Household Water Treatment Filters
Product Guide

unicef
for every child

Table of contents

First edition, April 2020

Cover photo: © UNICEF/UNI127727/Vishwanathan

1

Introduction

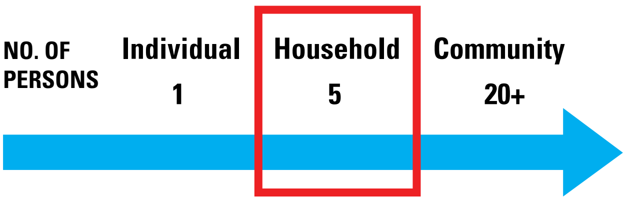
The provision of safe drinking water for all, in sufficient quantities, is a key priority for UNICEF and other water, sanitation and hygiene (WASH) actors, be it at the onset of an emergency or in a protracted crisis. With regards to household-level water treatment, there exists a wide range of options (chlorine tablets, water purifying sachets, solar disinfection devices and filters, among others), which have been applied already, across a range of settings.

There is a need for a low-cost and durable household-level solution and, among other products, UNICEF has targeted household water filters. However, there is a wide range of filter products in the global and local market, and it is often challenging to choose the appropriate product in a given context. Suppliers' claims are sometimes difficult to properly evaluate as the products have not had their performance (effective removal of bacteria, protozoa and viruses from the water) tested in independent laboratories or have not been field-trialled to test suitability and acceptability in field conditions. As limited field testing has been carried out for household water filters, further field trials could be conducted by UNICEF, as outlined in chapter 4.

Product guidance is required to help field colleagues identify the products that are the most appropriate in a given context in terms of performance, ease of use, robustness, acceptability, affordability, durability, logistics and risks. None of the existing filter technologies is a perfect and universal solution, with each having its pros and cons that must be evaluated, bearing in mind local considerations.

The scope of this product guide is concerns for household-level water filters, considering an average family size of five persons per household. Solar disinfection is discussed in this guide, as the other main non-chemical method of water treatment (along with boiling). Water intake needs are based on the Sphere standards of 2.5 to 3 L per person per day (survival needs), which leads to the requirement of 5 m^3 filtering capacity for a year of use (*see Figure 1*).

Figure 1. Scope of this product guide



The filters included in this product guide are all known of by the Supply Division of UNICEF up to Q1 2020. This guide does not present an overview of all the products that are available on the market, but looks at the categories that represent the majority of available filters, highlighting a few products in each category. **The products highlighted are examples only and may require further validation and testing in the field.**

The purpose of this product guide is to raise awareness in regional, country and/or field offices of the different products that are available on the market and their specificities, in view of empowering local procurement of water filtration products wherever possible. The first part of the guide (chapters 2 to 4) is intended to help WASH colleagues evaluate the different filter types on the market, while the second part (chapter 5) is designed to provide supply colleagues with an overview of local procurement for such products.

2

Key parameters

Before looking at different filter types, it is important to understand the different parameters to be considered when evaluating household water filter options. How to validate these parameters and take them into account when doing local procurement is further developed in the following chapters.

These parameters were developed by the Centre for Affordable Water and Sanitation Technology[1] in 2017 as part of the Humanitarian Innovation Fund Emergency Household Water Filter Challenge, setting a framework for comparison of filters. These same parameters have been adopted by the United Nations Humanitarian Response Depot[2] as part of its laboratory evaluation of filters, focusing on ease of use and some performance aspects. Understanding the different criteria behind these parameters allows for a comprehensive evaluation of the available solutions.

The parameters are separated into the following three groups:

Performance

This relates to the pure performance of the filter, without taking into account any environmental or human factors. It of course includes protection, which is directly linked to the quality of the output water, in view of being in line with the Sustainable Development Goal 6 of universal access to safe and affordable drinking water for all. But it also looks at other performance parameters, such as flow rate and overall treatment capacity, what kind of raw water can be treated using a specific filter (turbidity and robustness to turbid waters), or whether safe storage is included to avoid recontamination of the treated water. These parameters are usually checked in laboratories for validation, and are further explained below.

- **Protection:** Devices should ensure 99.9% virus protection (3 log removal) and 99.99% bacteria and protozoa protection (4 log removal). These are the ideal criteria; however, protection-level requirement depends on setting, context and needs. For example, in some geographical areas viral-related diseases are less prevalent than bacteria/cyst-related diseases, thus targeted protection against those latter two can be acceptable. In emergencies, targeted protection (removal of some and not all categories of pathogens) might also be acceptable, as some level of protection is better than no protection at all.

  For this criterion, independent testing results should be prioritized over manufacturer claims. For more information on log removal, pathogens and their specific sizes, see Table 1 and Figure 2.

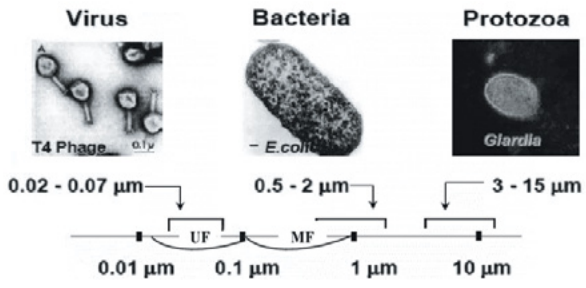
Table 1. Log removal and equivalency

Log removal	Equivalent
1 log removal	90% removal
2 log removal	99% removal
3 log removal	99.9% removal
4 log removal	99.99% removal
5 log removal	99.999% removal
etc.	etc.

1 Centre for Affordable Water and Sanitation Technology, <www.cawst.org/>, accessed 9 July 2020.

2 The United Nations Humanitarian Response Depot (UNHRD) is a network of strategically located hubs for prepositioning relief items and humanitarian support equipment: The United Nations Humanitarian Response Depot, <https://unhrd.org/>, accessed 9 July 2020.

Figure 2. Different pathogens and size



- **Flow rate:** The flow rate of the filter product (or time to treat) should be at least 20 L in 12 hours (i.e., 1.7 L per hour), with an ideal performance of 0.5 L/min (i.e., 30 L per hour), which allows for water to be poured directly into a cup, rather than into a storage container where recontamination can occur.
- **Treatment capacity (lifetime):** The treatment capacity of filters should be a minimum of 4,500 L to 5,000 L, which corresponds to the basic survival needs (2.5 L to 3 L/day as per Sphere standards) of a family of five over a period of one year.
- **Turbidity:** The filter should be able to treat water that has a turbidity of over 50 nephelometric turbidity units (NTU) (e.g., a pre-filter is included in the product) and reduce it to below 5 NTU at output level.

Ease of use and acceptability

The product must be easy to use and acceptable in order to be efficient, no matter how performant it is. A recent study showed that using a water filter for 90% of the consumed water instead of 100% (due to usability issues, for example) will reduce the health gains by 96%, thereby defeating the purpose of the filter.[3]

Ease of use parameters can be checked in laboratories and provide some indications on acceptability, however, only field trials in relevant settings can provide a clear picture of the acceptability of a given product.

These parameters include the design of the filter, the simplicity of its installation, operation and maintenance, which should require the minimum amount of training possible (ideally self-sustained through clear and visual instructions) and has a direct impact on its acceptability by end-users. The device itself should be as light and portable as possible, with no disassembly required for transportation; it should not rely on any external energy sources, and should include a fail-safe mechanism to avoid continued use when the filter stops performing (a visual indication, or preferably a mechanism that prevents the water from flowing through the filter once it has reached the end of its lifetime).

Sustainability

This part relates to 'external' considerations of the filter, such as: the filters' sustainability (they should be durable and have minimal environmental impact in terms of material used, recycling, reuse of parts of the filter, etc., and require as few consumables as possible, or ideally none at all); their packability to limit shipment volumes and environmental footprint; and their affordability, with a target capital cost of less than US$20 per filter for one family.

3 Brown, Joe, and Thomas Clasen, 'High Adherence Is Necessary to Realize Health Gains From Water Quality Interventions', *PLoS One*, vol. 7, no. 5, 7 May 2012, e36735. doi: 10.1371/journal.pone.0036735.

3

Filter categories

There exists a wide range of filter types, in terms of filtering material, filtration processes and shapes/design/usability. The main categories of filters available on the global market are provided and further described (*see Table 2*). Solar disinfection has also been included, as the other most common non-chemical water treatment method (excluding boiling).

There is no one-size-fits-all solution, and the most appropriate filter technology will depend on local characteristics and programme requirements, where acceptability by the targeted users will be a key consideration (*see Table 3*).

Ceramic filtration

Ceramic filters are the most commonly used filters at the household level, and have the advantage of being produced globally at a low cost, with a wide acceptance in many low-income countries. Ceramic filters can have pores as small as 0.2 microns, thus removing bacteria and protozoa (but only partly removing viruses), usually with 2 log to 3 log efficiency, while allowing flow that will range from 2 L to 15 L, depending on type and number of filtering elements (2 L to 4 L per single element). Ceramic filters sometimes include active carbon in their core to remove taste and odour, and/or can be coated or impregnated with silver to avoid bacterial growth on the ceramic surface.

Some ceramic filters come with additives, such as bromine, that are released in the filtered water to reportedly remove viruses as well, but this should be considered with care. These additives often have a limited lifetime in terms of efficiency (with no fail-safe mechanism) and their efficiency is not yet documented enough.

Table 2. Main categories of filters available on the global market

Group	Sub-group
Ceramic filtration	Bucket + pot
	Bucket + candle(s), vertical/horizontal
	Ceramic siphon filter
Membrane filtration and ultrafiltration	Gravity filters
	Pumping filters
	Screw-cap filters
Other filters	Multi-step filters
	Biosand filters
Solar disinfection	Polyethylene terephthalate (PET) plastic bottles (solar disinfection)
	Solar bags

Table 3. Comparison of different methods looking at key parameters

Type of filter/ treatment	Context	Transport-ability	Price	Protection	Flow rate	Capacity/ Lifetime	Set up	O&M	Safe storage
Bucket + ceramic pot	Development	☹	☺	☹	😐	☺	☺	😐	☺
Bucket + ceramic candle(s)	Development	☹	😐	😐	😐	😐	😐	☺	☺
Ceramic siphon filter	Development	😐	☺	😐	☺	😐	😐	☹	☹
Gravity membrane filters	Development	😐	😐	☺	😐	😐	😐	☹	☹
Pumping membrane filters	Both	😐	☹	☺	☺	😐	☹	☹	☹
Screw-cap membrane filters	Emergency	☺	☹	☺	☺*	☹	☺	😐	☹
Multi-step filtration	Development	☹	☺	☹	😐	😐	☺	☺	☺
Biosand filters	Development	☹	😐	☹	☺	☺	☹	😐	☹
PET plastic bottles (SODIS)	Development	☺	☺ ☺	😐	☹	☹	☺	☹	☺
Solar bags	Emergency	☺	😐	😐	☹	😐	☺	☹	☹

*Without suction, flow rate is low

> Note: It is important to make the distinction between silver coated/impregnated products (which can have a positive impact on water treatment as a secondary product) and silver-based products relying solely on colloidal silver to disinfect water. The latter are not recommended as a water treatment solution following failed certification during World Health Organization (WHO) evaluation.[4] Such products could give users a false sense of safety in terms of drinking water quality, while exposing them to an unacceptable level of risk.

In the case of ceramic filters, breakage means nullifying the efficiency of the apparatus since contaminated water would leak from the top water recipient to the bottom water container. This can only be found out by visual inspection or by abnormally high flow rate, and in those cases the ceramic component must be replaced.

4 World Health Organization, 'International Scheme to Evaluate Household Water Treatment Technologies: Results of Round 1, 2016, <www.who.int/water_sanitation_health/publications/household-water-treatment-report-round-1/en/>, accessed 9 July 2020.

CERAMIC FILTERS (BUCKET + POT)

Description: A ceramic pot is fitted in a recipient above a water container. Water is poured into the pot and filters by gravity to the lower container, which is equipped with a tap for distribution. Ceramic pots are sometimes coated with colloidal silver to avoid pathogen growth/re-growth on the surface of the pot.

PRODUCT FOCUS **PURIFAAYA FILTER**

Description: Made in Uganda from local products, it comprises a covered 20 L bucket with a tap and handle, with a 10 L silver coated ceramic pot fitted in it. Water to be treated is poured into the ceramic pot, filtered by gravity, and clean water is collected in the lower part of the bucket (10 L), ready to be dispensed by the tap.

Performance: The Purifaaya filter was evaluated by WHO and certified as providing targeted protection (1-star rating, with minimum 2 log removal of bacteria and protozoa, less for viruses). Its flow rate is 3–4 L/h and its expected lifetime is two years, after which the flow rate decreases.

Ease of use/acceptability: The filter is easy to install, operate and maintain. Maintenance is done by cleaning the pot every two weeks with a piece of cloth and water, as well as the bucket with water and soap.

Sustainability: The indicative cost of one filter is $22.6 (0.0025 $/L). No consumables are required for operation, and the stackable nature of the bucket can allow for lower volume shipment (which remains high overall). The bucket can be reused, if not broken, at the end of the filter's lifetime.

Comparative advantages: Straightforward installation/use, works with turbid water as well.

Comparative disadvantages: Limited removal of viruses and high volume for transport.

For more information visit: https://spouts.org

The expected flow rate for this type of filter is usually between 3 and 4 L/h.

Ceramic pots are mainly manufactured locally – as the risk of breakage occurring is high with international transportation – at a low price, and with an acceptable flow rate and lifetime (at least two years). In comparison with candles, ceramic pots do not pose a risk of leakage due to bad installation. No consumables are required for operation and maintenance, and the bucket can be reused at the end of the filter's lifetime.

Cleaning of the filter with a brush or a piece of cloth is required on a regular basis to avoid clogging of the pores, as well as cleaning of the bucket for hygiene purposes. Pathogen removal is generally lower compared with candles/plates, but is still above 3 log removal (except for viruses).

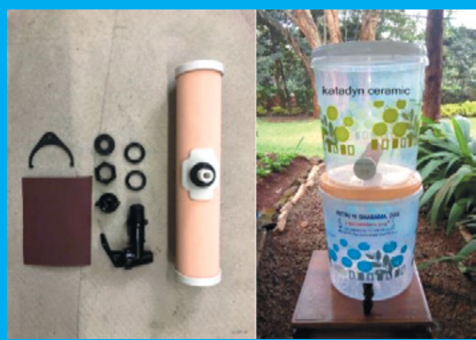
Lifecycle cost: The average cost for this type of filter for two years is $23.5 (range: $18–30).

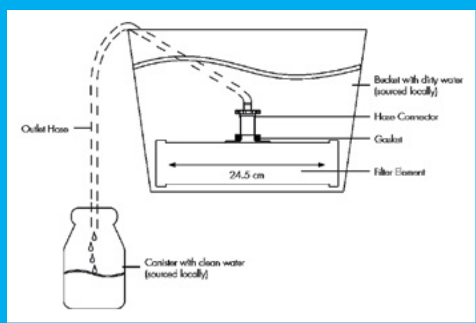
Some examples of models: Spouts Purifaaya, Filtron Nica.

CERAMIC FILTERS (BUCKET + CANDLE[S])

Description: Ceramic candle(s) is (are) fixed to the bottom of a recipient (which must be properly sealed), to filter water into a safe container using gravity. The ceramic filtering element comes in a varied number of shapes: vertical/horizontal candle(s), dome-shaped, or plate. In some cases, the outlet from the ceramic candle into the lower container is equipped with a tube to increase flow, which is normally expected to be around 4 L/h.

PRODUCT FOCUS **KATADYN RAPIDYN**





Description: Similar to traditional candle filters with buckets, but with one horizontal candle. Provided without the water containers, to be procured locally. It has an option to come as a siphon kit, with a tube fitted to the filter feeding into a clean water container.

Performance: Microfiltration (0.2 µm pore size) ceramic provides 5 log removal of bacteria and 3 log removal of protozoa, with a flow rate of 2 to 4 L/h and a capacity of 20,000 L. Safe storage happens in the lower bucket.

Ease of use/acceptability: Very easy to operate, maintenance is done by regularly cleaning the candle – which acts as a fail-safe mechanism. Installation must be performed correctly, otherwise the filter will be inefficient (water leaking from recipient to container).

Sustainability: Indicative cost per unit is $15 (0.001 $/L). Used with local buckets for increased sustainability, the filter fits 600 units per pallet. No consumables are required for operation.

Comparative advantages: A horizontal candle is placed low and stays in the water longer with higher water pressure > increased flow rate for longer.

Comparative disadvantages: Candle is harder to clean for maintenance (especially the lower part). Does not fit any type of bucket, as the bottom diameter needs to be above 25 cm.

For more information visit: www.katadyn.com/us/us/79156-8020642-katadyn-rapidyn-filter-kit

PRODUCT FOCUS **NAZAVA FILTERS**

Description: The Nazava filters use a single ceramic candle, which is either fitted on the specially designed structure with recipient and container, or on locally purchased buckets. The dome-shaped ceramic candle, which is impregnated with silver and filled with activated carbon, can be positioned both vertically and horizontally.

Performance: Nazava filters were tested by the WHO International Scheme to Evaluate Household Water Treatment Technologies, and got a 1-star rating (minimum 2 log removal of bacteria and protozoa, limited for viruses), having a 2 L/h flow rate and a capacity of 7,000 L.

Ease of use/acceptability: Easy to operate, maintenance is done by cleaning the filter regularly using the brush provided. Filters come with a lifetime indicator, which acts as a fail-safe mechanism. Installation needs to be done with care (especially on locally procured buckets) to avoid leakages into the clean water recipient.

Sustainability: Indicative price per unit is $14 including the structure ($4 for the filter alone/spare filter – 0.0015 $/L). Can be used with local buckets for increased sustainability. No consumables are required for operation (except for changing of the candle).

Comparative advantages: Very low price of the filter component, which can be used on locally procured buckets, and of the complete filter with structure.

Comparative disadvantages: Low flow rate and shorter lifetime (7,000 L).

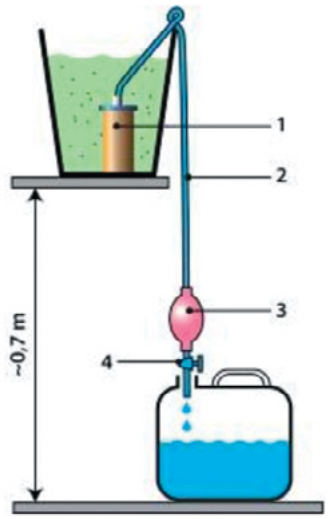
For more information visit: www.nazava.com/en/

This option has the advantage of being very low-volume if buckets are procured locally (these should match perfectly), reducing shipment costs. The product lifetime can increase to five years if it is maintained properly through regular cleaning, without the need of consumables, and end of life is sometimes monitored by measuring the diameter of the candle. Level of performance is higher than that of ceramic pots for bacteria and protozoa, but removal of viruses is still limited. The main risks are the risk of breakage of the filter element (especially for plates) and the mis-installation of the filter, resulting in leakages.

Lifecycle cost: The average cost for this type of filter for two years is $30.7 (range: $14–65).

Some examples of models: Katadyn Rapidyn and Gravidyn filter kits, Rainfresh Gravity water filter, Berkey candle water filters, Nazava filters, Imerys ImerPure, Tulip Table Top.

CERAMIC SIPHON FILTERS

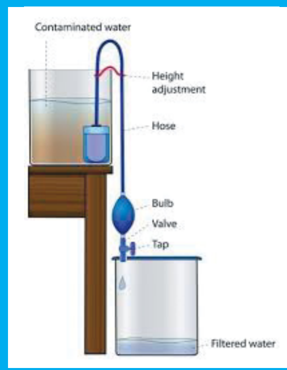


Description: A filter with a ceramic component is placed in a water recipient (with contaminated water), connected to a siphon pipe that leads to a clean water container – placed 50 cm to 1 m below – and is equipped with a pumping component to launch the siphon process (squeezing bulb or equivalent). Expected flow rate through the filter element is around 4–5 L/h. Ceramic filters with a 'fast-flow' tube connecting the upper and lower water

PRODUCT FOCUS **TULIP SIPHON**

Description: The Tulip filter comprises a ceramic filter element (surrounded by a washable pre-filter) and a tube with squeezable rubber bulb and a tap. The filter element is plunged into a container of contaminated water, placed around 70 cm above a protected recipient for clean water. The bulb operation and siphon pressure forces the water through the hose and into the clean water recipient.

Performance: The Tulip siphon filter uses the same ceramic component as the Tulip Table Top, which was evaluated by WHO as providing targeted protection against bacteria and protozoa (minimum 2 log removal) – 1-star rating. Flow rate is 4–5 L/h, with a total filtration capacity of 7,000 L before replacing the filter element.



Ease of use/acceptability: The use of this filter requires some amount of training (first treated 20 L must be discarded, rubber bulb needs a specific level of operation before acceptable flow is reached, filter requires backflushing). Maintenance is done by cleaning the pre-filter and brushing the filter with the provided scrub pad. A fail-safe mechanism is included in the form of a plastic sensor measuring the diameter of the filter.

Sustainability: The cost is $24.5 on average for the filter (0.003 $/L). The filter is used with local recipients for increased sustainability, and low volume shipment. No consumables are required for operation.

Comparative advantages: Low shipment volume and increased flow rate compared with gravity ceramic filters. Can be used with any bucket/recipients.

Comparative disadvantages: Short lifetime, and limited ease of use requiring training before distribution. Asperities in the hose at the bulb level could favour potential re-growth of pathogens.

For more information visit: www.basicwaterneeds.com/tulip-siphon/

chambers are not part of this category and are grouped with the ceramic candle filters.

On top of being lightweight and easily transportable, this type of filter can be used with any two containers (removing the fitting constraint) and avoids the risk of leakage from one container to the other. Flow rate is slightly higher than for pots/candles, while protection levels are similar.

The risk of breaking is still present, and though no consumables are required for operation and maintenance, the cleaning process is not as straightforward as for other ceramic filters since backwashing is required on a regular basis.

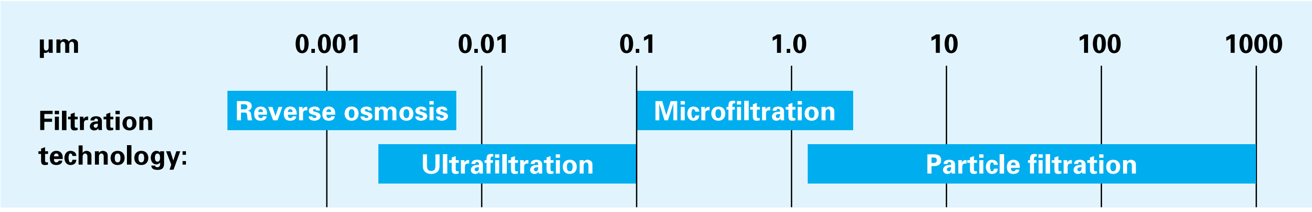
Lifecycle cost: The average cost for this type of filter for two years is $29.7 (range: $14–40).

Some examples of models: Tulip Siphon, Katadyn Siphon.

Membrane filtration and ultrafiltration

Along with ceramic filtration, membrane filtration is the most commonly used method for household filtration. The process of membrane filtration relies on pores on the membrane surface that are small enough to allow water through, while blocking pathogens that are bigger in size. Membrane filtration is split into two main categories – filtration and ultrafiltration – which depend on the size of particles that can be blocked: filtration (including microfiltration) blocks particles of 0.1 μm or more, while ultrafiltration blocks particles of 10 nm to 0.1 μm (*see Figure 3*).

Figure 3. Filtration technologies and size of particles



The smaller the particles a filter can block, the more efficient it will be at removing pathogens of all sizes, including viruses, from the filtered water (removing viruses and smaller bacteria is the main comparative advantage that filtration membranes have over ceramic filters). While ultrafiltration will remove most pathogens, smaller particles such as dissolved salt or smaller viruses may still pass through. On the other hand, the finer the filter, the harder it will be for water to flow through it, and in these cases, additional pressure is often required for the filtration process to provide an acceptable flow, as opposed to gravity alone. Household-level filtration will not remove minerals from the water, as reverse osmosis is required for this.

Regardless of the filter size, membrane filters tend to clog after a while (especially with turbid water), which will lower and eventually stop the water flow. They therefore need to be backwashed on a regular basis to maintain an adequate level of performance, and eventually replaced.

MEMBRANE GRAVITY FILTER

Description: Gravity membrane filters come in a variety of designs. Some have a structure that is comparable to that of ceramic table-top filters, with the recipient and safe container for water, and the filter element standing in the lower container (with or without tube). Others are attached at the beginning or end of a tube of around 1 m, sometimes using the siphon effect and attached to a hard container or a bag (low shipment volume). Most options do not come with integrated safe storage. Some are equipped with pre-filter and/or active carbon coating. The pore size varies from 0.1 µm (borderline for ultrafiltration appellation) down to 0.02 µm (at least 4/5 log removal of all pathogens), which can efficiently remove viruses as opposed to ceramic filters.

Backflushing is required (even more so in the case of turbid water) and is either integrated with a pump or can be done with a syringe through the pipe or filter element. As installation and maintenance for membrane filters is more complicated than for ceramic filters, training of the end-user must be considered. This type of filter does not usually require consumables and comes with a lifetime comparatively higher than that of ceramic filters, if used properly and if replacement cartridges are available on the market.

Flow rate for this type of filter varies from 2.5 to 12 L/h depending on the filter configuration and membrane pore size.

The risk of leakage is present in some models, in case the filter element or the tube is not properly fixed to the container with non-treated water. There is no fail-safe mechanism in case of membrane fouling, except abnormally high flow rate.

Lifecycle cost: The average cost for this type of filter for two years is $45.2 (range: $21.3–69.1).

PRODUCT FOCUS **LIFESTRAW FAMILY 1.0**

Description: This ultrafiltration (0.02 µm pore size) membrane filter comprises a 2 L reservoir with a pre-filter to remove coarse particles at its bottom, connected to a hose leading to the ultrafiltration hollow fiber membrane cartridge and a tap. Water is forced through the filter cartridge by gravity and released at the tap. The 2 L reservoir must be hung or suspended above a storage container. It comes with a bulb for backflushing of the cartridge. LifeStraw Family 2.0 is a tabletop version of the same filter element.

Performance: This filter was certified by WHO as providing comprehensive protection, with a 3-star rating (minimum 4 log removal of bacteria, protozoa and viruses). The estimated flow rate is 12 L/h when new, and the expected total capacity is 18,000 L. Safe storage must be procured separately.

Ease of use/acceptability: This filter is not straightforward in terms of operation and maintenance (the user manual is 10 pages long), and training of end-users is necessary for proper use. Pre-filter cleaning and backflushing are required. There is no fail-safe mechanism.

Sustainability: The indicative cost for the LifeStraw Family 1.0 filter is $69.09 or 0.004 $/L. No consumables are required, no power requirement, and it has low volume for shipment.

Comparative advantages: The protection level, flow rate and lifetime of the filter are high.

Comparative disadvantages: Complicated to operate and maintain, which might result in misuse.

For more information visit: www.lifestraw.com/

PRODUCT FOCUS **UZIMA 2.0**

Description: The Uzima 2.0 filter is a gravity-fed membrane microfiltration (0.1 µm pore size) table-top device. The assembled filter set comprises two 20 L buckets stacked on top of each other, the top one for raw water and the lower one for storage of clean water, with the filter cartridge screwed at the bottom of the top bucket. Water flows through the filter by gravity into the lower bucket, which is equipped with a tap.

Performance: The filter component was evaluated by WHO and certified for targeted protection (1-star rating, minimum 2 log removal of bacteria and protozoa, limited removal of viruses). Flow rate is 60 L/h when the top bucket is full, and the expected lifetime is 10 years.

Ease of use/acceptability: The filter's use is straightforward, and is similar to other table-top filters. Installation, if not performed prior to distribution, is sensitive in order to avoid leakages. Maintenance requires backflushing the filter cartridge regularly with the provided filter cleaner, which requires some training on how and when to do it.

Sustainability: The indicative price of Uzima 2.0 is $35 or 0.0001 $/L. No consumables are required for operation of the filter. The filter cartridge is

(continued on next page)

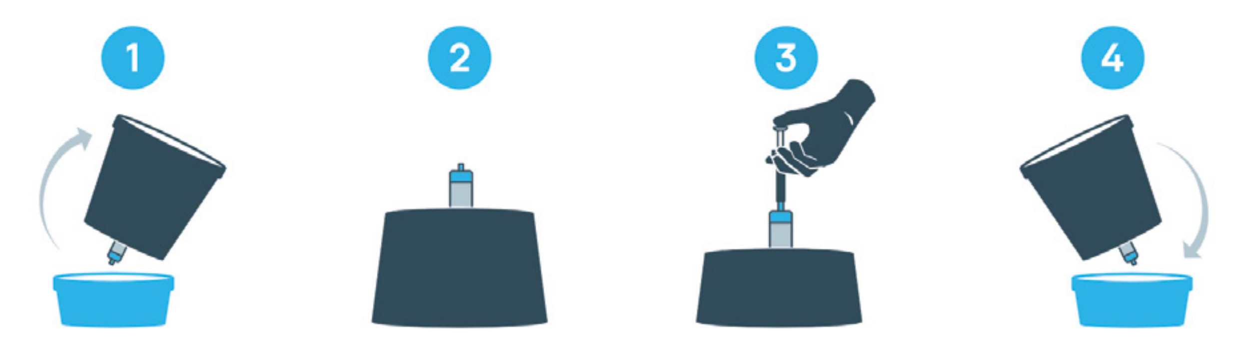
(continued from previous page)

low-volume, unlike the buckets, which are, however, stackable. The bottom bucket can be reused at the end of the filter's lifetime.

Comparative advantages: Very high flow rate (which decreases over the filter's lifetime). Long claimed life expectancy for a relatively low price. Suitable for turbid water, and the backflushing process is fairly simple (please see image below).

Comparative disadvantages: Protection level is low compared with other membrane filters (it is similar to ceramic filter protection level, at the high end of the microfiltration range).

For more information visit: https://uzimafilters.org/our-products/uz-2/



Some examples of models: LifeStraw Family 1.0 and 2.0, Uzima water filters (UZ-1, UZ-2 and UZ-BP), Katadyn Gravity BeFree, Village Water Filters VF 100, Innologic Siphon-C-Ultra.

MEMBRANE PUMPING FILTER

Description: Membrane filters equipped with pumps come in two main categories. The first one collects the water from a recipient (either a bucket, or a source) via a pipe. The water is pumped through the filter and is released into a container through a tube or tap. The second one stores the water in a container and allows it to pump out manually at any time through an outlet tap that includes the filtering element – these can potentially be reused at the end of the filter's lifetime.

The design of these filters allows for a lower pore size of the membranes (between 0.01 and 0.02 μm) with potentially up to 5 log removal of all pathogens (viruses included), while at the same time guaranteeing an increased flow rate that can reach between 75 and 240 L/h in optimal conditions; much higher than for any other type of household

filter. On the downside, it requires physical effort for operation of the filter to obtain treated water. The lifetime length varies with claims ranging from 5,000 to 500,000 L per filter cartridge, depending on the model, with no consumables required. The total lifetime depends on the availability of replacement filter cartridges locally.

The same considerations as for the gravity membrane filters apply (the need to backflush on a regular basis, risk of membrane fouling with no fail-safe mechanism, etc.). One additional risk of such types of filter is that

PRODUCT FOCUS **ROAMFILTER PLUS**

Description: This filter is on the borderline between household and communal use, but given its lightweight and low-volume feature, it has been included in this guide. ROAMfilter Plus is a membrane filter that comes with the intuitive design of a bicycle pump with a 0.02 µm pore size filter cartridge. It is operated using the footrests and the handle, pumping the water from the source through the filter and to the integrated tap, but can also be used in a gravity-fed configuration. The device weighs 4.2 kg with packaging.

Performance: The ROAMfilter Plus can achieve up to 6 log removal of bacteria and 4 log removal of viruses (it is yet to be evaluated by WHO). The flow rate has been evaluated by United Nations Humanitarian Response Depot to be 216 L/h, and the expected lifetime is two years. Safe storage is not included.

Ease of use/acceptability: Use of the filter is intuitive thanks to its design. Installation requires multiple steps including priming of the pump, operation requires physical effort while maintenance involves forward flushing, chemical cleaning and replacing the pre-filter. Fail-safe indication requires a specific test to be carried out.

Sustainability: The indicative non-profit cost for the ROAMfilter Plus is $250 or 0.0005 $/L. Consumables are required for operation (chemical cleaning). The device is durable and low volume for shipping.

Comparative advantages: Very high flow rate in comparison with other filters, and high total capacity. Protection level is in the high range for membrane filters.

Comparative disadvantages: Difficult to set up and maintain. The capital cost is high (but price per litre is low). Consumables are required for proper utilization.

For more information visit: www.wateroam.com/

PRODUCT FOCUS **LIFESAVER CUBE**

Description: LifeSaver Cube is a 5 L compact jerrycan with an integrated membrane filter cartridge (0.015 µm) paired with an activated carbon filter at the outlet level, and a pump that operates to get the water through the filter to the tap. The device is 1.2 kg at dry weight, and includes a handle.

Performance: With its pore size, this filter achieves up to 6 log removal for bacteria and 4 log removal for viruses. It has a flow rate of 75 L/h when the filter cartridge is new, and a capacity of 5,000 L. Safe storage is not included.

Ease of use/acceptability: Operation of the LifeSaver Cube is straightforward. The pump must be primed before use, and a minimum amount of water must be kept at all times in the jerrycan to avoid drying of the filter. Water will stop flowing at the end of the filter's lifetime, or spit from the tap in case of membrane fouling.

(continued on next page)

(continued from previous page)

Sustainability: The indicative price for this filter is $39 (non-profit bulk price) or 0.006 $/L. No consumables are required for operation, and spare parts are provided (protective cap and o-rings), but the filter cartridge should be changed after 5,000 L (≈100 cycles).

Comparative advantages: Robust solution for emergencies, low capital cost compared with similar products, high flow rate, high protection level and possibility to store raw water.

Comparative disadvantages: Shorter lifetime compared with other membrane filters, installation and maintenance require some amount of training of the end-users.

For more information visit: https://iconlifesaver.com/product/lifesaver-cube/

pumping that is too strong can cause breaching of the membrane, nullifying the filter's efficiency – this happened to the Grifaid filter while being tested by WHO for certification (the product has since been revised).

Lifecycle cost: The average cost for this type of filter for two years is $250.8 (range: $39–354.4).

Some examples of models: ROAMfilter Plus, LifeSaver Cube and Jerrycan, Grifaid Family Filter.

SCREW-CAP MEMBRANE FILTERS

Description: This type of filter uses ultrafiltration membranes, fixed on screw-caps for use on any bottles for some, on specifically designed bottles for others (which are therefore not interchangeable), and on 25 L jerrycans for one upcoming design. Filtration is easily done through suction of the water through the filter in the case of bottles, or by gravity in the case of the 25 L jerrycan. It is important to note that screw-cap filters for bottles are considered as individual solutions (that could potentially be shared among a family in an emergency situation).

The pore size used is usually 0.1 µm, which achieves efficient bacteria and protozoa removal, though not necessarily virus removal.

It does, however, allow for a high flow rate that can reach 2 L/min for drinking from the bottle, and a typical capacity of 1,000 L before the filter needs to be replaced – which is on the low side for membrane filters – increasing the long-term costs and environmental impact.

Screw-cap filters have a very low volume, making them ideal for easy shipment of large quantities.

Lifecycle cost: The average cost for this type of filter for two years is $200.7 (range: $73–255.1).

Some examples of models: Katadyn BeFree Tactical, Faircap, Nanomaji jerrycan filter, Sawyer MINI Water Filter, LifeStraw Flex.

PRODUCT FOCUS **FAIRCAP**

Description: Membrane filter with 0.1 µm pore size that fits on the vast majority of bottles (different sizes) on the market. Faircap is an individual filter, with water being pulled from the bottle through the filter using suction. A cap protects the water outlet. The aim of the Faircap project is to eventually reach a production price of $1 per filter, using 3D printing technology.

Performance: Bacteria and protozoa are removed at a good rate, but not necessarily all viruses (Faircap will take part in the third round of WHO evaluation). The flow rate is high thanks to suction (tested at 0.67 L/min by United Nations Humanitarian Response Depot) and the total capacity of the filter is 1,000 L.

Ease of use/acceptability: The filter is easy to install (screwed on a bottle) and use (drink through, like when using a straw). A fail-safe mechanism is not included, though clogging of the filter might prevent use at the end of its lifetime.

Sustainability: The current production price is $5 or 0.005 $/L. No consumables are required for the proper functioning of the Faircap filter. The filter has a very low volume for shipment.

Comparative advantages: High flow rate, very low volume, and intuitive to use.

Comparative disadvantages: Individual solution versus household, low total capacity compared with household filters, limited protection against viruses.

For more information visit: https://faircap.org/

Other types of filtration

MULTI-STEP FILTERS

Description: This type of filter is widely distributed and can be found in the small local markets of most countries, at a relatively low price. They rely on a staged filtration, which usually starts with regular ceramic filtration (0.3 microns pore size), after which the water goes through a range of different elements encased below the ceramic candle, into the lower container. These stages can include: activated carbon, silica sand, zeolites, mineral sand and ion exchange resin, among others. There is no strong body of evidence that these additional steps can sustainably have a beneficial effect on treated water – or a positive health effect – apart from activated carbon. For this type of filter, it is therefore recommended to look at the ceramic component of the filter (pore size, expected flow rate, etc.) and disregard the other stages of filtration as they would have little to no added value, except in terms of attractiveness. As the number of manufacturers of this type of filter is very large (especially in Southeast Asia) and since the quality of these products can vary greatly, it is recommended to get proper third-party laboratory certification – either an international certification, or from a nationally known laboratory – prior to procurement.

No consumables are required for operation (except for a change of ceramic candle or cartridge, if available locally). The shipment volume is higher than most other filters, as each individual filter comes in a box – but both containers are stacked inside each other.

Lifecycle cost: The average cost for this type of filter for two years is $15.4 (range: $5.9–23.6).

Some examples of models: Korea Queen.

BIOSAND FILTERS

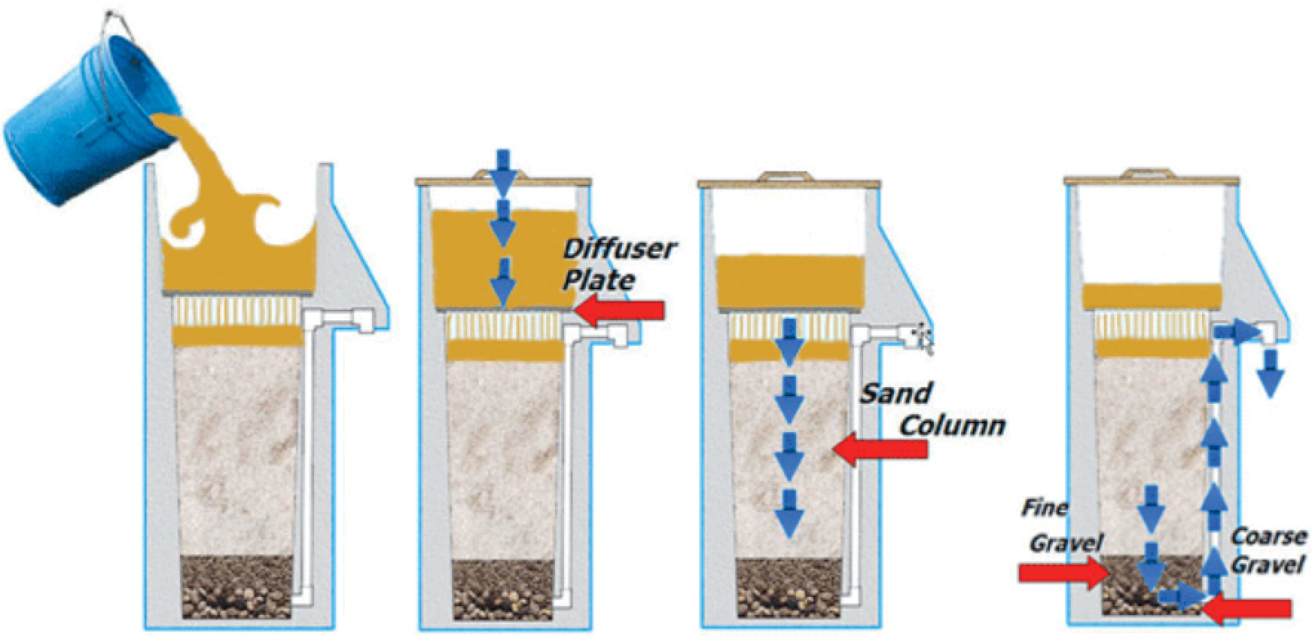
Description: Along with the ceramic pot filters, this is the other most common and widespread low-cost filtration method (biosand filtration technology is open-source). The biosand filter consists of a container (usually plastic, concrete or steel) which is filled with sand, as well as fine and coarse gravel at the bottom – pre-cleaned with running water. A water recipient at the top (or diffuser) diffuses the water onto the sand, and an outlet pipe from the bottom of the container rises to a level that is higher than the sand level by a few centimetres. By keeping the water in the container above the sand surface, water that has been filtered through the body of the filter comes out through the outlet pipe and flows thanks to hydrostatics (no tap required) at a good flow rate of 15 L/h on average.

It is important that untreated water is used, so that a biolayer of microorganisms forms up at the top of the sand formation, which allows water to flow through, but blocks and inactivates pathogens. Biosand filters are mostly efficient against protozoa (3 to 4 log removal) but less so against bacteria (2 log removal) and viruses (1 log removal), and are therefore overall less efficient than most other filter types. Turbidity above 50 NTU can be filtered, though the higher the turbidity the more often the top of the filter will need to be cleaned using a simple 'swirl-and-dump' process, to avoid clogging due to accumulated fine particles/biofilm on the sand layer (which acts as a fail-safe mechanism).

This type of filter can be made locally by anyone using locally procured material and does not require any consumables to function. Only soap will be required to properly clean the diffuser and lid on a regular basis, when the top of the sand layer is cleaned. The filter can be reused for as long as the plastic/steel/concrete components keep working.

Lifecycle cost: The average market cost for this type of filter for two years is $40. However, it is mostly produced locally at the household level and can cost as little as $10.

Some examples of models: Hydraid Biosand Filter, Grosche Biosand Filter.



PRODUCT FOCUS **HYDRAID**

Description: Hydraid is one of the few Biosand filters available on the market. It is a plastic-bodied filter filled with columns of sand, on which water is poured regularly. The created biofilm of microorganisms filters and removes pathogens from the water, which is then directed to a clean water recipient by siphon. Sand/gravel is procured locally.

Performance: Independent testing shows effective (3 to 4 log) removal of protozoa, and less effective removal of bacteria (2 log) and of viruses (1 log). Flow rate is 14 L/h, while the filter lifetime can be extended indefinitely by replacing the top of the sand column (for as long as the body of the filter lasts).

Ease of use/acceptability: The filter is very easy to use, but less so to set up (a specific size and characteristic of sand and gravel is required for the filter to work properly) and to maintain: a specific 'swirl and dump' process is needed to clean the top part of the sand layer and avoid clogging.

Sustainability: The indicative price for this filter is $37.5 (excluding sand, procured locally), or 0.002 $/L. No consumables are required (except a small quantity of sand). The filter is easy to ship, with a stackable bucket, which can be reused at end of life.

Comparative advantages: Biosand filters can work with high turbidity water, has a good flow rate and a long lifetime.

Comparative disadvantages: Can be complicated to set up (specific sand/gravel required) and maintain, lower protection level.

For more information visit: www.hwts.info/products-technologies/07e65cbc/hydraid-biosand-filter

Solar water disinfection

This guide is principally targeted at household-level water filters, but also looks at the other most commonly used non-chemical household water treatment method (other than sieving and boiling), which is solar disinfection (SODIS). A few variants of solar water disinfection are described below. Although the method changes, the treatment process is the same: diarrhoea-causing pathogens in the water are inactivated by the effect of solar irradiation, especially the ultraviolet (UV) range, with both UV-A and UV-B degrading proteins and DNA/RNA in pathogens either directly or indirectly. Solar pasteurization, which relates to water treatment using the sun's irradiating power for heating purposes is mentioned as well, although most solutions are made locally.

POLYETHYLENE TEREPHTHALATE (PET)PLASTIC BOTTLES (SOLAR DISINFECTION)

Description: This is the most classic and oldest (over 20 years) method of solar water disinfection, and is already widely used in the countries of Africa, Central/South America and Asia, mainly because of its simplicity.

For this method, transparent locally sourced polyethylene terephthalate (PET) bottles are used and reused, with a capacity of no more than 2 L for the treatment to be efficient. Plastic bottles for water and soda drinks are almost exclusively made of PET and should display the following symbol. Treatment has no adverse effect on the taste of water.

In some cases, plastic bottles can be made of polyvinyl chloride (PVC) (usually used for oil products) or polycarbonate, in which case they should not be used for SODIS as they could potentially release bisphenol A – a carcinogenic compound – into the water during the treatment. Glass bottles generally have a UV transmittance comparable to that of PET bottles and can therefore also be used, although this is not as convenient.

All the labels on the bottles must be removed, and the bottles filled with non-turbid water (the treatment is not efficient on water with turbidity above 30 NTU, which should be sieved/decanted before treatment). The bottles are then placed in direct sunlight, at an angle if possible, so that the surface of the bottle makes a 90° angle with the solar irradiation (similar to the tilt of solar panels: facing south in the northern hemisphere, facing north in the southern hemisphere). The bottle is left in the sun for a certain time period, according to the following rule:

- One full day in case of a mostly sunny day (at least six hours including noon hours)
- Two days in case the sky is more than 50% clouded
- SODIS should not be used on days of continuous rainfall

The process is easy to understand and operate, with little training required, but can be cumbersome and require both effort and time to treat the water, as well as time to let it cool down. This method can also suffer from technology bias: little prestige is associated to plastic water bottles as opposed to table-top filters or other methods.

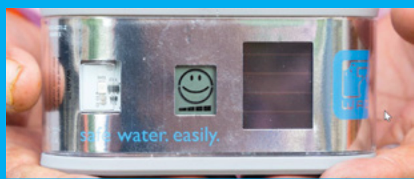
In terms of pathogen removal, the following can be expected from SODIS, based on studies made under both laboratory and field conditions:

- Bacteria: 2 log to 5 log removal
- Protozoa: Below 1 log removal for most pathogens
- Virus: Above 2 log removal for most pathogens

For further details, visit the SODIS website: www.sodis.ch/index_EN

Associated products: WADI – The Indicator for SODIS.

PRODUCT FOCUS **SODIS WADI**



Description: WADI is a tool for monitoring of water disinfection using the SODIS method. The WADI device is placed alongside PET bottles under the sun for disinfection of water and, based on UV measurement, it displays in a simple and intuitive way (happy smiley face) when the process is done, and the water is safe for drinking.

Performance: The WADI device used with PET bottles was certified by WHO as providing targeted protection against bacteria and protozoa (2 log removal), but limited protection against viruses.

Ease of use/acceptability: Dust-proof and water-resistant, the WADI device requires no maintenance or spare parts, minimal training, and is fully solar powered. It also has a fail-safe mechanism; at the end of its lifetime, the device stops functioning. Acceptability issues are more likely to lie with the SODIS process than with the device itself.

Sustainability: WADI costs $38.4 (indicative price) and is guaranteed for two years, with a longer expected lifetime. The device has a low volume for shipment, and does not require consumables (with the exception of the PET bottles used for SODIS.

(continued on next page)

(continued from previous page)

Comparative advantages: With the cost of bottles being close to null, WADI can treat a large of quantity of water at any one time. The device is easy to understand and to use.

Comparative disadvantages: SODIS and WADI are sun-dependent, and therefore not adapted to function in any context or season. The SODIS process can be seen as time-consuming and cumbersome. Proper waste disposal of the devices at the end of their lifetime can be an issue.

For more information visit: https://www.helioz.org/WADI/

SOLAR BAGS

Description: Solar bags follow the same principle as SODIS, but they have the advantage of heating up the water to a temperature high enough to remove a wider range of pathogens. The bags can hold between 3.5 and 5 L of water and are made of polyethylene or other equivalent bisphenol A-free material. They are filled with water and left to sit in the sun to heat up to 40°C or more – usually using a dark-coloured base – and receive UV radiation, for a shorter time period than is required for SODIS (ranging from two to four hours for bags). This results in 4 log or above removal of bacteria, protozoa and viruses, thus attaining the highest level of certification from WHO's 'Scheme to Evaluate Household Water Treatment Technologies'. Each model of bag has its variations, some being able to trap metal particles in the water, some including a pre-filter, but in all cases non-turbid water is preferred at the risk of efficiency decrease. One of the existing solar bags (AquaPak) uses primarily solar pasteurization, relying on heating up of the water and avoiding direct contact between UV rays and the water (the bag is completely non-transparent), thus increasing the time needed to treat the water to similar levels. Most models come with a mechanism to warn the user when the water has been treated and is therefore ready for consumption.

The process is easy to understand and operate, with little training required; however, it requires effort and time for treatment and for the water to cool down. The process depends very much on sunlight, therefore, it is not usable every day or during every season.

These bags have a very low weight (100 to 150 g) and volume when folded, making it possible to ship large quantities at a reduced cost. The proposed lifetime ranges from one-and-a-half to three years, allowing treatment of up to 2,000 L (below the required amount for a household), with no consumables or maintenance required. All the bags reviewed are recyclable, though the proper infrastructure needs to be in place at the risk of having some environmental impact.

Lifecycle cost: The average market cost for this type of filter for two years is $39 (range: $10–80).

Some examples of models: AquaPak, SolarBag, SolarSack.

PRODUCT FOCUS **AQUAPAK**

Description: The AquaPak is a portable pasteurization device that combines solar and thermal energy. It consists of a 5 L polyethylene bag with a bubble pack layer of clear plastic on the front and a black plastic layer on the back. It is placed in direct sunlight, where pasteurization is achieved thanks to radiation on the black layer. Similar to WADI, the AquaPak comes with an indicator inside the cap that lets the user know when the treatment is complete, using a wax that melts to a clear colour at 65°C when the water has been sufficiently treated.

Performance: AquaPak was evaluated by WHO and certified as providing comprehensive protection with a 3-star rating (4 log or above removal of bacteria, protozoa and viruses). Aquapak treats 5 L of water at a time and has a lifetime of three years. Safe storage is done in the bag itself. For turbid water, a pre-filtration cloth is provided.

Ease of use/acceptability: Filling the bag should usually require the presence of two persons. The process is straightforward but requires a limited amount of training for use, especially with regards to the indicator. The general process requires good organization.

Sustainability: The indicative price for one AquaPak is $26.99 or 0.003 $/L. It requires no consumables or spare parts, and can be shipped easily in low volumes.

Comparative advantages: Very high protection performance, and very lightweight solution for shipping in emergencies.

Comparative disadvantages: The general process can be cumbersome, with a waiting time to get clean water (5 L) and for it to cool down. If the bag is used as safe storage, each household would require at least two units to have continuous access to clean water.

For more information visit: https://www.solarcleanwatersolution.com/

PRODUCT FOCUS **SOLARSACK**

Description: SolarSack is a water treatment bag that relies mainly on UV rays from the sun, but also on heat. Water is poured into the bag, which is left under the sun for around four hours, after which the water can be consumed. The process is an accelerated/optimized version of SODIS, using durable plastic with strong UV penetration of blue colour (to reach temperatures of around 45°C, below pasteurization level). Two weldings in the middle keep the water depth low, which is necessary for good UV penetration.

Performance: Similar but better than SODIS, SolarSack protects against bacteria (up to 5 log removal) and protozoa, and less so against viruses. One bag will treat 4 L of water in four hours, with a total of 500 cycles possible (2,000 L total capacity). Safe storage is done in the bag itself.

Ease of use/acceptability: Though the process is very straightforward, it can require two persons to fill the bag. Minimal training is required, especially with regards to treatment time depending on the cloud cover, as there is no indicator included.

Sustainability: The indicative cost for SolarSack is $2 per bag or 0.001 $/L. No consumables/spare parts are required for operation and the bags are very lightweight and low volume for easy shipment. SolarSack is developing a network of recyclers in Africa to incentivize giving broken bags back at the end of their lifetime, to be turned into building blocks.

Comparative advantages: Very low price compared to other solutions, and lightweight device.

Comparative disadvantages: Less efficient than solar pasteurization in terms of protection, and cumbersome to use as well (requires organization, and potentially two bags simultaneously to have continuous supply of clean water).

For more information visit: https://solarsack.com/

Other solar water disinfection products include Solvatten (a 10 L jerry can that opens up like a book once filled, to treat water using a combination of UV radiation and heating to inactivate pathogens), as well as projects under development such as a transparent solar jerrycan, or a combined solar/filter.

Apart from the AquaPak, solar pasteurization solutions are generally locally designed/prepared, and include a darkly painted or coloured water container, as well as sheets of reflecting material to direct the sun's irradiation towards the container (*see Figure 4*).

Figure 4. AquaPak versus local solar pasteurization

4

Validation methods

Some initiatives are under way by actors in the sector to fill the gap in evidence on household water filters and create a framework for comparison/validation of products through specific protocols:

- WHO's Scheme to Evaluate Household Water Treatment Technologies focuses on different treatment options including filters and evaluates their performance in the laboratory through a rating that goes from 'Fail' to '3 stars'. However, currently not all filter suppliers are applying for this scheme, while some have been certified equivalently by recognized laboratories.
- The Humanitarian Innovation Fund Emergency Household Water Filter Challenge focuses specifically on filters in emergency contexts and looks at the following parameters through tests, observation and end-user feedback: performance, ease of use, durability and robustness. Unfortunately, this has been done for only five filters, still leaving a very large gap. Further field trials of interesting products could be conducted at country offices' request and in collaboration with the Supply Division, to broaden the knowledge on product adaptability to the field. The Humanitarian Innovation Fund initiative will develop a short evaluation protocol that will be published in 2020 and shared with UNICEF and other partners for standardized trials.
- The United Nations Humanitarian Response Depot filter testing initiative: Based on Centre for Affordable Water and Sanitation Technology parameters, the United Nations Humanitarian Response Depot carries out ad hoc testing of filter samples sent by suppliers, in collaboration with UNICEF. Evaluation mainly focuses on usability aspects, while the United Nations Humanitarian Response Depot plans a collaboration with a university to carry out performance testing.

The list of tested filters is far from being exhaustive, highlighting the need for more products undergoing these evaluations to establish a comprehensive list of representative and comparable results. The Supply Division is maintaining an up-to-date table of products on the market and where they stand in terms of evaluation/validation processes. This table, as well as data from WHO, United Nations Humanitarian Response Depot or Humanitarian Innovation Fund's initiatives can be requested at any time by emailing washsupply@unicef.org.

There is a wide range of established standards and certifications available for evaluation of household water filters, with the most commonly used ones listed below:

- National Sanitation Foundation/American National Standards Institute (NSF/ANSI) Standard 53: 'Drinking water treatment units – health effects' (focuses on reduction of contaminants/pathogens, specifically for filters)
- National Sanitation Foundation/American National Standards Institute (NSF/ANSI) Standard 42: 'Drinking water treatment units – aesthetic effects' (focuses on reduction of chlorine and/or taste and odour, specifically for filters)

- United States Environmental Protection Agency, 'Guide standard and protocol for testing microbiological water purifiers' (focuses on inactivation of pathogens in challenge water)
- The above-mentioned WHO 'Scheme to Evaluate Household Water Treatment Technologies'
- Each country might have its own certification process, which should be equivalent to that of the National Sanitation Foundation/American National Standards Institute, United States Environmental Protection Agency and/or WHO in terms of methodology. Most often, standards will be on drinking water (e.g., Indian Standard 10500 in India), and not on the device itself.

5

Local procurement

The Supply Division holds long-term agreements for household candle filters, but as for a majority of supplies procured by UNICEF, it is recommended that the procurement of household water filters be done locally, as long as markets allow for it. The availability of filters will depend both on local production and importation of products, and should be evaluated prior to launching a procurement process. Selection of the right filter to fit the programme requirements will be done through a tendering process as per the Supply Manual guidance, and should take into account the following considerations:

- For performance evaluation, the key parameter is treatment efficiency (protection), for which certification will be required of suppliers, using the following phrasing: "Product must meet the requirements of National Sanitation Foundation/American National Standards Institute Standards 42 and 53 (or equivalent certification)". In case national certification is available locally, that certification should be mentioned in the specifications and can be accepted, especially in emergency situations. For longer-term procurement/programming, it is however recommended to require international certification or third-party verification – support from the Supply Division can be requested. Evaluation is done by checking certificates provided by the suppliers. The level of protection (removal rate of different pathogen classes) will depend on the context/setting and the programme requirements, however, as general guidance, a 1 log removal (90%) of viruses or less should be accepted only if the removal rate of bacteria and protozoa is 2 log (99%) or more. 1 log removal or less of protozoa and/or bacteria is not acceptable.
- In terms of ease of use, importance lies with the simplicity of setting up, using and operating the filter. This will have implications for the amount of training (if any) that will be necessary upon distribution to the end-user, and have a direct impact on programme resources (human and financial). The process must be clearly described by the suppliers and clear instructions including pictograms should be provided with the filters.
- Specifications must require suppliers to clarify whether any consumables are needed for the operation of their filter. Filters requiring consumables in the short- to mid-term should be avoided, unless the consumables are always available on the local market at an acceptable price. Replacement filters (ceramic or membrane) are replaced only after a year or more, however, availability of those locally should also be considered.

Though information provided on paper can help identify suitable products, acceptability of filters can only be evaluated during field trials. The same goes for performance of filters, which is evaluated in the laboratory and not in field conditions. This has been done on a small scale by the Humanitarian Innovation Fund, but the knowledge gap remains important. Should a country office be interested in a specific filter, and in order to increase the data on filters' acceptability, field trials can be conducted with Supply Division support on an ad hoc basis.

UNICEF has set up a Local Procurement Authorization requirement for local procurement of household water treatment products, to avoid procurement of products that could: (a) have a harmful effect on consumers; and/or (b) not achieve proper levels of water disinfection, thus leaving users at risk. Local Procurement Authorizations are granted by the Supply Division's WASH Technical Unit on the basis of do-no-harm and products being easy enough to use in the required way for proper water purification.

This system has been set up following increased solicitation from country offices regarding the procurement of silver-based disinfection products that have failed WHO testing while still being advertised as efficient – therefore posing an unacceptable level of risk for the safety of end-users.

In case of a Local Procurement Authorization request, the WASH Technical Unit in the Supply Division will either review the selected product in case the tender can be waived (low-value procurement, standardization, etc.) to inform the decision on granting the authorization, or will provide support to the requesting country office in case a tendering process is required, specifically on ensuring that the key parameters (mentioned above) for selecting the right filter are taken into account in the bid documentation.

The Supply Division's WASH Technical Unit can be contacted at any time at washsupply@unicef.org for support with regards to local procurement of household water filters: identification of appropriate solutions, sharing or review of specifications in preparation of tender, sourcing, certification, and so on.

Useful links

Centre for Affordable Water and Sanitation Technology, 'Household Water Treatment and Safe Storage – Products & Technologies', www.hwts.info/products-technologies, accessed 9 July 2020.

Engineering for Change, 'Solutions Library', www.engineeringforchange.org/solutions/products, accessed 9 July 2020.

World Health Organization, 'WHO Household Water Treatment Evaluation Scheme & Results from Rounds I and II', https://www.who.int/water_sanitation_health/water-quality/household/scheme-household-water-treatment/en/, accessed 15 July 2020.

World Health Organization, 'International Scheme to Evaluate Household Water Treatment Technologies: Results of Round 1', www.who.int/water_sanitation_health/publications/household-water-treatment-report-round-1/en/, accessed 9 July 2020.

World Health Organization, 'Results of Round II of the WHO Household Water Treatment Evaluation Scheme', www.who.int/water_sanitation_health/publications/results-round-2-scheme-to-evaluate-houshold-water-treatment-tech/en/, accessed 9 July 2020.

elrha, 'Evaluating household water filters in emergency contexts', www.elrha.org/project/evaluating-household-water-filters-emergency-contexts/, accessed 9 July 2020.

For more information on this publication and procurement of household water filters, contact Supply Division's WASH Unit at washsupply@unicef.org

unicef

for every child