

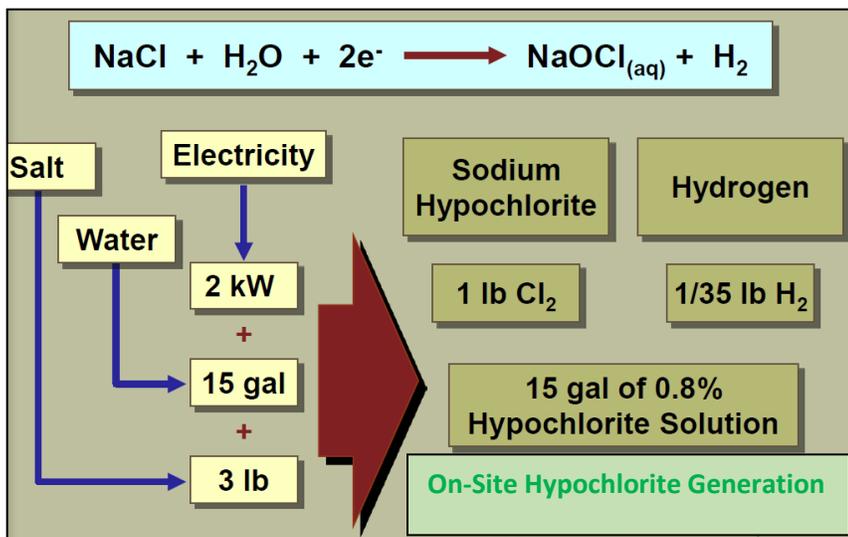
## Conversion to On-Site Sodium Hypochlorite Generation Improves the Safety and Resilience of Two Wastewater Re-Use Plants with a Three Year Economic Payback

Aqua Engineers is a local Hawaiian company founded almost 40 years ago which delivers operations, engineering and construction management to the water and wastewater industry throughout Hawaii. Also, as an owner and operator, Aqua Engineers is keenly focused on the return on investment for process equipment decisions, but also on the safety of its operators and surrounding community. Choices between disinfection technologies on the Hawaiian Islands involves evaluating a host of trade-offs that often includes a heavy weighting of reliability, self-sufficiency and resilience as a result of the inherent distance from mainland suppliers.

In evaluating disinfection options for various projects, Aqua Engineers came to following conclusions:

Disinfection Option	Cost Per Pound of Free Chlorine	Capital Cost	Safety
Gas Chlorine	\$1.30 - \$1.50	Low	Hazardous Gas
Bulk Sodium Hypochlorite	\$3.50 - \$4.00	Low	Hazardous Liquid
Calcium Hypochlorite	\$3.85 - \$4.50	Low	Hazardous Solid
On-Site Generated Sodium Hypochlorite (OSHG)	\$1.10 - \$1.50	High	Non Hazardous Liquid

Based on this analysis, Aqua Engineers evaluated two wastewater treatment plants that both generated water for beneficial re-use for conversion to the latest version of on-site hypochlorite generation. Both the Puhi Sewer & Water WWTP (0.4 MGD) and the Turtle Bay WWTP (0.2 MGD) had already converted from gas chlorine to bulk hypochlorite (~ 12.5% sodium hypochlorite) in previous years. OSHG uses power, salt and softened water to produce a ~ 0.8% concentration (8,000 ppm) of sodium hypochlorite as a powerful water disinfectant.



Ultimately, Aqua Engineers chose the Microclor® OSHG system provided by UGSI Solutions for both sites in 2016. In addition to proven reliability, the modular design of the Microclor® system allowed for easy maintenance and even safe operation with one of the electrolytic cells removed. The vertically oriented electrolytic cells also ensure the safe evacuation of the hydrogen gas by-product with no opportunity for cell pressurization. In general, maintenance consists of cleaning the electrolytic cells of calcium that accumulates over time inside the cells. This is accomplished by flushing

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*Aqua Engineers Aqua Puhi Site with 40 pound per day (PPD) Microclor® OSHG unit*

the system with a dilute muriatic acid (“pool acid”) when a build-up can be observed on the cells by viewing through the transparent cell housings. This cleaning routine may occur as frequently as once per quarter to once per year depending on the quality of salt and softened water.

Throughout a pilot period, Aqua Engineers focused on the new operational, training and maintenance demands of introducing a new process to their operations. Key pre-planning items included the availability of make-up water, power (a 40 PPD unit can run on 240V single phase) and softener brine discharge. Initial engineering considerations included matching the production capacity of the Microclor® OSHG units and subsequent product storage with the plants’ disinfectant demand as well as salt storage and delivery.

After over a year of observation and operation, Aqua Engineers published the following economic returns at a recent technical conference:

Treatment Plant	Annual Savings Over 15 Year Life	Return on Investment
Turtle Bay	~ \$28,000/year	~ 3 Years
Aqua Puhi	~ \$32,000/year	~ 3 Years

“On site generation (OSG) in Hawaii is relatively new. However, with rising costs of bulk sodium hypochlorite or calcium hypochlorite Aqua Engineers evaluated the features and benefits of OSG systems in 2015. After a detailed evaluation of OSG systems, we chose the Microclor® system. We are seeing a 60-70% reduction in operating costs compared to existing disinfection options. The previous generation of OSG systems were complicated and difficult to maintain for the operator which often lead to local utilities abandoning the system. The open architecture and simplicity of the Microclor® system addresses historical issues with previous OSG systems. The safety benefits, ease of operation and cost savings makes this a tremendous value to our ratepayers. Lastly, the initial and ongoing engineering and field support has been nothing short of exceptional.”

*David Paul, VP of Engineering, Aqua Engineers*