CCWF Part 1

Cabin Clean Water Filter

Market for Household Water Treatment

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1.0 Water Use in Households

Households in advantaged and disadvantaged communities use water for the same purposes. The so-called developing world has a greater proportion of disadvantaged communities and the developed world has a greater proportion of advantaged communities. Interestingly, water use in households in both advantaged or disadvantaged communities of the developed and developing world, is the same. It is used for a variety of purposes including:

- Human consumption (drinking),
- Food preparation,
- Kitchen hygiene,
- Personal hygiene,
- Household hygiene,
- Laundry, and
- Toilet.

The quantity and quality of the water used for each of these purposes can vary considerably.

Consider Table 1 relates quality of water to potential use in households. It is apparent that WHO quality water is suitable for all purposes.

In urban communities in the developed world this is the quality of water that is expected to come from the tap, and, it usually meets this standard so there is no need for further treatment. Typically, only the rural households in developed countries will own and operate their own water treatment system.

Urban communities in developing countries cannot trust the quality of water coming from their tap to be safe. Water available for use in rural households is definitely not safe and will require treatment.

Table 1. Water quality available to consumer and potential use.

Quality		Viruses	Bacteria	Parasites	Skin Penetrating Organisms	Toxins	Uses
WHO	**Meets WHO Guidelines**	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**All uses including:** **- Human consumption** **- Food preparation** **- Kitchen hygiene** **- Personal hygiene** **- Household hygiene** **- Laundry** **- Toilet**
Safe	**Does not meet WHO Guidelines for non-health impacting chemical or physical characteristics**	**Nil**	**Nil**	**Nil**	**Nil**	**Nil**	**As per WHO, but use may be limited depending on issues (e.g., presence of iron, manganese, turbidity, taste, odor or hardness)**
A	**Does not meet WHO Guidelines for bacteria and viruses but considered safe**	**Sub-infectious**	**Sub-infectious**	**Nil**	**Nil**	**Nil**	**All uses including:** **- Human consumption** **- Food preparation** **- Kitchen hygiene** **- Personal hygiene** **- Household hygiene** **- Laundry** **- Toilet**
AA	**Does not meet WHO guidelines for bacteria and viruses and for non-health impacting chemical and physical characteristics**	**Sub-infectious**	**Sub-infectious**	**Nil**	**Nil**	**Nil**	**As per 'A', but use may be limited depending on issues (e.g., presence of iron, manganese, turbidity, taste, odor or hardness).**
B	**Does not meet WHO Guidelines for toxins**	**Sub-infectious**	**Sub-infectious**	**Nil**	**Nil**	**Present**	**Not safe for human consumption but satisfactory for all other uses**
BB	**Does not meet WHO Guidelines for toxins and non-health impacting chemical or physical characteristic**	**Sub-infectious**	**Sub-infectious**	**Nil**	**Nil**	**Present**	**Not safe for human consumption and use may be limited depending on issues (e.g., presence of iron, manganese, turbidity, taste, odor or hardness).**
C	**Does not meet any WHO guidelines except removal of skin penetrating organisms**	**Infectious**	**Infectious**	**May of may not be present**	**Nil**	**May or may not be present**	**Not safe for human consumption, food preparation, kitchen hygiene and possibly personal hygiene. Depending on chemical and physical characteristics use may be limited to household hygiene, laundry and toilet.**

2.0 The Market

Access to sufficient, safe water supply, SSWS, is a matter of public health. There is often water available but it is not safe for drinking, food preparation or personal hygiene because of the presence or possible presence of pathogens. Some water supplies might contain pathogens that can penetrate or infect skin and cause eye and a variety of other infections that do not require ingestion. So even activities such as laundry, personal hygiene (with or without soap) and household hygiene may result in 'disease'. Some water supplies contain toxic chemicals such as pesticides used in agriculture and those resulting from mining operations or oil production. Public health is easily compromised by lack of SSWS.

2.1 Developing Countries

Both rural and urban communities in developing countries are challenged to provide access to SSWS. Urban areas may be distinguished from the rural by the presence of a central water supply (safe or unsafe) that is distributed to the community though a piped distribution system (not necessarily to the places where it is consumed but is still conveniently available). Many peri-urban communities may be considered rural. Urban water supplies are typically free of toxins but rural water supplies may be at risk.

In rural areas of the developing world the general rule is or should be that a water supply is not safe for human use because of the possibility that pathogens are present. People know if a water supply is 'safe' or 'unsafe', but often they have no choice but to collect and use water that might be unsafe. The efforts that go into developing new wells or a spring will provide a supply but no guarantee that the water is safe since any initial supply protection is quickly compromised. Most community wells are cross-contaminated between consumers.

In most urban areas of the developing world the general rule is that the water coming from the distribution system (piped water) from a tap, delivered by some means (truck, mule or person), collected from private or community wells or is harvested rainwater is unsafe – with varying degrees and types of contamination. Water originating from a central treatment plant leaves the plant pathogen free and is subsequently contaminated in the distribution system while on route to consumers. The contaminants are pathogens, primarily parasites such as Entamoeba histolytica, and very low concentrations of bacteria and viruses, which leak into the pipes with the groundwater when there is little or no water pressure in the pipes. Note that even if the water appears chlorinated (smells chlorinated) there may still be parasites in the water that are not killed or deactivated by chlorine. Normally, there would be no skin penetrating or infection causing organisms in the urban water supplies delivered to consumers and it might appear aesthetically pleasing.

Water availability in urban communities can be a serious problem. In some urban communities piped water is available on a scheduled basis. Some days there is water available and others there is none. Even when it is available the pressure may be low, decreasing with distance from

the original supply point and lower when there is greater water demand. Those consumers that are closer to the supply will experience higher water pressure; and, when their needs are satisfied the water pressure will increase further along the pipeline. Household storage of delivered water is often a necessity. Improper water storage (often roof-top storage or a combination of underground storage and roof-top storage) aggravates the water safety problem. Living in an affluent neighbourhood provides no assurance that the water supply is safe. It is common to observe rooftop storage tanks on all homes and one for every apartment in three- or four-story apartment buildings where the roofs are covered in storage tanks serving each apartment.

Typically, access to SSWS is expensive to the consumer because provision is expensive. Interestingly, if consumers have access to 'near' sufficient supplies they feel that the authority responsible for supplying water to them has fulfilled its obligation. It was fascinating for me to learn that in places like Mexico this is actually how the distribution systems are designed and not the result of over subscription or shortage of water supply as might be the case in other jurisdictions.

The urban water problem described is typical of virtually every city in the developing world – many billions of people. The rural water problem is smaller but more dire – because the people have very limited income.

As mentioned, the quality of water considered safe for human use, called potable water, is described in the drinking water guidelines prepared by the World Health Organization, WHO, a body of the United Nations. Virtually every nation attempts to meet the WHO Guidelines for the water they make available to their citizens. The WHO Guidelines are primarily focussed on water dispensed from centralized facilities which may be as simple as direct production from a deep well (with or without chlorination prior to distribution) or as complex as production from a specialized treatment plant. The WHO Drinking Water Guidelines are clear. They are not ambiguous or subject to interpretation and they apply to every water supply at the time it is consumed – for any purpose - anywhere. The WHO Guidelines are very conservative. The WHO will not endorse <u>any</u> water treatment process, urban or rural, that doesn't result in a quality that meets their Guidelines.

WHO Guidelines aside, it is very important to note that the risk of infection is a function of the quantity of bacteria or viruses that are ingested and the health of the consumer. This is known as the infectious dose. Consumers may not experience life-threatening symptoms from bacteria or viruses even if they are present in the water and consumed. Consumers will not develop the same accommodation to parasites or larger organisms (helminths) such as Guinea worm or bilharzia. In disadvantaged communities in developing countries, children for whom the symptoms from infections of bacteria and viruses are serious, usually do not survive past the age of five. Older children or adults who become immune compromised may succumb to what would otherwise be considered a mild infection.

If the water available to the consumer does not meet WHO Guidelines, (national standards withstanding), the consumer may choose to treat water to the quality required for different uses. Ideally, the consumer would be able to take whatever supply they have available and treat it themselves to the quality they desire. There are many treatment technologies and a water supply of any quality can be treated to a potable standard. It is realistic to assume that all water supplies will need some form of treatment to be considered potable. The consumer may choose to treat all the water used or just a portion of it.

The treatment technology available to the advantaged (wealthy) communities in developing countries is the same as it is in developed countries. Homes of the advantaged are equipped to supply water in exactly the same way as developed countries. If power supply is a problem these homes often have their own generator. The treatment systems used do require the services of a specialist.

Consumers want to drink water that is pathogen and toxin free and is aesthetically pleasing (looks appealing and tastes good). This is the 'gold standard'. Historically, what might be called the 'pre-bottled water era' or PBWE, the consumer had no option but to try and treat whatever available supplies they had to a quality they considered acceptable. Not any more. Virtually all bottled water available around the world meets World Health Organization Guidelines. Drinking bottled water is safe (usually). Bottled water is considered expensive and the plastic bottles used to dispense the bottled water have become a global pollution problem.

2.2 Developed Countries

Developed countries are distinguished from developing countries by their ability to supply sufficient, safe water that meets WHO Guidelines – even to the smallest, most remote communities. Failure to do so is acknowledged and steps are taken to rectify the situation. It follows that households in these communities do not require their own treatment system unless they wish to improve the water quality by reducing hardness, removing all dissolved solids as part of a perceived health issue or removing chlorine that must be in the water when it is delivered (distribution disinfection protocols).

In most developed economies all water consumed must be treated to a potable quality and delivered to the consumer with a potable quality. In all jurisdictions in Canada, for instance, water is tested at the place of the consumer to determine if the treatment and distribution is operating satisfactorily. When it isn't satisfactory a boiled water order is issued and the problem is discovered and resolved. It is interesting to note that all nations, developed or otherwise, view the WHO Guidelines as their standard for the quality of water delivered to the consumer.

Rural households are responsible for supplying their own water. They are not bound by WHO Guidelines. They have access to treatment technology to improve physical and chemical characteristics and eliminate any pathogens if they wish.

3.0 Household Water Filter Evaluation Criteria

There are a very large variety of household filters available in the world market. Today, anyone with a smart phone can access treatment technologies produced anywhere in the world through the internet. Consumers in both advantaged and poor households will evaluate water treatment technologies based on the following criteria:

1. Effectiveness of treatment. (Ability to meet consumer expectations.)
2. Rate and volume of treated water.
3. Purchase cost.
4. Operating cost.
5. Maintenance cost.
6. Convenience of use.
7. Complexity of use.
8. Aesthetics (equipment should look pleasing).
9. Energy consumption (type of energy and cost of energy).
10. Chemical use (including type of chemical).
11. Wastewater production.
12. Useful life.
13. Product technical support.
14. References (track record).

Most BSF technology has several advantages over other point-of-use, POU, or point-of-entry, POE, household water filter. Typically, filters using the BSF technology:

- Provide effective treatment. (Expected performance supported by experience with millions of installations worldwide.)
- Able to treat water with high suspended solids loads.
- Treat sufficient water for all household needs.
- Very robust and difficult to damage (particularly concrete versions).
- Difficult to steal.
- Are reasonably priced when compared to other manually operated filters with similar production capacity. (Locally manufactured using local labour and usually subsidized by charitable organizations.)
- Incur no operating costs.
- Are convenient to operate when compared to other manually operated filters.
- Are usually simple to maintain.
- Use no chemicals.
- Use no energy to operate. (No need for fire, electricity, propane, or other energy.)

- Produce very little wastewater.
- Have a useful life of twenty years or more.
- Require very little product technical support.
- Replace the need for bottled water and reduce plastic pollution.

Disadvantages of filters using the BSF technology include:

- Questionable quality control particularly as it relates to media production.
- Weight. (Concrete variations are quite heavy when empty. All filter variations are quite heavy when charged with media and operating.)
- Difficult to move once charged with media. (The filters are heavy. Media will compact when filters are moved. Compacted media must be removed and reinstalled.)
- Concrete filters are difficult to transport.
- Limited to manual operation.
- Difficult to use as part of a larger treatment system.
- Most are not aesthetically pleasing.

4.0 Market Niche for the Cabin Clean Water Filter – CCWF

The Cabin Clean Water Filter, CCWF, design maximizes the advantages of using the BSF technology and overcomes all of the disadvantages.

The CCWF is described in great detail in its own website, www.cabincleanwaterfilter.com. A brochure that describes the CCWF follows:

CABIN *'Clean Water Filter' Manual and Automatic*

www.cabincleanwaterfilter.com

The CABIN Clean Water Filter treats water so that it is safe for human consumption and is aesthetically pleasing. It is designed for use in isolated homes or cabins, homes in communities without access to safe drinking water, camps, emergency supplies, boats, barges and recreational vehicles. Electrical power is not required for the manual operation. Automatically operated filters may use any available power supplies as required to provide raw water, operate valves, distribute treated water and power UV disinfection.

The CABIN Clean Water Filter is effective, compact, lightweight and portable. It is used to remove particulate matter (including iron) and disease-causing organisms from surface water (rivers, ponds and lakes), groundwater (wells and springs), captured rainwater and unsafe municipal supplies (piped or delivered). The CABIN Clean Water Filter can produce up to 12 litres of filtered water in one hour. The basic filter is manually operated and simple to clean. It is used as required. The automatic version may be used as part of a completely automated system including management of raw water supply, filter production, disinfection and treated water distribution as required by user.

Water produced by the CABIN Clean Water Filter is free of all types of water borne parasites such as Giardia and Cryptosporidium, and larger organisms such as Bilharzia and Guinea Worm and spores of infectious fungi. Most bacteria and viruses are also removed. Cholera is completely removed because it only survives in the gut of larger organisms that are easily removed. It is strongly recommended that filtered water be disinfected using chlorine tablets or household bleach or UV disinfection if available. The treated water should be safely stored and dispensed to provide treated water that is free of disease-causing organisms. The ability of the CABIN Clean Water Filter to remove disease causing organisms has been verified by independent laboratory testing.

The CABIN Clean Water Filter will not remove most dissolved substances but does provide excellent pre-treatment for filters that do remove dissolved substances such as micro filters and reverse osmosis. The filter will remove oxidized iron (typical form) and dissolved arsenic with the iron (co-precipitation). The biosand filtration process has been proven to reduce concentration of organic pesticides.

The manual version of the Cabin Clean Water Filter is intended to be placed on a counter-top safe from unwanted disturbance. Manual operation consists of removing the lid and pouring water to be treated directly into the top of the filter Filtered water is immediately produced from the filter outlet. Automatic versions may be placed and used where convenient including under counters, in cabinets or other locations where it is not conspicuous or uses counter space. Commissioning may be manual using the kit provided with the filter or using a small pump selected specifically for the commissioning purpose.

The CABIN Clean Water Filter is constructed using food grade plastic and media that are all NSF 61 certified. The filter is 50 cm tall and 30 cm wide at the lid. When filled with media the filter and accompanying commissioning kit weigh approximately 15 kg.

The filter construction is very durable and should provide satisfactory service for many years. With normal use the media will never require replacement.

The treatment and cleaning processes used by the CABIN Clean Water Filter are similar to those used by the millions of BioSand Water Filters in use around the world for more than twenty-five years. For more technical information and for information regarding price, availability, shipping costs and conditions of sale contact manzcabin@shaw.ca.

Clearly, the CCWF is intended to be a commercial product. Householders are expected to purchase the product. Manufacturers, distributors and retailers are expected to make a profit. As such, the market for the CCWF does not include the least advantaged households who wouldn't be able to afford the product but it may be purchased by NGOs and charitable organizations and donated to the poor for less cost than local production of concrete filters.)

The CCWF is intended to be retailed in local, traditional markets and upscale markets where its advantages are readily seen. It has a competitive advantage particularly in urban markets in

developing countries. It can provide a very economic alternative to bottled water, a market not accessible to BioSand Water Filters using traditional designs, and substantially reduce plastic pollution from use of bottled water. The CCWF has advantages which allow it to access markets practically unavailable to any other point-of-entry or point-of-use applications (discussed in the paper, Cabin Clean Water Filter Comparison to Other Household Water Filters).

The market for household water treatment technologies is greater than US $12 billion with forecasts of over US $25 billion by 2025. Clearly, it is a very large and growing market.

The household water treatment market in rural communities in both developed and developing countries and urban communities in developing countries is under serviced or not serviced at all. This market is quite sizeable, perhaps as much as 20% of the available market. Most of the households in these markets have sufficient income to purchase a CCWF.

The cost of manufacturing the CCWF may be a low as $US 20.00 if manufactured in quantity and retailed for as little as $50.00, a price-point well within the affordability range of the intended markets.

5.0 Emergency Response Using CCWFs Compared to the Use of Bottled Water

The CCWF can provide great support to emergencies resulting from cyclones or hurricanes (e. g. Puerto Rico 2018, Nicaragua and Honduras 2020), earthquakes (e. g. Haiti 2010) and tsunami (Indonesia 2004). Bottled water and lots of it is the best choice for immediate response. But, for secondary relief, to provide adequate safe water by treating available supplies, the best choice must be the CCWF. This technology has the advantage of being light, easy to transport, effective, requires little technical support, is robust and can provide a lasting legacy when the worst of the situation is in hand. CCWFs are able to provide a large amount of safe water quickly and continuously.

Emergency preparedness is simple when using the CCWF technology. The filters are easily stored with little opportunity for being damaged while being stored. Several thousand filters, sufficient for tens of thousands of people can be located convenient to where potential disasters can take place. (Regions vulnerable to cyclones, earthquakes and tsunami are known.)

Figure 1 provides a comparison between a supply of bottle water to the CCWF. The short-term costs, logistical challenge due to weight and long-term benefit clearly favour the CCWF.

Figure 2 illustrates a case study comparing the emergency response to Puerto Rico hurricane 2018 by providing bottled water to similar response if the CCWF were used. Resources necessary to move bottled water to communities in need would be many times more effective if they were delivering CCWFs.

216 one litre bottles/pallet

About 22 days (person survival use)/pallet. Assumes consumption of about 10 L/person/day.

Weight: about 240 Kg or 440 pounds

Cost: At least $0.40 per bottle, $86.40/pallet.

Cost for 1 year for one person: $1,460.
Cost for 2 years for one person: $2,920.

Produces more than 10 litres per hour

About 20 days (person survival use)/day of water per 20 hour day.

Weight: about 12 Kg or 26.4 pounds

Cost: Initial cost of $200.

Cost for 1 year for one person: $20.
Cost for 2 years for one person per year: $10.
Cost for 10 years for one person per year: $2.

Figure 1. Comparison of the CCWF to supplies of bottled water.

Case Study: Emergency Response Puerto Rico hurricane 2018 (CNN).

20,000 pallets of bottled water (432,000 person-days survival supply). Enough for 1,184 people per year.
Cost of at least $2,000,000 delivered by truck or helicopter. Consumed after one year. No legacy.
20,000 pallets worth of plastic bottles to waste/year.
Cabin Clean Water Filter: Assuming 5 people per family, it follows that about 237 filters would be required for 1,184 people. (Note that this will only use 1/2 the daily treatment capacity of a filter.)
Cost would be about $47,342 delivered by truck, helicopter, car, motorcycle, bicycle, mule, horse, camel or person.
Can be used for at least 10 years. Cost per family of five over ten years is $20.00 per year or $4.00 per year per person.
No plastic bottles to waste.
See www.cabincleanwaterfilter.com and www.manzwaterinfo.ca

Figure 2. Case study of emergency response to Puerto Rico hurricane 2018 by providing bottled water to similar response if the CCWF were used.

6.0 Other Markets

There are numerous markets for household filters in disadvantaged communities world wide and these are presented in the brief, CCWF Part 4 which compares the Cabin Clean Water Filter to other Household Water Filters for use in the developing world.

There are also many markets for the CWWF in the developed world including:

1. Rural households (farm, acreage).
2. Vacation homes.
3. Camps (hunting, recreation, hiking, exploration).
4. Emergency preparation and relief (hurricanes).
5. Survival equipment.
6. Recreational vehicle water supply.
7. Boating water supply.

7.0 Pricing and E-marketing for the Developed Country Market

The advantage of the CCWF over other variations of the BSF is that it can be sold through the internet and delivered using the postal service at a reasonable cost. In fact, because of its weight and dimensions it may be shipped anywhere by air transport or as part of luggage.

Table 2 compares the CCWF to a sampling of other available filter technologies intended for similar use in developed countries.

It is assumed that the filters will be used to treat a rural water supply. Several of the technologies will be challenged treating water with a high suspended sediment concentration because of the need for frequent cleaning.

Treatment of urban water supplies in developed countries is not considered because this water is intended to be treated to WHO Guidelines. When this is in doubt it is recommended that bottled water be purchased (plastic bottles are recycled in developed countries).

Table 2 Comparison of the Cabin Clean Water Filter to Other Available Filter Products Intended for Household Use in Developed Countries.

Filter	Household Applications									
	Cost US D	Rural Water	Drinking	Food Preparation	Kitchen Hygiene	Personal Hygiene	Household Hygiene	Laundry	Toilet	Life yrs.
BioSand Water Filters										
Cabin Clean Water Filter	50 – 200 (depending on quantity)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	20+
Ceramic Candle Filters										
Berkey Big Berkey	278	?	Yes	Yes	Limited	Limited	No	No	No	?
Doulton	364	?	Yes	Yes	Limited	Limited	No	No	No	?
RainFresh Steel Gravity Filter	200	?	Yes	Yes	Limited	Limited	No	No	No	?
Katadyn	400 +	?	Yes	?	?	?	No	No	No	10+
Membrane Filters										
Sawyer Mini	1 gal 80	?	Yes	Yes	Limited	Limited	No	No	No	3-5 (?)
LifeStraw Community	450	?	Yes	Yes	Yes	Yes	No	No	No	3-5