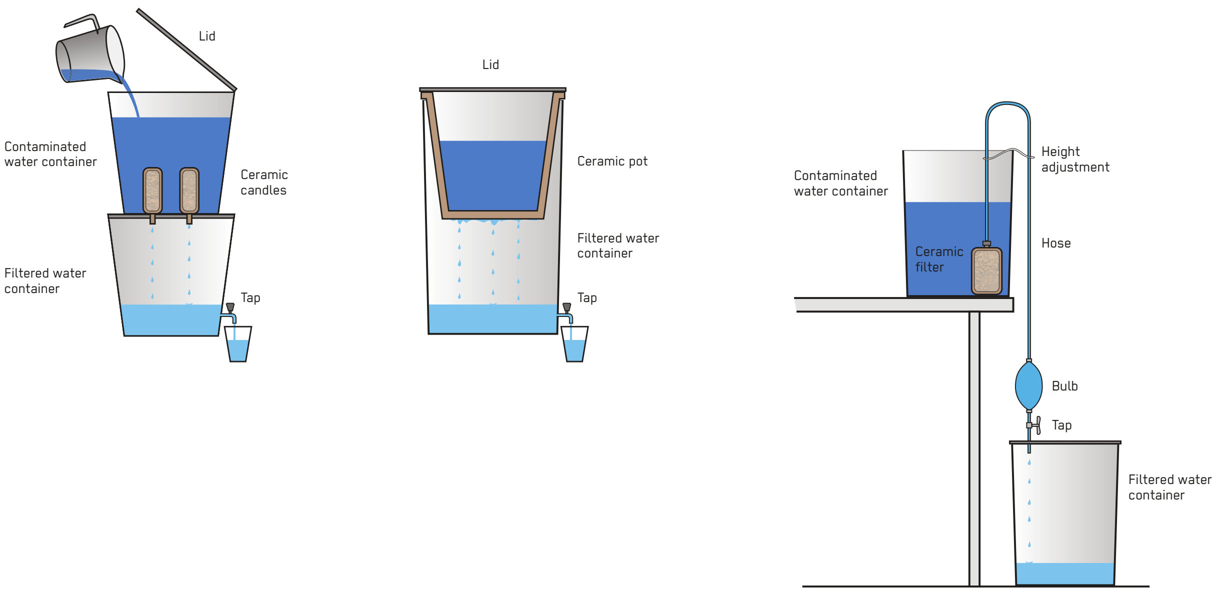
Ceramic Filtration

Response Phase	Application Level	Management Level	Objectives / Key Features
** Acute Response ** Stabilisation ** Recovery	** Household Neighbourhood City	** Household Shared Public	Point-of-use treatment, mechanical pathogen removal
Local Availability	**Technical Complexity**	**Maturity Level**	
** Medium	* Low	*** High	



A Ceramic Filter is a mechanical filtration device made of clay that traps particles and micro-organisms within the ceramic element, which can be a pot, candle or disc. Ceramic Filters typically consist of two parts, the top containing raw water together with the ceramic element, and the bottom containing the filtered water and a tap. Ceramic Filters can also be plumbed directly into a pressurised water pipe.

Ceramic Filters have micron-sized pores that filter suspended particles and pathogenic microorganisms through mechanical trapping and adsorption, and the quality of the filter elements is essential for this process. Ceramic Filters usually do not remove viruses. Colloidal silver is sometimes used in Ceramic Filters to protect against recontamination, though its performance is doubted, with several studies showing limited to no effects. Some filters also contain activated carbon to remove organics or heavy metals. Ceramic Filters remove some iron and taste and improve the smell and colour of water.

Design Considerations: There are three types of filter designs. In pot filters, ceramic pots are placed in a bucket with a tap. The ceramic pot is filled with water, which drips through to a second container. In ceramic candle or disk filters, two containers are placed on top of each other. A hole is drilled in the bottom of the upper container, and a ceramic candle is screwed in. To increase the flow rate, multiple candles can be used. Water is gravity filtered through the candle and collects into the lower safe storage container, where it can be released with a tap. In ceramic syphon filters, the filter elements are placed into a bucket on a table, and an attached long tube hangs out of the bucket by 30–100 cm. To start operation, the filter tube needs to be filled with water, sometimes via an integrated rubber bulb. Water can be collected directly from the tube or in another Safe Water Storage container. Ceramic Filters operated by gravity usually have a flow rate of 1–3 L/hour per filter, depending on the quality of the ceramic element, its surface area and age as well as hydrostatic pressure difference. Storage capacity of the clean water tank is about 10–15 L.

Materials: Ceramic pot filters can be produced with locally available material in a specially designed workshop, though differences in clay composition across geographic regions can cause quality problems. Holes also need to be drilled in local containers to attach the candles and taps. Conversely, candle filters are usually imported, and pre-drilled containers are often supplied by the manufacturer together with the candle. Filters prepared in gas-fired ovens are often of better quality than those prepared in wood-fired ovens, as the right temperature for the firing process can be better maintained in gas ovens. Regardless, good quality control procedures and training are essential to achieve high quality products. Ceramic Filters can be stacked for storage but still require a relatively large storage place, which might not be available. Ceramic Filter elements are fragile and can be damaged during transport.

Applicability: Ceramic Filters can be useful in all emergency phases. Household water filters can be distributed in the acute phase, when water is generally available but is contaminated with bacteria, protozoa or macro-organisms or there is a risk of contamination of water during transport and storage at home. Like other household water treatment systems, Ceramic Filters are especially applicable when the population is dispersed such that the installation of large-scale water treatment systems is not feasible. Ceramic Filters efficiently reduce the turbidity of water, but a high content of particles and organic matter will lead to clogging and the need for more frequent cleaning, which in turn will reduce the lifespan of the ceramic element. The turbidity of raw water should not exceed 25 NTU (Nephelometric Turbidity Units) on a long-term scale, or 50 NTU when the periods of elevated turbidity are short.

Operation and Maintenance: Ceramic Filters are very simple, and daily operation is limited to filling the containers with water. Maintenance includes scrubbing with a soft brush or cloth, which should be done frequently if turbid water is used. Chlorine or soap should not be used to clean the ceramic elements but can be used for lids, clean water storage containers and the tap. Pouring boiling water over the candles has shown be an effective cleaning method in some studies. With more frequent cleaning, the thickness of ceramic candles and pots decreases and therefore the removal efficiency might reduce over time. One challenge for the user is therefore to know when to replace the candle. To overcome this, some manufacturers include a simple gauge to measure the thickness of the candle and to know when a change is required. With very turbid water generating high levels of clogging and frequent cleaning, pre-settling of the water may extend the life of the Ceramic Filter elements.

Health and Safety: The efficiency of Ceramic Filters in removing pathogens varies depending on the type, production conditions and quality of the ceramic element. In general, it varies from 88–99.99 % for faecal-indicator microorganisms and protozoa depending on the study, product used and context. Removal efficiencies for viruses are also highly variable, with some studies and products showing 90–99 % removal of viruses, and other products showing no or almost no viral removal. It is crucial to ensure that the Ceramic Filter elements are fixed correctly to avoid leakage and recontamination. The treated water storage container and tap may be recontaminated. The risk of recontamination is higher when no Safe Water Storage container **(H.1)** is provided, as is the case for some syphon filters.

Costs: Ceramic pot and syphon filters usually cost around 8–30 USD. The costs for the ceramic candle filters are > 30 USD depending on the manufacturer, quality and housing type. The life span of Ceramic Filter elements is usually around 6–12 months but varies depending on the raw water quality and cleaning frequency.

Social and Environmental Considerations: Ceramic pot or candle filters are well accepted in most contexts. The removal of turbidity makes water treatment visible and easy to understand, and filters are easy to use. Users who have never seen a filter before might experience difficulties in installation and maintenance, so one or several follow up trainings may be required.

Strengths and Weaknesses:

(+) Provides simple one step filtration
(+) Has high acceptance rates
(+) Produced using locally available materials at low costs

(−) Provides limited protection from viruses, and bacterial/protozoa removal depends on manufacturing quality
(−) Breaks easily if dropped, and cracks are not always visible
(−) Clogs during filtration of turbid waters, requiring more frequent cleaning
(−) Filters fairly slowly (unless using syphon or multiple candles)
(−) Has relatively short life span for filter candles, and resupply of candles is challenging if there is no local supplier

→ **References and further reading material for this technology can be found on page 221**