Colorado Water Treatment Plant Discovers the Benefits of Safe and Reliable Chlorine Dioxide Generation System

CASE

Evergreen, Colorado
Spring 2003

GOALS

» Improve the safety and simplicity of the chlorine dioxide (ClO_2) feed system
» Reduce storage of on-site chemicals.

SITE

Evergreen's drinking water

HISTORY

Nestled among gently rolling mountain tops, the drinking water treatment plant in Evergreen, Colorado is located on a small area of land bordered by a lake, two streets, and a business. Over the past few years, the community's steady population growth had finally placed pressure on the conventional water treatment systems capacity to deliver treated water to the community (2.8 MGD).

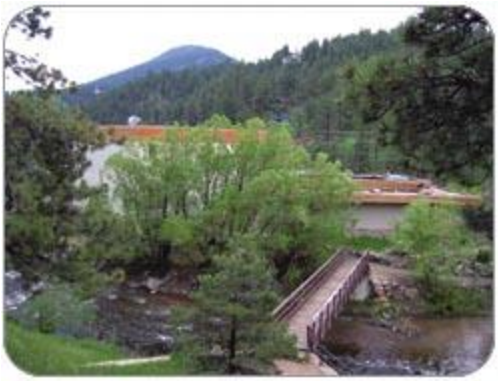
Evergreen Lake is the source for the city's drinking water.

Other key concerns regarding the plant's performance included turbidity reduction and manganese removal. Since 1991, the plant has successfully used chlorine dioxide pre-treatment to remove manganese from the incoming water source (0.1-0.2 ppm) and for pre-disinfection. Today, chlorine gas is still is used for post disinfection.

PROBLEM

Despite the challenges posed by the limited amount of space available for expansion, the Evergreen plant had to increase its production of treated water. As part of an initiative to upgrade equipment and modernize its operation, plant operators tried to find ways to minimize the on-site storage of chemicals while simultaneously increasing production capacity. Reducing the amount of on-site chemicals would not only minimize the risks associated with the storage and handling of hazardous chemicals, but also eliminate the need for an EPA mandated risk management plan.

The facility's existing dual-precursor ClO_2 generation system required extensive service. It also exposed operators to concentrated hazardous chemicals and vapors. The generation method involved diluting a stream of chlorine gas and concentrated sodium chlorite solution into a batch tank. The ClO_2 batch tank—needed in order to provide the necessary chlorine dioxide conversion efficiency—typically held 50 gallons of 400-600 ppm ClO_2 solution. On one occasion, there was a hazardous spill of ClO_2 solution from the tank. In addition, sodium chlorite, Cl2, and ClO_2 were discovered leaking from fittings.



Despite limited space, PureLine's E-Chem ClO_2 generator allowed the Evergreen facility to expand its production while reducing on-site storage of hazardous chlorine.

Maintenance on the outdated ClO_2 generator and feed system was extremely hazardous. It required that operators receive extensive training in order to safely perform equipment inspections, modifications and parts replacements. For example, many of the connections within the unit needed to be opened so that O-rings could be switched out every quarter to avoid dangerous leaks during operation. In fact, each time the generator required service, operators were placed at significant risk for exposure to strong vapors or solutions of chlorine or ClO2.

In addition, the generator's vendor did not provide adequate service or technical support. This lack of technical support required plant personnel to develop best practices for operating and maintaining the generator while managing a hazardous chemical inventory. Plant management and operators were forced to cope with intensive issues regarding maintenance, ClO_2 solution storage, and the appropriate handling of multiple precursors on a daily basis.

SOLUTION

To address the Evergreen facility's need for increased production in a small space, a 2.7 MGD microfiltration membrane plant was added to the 2.8 MGD conventional water treatment plant. This enabled the plant to double the throughput of treated water for the district.

PureLine Electrochemical Chlorine Dioxide Generation. The existing dual-precursor ClO_2 generation system was replaced with a PureLine P-40 single-precursor electrochemical ClO_2 generator. The P-40 generation system uses a sodium chlorite solution to provide up to 30 lbs/day of pure ClO_2 gas. Since the gas is directly educted into a flowing side-stream water line and delivered into the water system, there is no need to store ClO_2.

RESULTS

Microfiltration facilitated the removal of suspended solids to 0.1 micron. This minimized the need for polymer and coagulant feed while providing a significant improvement in microorganism reduction (5 log) compared to that achieved with the conventional water treatment system (3.5 log). With its successful expansion, the microfiltration membrane plant has now become the primary treatment system—allowing the conventional plant to remain off-line except during the peak summer months. As a result, the chemical inventories for polymer and coagulant have been significantly reduced.

PureLine Electrochemical Chlorine Dioxide Generation. Despite doubling the potential throughput of treated water, the plant realized an overall reduction in their inventory of chlorine gas cylinders from 2500 pounds to 1500 pounds since chlorine gas is no longer needed for pre-disinfection. In addition, because the P-40 generator makes pure ClO_2 gas, THM values have been reduced 20-30% from those generated by the old system that produced a ClO_2 stream with residual Cl_2. Performance regarding manganese removal remained unchanged.

Maintenance for the PureLine P-40 generator is minimal compared to those required for the dual-precursor generator. With proper installation and system parameter inputs, the P-40 automated system guides the process of pulling sodium chlorite precursor into the recirculating electrochemical ClO_2 generation loop, and eductes pure ClO_2 gas from a stripper column into the water system. The stripping process is actuated by an ORP signal that initiates side-stream water flow, and feeds a dosage of ClO_2 according to flow-pacing software. Multiple safety interlocks and alarm features ensure safe and simple operation.

Plant personnel responsible for overseeing the ClO_2 feed system are very glad to be free from chlorine gas. The electrochemical cells operate as they are designed to function without interruptions in service. Standard preventative maintenance is performed by PureLine field experts as part of the contract — freeing plant operators to focus on other mechanical and operational projects.

CONCLUSION

The combination of microfiltration and PureLine's electrochemical ClO_2 generation system provided a cost-effective way for the Evergreen water facility to expand the plant's capacity, kill bacteria more effectively and efficiently, and minimize the amount of water treatment chemicals stored on-site. Since the installation of the PureLine's P-40 generator, the Evergreen plant has reduced the volume of stored chlorine by 25% while more than doubling their capacity.

Maintenance of PureLine's P-40 single-precursor ClO_2 feed system is much simpler and safer than that required for the traditional generator. The fully automated P-40 electrochemical ClO_2 generation system is much safer and simpler to operate, yet provides comparable pre-disinfection and manganese removal results. Because the P-40 delivers pure chlorine dioxide into the water system rather than the mixture of ClO_2 and Cl_2 delivered by the old generator, the Evergreen facility has dramatically decreased its THM levels by 20-30%.