

Disinfectant #7: Silver: Is Silver good for more than jewelry?

When asked about Silver, the first thought is often with regards to the precious shiny white metal that is used in making jewelleries. Silver, in disinfection, refers to colloidal nanoparticles of silver that are stabilized by chelating molecules. This can range from solutions of silver nitrate in water to silver dihydrogen citrate that is a more stabilized form in comparison. Silver containing disinfectants have been used extensively for topical wound applications and other medical surface antisepsis such as catheter surfaces and gauzes for covering burns and wounds. In addition, silver has long been used in water treatments as an additive. In terms of its application for general surface disinfection, in the past decade the use of silver disinfecting agents has increased dramatically.

This is how we would rate Silver disinfectants based on the key decision making criteria: (see below)

Silver Disinfectant Report Card

Subject	Grade	Comments
Speed of Disinfection	B to C	Contact times range from minutes to hours depending on the type of silver-containing solution used.
Spectrum of Kill	B to C	Silver disinfectants can kill a selection of bacteria, virus, and fungi; however performance in this criteria is tied to type of silver-containing solution. Some nanoparticle solutions have shown the ability to provide residual activity on surfaces.
Cleaning Effectiveness	D	Most formulations do not contain surfactants making their cleaning efficacy no better than water.
Safety Profile	C to D	Silver is generally considered to induce minimal toxicity; however this is dependent upon the type of silver containing compound, its concentrations and bioavailability. Ionic Silver is one of the most toxic metal residues to aquatic organisms.
Environmental Profile	D	Silver is considered as an environmental hazard because of its toxicity, persistence and bioaccumulative potential.
Cost Effectiveness	B to C	Cost is dependent on the formulation of the disinfectant and thus the concentration at which silver ions are used.

From a cleaning perspective, **almost none of the generally-used silver containing solutions has cleaning abilities better than pure water.** For use as an environmental surface disinfectant, cleaning ability needs to be taken into consideration both for removal of soils and bioburden from surfaces to be disinfected, but also with respect to any effect that soils may have on the disinfection capability of the product being used.

With respect to disinfection efficacy, silver containing disinfectants are bactericidal, virucidal, and fungicidal and some formulations have also been reported to show inactivation against Mycobacteria. Microbial resistance to silver containing disinfectants have been reported in numerous studies along with detailed descriptions of the mechanisms microbial resistance.

Oral administration of silver is generally considered to induce minimal toxicity; however this can depend on the type of silver containing compound and its concentrations. For example, **extended uses of silver containing agents on topical and nasal routes can cause Argyria, which is a blue-grey darkening of the region's skin.**

Silver is considered as an environmental hazard because of its toxicity, persistence and bioaccumulative potential. Ionic silver is known to be one of the most toxic metal residues to aquatic organisms. An example could be silver nitrate, which has high aquatic toxicity at even low concentrations. Silver nanoparticles could enter the sewage plants and seriously challenge the biological purification process during water treatment. Soils and waters contaminated with silver ions are often viewed as low in concentration when compared to other metal ions present; however silver is a rare metal in nature and **thus its perceived low concentrations are still higher than its natural safe concentration in nature.** Ultimately, silver's toxicity to living organism is limited by the exposure concentration and bioavailability. The uptake level of silver ions, or silver containing compounds, by the organisms' cells is highly influenced by the form of silver.