Summary of evaluation

This report summarizes the results of laboratory testing of a silver disinfectant known by the tradename ‘Silverdyne®’ under Round I of the World Health Organization (WHO) International Scheme to Evaluate Household Water Treatment Technologies (the Scheme). Testing followed the requirements of the WHO protocol for silver disinfectant technologies. Testing investigated the ability of the disinfectant to inactivate bacteria and viruses. Based on existing evidence on the use of silver in inactivating protozoa, testing against this microbial group was not conducted. Silverdyne® fails to meet WHO performance criteria and is classified as providing Little or no protection.
### Background

Evaluation under Scheme is based on performance criteria set out in *Evaluating Household Water Treatment Options: Health-based targets and microbiological performance specifications* (WHO, 2011). The criteria were determined by applying quantitative microbial risk assessment methods outlined in the WHO *Guidelines for Drinking-water Quality* (2011) and set \( \log_{10} \) reduction targets against bacteria, viruses and protozoa (Table).

<table>
<thead>
<tr>
<th>Performance classification</th>
<th>Bacteria (( \log_{10} ) reduction required)</th>
<th>Viruses (( \log_{10} ) reduction required)</th>
<th>Protozoa (( \log_{10} ) reduction required)</th>
<th>Interpretation (with correct and consistent use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>★★★</td>
<td>( \geq 4 )</td>
<td>( \geq 5 )</td>
<td>( \geq 4 )</td>
<td>Comprehensive protection</td>
</tr>
<tr>
<td>★</td>
<td>( \geq 2 )</td>
<td>( \geq 3 )</td>
<td>( \geq 2 )</td>
<td>Targeted protection</td>
</tr>
<tr>
<td>*</td>
<td>Meets at least 2-star (★★) criteria for two classes of pathogens</td>
<td></td>
<td></td>
<td>Little or no protection</td>
</tr>
<tr>
<td>–</td>
<td>Fails to meet criteria for 1-star (★)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Product description

Silverdyne® is a colloidal silver suspension. It is available in 30 mL bottles. Each bottle is intended to treat approximately 150 gallons of water. The full description, illustrations and use instructions can be found at: www.whaintl.com.

### Test methods

**Product-specific test plan:** A product-specific test plan was developed based on the manufacturer’s instructions for use; the WHO Scheme Harmonized Testing Protocol: Technology Non-Specific V 1.0 (WHO, 2015); and the test plan for Silver Disinfectant Technologies V 1.0. Testing was conducted at a WHO-designated laboratory, KWR Watercycle Research Institute, in the Netherlands.

**Test organisms:** Evaluation of Silverdyne® investigated its performance in reducing the quantity of bacteria and viruses. The test organisms were *Escherichia coli* (*E. coli*) and the coliphages MS2 and phiX174. Because the available evidence indicates that colloidal silver has little to no efficacy against protozoa, testing against this microbial group was not conducted.

**Test waters:** The device was tested in two simulated natural waters: General Test Water (GTW), simulating high quality groundwater, and Challenge Test Water (CTW), simulating surface water. Refer to the technology test plan for Silver Disinfectant Technologies V 1.0 for details on the physicochemical characteristics of the test waters.

**Test set-up:** Sample units from two production lots were provided for the test. The units were applied according to the manufacturer’s use instructions. Pretreatment and posttreatment water grab samples were analysed using methods identified in the product-specific test plan. Three units from each lot were used in the test, resulting in a total of 12 sample points for each organism (i.e. 2 lots \( \times \) 3 units \( \times \) 2 test waters. Posttreatment silver residual samples were collected and analysed. According to the *Guidelines for Drinking-water Quality* (WHO, 2011), where silver salts are used for drinking-water treatment, a concentration of 0.1 mg/L could be tolerated without risk to health.  

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1 \quad \text{The 0.1 mg/L level is a health advisory rather than a guideline value.}
\]
Results

The figure presents the results of the laboratory testing for the three units in GTW and CTW. All test water characteristics were within specifications.

Performance across test units

The Silverdyne® achieved mean log_{10} reductions of 2.3 for E. coli, 0.2 for MS2 and 0.2 for phiX174. Performance across the two test waters was consistent.

Residual silver concentrations in treated water ranged from 0.21 to 0.24 mg/L. The mean concentration was 0.22 mg/L; above the 0.1 mg/L health advisory value in the Guidelines for Drinking-water Quality (WHO, 2011).

Interpretation and application of results

Performance is classified in three ascending tiers: ★ (one-star), ★★ (two-star) and ★★★ (three-star), as shown in the table. Both three- and two-star products provide Comprehensive protection against all three microbial groups. One-star products meet performance targets for only two of the three microbial groups, providing Targeted protection.

Each production unit should consistently meet or exceed the performance target for each microbial group in both test waters (GTW and CTW). A maximum deviation of 0.2 log_{10} is acceptable for 25% of sample points at the two-star performance tier and of 0.4 log_{10} at the three-star performance tier\(^2\). This means that for classification as a two-star product, up to three of the 12 sample points can achieve a reduction of 1.8 log_{10}.

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1. The maximum microbial reduction that can be demonstrated is limited by the pretreatment challenge concentration delivered. For each organism tested, the pretreatment concentration must be sufficient to allow for the demonstration of the performance targets shown in the table. Due to the complexity of using viable organisms, there may be variations in these pretreatment concentrations above what is sufficient. Although these variations may lead to demonstrated reductions that far exceed the performance targets, the emphasis is on whether the performance target has been met and not the extent by which it was exceeded.

2. These cut-off values were determined using QMRA modelling and selecting ranges that still resulted in appreciable health gains within a specific performance tier.
for bacteria or protozoan cysts (instead of $2 \log_{10}$) or of $2.8 \log_{10}$ for viruses (instead of $3 \log_{10}$). Each phage is treated separately for evaluating acceptable allowance; the overall claim for viruses is based on the lower performing phage.

**Performance classification**

Silverdyne® met the minimum bacterial reduction target of $2 \log_{10}$ and does not meet the minimum viral reduction target. Testing against protozoa was not conducted as existing evidence indicates that at levels within a tolerable health limit, colloidal silver is not effective against this microbial group. As such, Silverdyne® does not meet WHO performance criteria, and is classified as providing *Little or no protection*.

**References**


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