Alaskan WTP Finds Safer, More Cost-Effective On-site Alternative to Transporting Chlorine Gas Hundreds of Miles

Sam Fleury and Brian Shugrue

Golden Heart Utilities (GHU), a subsidiary of Fairbanks Water & Sewer, treats water and wastewater for more than 55,000 people in the greater Fairbanks, Alaska, area. The water treatment plant (WTP), which is located near downtown and along the banks of the Chena River, is designed to treat 8 million gallons per day (MGD), with an average daily flow of 5 MGD. The plant pumps water from four groundwater wells along the river, removing 3 to 4 million lbs/year of manganese, iron, and calcium slurry for landfill disposal.

Because of its proximity to the river and to downtown Fairbanks, the strict requirements set by the USEPA and the Alaska Department of Environmental Conservation for storing and handling chlorine gas were a constant concern. Any potential release of chlorine gas would create a serious safety issue. Also, the plant could only store a single ton container of chlorine gas onsite at any given time. It had to closely monitor the chlorine gas level inside the container and could only order another when it was halfway empty. This frequent handling of chlorine gas cylinders increased the opportunity for problems to occur. The plant also had to follow a Risk Management Plan to ensure plant personnel were kept up-to-date with training and certifications to handle any potential chlorine gas release.

Additionally, Fairbanks is located in the center of what is a very large state. So transporting chlorine gas by road or rail 366 miles from Anchorage was costly and hazardous, especially during the winter months. And, with the rising cost of oil during the past two years and the subsequent fuel surcharges by common carriers, transportation costs were forcing the overall cost of chlorine gas to rise considerably. The plant considered using commercial bleach, but faced similar issues to using chlorine gas. Since bleach is also a hazardous material, plant personnel still had regulatory issues to deal with, and transportation costs for this bulky and hazardous product were just as much an issue as they were with chlorine gas.

A More Cost-Effective Solution

Seeking an alternative, GHU contacted Siemens Water Technologies' local representative, **T M G Services** of Tacoma, WA. **T M G Services** conducted a Siemens Life Cycle Cost (LCC) analysis to compare the plant's costs between using chlorine gas, liquid bleach or OSEC® onsite generation of sodium hypochlorite. The LCC spreadsheet takes local plant data such as labor, power and other costs and combines them with the expected capital costs for all three potential systems – chlorine gas, bulk bleach and the OSEC system.

Once the data were analyzed, GHU determined that an OSEC system from Siemens Water Technologies would be the best choice, providing a payback in capital expenditure of approximately three years. Beyond that, the utility would be saving money over bulk liquid bleach or gas chlorination systems due to the lower operating costs. This is especially

important for larger treatment plants, as the greater the quantity of required chlorine in pounds per day (PPD) for a treatment plant, the better the payback over time. This was a deciding factor since the GHU plant in Fairbanks required 500 PPD. It is important to note that safety concerns are not included in LCC analysis. Since less equipment and fewer safety measures and processes are required for onsite sodium hypochlorite systems, these costs are eliminated, creating an added benefit.

Safety is The Key

Since safety was one of the driving factors in deciding to make this change, the overall safety of the onsite generating system was important. The Siemens OSEC product line, which has been on the market for over 30 years, has numerous safety features built into each system to prevent potential explosions. The system incorporates an inter-stage removal of hydrogen gas from each and every cell, and retains the gas in a confined pipe pathway at a positive 2% grade into the top portion of the solution tank. No open vents or valves are allowed in these lines. Once inside the tank, any entrained gas can safely come out of solution as it is diluted with air and force-vented into the atmosphere via an orifice plate that is linked to the control system.

Also, all electrical components have intrinsically safe barriers to eliminate any potential sparking. Additionally, liquid level sensors are included in the top cell to prevent the system from starting if those levels drop for any reason.

Safety is a major factor when installing and operating this technology. Siemens and its local Service Contractors like **T M G Services** ensure that plant personnel receive thorough training on how to use the equipment during the initial startup. Also, factory authorized experts are available at all times for long-term service and support. According to Dave Dean, director of administration at Fairbanks Water & Sewer, TMG Services has been very helpful and responsive during the past four years in supporting Fairbanks' OSEC system.

Onsite Hypochlorite Generation at Fairbanks

Fairbanks installed the OSEC B2-200 model, which consists of two short skids, in June 2004. Each skid has two electrolyzer cells and a capacity of 250 PPD, for a combined total capacity of 500 PPD of equivalent chlorine.

The OSEC hypochlorite generating system produces a low-strength sodium hypochlorite solution of 0.8% through the electrolysis of brine, consuming only salt, water and power. Since these components are easy to acquire and handle, operating costs are much less than for other disinfection options. In general, it takes 3 lbs of salt, 2 kW-hours of power and 15 gals of water to produce the equivalent of 1 lb of chlorine gas.

The water is softened, mixed with a brine solution, diluted and then pumped into special electrolyzer cells that contain cathodes and specially coated anodes. When electricity is applied, electrons flow between the cathodes and the anodes. Chloride ions in the water

approach the anodes, donate their electrons and form chlorine molecules – the same chlorine molecules found in chlorine gas.

The low concentration level of 0.8% means the solution is non-hazardous, which eliminates the need to develop a Risk Management Plan. The OSEC system has a small footprint, making it easy to retrofit practically any plant. The GHU plant installed the OSEC system in its old chlorine gas room, which saved time and money.

The operating water temperature greatly affects reaction efficiency. Because of their unique anode coating, OSEC electrolyzer cells have an operating range of 50 to 80°F. However, when plants have incoming water below that range, it must be heated in order to maintain optimal electrolyzer cell performance. This often requires additional electric heaters, which can add more cost (both capital and operational) to a system. Since Fairbanks has incoming water that averages 45°F, it needs to be heated accordingly. The OSEC system's unique heat exchanger captures the heat naturally generated during the electrolysis process and circulates it back to the inlet water. This heats the water an additional 5 to 7°F without the use of electric heaters, which has resulted in incremental cost savings over time.

Dave Dean said he was pleased with the plant's OSEC system, which has actually performed beyond what was expected. "The GHU plant is using less than 3 lbs of salt and less than 2 kW hours per lb equivalent of generated chlorine," says Dean, "and operating costs are subsequently that much less."

About the Authors

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Suggested Photos and Captions

Fairbanks, AK – Fairbanks' OSEC system has a capacity of 500 PPD of equivalent chlorine.

GHU aerial – The Golden Heart Utilities WTP, which is located near downtown Fairbanks and along the banks of the Chena River, is designed to treat 8 MGD and has an average daily flow of 5 MGD. The original plant was built in 1953, with expansions in 1962 and 1990.

Sam & OSEC – The lead co-author, Sam Fleury, standing alongside Fairbanks' OSEC system.