

Global Landscape of Household Water Treatment and Safe Storage Products

Overview

Safe drinking water is essential to good health. However, in resource-poor settings, water often comes from unsafe sources and carries deadly pathogens. The World Health Organization estimates that 1.8 million people die each year from diarrheal diseases, many of which are attributed to unsafe water. Safe drinking water is one of the United Nations Millennium Development Goals—by 2015, the United Nations hopes to decrease the proportion of people without sustainable access to safe drinking water by 50 percent.

To increase access to safe water, PATH's Safe Water Project is exploring the potential for commercial enterprises to target low-income populations with household water treatment and storage (HWTS) consumer products. We are working to identify, adapt, and develop appropriate HWTS products and business models with the goal of enabling market-based forces to take on production, distribution, sales, and maintenance to low-income households.

The Safe Water Project is spending some of its efforts to catalyze changes within the HWTS product category, specifically to benefit low-income populations. We are continually assessing and reviewing the state of technology and research, as well as development activities aimed at producing HWTS products available in the developing world.

The matrix on the following pages portrays a global landscape of technologies both presently existing and under development by numerous researchers and manufacturers. The assessment is not weighted nor does the matrix provide

a final ranking value. The colors demonstrate an informed judgment based upon internal usability testing, field testing with users, outsourced laboratory testing, and published literature, especially for the parameters addressing public health impact and treatment efficacy. Overall, the matrix reflects the complexity of making choices regarding the use of HWTS in various geographies with variable source waters and user needs.



Wendy Stone

Technology assessment of household water treatment and safe storage (HWTS) products*

Analysis as of May 2010

- Parameter negative or with a higher level of concern
 Parameter weakly positive or with moderate concern
 Parameter strongly positive
 Insufficient information available

Household Water Treatment and Safe Storage (HWTS) Product† Description	Examples of Manufacturers and/or Advocates‡
Ceramic water pot + durable safe storage vessel	Potters for Peace; Potters Without Borders; International Development Enterprise (IDE); Rural Development Institute (RDI); Thirsting to Serve
Carbon block filter + bromine + durable safe storage vessel	HaloSource & Eureka Forbes Ltd. (Aquasure)
Carbon block filter + chlorine + durable safe storage vessel	Hindustan Unilever (Pureit)
Rice husk/ash filter	Informal market with support from academic institutions and nonprofit organizations
Rice husk/ash filter + silver treatment + durable safe storage vessel	Tata (Swach)
Higher-quality ceramic candles + durable safe storage vessel	Doulton; Katadyne
Lower-quality ceramic candles + durable safe storage vessel	Rama, Butterfly, OK Industries, Neelam
Higher-quality hollow fiber membrane (+virus)	Vestergaard Frandsen (LifeStraw Family)
Lower-quality hollow fiber membrane + carbon filter + durable safe storage vessel	Kent (UF Membrane Water Purifier)
Household biosand (slow-sand) filtration	Center for Affordable Water and Sanitation (CAWST); BushProof; Samaratin's Purse; Hydraid
High-quality hollow fiber membrane (+virus) + carbon filter	LifeSaver Systems (LifeSaver Bottle)
Chlorine (liquid—sodium hypochlorite) + durable safe storage vessel	WaterGuard, AquaGuard, Population Services International (PSI), Center for Disease Control and Prevention (CDC) Safe Water System
Chlorine (tablet—NaDCC)	Medentech (Aquatabs); Hydrachem
Coagulant/flocculant + disinfectant	Bishan Gari; Ion Exchange (Jalshudhi Water Purifier - Zero B); Thanh Mai; Nissei Trading Co.
Coagulant/flocculant + adsorptive ingredients + disinfectant	Proctor & Gamble (PUR)
Other natural coagulants/flocculants	Informal markets (moringa seeds, alum, prickly pear cactus); Kemira Kemi AM (alum); Nippon (polyglutamic acid)
Metal disinfectants (liquid and/or controlled release media)	AquaSalveo
SODIS or similar solar-based system	Swiss Federal Institute for Environmental Science and Technology (EAWAG)
Ceramic filtration via siphon pressure	Basic Water Needs (Tulip, CrystalPur)
Filter cartridge with brominated media	In research and development stage
Lower-quality ceramic candles + disinfectant + durable safe storage vessel	In research and development stage
Adsorptive media (nanotechnology) incorporated into filter element	In research and development stage
Core chlorination unit amendable to user-supplied durable safe storage vessel	In research and development stage
Chlorine (NaDCC) tablets + durable safe storage vessel	In research and development stage
Ultra violet (UV) light emitting diodes (LEDs)	In research and development stage
Household scale mixed oxidants—solar powered	In research and development stage
Ceramic filtration via siphon pressure + durable safe storage vessel	In research and development stage

* Cells without color indicate insufficient data to determine a ranking. Colors are not weighted and represent an informed judgement based upon internal user testing, outsourced laboratory results, user testimonials, and other sources.

† All products do not require plumbed water connection or mains electricity to treat water.

‡ Assessments for items labeled as "Research and development" are projections from available data and knowledge.

		Filtration	Adsorption	Disinfection	Bacteria	Viruses	Protozoan cysts	Protection against recontamination	Turbidity	Other contaminants	Evidence level of efficacy	Media toxicity	Quality control	Incorrect use	Technology readiness	Acceptability by user	Capacity of product	Acquisition cost	Maintenance costs	Uptake and continued use	Supply chain	Training and support
	Source of pressure	Treatment mechanism			Primary treatment efficacy			Other factors affecting treatment efficacy			Public health impact	Safety			Primary technology factors					Secondary technology factors		
	Gravity	✓																				
	Gravity	✓	✓	✓																		
	Gravity	✓	✓	✓																		
	Gravity	✓	✓																			
	Gravity	✓	✓	✓																		
	Gravity	✓																				
	Gravity	✓																				
	Gravity	✓																				
	Gravity	✓	✓																			
	Gravity	✓																				
	Gravity	✓																				
	Mechanical pump	✓	✓																			
OC)	Not applicable			✓																		
	Not applicable			✓																		
	Not applicable	✓		✓																		
	Not applicable	✓	✓	✓																		
id)	Not applicable	✓																				
	Not applicable			✓																		
	Not applicable			✓																		
	Siphon + gravity	✓																				
	Gravity			✓																		
	Gravity	✓		✓																		
	Gravity	✓	✓																			
	Gravity			✓																		
	Not applicable			✓																		
	Not applicable			✓																		
	Not applicable			✓																		
	Siphon + gravity	✓																				

sting in India, and published literature (primarily for public health impact and treatment efficacy).

Glossary

Term	Definition
Acceptability by user	Acceptability is a combination of reported and projected acceptability. Reported acceptability represents a limited subset of data (e.g., flow, function, maintenance, aesthetics) from both an informal user testing study in India and an extended user testing study (product placement inside households) in Andhra Pradesh, India. Projected acceptability represents in-house testing of numerous factors including, but not limited to, product assembly, cleaning procedures, maintenance procedures, flow rate, and filling and dispensing procedures.
Acquisition cost	To compare fast-moving consumer goods or FMCGs (sachets and/or small bottles of consumable treatment products) against durable goods, acquisition cost was compared between an FMCG-calculated cost for a four-month period against a durable good because many durable goods require replacement components starting at four to six months into product life.
Adsorption	The process by which molecules collect on the surface of another substance, which is also referred to as surface adhesion. The adsorptive capacity is highly dependent on surface area. Adsorptive affinity is a function of charge density.
Capacity of product	The capacity of product is representative of the volume of water treated before replacement components are required due to expired media, breaking clogged pores, or other factor.
Coagulation-flocculation	The process is defined as one in which coagulants destabilize (offset the charge) the colloidal mixture while the flocculants aggregate/clump. The process is followed by sedimentation (settling by gravity) and/or filtration to remove the aggregate material.
Disinfection	Disinfection methods include thermal/heat, chemical, and/or irradiation processes.
Evidence level of efficacy	The term is intended to include products with demonstrated and documented (e.g., Health Impact Study) reductions in disease burden (e.g., diarrheal disease or helminthic infections) the product is within a shared technology class/group with documented public health impact (e.g., health impact or epidemiological study).
Filtration	Filtration includes mechanical, membrane/gradient, and/or biological filtration methods.
Incorrect use	Incorrect use is an assessment of the likelihood of and implications for incorrect use of the technology and all components.
Maintenance costs	The assessment of ongoing costs (maintenance costs) includes the frequency and cost of replacement parts due to media exhaustion, clogging, or breakage.
Media toxicity	Media toxicity is noting whether or not a potential risk exists or could exist for the introduction of toxicity by the technology to the consumer's drinking water due to the use of media for treatment.
Membrane filtration	The process of membrane filtration includes those methods that utilize pressure, electrical potential, and concentration gradients to remove dissolved constituents and colloidal materials. Membrane filtration includes no pressure (forward osmosis), low-pressure (microfiltration and ultrafiltration), and high-pressure (nanofiltration and reverse osmosis) systems.
Other contaminants	The technology is capable of addressing non-microbiological contaminants such as fluoride, arsenic, nitrates/nitrites, volatile organic carbons (VOCs), or other contaminant of concern.
Protection against recontamination	Recontamination of treated water with microbial contaminants is mitigated by the use of chemical residual or inclusion of a safe storage container or other protective barrier/agent.
Quality control	Both quality-control and quality-assurance practices are noted for manufacturers, whether large commercial entities or smaller artesanal groups.
Supply chain	Assessments of supply chains included barriers to transportability (volume, fragility, weight) as well as availability.
Technology readiness	Technology readiness includes commercial availability, manufacturing capability/capacity, and the stage of research and development (R&D).
Training and support	The training and support analysis depicts the level of training and/or support needed to operate the technology correctly, including assembly, cleaning, and maintenance.
Turbidity	Turbidity is cloudiness or opacity in the appearance of a liquid caused by solids, particles, and other pollutants. Turbidity measurement is typically done in either nephelometric units (NTUs), formazin turbidity units (FTUs), or visible height using a disk or tube (translated into approximate NTUs or FTUs through a table). The measurement provides an indication of the clarity of water and serves as a proxy for water quality.
Uptake and continued use	The assessment included a search for the demonstrated uptake (published literature, anecdotal evidence, observational evidence, etc.) and continued use by persons within the base of the (economic) pyramid (BoP) segment. According to the World Resources Institute and depicted in the World Economic Pyramid, the persons at the BoP consist on those populations (~4 billion people) living on less than \$2 per day per person for more than 50 years and represent the "survival market."