Aquatabs

Source Protection	Safe Transportation	Sedimentation	Filtration	**Disinfection**	Safe Storage

What is it?

Aquatabs are self-dissolving water disinfection tablets made and sold by Medentech Ltd for household water treatment. When the active ingredient—sodium dichloroisocyanurate (NaDCC)—reacts with water, it releases hypochlorous acid, which inactivates microorganisms. The tablets are produced in a range of sizes, each made to treat a certain volume of water, from 1 L to 2,500 L.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	Very Effective (>99%)
Cryptosporidium (Protozoa)	Not Effective*
Ascaris (Helminth)	Not Effective*
Other Protozoa and Helminths	Very Effective*

**Assumption based on performance of other chlorine products. No independent tests available.*

Other Parameters
Not effective for chemical contaminants or turbidity.

Source Water Requirements
Turbidity, organic matter, pH, and temperature affect how well chlorine works. Turbid water (>50 NTU) should be settled or strained before adding chlorine.

Capacity
Tablets are dosed to treat specific volumes, ranging from 1 L to 2,500 L. Treatment time is at least 30 minutes.

Lifespan
Shelf life is 5 years in strip packs and 3 years in tubs.

Ease of Use & Acceptability

Operation & Maintenance
Users add the correct size of tablet for the amount of water to be treated, following the manufacturer's instructions. They mix well, then allow the water to sit for 30 minutes to provide time for the chlorine to react with contaminants.

Repair & Replacement
New tablets must be purchased regularly.

User Considerations & Preferences
Users must follow manufacturer's instructions to ensure effective treatment. An ongoing supply chain is needed for replacement tablets. Some users do not like the taste or smell of chlorine. Free chlorine residual protects against recontamination.

Feasibility

Availability
Sold in many countries. Tablets can be bought in bulk and packaged locally; this requires tablets, packaging materials, and workshop space.

Cost
US$10.95 per person per year, assuming treatment of 20 L/day.

Size & Weight
Very small and easy to transport.

More Information

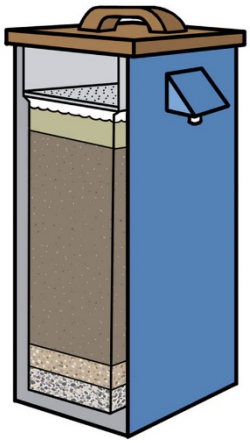
Details and references: www.hwts.info/products-technologies/114cf355/aquatabs

Biosand Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	Safe Storage

What is it?

Biosand filters (BSFs) are columns of finely crushed rock on which microorganisms are living. The BSF body can be made of a variety of materials, such as concrete, plastic, or stainless steel. Water is poured into the top of the column and spends a period of time in contact with the sand. This allows the microorganisms living in the sand to remove pathogens from the water. Each new batch of water displaces the batch before.



Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Effective (>90%)
Viruses	Somewhat Effective (>80%)
Cryptosporidium (Protozoa)	Very Effective (>99%)
Giardia (Protozoa)	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
High removal of turbidity. Removes iron. Can be modified to remove arsenic (see Kanchan Arsenic Filter). Not effective for most other chemical contaminants.

Source Water Requirements
Turbid water (>50 NTU) should be settled or strained before filtering.

Capacity
Treats one to four batches per day (12 L per batch).

Lifespan
Ten years or more.

Ease of Use & Acceptability

Operation & Maintenance
User pours water into the filter each day. Simple maintenance is required to clean sand when flow rate slows down.

Repair & Replacement
Lids and diffusers need replacement every few years.

User Considerations & Preferences
Requires that water be added every day or two to develop and maintain the microbiological community. Filter is heavy and difficult to move, making it unsuitable for people who move often.

Feasibility

Availability
Concrete bodies can be made anywhere. Other body types may need a centralized manufacturing facility, or they can be imported. Making steel molds to construct concrete BSFs requires skilled welders. Anyone can be trained to construct and install filters.

Cost
US$12–100

Size & Weight
Average size is 0.9 m tall by 0.3 m wide. Empty filter cases weigh 70–135 kg (concrete body) or 3.5 kg (plastic body).

More Information

Details and references: www.hwts.info/products-technologies/074f5f20/Biosand-Filter

Boiling

What is it?

Boiling is one of the world's oldest and most common methods for disinfecting water. It involves heating water until it boils (the boiling point of water depends on elevation but is often approximately 100°C). As the water temperature increases, pathogens are killed by the heat. CAWST recommends boiling water for one minute, plus one extra minute per 1,000 m of elevation above sea level.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	Very Effective (>99%)*
Protozoa	Very Effective (>99%)*
Helminths	Very Effective (>99%)*

**Assumed values. No independent test results available.*

Other Parameters
Not effective for turbidity, colour, or chemicals.

Source Water Requirements
Turbid water should be settled or filtered before boiling. Boiling may not be appropriate for chemically contaminated water, as the concentration of chemicals may increase after boiling.

Capacity
Depends on size of pot or kettle.

Lifespan
Not applicable.

Ease of Use & Acceptability

Operation & Maintenance
The user heats water over a fire or stove until the water boils, then keeps it boiling for one minute or more (allowing one additional minute per 1,000 m elevation). Boiled water should be kept in the pot and covered with a lid until consumed. The pot and lid should be cleaned regularly.

Repair & Replacement
Fuel needs to be replaced regularly. Stove and pots may need to be repaired or replaced over time.

User Considerations & Preferences
Users must wait for water to cool before drinking, unless they prefer hot/warm water. Stoves and hot pots can cause burns and should be kept out of reach of young children. Indoor stoves that burn wood or coal can cause respiratory infections. Boiled water tastes flat to some people, and taste can be improved by shaking or stirring the cooled water.

Feasibility

Availability
Fuel, stoves, and pots can be found in every community and can often be produced locally. Sometimes fuel may be scarce or expensive.

Cost
Depends on cost of fuel.

Size & Weight
Depends on size of pot or kettle.

More Information

Details and references: www.hwts.info/products-technologies/819dad5c/boiling

British Berkefeld Household Filter Kit

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	**Safe Storage**

What is it?

This tabletop filter is produced in the UK by British Berkefeld. The kit includes two, three, or four ceramic candles, two 16 L buckets with snap-on lids, a tap for the storage container, hardware for installation, and a tool to measure the diameter of the candles. Kits sold for emergency response typically come with two silver-impregnated ceramic candles.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	No independent tests
Protozoa	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
Effective for removing turbidity.

Source Water Requirements
Very turbid water may cause the filter to clog quickly and require more frequent cleaning.

Capacity
Can treat 16 L at a time. Flow rate is 1 L per ceramic candle per hour.

Lifespan
Manufacturer-stated lifespan is 10,000 L per ceramic candle. Actual lifespan will vary, depending on water quality, use, and maintenance.

Ease of Use & Acceptability

Operation & Maintenance
Users pour water into the top of the upper container and wait for water to flow through the filter into the lower safe storage container. Treated water can be accessed through the tap. When flow rate decreases after some time, a scrub pad can be used to rub away a very small layer of the ceramic material.

Repair & Replacement
The ceramic candles are fragile and must be replaced if there are cracks or leaks, or when repeated cleaning makes them thinner than the measuring tool provided. Plastic parts are more durable but may need replacement.

User Considerations & Preferences
A safe storage container is included with the filter. The filter should be kept out of sunlight to avoid degradation of plastic parts.

Feasibility

Availability
Produced and sold by British Berkefeld. Can ship internationally. Must be ordered in bulk (100 filters or more).

Cost
US$24–31 (plus shipping) for kits with two candles.

Size & Weight
Not available.

More Information

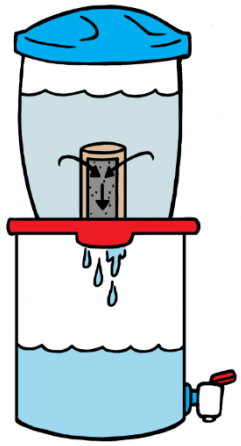
Details and references: www.hwts.info/products-technologies/62d9fef4/british-berkefeldr-household-filter-kit

Ceramic Candle Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	**Safe Storage**

What is it?

Ceramic candle filters are hollow cylinders made from porous fired clay. Colloidal silver is sometimes painted on the ceramic unit to help with pathogen removal. Water is poured into an upper container and flows through one or more ceramic units to reach a bottom container with a tap. The ceramic units trap pathogens and other particles, and the bottom container provides safe storage for the treated water.



Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	Effective (>90%)
Protozoa	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
Effective at removing turbidity and colour.

Source Water Requirements
Turbid water (>50 NTU) should be settled or strained before filtering.

Capacity
Flow rate of 0.14 L/hour for filters with one ceramic candle, 0.23 L/hour for two ceramic candles.

Lifespan
Up to three years—generally six months to one year.

Ease of Use & Acceptability

Operation & Maintenance
The user pours water into the filter. Water moves through the ceramic candle by gravity. The lower container, tap, and lid need regular cleaning. When flow rate becomes slow, the user gently scrubs the ceramic surface to clean it.

Repair & Replacement
Ceramic units must be replaced every 6–12 months, or whenever users observe visible cracks or unexpected increases in flow rate. The entire filter should be replaced or repaired if the seal between the ceramic unit and the container is damaged.

User Considerations & Preferences
Filters may be of variable quality depending on the manufacturer. Small cracks can occur in the ceramic that are not visible but reduce treatment effectiveness. A good supply chain is needed to help users find replacement ceramic units every 6-–12 months.

Feasibility

Availability
Produced by different manufacturers around the world. A small factory or kiln and previous experience with ceramics is required for local production. Often, candles are imported and filters are assembled locally.

Cost
Varies, often around US$15–30 for filter; replacement costs for ceramic candles average US$4.50/year.

Size & Weight
Ceramic candles vary in size and weight. Most are around 5–15 cm long and 3–8 cm in diameter. Total filter size depends on the type of containers used.

More Information

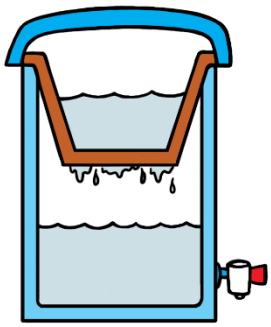
Details and references: www.hwts.info/products-technologies/a48a2cee/ceramic-candle-filter

Ceramic Pot Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	**Safe Storage**

What is it?

Ceramic pot filters are made from porous fired clay pots nested within a plastic, metal, or ceramic container. The clay is often mixed or painted with colloidal silver to help inactivate pathogens. Water is poured into the ceramic pot and collected underneath in a container with a tap at the bottom. This system provides safe storage for the treated water.



Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Effective (>90%)
Viruses	Somewhat Effective (>80%)
Protozoa	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
Effective at removing turbidity and colour.

Source Water Requirements
Turbid water (>50 NTU) should be settled or strained before filtering.

Capacity
Flow rate of 0.3–2.5 L/hour. Typically can treat around 8 L at a time.

Lifespan
Up to five years—generally one to two years.

Ease of Use & Acceptability

Operation & Maintenance
The user pours water into the filter. Water slowly moves through the ceramic pot by gravity, and is collected in a safe storage container. Users can access treated drinking water through a tap. The lower container, tap, and lid need regular cleaning. The ceramic pot should be regularly cleaned with a cloth or soft brush, taking care not to touch the bottom of the pot to anything that could be contaminated.

Repair & Replacement
Ceramic pots should be replaced every one to two years, or sooner if visible cracks appear.

User Considerations & Preferences
Small cracks can form in the ceramic pot that are not visible but reduce treatment effectiveness. Users should replace the pots every one to two years or when they observe unexpected increases in flow rate, which could indicate cracks.

Feasibility

Availability
Ceramic pot filters are locally produced in many countries. A small factory or kiln and previous experience with ceramics is required for local production of ceramic pots. Other filter components (container, lid, taps) can usually be found and assembled locally. Free designs for a hydraulic press and kiln are available from Potters for Peace.

Cost
Varies, often around US$15–30 for the whole filter; component replacements cost average US$4/year.

Size & Weight
Varies, often around 30 cm wide by 50 cm tall.

More Information

Details and references: www.hwts.info/products-technologies/d25e3821/ceramic-pot-filter

Cerâmica Stéfani Flex

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	**Safe Storage**

What is it?

The Cerâmica Stéfani Flex is a tabletop filter produced in Brazil by Cerâmica Stéfani S.A. The Flex setup sold to the international market includes one or two Stéfani Sterilizing Ceramic Cartridge(s), a float valve for each cartridge, two 6 L containers, a spigot tap, and the required hardware for installation. The ceramic cartridges (also called candles) are coated inside with colloidal silver and contain activated carbon.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	No independent tests
Protozoa	Very Effective*
Helminths	Very Effective*

**Assumption based on pathogen size. No independent tests.*

Other Parameters
Effective for removing turbidity, but clogs easily with very turbid water.

Source Water Requirements
Not intended for turbid water (>5 NTU).

Capacity
Flow rate of 0.5–3 L/hour per ceramic candle cartridge. The filter can treat 6 L per batch (top and bottom containers both hold 6 L).

Lifespan
Each ceramic cartridge has a service life of 500 L or 6 months of use. The plastic components last longer.

Ease of Use & Acceptability

Operation & Maintenance
Users pour water into the top of the upper container and wait for water to flow through the filter into the lower safe storage container. Overflow is prevented by the float valve(s) in the lower container. Treated water can be accessed through the tap. When the flow rate decreases after some time, a scrub pad can be used to rub away a very small layer of the ceramic material.

Repair & Replacement
The ceramic cartridges are fragile and must be replaced if there are cracks or leaks, when they have treated 500 L, or when they have been used for 6 months (whichever comes first). Plastic parts are more durable but may need replacement.

User Considerations & Preferences
Safe storage is included with the filter (lower container). The filter should be kept out of sunlight to avoid degradation of plastic parts.

Feasibility

Availability
Produced and sold by Cerâmica Stéfani through local Stéfani distributors.

Cost
Varies but is usually around US$35–60.

Size & Weight
26 x 26 x 26 cm (when packaged for shipping); weighs 1.2–1.5 kg, depending on number of candles.

More Information

Details and references: www.hwts.info/products-technologies/690a7147/ceramica-stefani-flex

Chemical Coagulants

What is it?

Chemical coagulants are substances added to water to cause particles to clump together and settle (sediment) more quickly. They are commonly used for community drinking water treatment, and occasionally for household water treatment. Chemicals used for coagulation include aluminium sulphate (alum), polyaluminium chloride (also known as PAC or liquid alum), and iron salts (ferric sulphate or ferric chloride).

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Somewhat Effective (>80%)
Viruses	No independent tests
Protozoa	Somewhat Effective*
Helminths	Somewhat Effective*

**Assumption based on data for natural settling*

Other Parameters
Somewhat effective at removing turbidity and colour.

Source Water Requirements
No specific limits.

Capacity
Varies based on container size and manufacturer instructions.

Lifespan
Varies; chemicals typically last for six months to one year.

Ease of Use & Acceptability

Operation & Maintenance
Users follow manufacturer's instructions to add a prepared dose of coagulant to water. They stir the water for a few minutes and then allow particles to clump and settle. Settled clumps are removed by filtering or gently pouring off the water.

Repair & Replacement
Chemicals must be kept in a dry location, and typically last for 6–12 months. Must be replaced regularly.

User Considerations & Preferences
Dosing is difficult to optimize without training and equipment. Using chemical coagulants requires an ongoing supply chain.

Feasibility

Availability
Products are made by many manufacturers around the world. Most chemical products are difficult and complex to manufacture; small-scale local production is usually not feasible.

Cost
Variable

Size & Weight
Products are easy to transport and can often be purchased in small packages.

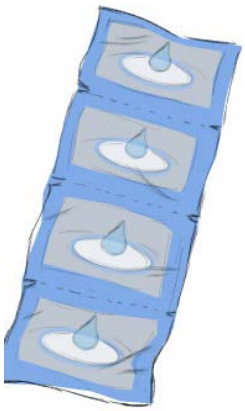
More Information

Details and references: www.hwts.info/products-technologies/25154a7c/Chemical-Coagulants

Chlorine (NaDCC Tablets)

What is it?

Chlorine is a popular chemical used to disinfect drinking water. It forms hypochlorous acid when added to water. This acid reacts with microorganisms, inactivating them. NaDCC, also known as sodium dichloroisocyanurate, is one form of chlorine used for disinfection. NaDCC tablets of various strengths are produced and sold around the world.



Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	Very Effective (>99%)
Cryptosporidium (Protozoa)	Not Effective (<80%)
Ascaris (Helminth)	Not Effective (<80%)

Other Parameters
Not effective for chemical contaminants or turbidity.

Source Water Requirements
Turbidity, organic matter, pH, and temperature affect how well chlorine works. When possible, settle or filter turbid water before using chlorine. Source water should have low turbidity and pH of 5.5–7.5.

Capacity
Tablets are dosed to treat specific volumes, ranging from 1–2,500 L. Treatment time is at least 30 minutes.

Lifespan
Shelf life is five years in strip packs and three years in tubs.

Ease of Use & Acceptability

Operation & Maintenance
User adds an appropriate dose (determined by manufacturer's instructions), stirs or shakes the water, and waits for at least 30 minutes.

Repair & Replacement
New tablets must be purchased before the user runs out. Tablets should be protected from exposure to temperature extremes or high humidity.

User Considerations & Preferences
Users must follow manufacturer's instructions to ensure effective treatment. An ongoing supply chain is needed for replacement tablets. Some users do not like the taste or smell of chlorine.

Feasibility

Availability
NaDCC tablets are produced and sold in many countries by different manufacturers. One example is Aquatabs (produced by Medentech). Tablets are difficult to produce locally but can be bought in bulk and packaged locally.

Cost
Varies, depending on manufacturer.

Size & Weight
Very small and easy to transport.

More Information

Details and references: www.hwts.info/products-technologies/a4b9ded7/chlorine-nadcc-tablets

Chlorine (Sodium Hypochlorite)

What is it?

Chlorine is a popular chemical used to disinfect drinking water. It forms hypochlorous acid when added to water. This acid reacts with microorganisms, inactivating them. There are many different brands of liquid chlorine products that can be used for household water treatment.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	Very Effective (>99%)
Cryptosporidium (Protozoa)	Not Effective
Giardia (Protozoa)	Depends on temperature, pH, and contact time
Ascaris (Helminth)	Not Effective

Other Parameters
Not effective for chemical contaminants or turbidity.

Source Water Requirements
Turbidity, organic matter, pH, and temperature affect how well chlorine works and how much chlorine is required. When possible, sediment or filter turbid water before using chlorine. Disinfection is less reliable if the water's a pH is below 5.5 or above 7.5.

Capacity
Depends on container size and dosing instructions. Treatment time of at least 30 minutes. Follow manufacturer's instructions.

Lifespan
Typical shelf life for liquid chlorine products is between six weeks and one year. Refer to packaging.

Ease of Use & Acceptability

Operation & Maintenance
User adds an appropriate dose (determined by manufacturer's instructions or careful dosing calculations), stirs gently, and waits for at least 30 minutes.

Repair & Replacement
New solution must be purchased regularly (often every six months or when solution runs out).

User Considerations & Preferences
Determining appropriate doses can be challenging if products lack dosing instructions. Chlorine products degrade over time. Some users do not like the taste or smell of chlorine.

Feasibility

Availability
Many chlorine products are produced and manufactured locally for water treatment. It is possible to make chlorine with salt, water, and electricity—but the resulting solution must be stabilized or used immediately.

Cost
Varies, often around US$0.45–3.29 per 1,000 L.

Size & Weight
Bottles of chlorine solution vary in size and weight but are typically easy to transport.

More Information

Details and references: www.hwts.info/products-technologies/4c1aeb66/Chlorine-Sodium-Hypochlorite

Concrete Biosand Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	Safe Storage

What is it?

A concrete biosand filter is a type of biosand filter housed within a concrete body. It is usually produced locally. Biosand filters (BSFs) are columns of finely crushed rock on which microorganisms are living. Water is poured into the top of the column and spends a period of time in contact with the sand. This allows the microorganisms living in the sand to remove pathogens from the water. When a new batch of water is poured in, water added earlier flows out.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Effective (>90%)
Viruses	Somewhat Effective (>80%)
Cryptosporidium (Protozoa)	Very Effective (>99%)
Giardia (Protozoa)	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
High removal of turbidity. Removes iron. Can be modified to remove arsenic (see Kanchan Filter). Not effective for most other chemical contaminants.

Source Water Requirements
Turbid water (>50 NTU) should be settled or strained before filtering.

Capacity
Treats 12–18 L per batch, and one to four batches per day.

Lifespan
Ten years or more.

Ease of Use & Acceptability

Operation & Maintenance
User pours water into the filter each day. Simple maintenance is required to clean sand when flow rate slows down.

Repair & Replacement
Lids and diffusers need replacement every few years.

User Considerations & Preferences
Requires that water to be added every day or two to develop and maintain the microbiological community. Heavy and difficult to move, making it unsuitable for people who move often.

Feasibility

Availability
Concrete bodies can be made anywhere. The mold design for the square version is freely available from CAWST. The design for the round version is freely available from Bushproof. The design for a wood mold for the square version is freely available from O'Horizon. Making a steel mold for concrete BSF construction requires a skilled welder. Anyone can be trained to construct and install the filter.

Cost
US$12–100

Size & Weight
Most common version is 0.9 m by 0.3 m. Empty filter body weighs 70–135 kg.

More Information

Details and references: www.hwts.info/products-technologies/d3df2470/concrete-biosand-filter

Grifaid Family Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	Safe Storage

What is it?

The Grifaid Family Filter is a membrane ultrafiltration system manufactured by the UK-based organization Grifaid. This system has a 0.01 micron filter membrane contained within a pump unit. The unit can be attached to a bucket using a built-in clamp.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	Very Effective (>99%)
Protozoa	Very Effective*
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
Very effective for removing turbidity.

Source Water Requirements
Low turbidity preferred. This filter can be used with turbid water, but it may clog more often and more frequent backwashing will be required.

Capacity
Can filter one bucket of water at a time. Flow rate is 1.5 L/minute. Requires constant pumping.

Lifespan
Manufacturer-stated lifespan is 5 years or longer. Actual lifespan varies, depending on source water, frequency of use, and maintenance.

Ease of Use & Acceptability

Operation & Maintenance
Users fill a container with untreated water and put the Grifaid Family Filter into the water. They attach the filter to the container with the built-in clamp. They use the pump to draw water into the filter, through the filter cartridge, and out the blue filtered water tap. Daily backwashing is recommended: users must follow the manufacturer's instructions to pump backwashed water out of the red tap. Maintenance procedures are also required, less frequently, for the piston and prefilter. A bubble test can be used to check for air leaks (see user manual).

Repair & Replacement
Does not require spare parts. The entire filter should be replaced at the end of its expected lifespan, or if it breaks, if flow rate suddenly increases, or if backwashing doesn't return flow rate to normal.

User Considerations & Preferences
Requires regular cleaning of prefilter and regular backwashing of filter cartridge. Safe storage container is required (not included).

Feasibility

Availability
Can be ordered (in bulk) from Grifaid.

Cost
Costs around US$50 (not including water containers), depending on the quantity ordered.

Size & Weight
48 x 10 x 14 cm when packaged for shipping. Weighs 1.2 kg.

More Information

Details and references: www.hwts.info/products-technologies/c2a268e8/grifaidr-family-filter

Hydraid® Biosand Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	Safe Storage

What is it?

The Hydraid Biosand Filter is a plastic-bodied type of biosand filter (BSF) manufactured by *Native*Energy. Biosand filters (BSFs) are columns of finely crushed rock on which microorganisms are living. Water is poured into the top of the column and spends a period of time in contact with the sand. This allows the microorganisms living in the sand to remove pathogens from the water. When a new batch of water is poured in, water added earlier flows out.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Effective (>90%)
Viruses	Somewhat Effective (>80%)
Cryptosporidium (Protozoa)	Very Effective (>99%)
Giardia (Protozoa)	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
High removal of turbidity. Removes iron. Can be modified to remove arsenic (see Kanchan Filter). Not effective for most other chemical contaminants.

Source Water Requirements
Turbid water (>50 NTU) should be settled or strained before filtering.

Capacity
Treats 15 L per batch and one to four batches per day.

Lifespan
Ten years or more.

Ease of Use & Acceptability

Operation & Maintenance
Users pour water into the filter each day. Simple maintenance is required to clean sand when flow rate slows down.

Repair & Replacement
Lids and diffusers may need replacement before the rest of the filter body.

User Considerations & Preferences
Requires that water to be added every day or two to develop and maintain the microbiological community. Filters should not be moved after installation.

Feasibility

Availability
Available for bulk purchase by partner organizations.

Cost
Price range given by *Native*Energy, which uses carbon credits to help finance production and implementation: US$25–50.

Size & Weight
0.77 m tall by 0.4 m diameter. Weighs 3.6 kg empty and 64 kg filled.

More Information

Details and references: www.hwts.info/products-technologies/07e65cbc/hydraidtm-biosand-filter

Kanchan Arsenic Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	Safe Storage

What is it?

The Kanchan Arsenic Filter (KAF) is a modified biosand filter with zerovalent iron (often in the form of rusty nails) added to the diffuser basin. Arsenic in the water gets adsorbed onto iron oxide (from the rusty nails) and then becomes trapped on the surface of the sand within the filter. Like other biosand filters, the body of the KAF can be made of concrete, plastic, or stainless steel. It contains a column of finely crushed rock (sand) on which microorganisms are living. The KAF removes microbiological contaminants through the same mechanisms as other biosand filters.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Effective (>90%)
Viruses	Somewhat Effective (>80%)
Cryptosporidium (Protozoa)	Very Effective (>99%)
Giardia (Protozoa)	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
Somewhat effective at removing arsenic (>80%).

Source Water Requirements
Turbid water (>50 NTU) should be settled or strained before filtering. The KAF's performance is affected by pH, hardness, iron and arsenic concentrations.

Capacity
Treats one to four batches per day (12 L per batch for the concrete v10 model).

Lifespan
Nails must be replaced every 2-3 years.

Ease of Use & Acceptability

Operation & Maintenance
User pours water into the filter each day. Simple maintenance is required to clean sand when flow rate slows down.

Repair & Replacement
Nails, lid and diffuser must be replaced over time.

User Considerations & Preferences
Water must be added every day or two to develop and maintain the microbiological community. Filter is heavy and difficult to move, making it unsuitable for people who move often.

Feasibility

Availability
Concrete bodies can be made anywhere with required materials and skills. Plastic bodies need a centralized manufacturing facility, or can be imported.

Cost
US$12–100

Size & Weight
Average size is 0.9 m tall by 0.3 m wide. Empty filter cases weigh 70–135 kg (concrete body) or 3.5 kg (plastic body).

More Information

Details and references: www.hwts.info/products-technologies/ccfddb7b/kanchan-arsenic-filter

Katadyn Drip Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	**Safe Storage**

What is it?

The tabletop filter is produced by the Swiss company Katadyn. The filter setup consists of three ceramic filter elements, two 10 L containers, a tap for dispensing water, a cleaning pad, a measuring gauge, emergency plugs, and the necessary hardware for installation. Two types of ceramic filter elements are available: one has silver-coated pebbles inside (to prevent microbial growth), and one has activated carbon inside (to remove chemicals).

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	No independent tests
Protozoa	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
Effective for removing turbidity. The version with activated carbon can help remove chemicals and improve the taste of water.

Source Water Requirements
Very turbid water may cause the filter to clog and require more frequent cleaning.

Capacity
Can treat 10 L at a time. Flow rate is up to 4 L/hour.

Lifespan
Manufacturer-stated lifespan is up to 50,000 L per ceramic candle, or up to 6 months for the candles with activated carbon. Actual lifespan will vary, depending on water quality, use, and maintenance.

Ease of Use & Acceptability

Operation & Maintenance
Users pour water into the upper container and wait for water to flow through the filter into the lower safe storage container. Treated water can be accessed through the tap. When flow rate decreases after some time, a scrub pad can be used to rub away a very small layer of the ceramic material. Emergency plugs are provided and make it possible to use the filter with only one or two ceramic candles by blocking the other holes.

Repair & Replacement
The ceramic cartridges are fragile and must be replaced if there are cracks or leaks, or when repeated cleaning makes them thinner than the measuring gauge provided. Plastic parts are more durable but may need replacement.

User Considerations & Preferences
Safe storage is included with the filter (lower container).

Feasibility

Availability
Bulk order information not available.

Cost
Varies.

Size & Weight
45 cm high, 25 cm in diameter. Weight, including filter elements, is 3 kg.

More Information

Details and references: www.hwts.info/products-technologies/e3cb323b/katadynr-drip-filter

LifeStraw Family 1.0 Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	Safe Storage

What is it?

LifeStraw Family 1.0 is a membrane ultrafiltration system manufactured by Vestergaard. Users pour untreated water into a container at the top of the filter. Filtered water comes out of the tap at the bottom, after passing through a prefilter with a pore size of 80 microns and a membrane with pore size of 0.02 microns (20 nm).

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	Very Effective (>99%)
Protozoa	Very Effective (>99%)
Helminths	Very Effective (>99%)

Other Parameters
Very effective for turbidity. Effective for colour.

Source Water Requirements
Low turbidity preferred. This filter can be used with turbid water, but it may clog more often and more frequent backwashing will be required.

Capacity
Can filter 2 L of water at a time, at an average flow rate of 8.8 L/hr.

Lifespan
Manufacturer states that the filter lasts long enough to treat 18,000 L, or about 2.5 years when filtering 20 L/day. Actual lifespan varies, depending on source water, frequency of use, and maintenance.

Ease of Use & Acceptability

Operation & Maintenance
User pours water into the dark blue upper container, then collects treated water from the tap at the bottom of the hose, into a safe storage container. Dirty water inside the cartridge should be removed daily by backwashing through the red tap (this water should not be consumed). The prefilter should be cleaned every day with safe water and a cloth. The safe storage container should also be cleaned regularly.

Repair & Replacement
Does not require spare parts. The entire filter should be replaced at the end of its expected lifespan, or if it breaks, if flow rate suddenly increases, or if backwashing doesn't return flow rate to normal.

User Considerations & Preferences
Requires regular cleaning of prefilter and regular backwashing of filter cartridge.

Feasibility

Availability
Can be purchased from Vestergaard (regional offices are located in parts of Africa and Asia). Must be purchased in large quantities.

Cost
US$25-40, only available in bulk orders.

Size & Weight
Upper container capacity is 2 L; hose length is 1 m. Weighs around 0.5 kg.

More Information

Details and references: www.hwts.info/products-technologies/83717cbd/lifestrawr-family-10

LifeStraw

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	Safe Storage

What is it?

Manufactured by Vestergaard, the LifeStraw is a portable filter intended for personal use. Users put one end of the LifeStraw directly into a water source or bucket of water, and suck on it like a straw to draw the water through. The membrane cartridge within this filter removes particles larger than 0.2 microns.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	No independent tests
Protozoa	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size. No independent tests.*

Other Parameters
Very effective for turbidity. Effective for colour.

Source Water Requirements
Low turbidity is preferred. This filter can be used with turbid water, but it may clog more often and more frequent backwashing will be required.

Capacity
Volume filtered depends on the user, since the filter is driven by the user sucking water through it. Flow rate will vary over the filter cleaning cycle and over the filter's lifespan. Average flow rate over a 5-month study was 0.128 L/min.

Lifespan
Manufacturer states that the filter lasts long enough to treat 1,000 L of water. Actual lifespan varies, depending on source water, frequency of use, and maintenance.

Ease of Use & Acceptability

Operation & Maintenance
The user holds one end of the LifeStraw in the water they want to treat, and sucks to draw water through the filter and into their mouth. The filter requires regular backwashing, which is done by blowing through the filter to release clogged particles. More frequent backwashing is required for turbid water.

Repair & Replacement
The entire filter should be replaced at the end of its expected lifespan, or if it breaks, if flow rate suddenly increases, or if backwashing doesn't return flow rate to normal.

User Considerations & Preferences
Recommended for use by adults and children over 3 years old, when away from the home. Should not be used to filter water for friends or family or for cooking, as the filter goes directly into the user's mouth. Regular backwashing is required, and flow rate can vary.

Feasibility

Availability
Must be purchased from Vestergaard.

Cost
US$3-6.50, available in retail and wholesale.

Size & Weight
Length 22.5 cm, diameter 2.5 cm. Weighs 56 g.

More Information

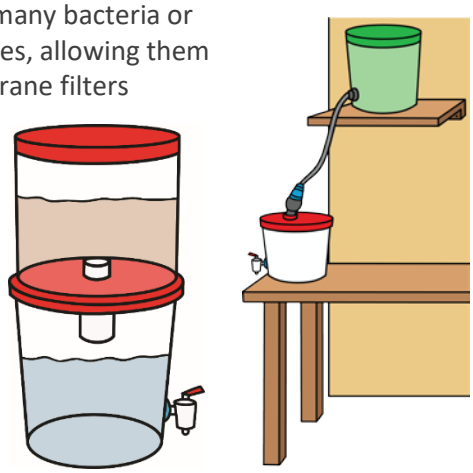
Details and references: www.hwts.info/products-technologies/471c6dce/lifestrawr

Membrane Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	**Safe Storage**

What is it?

A membrane is a thin barrier with tiny pores that allow water and certain small particles to pass through but are too small for larger particles to pass through. Membrane filters are classified according to the diameter of the pores in the membrane. Ultrafiltration membranes can remove large particles, bacteria, protozoa, helminths, and some viruses. Microfiltration membranes have bigger pores and cannot remove as many bacteria or viruses. Nanofiltration and reverse osmosis membranes have the smallest pores, allowing them to remove not only pathogens but also many types of chemicals. Some membrane filters include built-in safe storage in the bottom container.



Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective*
Viruses	Varies
Protozoa	Very Effective*
Helminths	Very Effective*

**Generalization based on pathogen size. Specific membranes vary.*

Other Parameters
Depending on pore size, some membrane filters can remove salts, pesticides, and other chemicals.

Source Water Requirements
Varies. High turbidity may cause filters to clog and require more frequent backwashing.

Lifespan
Manufacturer-stated lifespans range from several months to several years. Actual lifespan varies, depending on source water, frequency of use, and maintenance.

Ease of Use & Acceptability

Operation & Maintenance
Many types of membrane filters exist, each with different operation and maintenance requirements. Generally, the user pours water into the filter. Water moves through the membrane by gravity or by the user pumping to increase pressure. Backwashing (pushing water backwards through the filter to clean the pores) is required when flow rate slows. Some filters have built-in safe storage. Others must be attached to, or emptied into, a safe storage container.

Repair & Replacement
Varies. Often requires spare parts or replacement of membrane filter cartridge over time.

User Considerations & Preferences
Varies. See the fact sheets for specific membrane filter types.

Feasibility

Availability
Varies between types of filters and locations. Most are imported, but some membrane filters can be produced locally.

Cost
Varies. See fact sheets for specific filter types.

Size & Weight
Membrane cartridges tend to be small. The filters vary in size, depending on container volume and setup.

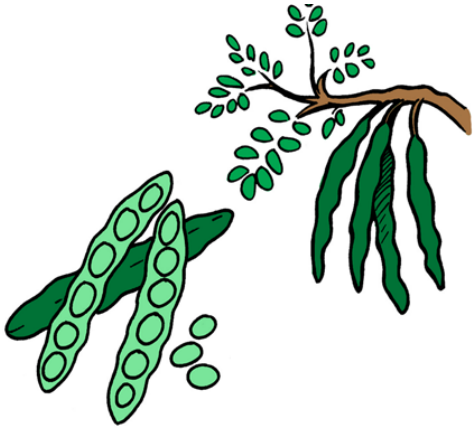
More Information

Details and references: www.hwts.info/products-technologies/69e8bea1/membrane-filter

Natural Coagulants

What is it?

Coagulants are substances added to water to cause particles to clump together and settle (sediment) more quickly. Some plants can be used as coagulants. Examples of natural coagulants include: extracts from *Strychnos potatorum* (the clearing nut or nirmali tree), the seeds of *Moringa oleifera*, and the flesh of prickly pear cactus.



Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Somewhat Effective (>80%)
Viruses	No independent tests
Protozoa	Somewhat Effective*
Helminths	Somewhat Effective*

**Assumption based on data for natural settling*

Other Parameters
Under certain conditions, some natural coagulants effectively remove turbidity, iron, and/or manganese.

Source Water Requirements
No specific limits.

Capacity
Volume treated depends on container size. Treatment dose and time depends on source water turbidity and the type of coagulant. Treatment with moringa usually takes four hours.

Lifespan
Varies; dried beans and seeds can be stored for a long time in a dry location. Prickly pear cactus needs to be used before the sap dries.

Ease of Use & Acceptability

Operation & Maintenance
Users add a prepared dose of coagulant to water. They stir the water for a few minutes, and then allow particles to clump and settle. Settled clumps are removed by filtering or gently pouring off the water. Most natural coagulants need to be prepared from the raw materials (for example, by peeling prickly pear cactus or crushing and drying moringa seeds).

Repair & Replacement
Users must pick or purchase new supplies regularly.

User Considerations & Preferences
Little research has been done to optimize and standardize the use of natural coagulants. Finding the correct plants and preparing them is required before treatment. Preparation, use, and dose vary depending on source water and type of coagulant. Natural coagulants leave organic matter in water and may make subsequent treatment with chlorine less effective. Some users say that natural coagulants affect the taste of water.

Feasibility

Availability
Different types of natural coagulants are available in different regions.

Cost
Varies; generally inexpensive.

Size & Weight
Variable.

More Information

Details and references: www.hwts.info/products-technologies/cc936ef7/natural-coagulants

P&G Purifier of Water

Source Protection	Safe Transportation	**Sedimentation**	Filtration	**Disinfection**	Safe Storage

What is it?

Formerly known as PUR, the P&G Purifier of Water is a combined flocculent-disinfectant that was developed by Procter & Gamble in collaboration with the US Centers for Disease Control and Prevention (CDC). Users add one packet of this product to 10 L of water, stir vigorously, filter the water through a cloth, and then wait 20 minutes. P&G Purifier of Water contains two components: a coagulant (to cause particles to clump together and settle) and a form of chlorine that works slowly to inactivate remaining pathogens.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	Very Effective (>99%)
Protozoa	Very Effective (>99%)
Helminths	Very Effective (>99%)

Other Parameters
Effective for removing turbidity, heavy metals such as arsenic, and chemical contaminants.

Source Water Requirements
Chlorine works best at a pH between 5.5 and 7.5.

Capacity
Each packet treats 10 L and treatment takes 30 minutes.

Lifespan
Packets need to be used within 3 years of manufacture. Each packet is single-use. An expiration date is given on the packet.

Ease of Use & Acceptability

Operation & Maintenance
The user adds the contents of one packet to 10 L of water, stirs vigorously for 5 minutes, and allows water to settle for 5 minutes. Next, the user filters the water through a cotton cloth, then waits an additional 20 minutes to allow the chlorine to disinfect any remaining pathogens. Packets should be protected from extreme temperatures or high humidity.

Repair & Replacement
Requires regular purchase of the product.

User Considerations & Preferences
Free chlorine residual provides protection against recontamination. Some users do not like the taste and smell of chlorine. Proper use of P&G Purifier of Water requires carefully following all the steps in the manufacturer's instructions.

Feasibility

Availability
Produced and sold by Procter & Gamble™.

Cost
Typical price is around US$0.10 per sachet, or US$.01 per litre treated.

Size & Weight
Lightweight and portable. Each packet weights 4 g.

More Information

Details and references: www.hwts.info/products-technologies/e0baff7f/pandgtm-purifier-of-water

Rainfresh MP4U Gravity Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	**Safe Storage**

What is it?

The Rainfresh MP4U Gravity Filter is a tabletop filter produced by Envirogard Products Ltd. The filter setup consists of four silver-impregnated ceramic cartridges, two buckets, a tap for dispensing water, a filter gauge to measure when the filters need to be replaced, cleaning mesh, and the necessary hardware for installation.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	No independent tests
Cryptosporidium (Protozoa)	Very Effective (>99%)
Giardia (Protozoa)	Very Effective (>99%)
Helminths	Very Effective (>99%)

Other Parameters
Effective for removing turbidity.

Source Water Requirements
Manufacturer states that this filter can be used for water with turbidity up to 50 NTU. Very turbid water may cause the filter to clog and require more frequent cleaning.

Capacity
Maximum flow rate of 2.9 L/hour under ideal conditions. Can filter 25 L per batch (top and bottom buckets both hold 25 L).

Lifespan
Each ceramic cartridge will last 6–12 months. Plastic components are more durable.

Ease of Use & Acceptability

Operation & Maintenance
User pours water into the top of the upper container and waits for water to flow through the filter into the lower safe storage container. Treated water can be accessed through the tap. When flow rate reduces after some time, the cleaning mesh provided with the filter can be used to rub away a very small layer of the ceramic material.

Repair & Replacement
The ceramic cartridges are fragile and must be replaced if there are cracks or leaks, or when repeated cleaning makes them thinner than the measuring gauge provided (likely every 6–12 months). Plastic parts are more durable but may need replacement.

User Considerations & Preferences
Safe storage is included with the filter (lower container). The filter should be kept out of sunlight to avoid degradation of plastic parts.

Feasibility

Availability
Produced and sold by Envirogard Products Ltd. The cartridges cannot be produced locally but can be shipped internationally.

Cost
Not available.

Size & Weight
Filter is 79 cm tall by 30.5 cm wide and weighs 3.5 kg.

More Information

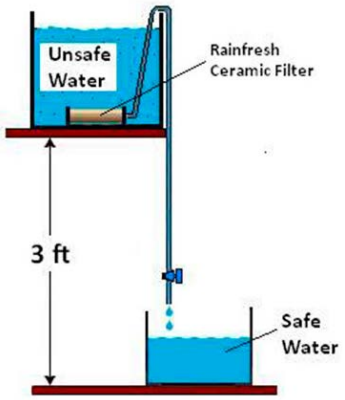
Details and references: www.hwts.info/products-technologies/29261770/rainfreshr-mp4u-gravity-filter

Rainfresh P2S Siphon Water Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	Safe Storage

What is it?

The Rainfresh P2S Siphon Water Filter is produced by the Canadian company Envirogard Products Ltd and was designed specifically for use in emergencies. The filter consists of a silver-impregnated ceramic cartridge with attached tubing. It comes with two water containers, a scrub pad, and a filter gauge.



Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	No independent tests
Cryptosporidium (Protozoa)	Very Effective (>99%)
Giardia (Protozoa)	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
High removal of turbidity.

Source Water Requirements
Turbid water (>50 NTU) should be settled or strained before filtering. Very turbid water may cause the filter to clog and require more frequent maintenance.

Capacity
Treats 25 L per batch. Flow rate is up to 1.2 L/hour.

Lifespan
Lasts 6–12 months or up to 3,800 L, according to the manufacturer. Actual lifespan may vary depending on use, source water, and maintenance.

Ease of Use & Acceptability

Operation & Maintenance
User places the filter element in a raised container of untreated water, applies suction to start a siphon in the tube, and lets treated water flow through the tube into a safe storage container. The safe storage container should be 1 m below the source water container. When the flow rate slows, the filter can be cleaned with the scrub pad provided.

Repair & Replacement
The ceramic cartridges are fragile and must be replaced if there are cracks or leaks, or when repeated cleaning makes them thinner than the gauge provided (likely every 6–12 months).

User Considerations & Preferences
The filter should be kept out of sunlight to avoid degradation of plastic parts.

Feasibility

Availability
Produced and sold by Envirogard Products Ltd. The cartridges cannot be produced locally but can be shipped internationally.

Cost
Not available.

Size &Weight
2.95 kg including the two water containers.

More Information

Details and references: www.hwts.info/products-technologies/660290f6/rainfreshr-p2s-siphon-water-filter

Sawyer PointONE

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	Safe Storage

What is it?

Produced by Sawyer Products, the Sawyer PointONE™ is a gravity-driven membrane filter. It uses hollow fibre membranes with a pore size of 0.1 microns, making it effective for removing bacteria, protozoa, and helminths. With an adapter kit, the filter can be attached to a plastic bucket. Dirty water is poured into the plastic bucket, flows down through the filter (which traps particles and pathogens), and out into a safe storage container.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	No independent tests
Cryptosporidium (Protozoa)	Very Effective (>99%)
Giardia (Protozoa)	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
Effective for removing turbidity. Not effective for chemicals.

Source Water Requirements
Can be used with turbid water, but the filter may clog more often and require more frequent backwashing. Turbid water (>50 NTU) should be settled or strained before filtering.

Capacity
Can treat 32.8–46.5 L/hour. Typically treats 20 L (one bucket) at a time.

Lifespan
Manufacturer states that the filter can be backwashed and reused indefinitely without needing replacement. Recent studies indicate lifespan may be shorter than this.

Ease of Use & Acceptability

Operation & Maintenance
Users pour water into the upper container, and wait for water to flow down the hose, through the filter into a lower safe storage container. A syringe (included) can be used to backwash the filter when flow rate slows down. The safe storage container must be cleaned regularly.

Repair & Replacement
The filter should be replaced if it breaks, if flow rate suddenly increases, or if backwashing doesn't return flow rate to normal.

User Considerations & Preferences
Usually the user must connect the filter to a bucket. The flow rate may slow down quickly for turbid water.

Feasibility

Availability
Available online. Cannot be exported internationally through Sawyer Products Inc. They recommend contacting an international logistics company.

Cost
US$60 from manufacturer.

Size & Weight
Filter unit is 22 cm long by 7 cm wide, weighing 0.3 kg.

More Information

Details and references: www.hwts.info/products-technologies/cd408b5b/sawyerr-pointonetm-filter

Settling

What is it?

Settling involves letting a container of water sit, usually for 24 hours, allowing particles to settle to the bottom of the container. The water is then gently poured or ladled into a clean container, leaving settled particles behind. This process can be repeated two or three times as needed. It removes some turbidity and pathogens from water and is often used as a first step in treatment, before filtration or disinfection.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Not Effective (<80%)
Viruses	Not Effective (<80%)
Protozoa	Somewhat Effective (>80%)
Helminths	Somewhat Effective (>80%)

Other Parameters
Effectiveness at removing turbidity varies, depending on the size of suspended particles.

Source Water Requirements
No specific limits.

Capacity
Volume treated depends on container size. Water can be settled for a few hours or several days, depending on its quality.

Lifespan
Containers may need to be replaced over time.

Ease of Use & Acceptability

Operation & Maintenance
User allows water to sit in a container for a given period, usually 24 hours. During this time, particles settle to the bottom of the container. The user then gently pours the water into another clean container. This can be repeated two to three times. Containers should be cleaned between uses.

Repair & Replacement
Containers may need to be replaced over time.

User Considerations & Preferences
This method requires multiple buckets and advance planning. Settling is often used as first step in treatment, before filtration or disinfection.

Feasibility

Availability
Containers can be found anywhere.

Cost
Only requires containers (local prices vary).

Size & Weight
Many buckets are sized to hold 20 L of water, and can stack easily. Other containers vary in size and weight.

More Information

Details and references: www.hwts.info/products-technologies/241df321/Settling

Solar Disinfection (SODIS)

Source Protection	Safe Transportation	Sedimentation	Filtration	**Disinfection**	**Safe Storage**

What is it?

SODIS uses the sun's rays to kill pathogens in the water. It can be used to disinfect small volumes of water, as long as the water has low turbidity (is not cloudy). To use SODIS, people fill transparent plastic bottles made from polyethylene terephthalate (PET) and place them in direct sunlight. Water can be consumed directly from the bottle to avoid recontamination.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	Somewhat Effective (>80%)
Cryptosporidium (Protozoa)	Somewhat Effective (>80%)
Giardia (Protozoa)	Very Effective (>99%)
Helminths	Effective (>90%)

Other Parameters
Not effective for removing chemicals or turbidity.

Source Water Requirements
Water must have low turbidity (<30 NTU). Filter or sediment turbid water before treatment.

Capacity
Water is treated in plastic bottles, each of which can usually hold 1–2 L. Treatment takes between six hours (sunny conditions) and 48 hours (cloudy conditions).

Lifespan
Bottles must be replaced when they are scratched or become aged by sunlight.

Ease of Use & Acceptability

Operation & Maintenance
User fills a 1–2 L transparent, noncoloured plastic PET bottle with water. They place the bottle on its side in direct sunlight. After 6–48 hours (depending on weather conditions), the water is safe to drink. Water can be consumed directly from the bottle, which acts as a safe storage container.

Repair & Replacement
Bottles must be replaced when scratched or aged.

User Considerations & Preferences
Requires a sunny climate and ongoing availability of plastic PET bottles. Water can be safely stored in the same bottle it was treated in. Users need to keep track of when bottles were placed for treatment and add additional treatment time if weather is cloudy. Several bottles are required for large families.

Feasibility

Availability
Plastic PET bottles can be found around the world.

Cost
PET bottles are generally inexpensive (often much less than US$0.50). Each household requires multiple bottles (number depends on size of household).

Size & Weight
Bottles are small, light, and easy to transport.

More Information

Details and references: www.hwts.info/products-technologies/a01550ee/solar-disinfection-sodis

See also: SODIS website (www.sodis.ch)

Solar Distillation

Source Protection	Safe Transportation	Sedimentation	Filtration	**Disinfection**	Safe Storage

What is it?

Solar distillation is an ancient method of using the sun's energy to treat drinking water. Distillation is the process of evaporating water into vapour, and then capturing and cooling the vapour so it condenses back into a liquid. Contaminants get left behind when the water evaporates. There are many different designs for solar distillation units (solar stills).

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	No independent tests
Protozoa	Very Effective (>99%)
Helminths	Very Effective (>99%)

Other Parameters
Effective at removing turbidity, chemicals, and colour.

Source Water Requirements
No specific limits. Very turbid water should be settled or filtered first to reduce maintenance and cleaning required for the reservoir.

Capacity
Solar still sizes can vary from 0.5 m^2 for household use to 600 m^2 for community use. Volume treated depends on the type and size of solar still. Box stills produce: 4–8 L/m^2; cone stills produce: 1–1.7 L/m^2.

Ease of Use & Acceptability

Operation & Maintenance
The user fills the solar still with water (for self-cleaning units, they add two to three times more water than will be produced). They wait, allowing the sun's rays to heat the water, and then they collect the treated water from the collection container. Some systems are self-cleaning and flush out contaminants. Others need regular cleaning with soap and water.

Repair & Replacement
Depending on the design, components may be fragile and may require regular replacement and repair.

User Considerations & Preferences
Requires a suitable climate and weather conditions. Requires airtight seals and smoothly stretched plastic during construction and operation. Users must handle the still with care to avoid breaking seals. About 0.5 m^2 of solar box still space is required per person to meet drinking water needs.

Feasibility

Availability
There are many worldwide producers. Simple designs are available for free online. The simplest designs can be made at home using a piece of plastic stretched over a container of water, with the centre weighted down so evaporated water condenses into another container.

Cost
Varies, depending on type and size.

Size & Weight
Varies, depending on type and size.

More Information

Details and references: www.hwts.info/products-technologies/6bfb8c81/solar-distillation

Solar Pasteurization

What is it?

Pasteurization is the process of heating water to kill pathogenic microorganisms, usually at temperatures below the boiling point (65–70°C). A simple method of pasteurizing water is to put containers of water in a solar cooker (a set of reflective panels, usually arranged as a box, that concentrate sunlight on the water container). As the water slowly heats up, pathogens begin to die. A thermometer or indicator is needed to tell when the temperature is high enough for effective pasteurization.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	Very Effective (>99%)
Protozoa	No independent tests
Helminths	No independent tests

Other Parameters
Not effective for turbidity, colour, or chemicals.

Source Water Requirements
No specific limits. Turbid water should be settled or filtered before using this method.

Capacity
Varies; volume treated depends on the size and capacity of the solar cooker. Treatment often takes one to four hours or more as the water heats up slowly from the sun's reflected rays.

Lifespan
Varies, depending on the type of solar cooker and whether it is homemade or manufactured.

Ease of Use & Acceptability

Operation & Maintenance
Users put water in a black container within a solar cooker. They place the cooker in the sun, repositioning it as needed to make sure it stays in direct sunlight. The cooker must stay in the sun until the water reaches at least 65°C. A thermometer or wax indicator (beeswax, soya bean fat, or Water Pasteurization Indicator, also called a WAPI) should be used to determine when the water has reached the required temperature.

Repair & Replacement
The cooker may need to be repaired over time (especially if homemade), and temperature indicators may need to be replaced.

User Considerations & Preferences
This method does not work on rainy or cloudy days. A thermometer, indicator device, or wax is needed to help the user know when the water reaches 65°C. Users must wait for water to cool before drinking.

Feasibility

Availability
There are many producers of solar cookers worldwide. Simple designs are freely available online.

Cost
Varies, depending on materials used.

Size & Weight
Varies, depending on the type of solar cooker used.

More Information

Details and references: www.hwts.info/products-technologies/4c156b83/Solar-Pasteurization

Solvatten

Source Protection	Safe Transportation	Sedimentation	Filtration	**Disinfection**	**Safe Storage**

What is it?

Solvatten is a portable water treatment device that doubles as a solar water heater. Users open Solvatten like a book, pour water into the inner containers, and expose it to sunlight. Fabric filters (35 micron pore size) in the container openings remove larger particles. Heat and ultraviolet radiation from the sun inactivate and kill pathogens.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	Very Effective (>99%)
Protozoa	Very Effective (>99%)
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
Not effective for turbidity, chemicals, or colour.

Source Water Requirements
Turbid water should be filtered or settled before using Solvatten.

Capacity
Treats 10 L at a time. Treatment takes two to six hours, depending on weather conditions.

Lifespan
According to the manufacturer, Solvatten lasts 7 years on average. Actual lifespan will vary depending on use, care, and source water quality.

Ease of Use & Acceptability

Operation & Maintenance
The user opens Solvatten like a book and fills both containers with water. They push the "sun" button to reset the indicator, then place Solvatten in direct sunlight until the face on the indicator turns from red/sad to green/happy. Typically treatment takes two to six hours. The inside of Solvatten should be cleaned occasionally by adding a handful of dry beans, rice, or woolen balls to the unit along with water, then shaking and rinsing.

Repair & Replacement
Made of durable plastic, Solvatten does not require batteries, chemicals, or other consumables. The fabric prefilters can be replaced with locally-sourced cloth if needed. The whole unit must be replaced if it breaks.

User Considerations & Preferences
Solvatten works best in areas where there is lots of sunshine. It can be used for short-term storage of treated water. Solvatten doubles as a solar water heater, warming water to up to 75°C. It does not reduce turbidity.

Feasibility

Availability
Must be purchased from Solvatten AB; can be purchased online.

Cost
US$46–93, depending on unit type and size.

Size & Weight
The 10 L unit is 36 x 47 x 13 cm and weighs approximately 2.7 kg (empty).

More Information

Details and references: www.hwts.info/products-technologies/6201ce2b/solvatten

Straining

What is it?

Straining involves pouring water through a clean piece of cloth. Typically, fine and tightly-woven cotton, such as a sari cloth, is used. The cloth is folded eight times into layers, which makes it more difficult for sand, silt, clay, and pathogens to pass through. A sari cloth folded eight times will allow water to pass through but will filter out particles larger than 20–30 µm.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Somewhat Effective*
Viruses	Not Effective (<80%)
Protozoa	Somewhat Effective**
Helminths	Very Effective (>99%)**

**A study found this method very effective at filtering plankton to which cholera-causing bacteria were attached. Straining may not be as effective for other bacteria.*
***Assumption based on pathogen size. No independent tests.*

Other Parameters
Somewhat effective at removing turbidity. Does not remove colour or chemicals.

Source Water Requirements
No specific limits.

Capacity
Volume treated depends on container size. Treatment takes only a few minutes and can be repeated multiple times in one day (using a clean cloth each time).

Lifespan
After many washings, threads of old cloths become soft and loose. This makes the cloth less effective at filtering particles. The cloth should be replaced if holes develop.

Ease of Use & Acceptability

Operation & Maintenance
Users fold a large, freshly cleaned cloth eight times. They securely tie the folded cloth over a clean container, and then pour water through the cloth into the container. The cloth should be washed in clean water between uses.

Repair & Replacement
New cloth must be purchased occasionally.

User Considerations & Preferences
Simple and easy to perform.

Feasibility

Availability
Requires buckets and finely woven cotton cloths. These supplies can be found in most communities.

Cost
Varies; depends on local costs for buckets and cloth.

Size & Weight
Small and easy to transport.

More Information

Details and references: www.hwts.info/products-technologies/98da1115/straining

Tulip Siphon Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	Safe Storage

What is it?

Manufactured by Basic Water Needs, the Tulip Siphon Filter is a ceramic candle filter for households. It uses a siphon and gravity to draw water through a ceramic filter element impregnated with silver. The user places the filter element in a raised container of water, squeezes the rubber bulb to start a siphon, and lets treated water flow out of the hose into a safe storage container.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Effective (>90%)
Viruses	Somewhat Effective (>80%)
Protozoa	Very Effective (>99%)
Helminths	Very Effective (>99%)

Other Parameters
Effective at removing turbidity.

Source Water Requirements
Very turbid water may cause the filter to clog quickly and require more frequent backwashing.

Capacity
Can treat water at a rate of 4–5 L per hour. Amount treated per batch depends on the capacity of the containers used for source water and safe storage.

Lifespan
Manufacturer states it will last long enough to treat 7,000 L. For a household using 20 L/day, the candle will last just under a year. Plastic parts last 5 years.

Ease of Use & Acceptability

Operation & Maintenance
The user places the filter element in a raised container of untreated water, squeezes the rubber bulb to start a siphon, and lets treated water flow through the hose into a safe storage container. The safe storage container should be 70 cm below the source water container. When the filter clogs, the user cleans it by backwashing (closing the tap and squeezing the bulb to force water back through the filter), or by cleaning the ceramic candle.

Repair & Replacement
The ceramic candle is fragile and must be replaced if there are cracks or leaks, or when it becomes too thin because of repeated cleaning (likely every 6–12 months). Plastic parts are durable.

User Considerations & Preferences
A washable fabric layer prefilters large particles before water reaches the ceramic candle. The candle may clog if water is turbid. The filter should be kept out of sunlight to avoid degradation of plastic parts.

Feasibility

Availability
Produced and imported by Basic Water Needs. The ceramic candle cannot usually be produced locally.

Cost
Varies; usually US$20-35 from a local agent. Replacement ceramic candles cost US$8-12.

Size & Weight
Ceramic candle is 60 mm in diameter. Filter weight is 0.45 kg (not including containers).

More Information

Details and references: www.hwts.info/products-technologies/9803eb08/tulip-siphon-filter

Tulip Table Top Filter

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	**Safe Storage**

What is it?

Manufactured by Basic Water Needs, the Tulip Table Top is a two-bucket ceramic candle water filter for households. Gravity causes water to flow from an upper container, through a ceramic candle impregnated with silver, into a lower safe storage container. Users pour treated water into their glass through a tap on the bottom safe storage container.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Effective (>90%)
Viruses	Somewhat Effective (>80%)
Protozoa	Very Effective (>99%)
Helminths	Very Effective (>99%)

Other Parameters
Effective at removing turbidity.

Source Water Requirements
Very turbid water may cause the filter to clog quickly and require more frequent cleaning.

Capacity
Flow rate of 1–3 L/hour, depending on turbidity of source water. Can filter 10 L per batch (top and bottom buckets both hold 10 L).

Lifespan
Manufacturer states it will last long enough to treat 7,000 L. For a household using 20 L/day, the candle will last just under a year. Plastic parts last 5 years.

Ease of Use & Acceptability

Operation & Maintenance
Users pour water into the top of the upper container and wait for water to flow through the filter into the lower safe storage container. Treated water can be accessed through the tap. The filter element should be cleaned regularly with a cloth or toothbrush (no soap). When flow rate decreases after some time, a scrub pad (included with filter) can be used to rub away a very small layer of the ceramic material.

Repair & Replacement
The ceramic candle is fragile and must be replaced if there are cracks or leaks, or when it becomes too thin because of repeated cleaning (likely every 6–12 months). Plastic parts are more durable but may need replacement.

User Considerations & Preferences
Safe storage is included with the filter (lower container). The filter should be kept out of sunlight to avoid degradation of plastic parts.

Feasibility

Availability
Produced and imported by Basic Water Needs. The filter element cannot usually be produced locally.

Cost
Varies; usually US$20-35 from a local agent. Replacement ceramic candles cost US$8-12.

Size & Weight
The filter is 55 x 22 x 22 cm and weighs 1.3 kg.

More Information

Details and references: www.hwts.info/products-technologies/83ad679e/tulipr-table-top

UZima Filter UZ1

Source Protection	Safe Transportation	Sedimentation	**Filtration**	Disinfection	**Safe Storage**

What is it?

The UZima Filter UZ1 is a 0.1 micron membrane filter cartridge produced by the Kenya-based organization UZima Water Filters. It is intended for use as a two-bucket tabletop setup (buckets must be purchased separately). Filter kits are sold in sets of 10, with each box containing 10 filters and bucket connectors; 11 backwashing syringes, clean water taps, instructional stickers and hygiene brochures; and 15 data collection sheets for implementation and follow-up surveys.

Performance

Microbiological Effectiveness:

Parameter	Effectiveness
Bacteria	Very Effective (>99%)
Viruses	No independent tests
Protozoa	Very Effective*
Helminths	Very Effective*

**Assumption based on pathogen size*

Other Parameters
Effective for removing turbidity.

Source Water Requirements
Very turbid water may cause the filter to clog and require more frequent cleaning.

Capacity
Batch volume depends on the size of upper and lower containers. Flow rate is up to 1 L/hour.

Lifespan
Not available.

Ease of Use & Acceptability

Operation & Maintenance
Users pour water into the top of the upper container, and wait for water to flow through the filter into the lower safe storage container. Treated water can be accessed through the tap. The manufacturer recommends backwashing the filter after every use, by filling the provided syringe with filtered water and pushing the water backwards through the filter three to five times.

Repair & Replacement
The filter should be replaced at the end of its lifespan, or if it breaks, if flow rate suddenly increases, or if backwashing doesn't return flow rate to normal.

User Considerations & Preferences
Safe storage is integrated into the filter (lower container). Regular backwashing is required.

Feasibility

Availability
Must be ordered through UZima Filters.

Cost
Cost per filter kit (not including buckets) is US$30. Filter kits come in boxes of 10. Discounts are given for bulk orders.

Size & Weight
Dimensions of assembled filter depend on the containers used. The box of 10 filter kits is 38 x 23 x 12 cm and weighs 2.7 kg.

More Information

Details and references: www.hwts.info/products-technologies/f23373fe/uzima-filter-uz1