchers studied nine different textiles: two antibacterial socks, six fabrics provided by companies, and one still in ongoing development. All had different compositions, but were largely made of cotton, polyester or a mixture of the two, and incorporated silver and nanosilver in different ways. The researchers precisely controlled temperature, pH, concentration of detergents, and mechanical stress, to simulate conditions during household washing. Most fabrics were washed twice.

They found that the amount of silver released during the first wash varied considerably – between 1 and 45 per cent of the total in a product, depending on the fabric. However, the largest fraction of the silver released (typically over 75 per cent) was released as particles larger than 450nm, thus not within the nano-range. Less silver was released under the alkaline conditions of washing than in neutral conditions, as in water. Yet one fabric still released a quarter of its total silver content within minutes. Bleaching agents did not seem to increase the amount released under washing conditions.

Current EU legislation, in principle, governs the safe use and disposal of nanomaterials. In particular, the use of silver-compounds in textiles and drinking bottles for anti-microbial purposes is regulated by Directive 98/8/EC concerning the sale of biocidal products. In June 2009 the European Commission adopted its proposal for a new Biocides Regulation (COM(2009) 267). The proposal addresses articles and materials (e.g. textiles, furniture) treated with biocidal products, such as silver compounds. Under the proposal, only articles and materials treated with authorised biocidal products will be allowed on the market. The nature of nanomaterials currently in development or on the market is, however, diverse – they are also of many different shapes and sizes and can be of completely different compositions. Therefore a case-by-case approach is often recommended, but this means gathering large volumes of data about many different materials.

Previous studies have only been carried out in pure water, and this current research may show the importance of carrying out tests under “real world” conditions. In this case, the researchers claim the results of their study may have important implications for the risk assessment of silver-textiles and also for environmental fate studies of nano-silver, because they demonstrate that under conditions relevant to washing (although as large particles and in different percentages for different manufacturers) primarily coarse silver-containing particles are released.

1. Ratte, H. T. (1999). Bioaccumulation and toxicity of silver compounds: a review. *Environ. Toxicol. Chem.* 18(1): 89–108.
2. Blaser, S. A., Scheringer, M., MacLeod, M., Hungerbühler, K. (2008). Estimation of cumulative aquatic exposure and risk due to silver: Contribution of nano-functionalized plastics and textiles. *Sci. Total Environ.* 390(2-3):396-409.

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