This report summarizes the evaluation results of a chlorine dioxide disinfectant known by the tradename ‘AquaCare’, under Round III of the World Health Organization (WHO) International Scheme to Evaluate Household Water Treatment Technologies (the Scheme). Evaluation of AquaCare followed the requirements of the WHO protocol for chlorine disinfection technologies and investigated the ability of the device to reduce bacteria and viruses. No testing against protozoa was conducted.

Based on the evaluation results, AquaCare does not meet WHO performance criteria and is classified as providing little or no protection.
1. Background

Evaluation under the 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 the quantitative microbial risk assessment (QMRA) methods outlined in the *Guidelines for Drinking-water Quality* (WHO, 2017) and set log10 reduction targets against bacteria, viruses and protozoa, as shown in Table 1.

### Table 1. WHO performance criteria for household water treatment technologies

<table>
<thead>
<tr>
<th>Performance classification</th>
<th>Bacteria (log10 reduction required)</th>
<th>Viruses (log10 reduction required)</th>
<th>Protozoa (log10 reduction required)</th>
<th>Interpretation (with correct and consistent use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>★★★</td>
<td>≥ 4</td>
<td>≥ 5</td>
<td>≥ 4</td>
<td>Comprehensive protection</td>
</tr>
<tr>
<td>★★</td>
<td>≥ 2</td>
<td>≥ 3</td>
<td>≥ 2</td>
<td>Meets at least 2-star (★★) criteria for two classes of pathogens Targeted protection</td>
</tr>
<tr>
<td>★</td>
<td></td>
<td></td>
<td></td>
<td>Fails to meet criteria for 1-star (★) Little or no protection</td>
</tr>
<tr>
<td>–</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### Product description

AquaCare is a chlorine dioxide solution containing sodium chlorite, hydrochloric acid and other ingredients.\(^1\) The product is available in 50, 200 and 300 mL bottles. One capful of the disinfectant liquid treats between 10 and 12.5 L of water.

The full product description, illustrations and use instructions can be found on the manufacturer’s website: www.xinix.se.

2. Evaluation approach

**Product-specific test plan:** A product-specific test plan was developed based on the manufacturer’s instructions for use; the *Harmonized Testing Protocol: Technology Non-Specific V 3.0* (WHO, 2019); and the WHO *Chlorine Disinfection Technology Testing Protocol V 3.2* (2020). Testing was conducted at a WHO-designated laboratory, NSF International, in the United States.

**Test organisms:** Evaluation of AquaCare investigated its ability to inactivate bacteria and viruses. The test organisms were *Escherichia coli* (*E. coli*), representing bacteria, and coliphages MS2 and phiX174, representing viruses. Based on the available evidence on protozoan cyst inactivation by chlorine, testing against this microbial group was not conducted (WHO, 2019).

**Test waters:** The device was tested in two waters: general test water (GTW), simulating high quality groundwater, and challenge test water (CTW), simulating surface water. Refer to the *Chlorine Disinfection Technology Testing Protocol V 3.2* for details on physicochemical characteristics of the test waters.

**Test procedure:** For the test, the manufacturer provided eight sample bottles, each from two production lots of the AquaCare 300 mL bottles. The samples were applied to the test waters according to the manufacturer’s instructions, that is, one capful of the disinfectant was added to 12.5 L of GTW and CTW batches, and the water was stirred vigorously for five seconds and then allowed to sit for two minutes. The samples were then collected for analyses. Pretreatment and posttreatment water grab samples were analysed using the methods identified in the product-specific test plan. Three sample bottles from each production lot were tested in GTW and CTW, resulting in a total of 12 sample points for each organism (i.e. 2 lots x 2 test waters x 3 sample units).

The concentrations of free residual and total chlorine delivered in deionized, demand-free water were measured as an indicator of product quality. Posttreatment free residual and total chlorine samples were collected and analysed.

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\(^1\) The manufacturer did not submit full information on the product ingredients and formulation
3. Results

Fig. 1 presents the results of the bacterial and viral testing in GTW and CTW. All test water characteristics were within specifications.

Figs. 1. Performance across test organisms

Xinix AquaCare achieved mean log10 reductions of 0.47 for E. coli; 1.13 for MS2; and 0.25 for phiX174.

Posttreatment mean concentrations of both free residual and total chlorine in CTW were 0.09 mg/L. No free residual nor total chlorine was detected in GTW.

4. Interpretation and application of results

As shown in Table 1, performance is classified in three ascending tiers: ★ (one-star); ★★ (two-star); and ★★★ (three-star). 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 log10 is acceptable for 25% of sample points at the two-star performance tier, and of 0.4 log10 at the three-star performance tier. This means that for classification as a two-star product, up to three of the 12 sample points can achieve a minimum reduction of 1.8 log10 for bacteria or protozoan cysts (instead of 2 log10), or 2.8 log10 for viruses (instead of 3 log10). Each phage is treated separately for evaluating acceptable allowance, and the overall claim for viruses is based on the lower-performing phage.

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2 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 Table 1. Due to the complexity of using viable organisms, these pretreatment concentrations may be above what is sufficient, which may lead to reductions that far exceed the performance targets. However, the emphasis is on whether the performance target was met and not the extent by which the target was exceeded.

3 These cut-off values were determined using QMRA modelling and selecting ranges that still result in appreciable health gains within a specific performance tier.
Performance classification

Xinix AquaCare did not meet the minimum performance targets for bacteria and viruses. It is classified as providing little or no protection.

Notes:

a. According to the manufacturer Xinix AB, the courier they used to ship samples of the product to the designated testing laboratory did not pack and ship the samples in accordance with the manufacturer’s instructions.

b. The manufacturer did not submit full information on the product ingredients and formulation to WHO.

References


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