Affordable safe drinking water for poor communities in poor countries – on scale

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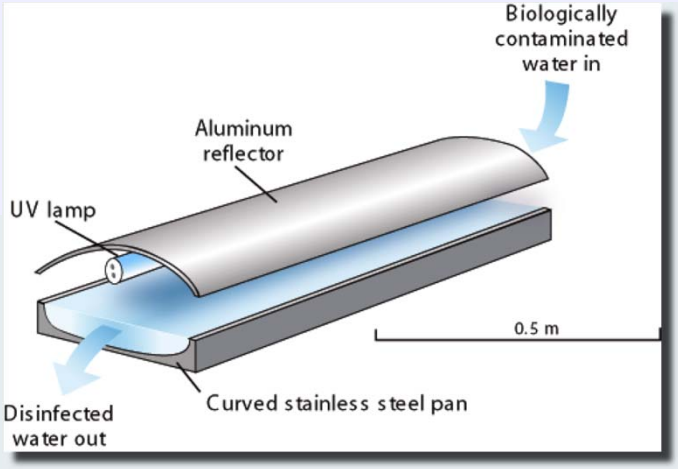
Motivation

In mid 1990s, the estimate from the World Bank,, the WHO, and UNICEF was that annually 4 million people (most were children below age 5 y) were prematurely dying from waterborne diarrheal diseases. They had no access to safe and affordable drinking water. Governments in the developing countries were unsuccessful to deliver on the promise of safe drinking water to large number of their populations. A financially viable, technically effective, and locally affordable solution was needed.

A community-scale micro water-utility, based on UVWaterworks technology, operates in village Asiaman in Ghana in 2011. In 2018, more than 7 million poor people were daily purchasing safe drinking water at similar rural centers, avoiding about 1500 child deaths per year from dirty water.

Technological Challenges

The water disinfection technology had to be extremely low cost, fail-safe, meet or exceed the US EPA and WHO criteria for acceptable disinfection (a larger than 99.999% kill rate for colony forming units of waterborne E. Coli), must be highly energy efficient, and have no moving parts for robust operation in remote areas. It also must have very low demands on operator skill and maintenance must be easily feasible for someone with a 4th grade formal education.



Schematic showing essential core concepts of UVWaterworks. A UV source is suspended above an open water channel that gets disinfected in 12 seconds

Research

We decided to develop a community-scale drinking water disinfector. Thus capital amortized costs were distributed over a large number of purchasers of water, and unit cost of disinfecting water became highly affordable. A single semi-skilled operator could operate the plant for the whole community, thus reducing the salary burden on any single purchaser of water. The selected disinfection technology was implemented in a design that gives 300% overdose of UV energy relative to that needed to achieve 99.999% kill. So, a very large factor of safety. Sedimentation and mechanical filters produce final water that is visibly of much higher clarity and transparency, and an activated carbon filter removes organic odors. Final price, including all treatment, capital amortization, interest on loan, and business margin, remains less than US$ 0.01 per Liter of safe drinking water.

Reference

US Patent **5,780,860** issued July 1998.

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