Summary of evaluation

This report summarizes the evaluation results of a combined flocculation–disinfection and filtration system known by the tradename 'DayOne Waterbag' under Round II of the World Health Organization (WHO) International Scheme to Evaluate Household Water Treatment Technologies (the Scheme). The DayOne Waterbag™ uses a multitreatment process that combines flocculation–disinfection via the P&G Purifier of Water sachets followed by microfiltration. Evaluation of the DayOne Waterbag™ was in three components: laboratory testing of the filtration component and the flocculant-disinfectant component, and desk review of existing laboratory data on the P&G™ Purifier of Water.

The complete DayOne Waterbag™ was not evaluated as a single system due to limitations with the test protocol. Evaluation of the flocculation–disinfection component comprised bacterial inactivation testing, review of the data submitted in Round I for the P&G™ Purifier of Water, and measurement of chlorine dose delivered and posttreatment concentrations of free available chlorine. Evaluation of the filtration component investigated its ability to reduce bacteria and viruses. Based on the evaluation results, the DayOne Waterbag™ meets WHO performance criteria and is classified as providing Comprehensive protection (★★).
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 quantitative microbial risk assessment (QMRA) methods outlined in the Guidelines for Drinking-water Quality (WHO, 2017) and set out \( \log_{10} \) 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 (( \log_{10} ) reduction required)</th>
<th>Viruses (( \log_{10} ) reduction required)</th>
<th>Protozoa (( \log_{10} ) reduction required)</th>
<th>Interpretation</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>Meets at least 2-star (★★) criteria for two classes of pathogens</td>
<td>Meets at least 2-star (★★) criteria for two classes of pathogens</td>
<td>Meets at least 2-star (★★) criteria for two classes of pathogens</td>
<td>Targeted protection</td>
</tr>
<tr>
<td>—</td>
<td>Fails to meet criteria for 1-star (★)</td>
<td>Fails to meet criteria for 1-star (★)</td>
<td>Fails to meet criteria for 1-star (★)</td>
<td>Little or no protection</td>
</tr>
</tbody>
</table>

Product description

DayOne Waterbag™ is a combined flocculation–disinfection and filtration device. DayOne Waterbag™ comprises a 10 L backpack that incorporates the flocculation–disinfection via the P&G Purifier of Water sachet and an integrated microfilter at the dispensing outlet at the bottom of the bag. The full product description, illustrations and use instructions can be found on the manufacturer website at www.DayOneResponse.com.

Evaluation approach

Laboratory testing of the DayOne Waterbag™ was performed as two independent tests of the flocculation–disinfection component and the filtration component. The procedures for these two evaluations are outlined below. In addition, the P&G™ Purifier of Water, which comprises the flocculant–disinfectant component of the DayOne Waterbag™, was previously evaluated in Round I of the Scheme, and met minimum performance targets for bacteria, viruses and protozoa (WHO, 2016). The performance classification of the DayOne Waterbag™ is therefore assigned based on the combined results of the laboratory testing of the flocculant–disinfectant and filtration components, and review of existing data on the P&G™ Purifier of Water.

**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 2.0 (WHO, 2018a); and Chlorine Disinfection Technology V 2.1 (WHO, 2018b) and Batch Filtration Technology protocols V 2.1 (WHO, 2018c). Testing was conducted at a WHO-designated laboratory, NSF International, in the United States of America.

**Test organisms:** Laboratory testing of the flocculation–disinfection component investigated the ability of the product to inactivate bacteria. The test organism was *Escherichia coli* (*E. coli*). Laboratory testing of the filtration component investigated the ability of the product to remove bacteria and viruses. The test organisms were *E. coli* and coliphages MS2 and phiX174, as viral surrogates. Based on the available evidence on filtration and the ability to remove protozoan cysts based on size exclusion, testing against this microbial group was not conducted. Reduction of protozoan cysts, which are larger than bacteria, was assigned based on the bacterial reduction achieved.

**Test waters:** For each component of the evaluation, the product was tested in two simulated natural waters: General Test Water (GTW), simulating high quality groundwater, and Challenge Test Water (CTW), simulating surface water. Details of the test water characteristics are provided in the Batch Filtration and Chlorine Disinfection Technology protocols.

**Test set-up:** Three production units of the filter bag and samples from two production lots of the flocculant–disinfectant were provided for the test. The product has a batch size of 10 L. For the evaluation of the filtration component, each unit was used to filter two batches each day over 2 test days in each test water, resulting in a daily test volume of...
20 L and a total test capacity of 80 L per unit. The total number of sample points per organism was 12 (i.e. 3 units x 2 test days x 2 test waters).

For the disinfection component, three replicates each were tested from the two lots in CTW and GTW. This resulted in 12 sample points: 3 replicates x 2 lots x 2 test waters. All samples were prepared according to the manufacturer’s indicated mixing time (5 minutes) and minimum wait times prior to sampling (25 minutes). Pretreatment and posttreatment water grab samples were analysed in triplicate, using methods identified in the product-specific test plan.

The concentration of free residual and total chlorine delivered in deionized, demand-free water was measured as a general indication of product quality. Posttreatment free residual and total chlorine samples were collected and analysed. Per the Guidelines for Drinking-water Quality (WHO, 2017), a minimum of 0.2–0.5 mg/L of residual chlorine should be maintained at the point of delivery to ensure sufficient disinfection. However, the concentration of total chlorine should not exceed the health-based guideline value of 5 mg/L.

**Results**

Fig. 1 presents the microbial test results of the three DayOne Waterbag™ units for the filtration component in GTW and CTW. Test water characteristics were within specifications.

**Fig. 1 Performance across test units**

![Graph showing microbial reduction across test units](image)

The filtration component of the DayOne Waterbag™ achieved mean log_{10} reductions of 4.1 for *E. coli*; none for MS2; and 0.09 for phiX174. The disinfection component achieved a mean *E. coli* inactivation of ≥8.6 log_{10}. The mean concentrations of free residual and total chlorine in deionized, demand-free water were 1.8 and 2.0 mg/L, respectively. Posttreatment mean concentrations of free residual and total chlorine in GTW were 0.84 and 1.0 mg/L, and in CTW were 0.80 and 1.0 mg/L, respectively.

**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.

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1. Most commercially available chlorine products are generally designed to deliver a dose of 2 mg/L in clear, nonturbid water.

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, there may be variations in these pretreatment concentrations above what is sufficient. As these variations may lead to reductions that far exceed the performance targets, the emphasis is on whether the performance target has been met and not the extent by which the target was exceeded.
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\(^1\). 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 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; the overall claim for viruses is based on the lower-performing phage.

**Performance classification**

The *flocculation–disinfection* component of the product was previously evaluated in Round I, where it met the minimum performance targets for bacteria, viruses and protozoa and was classified as two-star (WHO, 2016). From the current results of the disinfection component and review of existing data on viral inactivation by chlorine and measured concentrations of free residual chlorine in the posttreatment samples, the product meets performance targets for bacteria and would likely meet the minimum performance target for viruses. The *filtration* component of the DayOne Waterbag™ met the minimum performance target of 2 log_{10} removal of bacteria and protozoa only, but did not meet the minimum performance target of 3 log_{10} for viruses. As such, the filtration component does not provide additional reduction against this microbial group. Overall, the DayOne Waterbag™ is classified as providing **comprehensive protection** (★★).

**Considerations for product selection**

<table>
<thead>
<tr>
<th>Microbial conditions</th>
<th>Can be used in all microbial water quality conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physicochemical water characteristics</td>
<td>Can be used to treat turbid water</td>
</tr>
<tr>
<td>Product information and labelling</td>
<td>Check that the product is appropriately labelled and has clear instructions for use</td>
</tr>
</tbody>
</table>

**References**


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