

JAMEBI - white paper on water disinfection

A dirty drinking water problem in sunny tropical countries

Problem.

This white paper starts with facts. Then identifies a problem and explains how it we solve it.

Global facts (WHO 12/2015)

- By 2025, half of the world's population will live in water-stressed areas.
- In low- and middle-income countries:
 - 19% of people do not have improved sanitation
 - 35% of people lack water and soap for handwashing
 - 38% of health care facilities lack an improved water source
- 159 million people depend on surface water.
- 844 million people lack even a basic drinking-water service
- Contaminated drinking water transmits diarrhoea, cholera, dysentery, typhoid, and polio.
 - Contaminated drinking water causes 502,000 diarrhoeal deaths each year.
 - Most diarrhoeal deaths occur in Africa and SE Asia.
 - Of the diarrhoeal deaths, three-quarters of those who die are children under 5.
- At least 2 billion people use a drinking water source contaminated with faeces.

Problem

Dirty water making people ill, even killing many people, is the context of the problem.

Specifically, the problem we address is the lack of a reliable and transportable device to deliver low-cost clean water without the device requiring regular inputs such as replacement filters, chemicals or supply of bought-in energy.

The global water and sanitation crisis claims more lives through disease than any war claims through guns: indeed clean water is one of the United Nations' Millennium Goals. Although essential for a healthy life, not everybody has access to it. Some lack clean water all the time, others lack it intermittently or even unexpectedly.

While most of these half a million deaths are in tropical developing countries, even developed countries suffer failures of water supply following, for example, wars or natural disasters such as floods, hurricanes and earthquakes. Plus a market exists for off-grid ways to make clean water in the developed world.

Global water stress is increasing. Clean pathogen-free water can be expensive, for example in places such as Sudan, where contaminated water quality causes one of the world's highest mortalities, over 10% of household income is spent on buying clean water.

Ways to clean up water which is bio-contaminated (generally by bacteria, viruses, protozoa or parasites) use either boiling it or a diversity of water cleaning technologies. However,

many of these are not fully effective, and many also bring problems, such as those which relate to energy supply, the environment, health and cost, which are discussed next.

Where electricity is used as a fuel, this also suffers constraints in terms of cost and intermittency of supply. Environmental concerns of global warming stem from using fossil fuels to generate electricity. They also arise from using fossil fuels to boil water directly, whether these fuels are gas, kerosene or coal. Additional safety concerns due to scald come from large pots of hot water potentially overturning in small kitchens. A further health issue is that of respiratory problems through water heating fuels using smoky solid fuels such as coal and wood, use of the latter also causing deforestation problems.

Even non-boiling technologies bring problems of supplier reliability and safety, also odour and taste, the latter two sometime coming from approaches relying on regular inputs of chemicals, such as chlorine. Products relying on proprietary filters are not only costly to replace, but in turn, bring acute problems of supplier dependency and contingency management, such as if they go out of business.

Only two conventional solar water pasteurisers appear to be on the world market today. Both have heavy and fragile design which depends on multiple glass tubes, these making them unreliable and problematic to deploy. Neither have WHO certification in any case.

- A recurrent problem across almost all water cleaning methods is the “local money departure” impact of buying or creating clean water for households and communities. This export of cash causes local impoverishment and thwarts attempts at development.
- A second problem, particularly faced by developing countries, is low availability of standby clean water supplies, beyond bringing in bottles and water tankers, in the eventuality of water supply failure.
- A third problem is logistics of clean water supply, this is faced by relief agencies or the military when establishing sudden encampments of displaced people or military personnel.

Solution

Destroy waterborne pathogens at zero operating cost, both financial and environmental. Our solution is a novel household-scale flow-through solar water pasteuriser. By day, it heats dirty water to near-boiling temperatures. All pasteurised milk and most fruit juices are treated similarly. Our technology is based upon a dedicated solar water heating panel, an adaptation of a panel that has been on the world market for 20 years, to which we add a specially redesigned thermostatic valve to ensure safe pasteurization across a range of sunlight levels, and include an easy-to-clean heat exchanger which acts as a re-cooler which thus allows the system to deliver five times more water than it otherwise would.

All JAMEBI's sub-technologies and operational principles are proven: mitigating innovation risk.

The process of using heat to kill pathogens is similar to water-boiling processes using fuels such as electricity, gas, kerosene or wood.

The pasteurisation concept is socially accepted, by rural and urban communities alike.

Our solution is, in terms of solutions hierarchy, classified as an upstream solution rather than downstream. Rather than cure disease, we prevent it, so our solution is strategically superior. It also eliminates multiple other problems, including those of: power supply, chemical inputs and environmental damage. It cleans water at a low lifetime cost of only £1.14 per 1000 litres, cheaper than domestic piped water in the UK.

Solar technology prevents, rather than cures. It is sustainable with low lifetime water cost.

While one unit itself costs is far lower, statistically analysed, our technology costs only £15k to save one life, with calculations based on WHO figures. For comparison, the statistical value of a life in a lower middle-income country is £100,000, while in UK it is valued at £1.8M.

Solar technology is demonstrably cost-effective at life-saving: a compelling proposition.

It is physically robust. Its large solar panel is roughly the size of a single bed. It requires no chemical inputs. It needs no electricity, and no energy inputs apart from positioning in a sunny place.

Solar is totally off-grid: it can be used, not only in on-grid applications, but also in remote or challenging areas, such as disaster relief zones, refugee camps or military arenas.

Simple safe solar water disinfection, all in a box, is the concept. It is designed for non-technical people to set up and operate. After unboxing and assembling in the morning it will be producing fresh clean drinking water by noon. All it needs is sunlight and water as an input, water which must be soft rather than hard. Soft water is generally water which does not form limescale when boiled. This water, typically surface water from rivers or ponds, may arrive contaminated with bacteria, viruses, protozoa or parasites as it enters the unit, but it will be free of such living pathogens when it leaves: they will have been heated to death.

The solar solution is convenient - simple to set up and use - safe water within hours.

Safety is third-party assured. Independent testing conducted in 2017 by the WHO concluded that our solar water pasteuriser falls into the top category of household water hygiene technologies that they have tested, killing over 99.99% of pathogens. This extraordinarily high lethality means that it is suitable not only for general domestic use, but also for schools and even in healthcare.

**JAMEBI is now ready for market. Author: Barry Johnston
barry.johnston@jamebi.com**