WHO International Scheme to Evaluate Household Water Treatment Technologies

Blue\textsuperscript{QTM} Two-Stage System

Product evaluation report

\begin{tabular}{|l|l|}
\hline
\textbf{WHO performance classification} & Targeted protection (bacteria and protozoa only) \\
& One-star (\textbullet) \\
\hline
\textbf{Manufacturer} & Amway Corporation \\
& 7575 Fulton Street East \\
& Ada \\
& MI 49355 \\
& United States of America \\
& www.amway.com \\
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\textbf{Evaluation procedure} & Full laboratory testing \\
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\textbf{WHO report issue date} & Round II, 2018 \\
\hline
\textbf{WHO reference number} & 23/9/2015-R2-29 \\
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\end{tabular}

Summary of evaluation

This report summarizes the results of laboratory testing of a combined flocculation-biofiltration device known by the tradename ‘Blue\textsuperscript{QTM} Two-Stage System’, under Round II 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 flocculation-bioactive technologies. Testing investigated the ability of the advice to inactivate bacteria, viruses and protozoa. Based on the evaluation results, the Blue\textsuperscript{QTM} Two-Stage System meets WHO performance criteria and is classified as providing one-star (\textbullet) Targeted protection against bacteria and protozoa only.
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 quantitative microbial risk assessment methods outlined in the WHO *Guidelines for Drinking-water Quality* (2017) and set out log10 reduction targets against bacteria, viruses and protozoa, as shown in the table below.

### 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</td>
</tr>
<tr>
<td>★</td>
<td></td>
<td></td>
<td></td>
<td>Targeted protection</td>
</tr>
<tr>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td>Little or no protection</td>
</tr>
</tbody>
</table>

### Product description

The BlueQ™ Two-Stage System is a gravity-fed device that combines coagulation, flocculation and biological filtration. The assembled unit comprises a series of three stacked buckets. Untreated water is poured into the top bucket, and aluminium sulfate is added as a coagulant/flocculant. The water passes through a pre-filter that traps the flocules formed. In the next bucket the water filters through a foam filter with a bioactive layer around it. The filtered water then passes into the third bucket with a spigot, through which the treated water can be collected. The full product description, illustrations and use instructions can be found at: www.amway.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 2.0 (WHO, 2018); and the technology test plan for Coagulation, Flocculation and Bioactive Layer Batch Technologies V 2.0. Testing was conducted at a WHO-designated laboratory, NSF International, in the United States.

**Test organisms:** Evaluation of the BlueQ™ Two-Stage System investigated its performance in removing bacteria, viruses and protozoa. The test organisms were *Escherichia coli* (*E. coli*); bacteriophages MS2 and phiX174; and *Cryptosporidium parvum* (*C. parvum*) oocysts.

**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 Coagulation, Flocculation and Bioactive Layer Batch Technologies V 2.0 for details on physicochemical characteristics of the test waters.

**Test set up:** Three production units were used in the test, with daily test volumes of 75 L. All units were operated according to the manufacturer’s use instructions. Pretreatment and posttreatment water grab samples were analysed using methods identified in the product-specific test plan. Testing was conducted over four days (GTW on Days 1 and 2; CTW on Days 3 and 4), resulting in a total of 12 sample points for each organism (i.e. 2 days x 2 test waters x 3 test units).
Results

The figure below presents the results of the bacterial, viral and protozoan testing for the three units in GTW and CTW. All test water characteristics were within specifications.

Performance across test units

The BlueQ™ Two-Stage System achieved mean log_{10} reductions of 2.2 for E. coli; 2.4 and 1.7 for MS2 and phiX174, respectively; and 2.5 for C. parvum. Performance across all three test units was generally consistent. Bacterial and viral reductions were generally higher in GTW than in CTW.

Interpretation and application of results

Performance is classified in three ascending tiers of performance: ★ (one-star); ★★ (two-star); and ★★★ (three-star), as shown in Table 1. Both three- and two-star products are classified as providing Comprehensive protection against all three microbial groups. One-star products are those that meet performance targets for only two of the three microbial groups, and are classified as providing Targeted protection.

Each production unit should consistently meet or exceed the performance target for each microbial group, and in both test waters (GTW and CTW). However, a maximum deviation of 0.2 log_{10} is acceptable for 25% of sample points at the two-star performance tier, and 0.4 log_{10} at the three-star performance tier. This means that for classification as a two-star product, up to three of the twelve sample points can achieve a reduction of 1.8 log_{10} for bacteria or protozoan cysts (instead of 2 log_{10}), or 2.8 log_{10} for viruses (instead of 3 log_{10}). Each phage is treated separately for evaluating acceptable allowance, and the overall claim for viruses is based on the lower performing phage.

1 The maximum 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 in the table showing the performance criteria. Due to the complexity of using viable organisms, there may be variation in these pretreatment concentrations above what is sufficient, which may lead to demonstrated reductions reported that far exceed the performance targets. However, the emphasis is on whether the performance target has been met and not the extent by which the target 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.
Performance classification

The Overall, the BlueQ™ Two-Stage System met minimum performance target of $2 \log_{10}$ for bacteria and protozoa. For both MS2 and phiX174, the minimum performance target of $3 \log_{10}$ was not met. As such, the BlueQ™ Two-Stage System is classified as providing Targeted protection (★) against bacteria and protozoa only.

Considerations for product selection

<table>
<thead>
<tr>
<th>Microbial conditions</th>
<th>Use where contaminant of concern is known to be bacterial or protozoan microbes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physico-chemical water characteristics</td>
<td>Suitable for treating both turbid and non-turbid water</td>
</tr>
<tr>
<td>Product information and labelling</td>
<td>Check that product is appropriately labelled and has clear instructions for use</td>
</tr>
</tbody>
</table>

References


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