SafiStation Chlorine Generator

Advancing the development of a chlorine generator for infection prevention and control and drinking water treatment

HEALTH NEED

Poor water, sanitation, and hygiene practices contribute to the spread of infections and negative health outcomes in communities and health care settings. Health care facility-acquired infections (HCAIs) negatively affect hundreds of millions of individuals worldwide, namely mothers and infants. Patients in low-resource countries face an increased risk of exposure to HCAIs: 3–20 times higher than patients in similar settings in high-income countries.[1] Factors contributing to this risk include unhygienic environments and lack of adequate handwashing infrastructure, and lead to disastrous outcomes: 10–16% of all maternal and newborn deaths—303,000 women and 2.7 million newborns—that occurred during childbirth in 2015 were directly linked to unhygienic conditions.[2,3] Nearly all of these deaths occurred in low- and middle-income countries.

Globally, 1.3 million people die each year from diarrheal disease, roughly a third from consuming contaminated drinking water.[4,5] Chlorination at the source of drinking water collection is one of the most effective treatment methods; however, chlorine supply chains in developing countries are inconsistent, and municipalities and other institutions frequently lack the appropriate technology or training to consistently chlorinate drinking water.

Chlorine is a widely used, effective chemical disinfectant recommended for infection prevention and control in health care settings. However, despite its proven effectiveness, the lack of consistent access to chlorine limits the ability of health care facility staff to provide a safe and hygienic environment for patients. A recent World Health Organization survey of across 54 countries revealed that 28% of health care facilities lacked disinfection solution.[3] Additionally, weak supply chains, burdensome procurement processes, and logistical complexities involved in distribution contribute to an unsteady supply of chlorine in health care facilities, a challenge further exacerbated during times of crisis. Existing chlorine generation devices often require large capital investments, specialty replacement parts and high ongoing maintenance costs, or dedicated technical staff to constantly monitor and adjust chlorine production.

TECHNOLOGY SOLUTION

To address these gaps, PATH and MSR® Global Health developed an innovative and easy to use chlorine generator for low-resource settings—SafiStation™ Chlorine Generator. The device uses salt, water, and electricity to produce a 1% chlorine solution for infection prevention and control and drinking water treatment.

SafiStation. PATH/Adam Drolet .

The SafiStation addresses current market, product, and technology gaps related to chlorine availability, correct use, and production through:

- Onsite, continuous production using widely available inputs, which eliminates supply chain and hazardous transportation challenges.
- User-friendly design, simple error icons, and internal circuitry that automatically regulates chlorine generation solution, which vastly reduces the technical knowledge required to operate the device.
- Consistent 1% concentration, simplifying dilution calculations and on-demand production and allowing the user to produce specific volumes.
- Initial economic feasibility modeling shows a five-year cost savings of using the SafiStation compared to locally purchased, pre-packaged liquid sodium

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hypochlorite.

TECHNICAL SPECIFICATIONS

Chlorine concentration produced	1%
Chlorine production rate	3 L/hour
Drinking water treatment rate	Up to 15,000 L/hour*
Production rate for strong disinfection solution (0.5%)	Up to 6 L / hour
Power flexibility	12 V DC 110-220 V AC
Target device lifetime	~5 years at 8 hours/day
Estimated cost	US$1,500-2,000
Target use mode	Disinfection (primary); Water treatment (secondary)

*At a 2 parts per million (ppm) chlorine residual.

COSTING ANALYSIS

Initial analysis has shown that the estimated cost to produce 1 L of 1% chlorine from the SafiStation is <$0.10. This includes an averaged up-front device cost of US$1,250, in addition to the cost of all consumables (salt, water, electricity, and vinegar), which may vary by country. This also assumes the device is running for eight hours per day and five days per week for the duration of its expected product lifetime of five years. When compared to purchasing bottles of liquid sodium hypochlorite, this could represent cost savings of up to 50% over five years (compared to a healthcare facility in Kenya that is currently purchasing 5 L bottles of 4% liquid chlorine for $3.50 per container). Costing analyses and estimates will be updated throughout the project as more data is gathered in order to better show projected cost savings with the device.

ADVANCING THE DESIGN

The project has successfully advanced the SafiStation from initial concept to a beta prototype and continues to build momentum toward the low-rate initial production phase by 2018. Data collected from 15 beta units, as well as recent interviews with users, buyers, and other stakeholders, have provided clear guidance on required technical device refinements and industrial design direction. These advancements are aimed at simplifying assembly processes and time, improving the user experience, and reducing the overall product cost. Additional research is being conducted into high-priority accessory components, such as solar power options and remote, wireless device monitoring. Looking ahead, the project will conduct two more rounds of technical product evaluations and incorporate findings into design refinements. Evidence-based design decisions have been made to meet target user needs, market considerations, and stakeholder input, which will ultimately position the device for commercial launch and wide-scale adoption.

VALIDATING THE MARKET

PATH and MSR® Global Health continue to build momentum and a strong business case toward commercialization of the SafiStation. Data from a series of in-depth interviews with key water, sanitation, and hygiene experts and health care facility staff involved in chlorine production, use, storage, management, and procurement identified health care facilities (HCF) as the most appropriate use-mode. The primary use of the SafiStation in HCFs is for disinfection purposes, with the secondary use of the device being onsite water treatment. Future market activities will continue to build on initial market size and demand estimates, distribution strategies, and future sales approaches.

NEXT STEPS

Beginning in June 2018, PATH will launch an operational study evaluating the usability, acceptability, and economic feasibility of the SafiStation in low-resource health care facilities and emergency/humanitarian relief settings. A total of 50 devices will be placed in a variety of geographical settings. The product-, user-, and market-related data generated under the study will form the basis for a commercialization strategy and pathways to scale.

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