

The aquatic ecotoxicity of a marketed nanosilver product - a direct comparison with ionic silver

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As part of the REACH Substance Evaluation for silver, new data was required to be generated to further justify readacross from ionic silver to silver nanoforms. Therefore, the aquatic ecotoxicity and fate and behaviour of ionic silver and the smallest silver nanoform with the highest specific surface area registered under REACH were tested.

An ecotoxicity testing programme was undertaken comparing the effects of this silver nanoform with silver nitrate using the following internationally standardised and accepted aquatic ecotoxicity tests: Toxicity to the alga, *Pseudokirchneriella subcapitata* (OECD Test Guideline No. 201). Long-term toxicity to *Daphnia magna* (OECD Test Guideline No. 211). The silver nanoform was fully characterised and was an aqueous suspension containing approximately 37% nanoparticles with spheroidal-like shape (mean primary particle size 9.4 nm). Total silver, 'conventional' dissolved silver (0.45 µm membrane filtered) and 'truly' dissolved silver (3 kDa centrifuge filtered) were measured (ICP-MS) in samples taken from test vessels. Membrane filters (0.45 µm) and centrifuge filters were conditioned before use with the test solution/dispersion to be filtered. Particle size & Zeta Potential were determined (DLS) in vessels without test organisms. Elemental particle size distribution was analysed in separately prepared samples of the test item in test medium by means of asymmetric Flow-Field-Flow- Fractionation (4F) coupled to ICP-MS (for the silver nanoform only).

Based on measured silver concentrations, silver nitrate was more toxic than nanosilver to both algae growth and *Daphnia* reproduction, for all silver fractions. Size and Zeta Potential measurements are inconclusive for all tests and it appears that the test concentrations were too low / particles too few to resolve from control / background level (using the Zetasizer Nano equipment). In addition, the dissolution rate of the tested silver nanoform was determined for the specific test media used in the ecotoxicity tests over a period of 28 days (following OECD Test Guideline No. 29), with measurements of the same three silver fractions. This showed a different dissolution behaviour in both test media, which agreed with observations in the ecotoxicity tests.