Point-of-Use Water Purification Methods

Boiling and safe storage are the most common household water treatment method. It kills or inactivates all waterborne bacteria, viruses, and protozoa that cause diarrheal disease. The World Health Organization (WHO) recommends heating water until it reaches the boiling point. Boiling time recommendations vary si, from 1–20 minutes, but waterborne microbes that are pathogenic to humans are killed or inactivated even before the water reaches 100°C. Water should be stored in the same container in which it was boiled, handled carefully, and drunk within 24 hours to minimize recontamination.

Chlorination effectively kills bacteria and viruses and provides residual chlorine for some protection against recontamination (http://www.poverty-action.org/study/chlorine-dispensers-safe-water-kenya; http://www.nanotechsa.co.za/). Chlorination is common in many sub-Saharan African countries because it is simple, inexpensive, reliable, easy to use, and widely available. However, chlorine does not deactivate parasites such as cryptosporidium and worm eggs. Some people do not like the taste, and it requires clear water to be most effective.

Flocculant/disinfectant powders (https://www.cdc.gov/safewater/flocculant-filtration.html) remove most bacteria, viruses, and protozoa, as well as heavy metals and pesticides, from water. The sachets have a long shelf life, but using them requires training, equipment (buckets, cloth, and a stirrer), and the cost is higher than chlorine solution. The Procter & Gamble (P&G) PuR Purifier of Water™ product (http://www.csdw.org/csdw/index.shtml) is the only rigorously evaluated powder. It comes in a small sachet containing powdered ferric sulfate (a flocculant) and calcium hypochlorite (a disinfectant). PuR was designed to replicate the processes used in a water treatment plant, incorporating the multiple barrier processes of removal of particles followed by disinfection. To treat water with PuR, add the contents of the sachet to an open bucket containing 10 liters of water, stir for 5 minu to the bottom of the bucket, strain the water through a cotton cloth into a second co minutes for the hypochlorite to inactivate the microorganisms. PuR removes most ba protozoa, even in highly turbid waters, and reduces levels of chemical contaminants, such as pesticides, from water.

Photo: https://www.cdc.gov/safewater/flocculant-filtration.html

Water filters are installed at a single water connection in the home to filter water at the point where it is used. They include basic sediment and carbon faucet filters and under-counter and countertop reverse osmosis systems (http://www.psi.org/program/household-water-treatment/; http://shurflo.com/rv-products/rv-water-filtration/rv-in-line-filters; http://www.pur.com/water-filtration). Ceramic water filters can

Ceramic water filter. Photo http://pdf.usaid.gov/pdf_docs/Pnads134.pdf

remove microbes and reduce cloudiness. Depending on the size of the unit, POU filters can last from 3 months to 1 year or more. They are relatively cheap and if used properly, can removed up to more than 99 percent of organisms. However, the filters can break and require regular cleaning.

Solar water disinfection (SODIS) is a simple, low-cost household technology that improves the microbiological quality of drinking water with solar radiation. It uses plastic bottles and is most effective in areas with strong solar radiation. However, SODIES only treats small amounts of water at a time and requires recyclable polyethylene terephthalate (PET) bottles. A manual on SODIS can be found at http://www.sodis.ch/methode/anwendung/index_EN and http://www.sodis.ch/methode/anwendung/ausbildungsmaterial/dokumente_material/sodismanual_2016.pdf.

Photo: http://buildsolar4betterlife.com/death-contaminated-water-preventable-sunlight-can/sodis-2/

Biosand filtration (http://www.sswm.info/category/implementation-tools/water-purification/hardware/point-use-water-treatment/bio-sand-filtrat) removes protozoa and bacteria, is easy to produce from locally available materials, can last over 10 years, and requires little maintenance. However, it is not as effective against viruses as other methods and has no chlorine residual protection, so can lead to recontamination. It is also costly and heavy to transport. A concrete or plastic container approximately 0.9 meters tall and 0.3 meters square is filled with layers of sand and gravel. The water level is maintained to 5−6 cm above the sand layer by setting the height of the outlet pipe. This shallow water layer allows a bioactive layer to grow on top of the sand, which helps reduce disease-causing organisms. A diffuser plate with holes in it is placed on the top of the sand layer to prevent disruption of the biolayer when water is added to the system. To use the filter, users pour water into the top and collect finished water out of the outlet pipe into a bucket. Over time, especially if source water is turbid, the flow rate can decrease. The flow rate can be maintained by cleaning the filter through agitating the top.

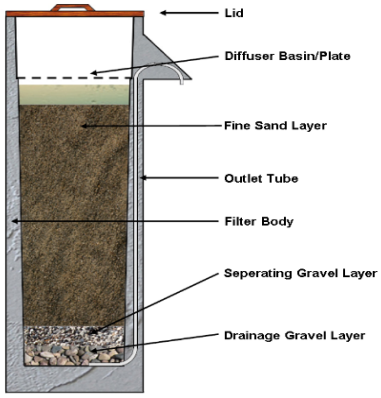

Photo: http://www.sswm.info/category/implementation-tools/water-purification/hardware/point-use-water-treatment/bio-sand-filtrat