Southeastern Municipality Uses Chlorine Dioxide to Control THMs in Drinking Water

Challenge

This municipality disinfects 33 million gallons per day of drinking water. Chlorine gas was used as the primary disinfectant for the raw water entering the plant. Free chlorine is known to react with certain organic species present in the raw water to form trihalomethanes (THMs) as a disinfection by-product. The USEPA regulates the amount of THMs present in drinking water (The U.S. Environmental Protection Agency (EPA) has mandated public water systems check for THMs on a regular basis and that the level of THMs in the water should be less than 80 parts per billion (ppb), EPA has set standards for THMs in water because there is a slight possibility of an increased risk of bladder or colorectal cancer over a lifetime of drinking water with THMs above 80 parts per billion.). This plant produced relatively high levels of THMs in the drinking water. An alternative primary disinfectant was required, which would prevent the formation of elevated levels of THMs while adequately disinfecting the drinking water.

Solution

A recommendation was made to the municipality to treat the raw water with chlorine dioxide, using a two-chemical chlorine dioxide generator, at a feed rate of 0.5 mg/L. Chlorine dioxide does not react with most organics and will not form THMs if applied properly in accordance with use instructions. The continued use of chlorine gas as a final disinfectant prior to distribution was also recommended.

Results

Chlorine dioxide effectively lowered THM levels in the disinfected drinking water to well below the levels required by the USEPA. Additional benefits resulted from the use of chlorine dioxide: control of iron and manganese and oxidation of substances known to produce adverse taste and odor in the disinfected drinking water. The program has been in place since 1992 and the customer continues to be extremely satisfied with the results.

Courtsey by : Siemens

Chlorine Dioxide Reduces THMs, Improves Taste for Arkansas Water Treatment Plant

Challenge

The 1.8 MGD Greenwood Water Treatment Plant was built in 1964 and upgraded in 1992. The facility provides drinking water to a population of more than 7,000 and, like many small towns, Greenwood has faced major decisions about how to remain in compliance with the Safe Drinking Water Act. Because its water supply is provided by a very shallow lake (less than 10-feet deep), sourcewater quality can vary widely. “We often get a lot of organics, and this had brought about high trihalomethanes (THMs) in our finished water when we prechlorinated,” says Greenwood Water Superintendent, Mack Cochran. THMs were running more than 115 mg/l and as high as 175 mg/l.

In addition, the high organic levels in the sourcewater were causing problems with taste and odor. In the late 1990s, Greenwood started looking for ways to reduce THMs as well as improve taste and odor in its finished water.

Solution

The plant installed a Wallace & Tiernan Series 85-250 Chlorine Dioxide System.

Chlorine dioxide (ClO_2) is a powerful disinfectant and oxidizing agent applied in treatment plants for controlling tastes and odors, disinfection, oxidation of iron and manganese, and controlling THM formation.

Chlorine dioxide does not react with ammonia to form less-active chloramines and will not form THMs.

Results

The Chlorine Dioxide System makes up ClO_2 on a continuous batch process. Chlorine gas, sodium chlorite liquid, and water are combined to produce a 2 percent solution of chlorine dioxide in 25-gallon batches. “Everything is automatic,” says Cochran. “It automatically batches again when our 25-gallon reservoir drops." Level probes in the chlorine dioxide holding tank monitor the stored solution level and start and stop the batch cycles.

The system uses manually set feed rates of sodium chlorite and a high concentration of chlorine solution to completely convert the sodium chlorite to chlorine dioxide (the system converts 96 to 98 percent of sodium chlorite to chlorine dioxide).

The system at the Greenwood facility has a capacity of 80 pounds of chlorine dioxide per day. The plant treats an average of 850 gallons per minute using eight to 10 gallons a day of concentrated chlorine dioxide. The dosage rate is set at 0.55 ppm.

The chlorination equipment with the system includes a switch-over type of vacuum regulator so the system operation will continue when one of the chlorine cylinders is empty, and a fume -evacuation injector in the vent line from the holding tank controls any off -gassing during generation. Following the adoption of chlorine dioxide feed and the elimination of prechlorination, THMs have been significantly reduced, according to Cochran. Taste and odor have also improved significantly. Since switching to chlorine dioxide, twice the plant won two "Best Tasting Water" competitions sponsored by the Arkansas Water Works And Water Environment Association.

Courtsey by : Siemens

Rocky Mountain Drinking Water Plant Removes Manganese and Improves Turbidity with Chlorine Dioxide

Challenge

This 10 million gallons per day drinking water plant gets its raw water source from a 151,000 acre-feet reservoir situated at an elevation of 5430 ft. The water intake is through a tunnel at a depth of 200 feet. The intake does not have provisions for the withdrawal of water from multiple levels in the reservoir. The plant has a problem with manganese: levels rise in the fall as the water temperatures in the reservoir drop until the turnover of the reservoir in summer. Implementation of a new pH adjustment system in 1992 increased the pH of the water leaving the plant, causing some of the soluble manganese to oxidize and precipitate out in the storage tanks and pipelines. Numerous 'brown water' complaints from city residents followed. Potassium permanganate was employed at dosages from 0.2 - 1.2 mg/L during 1993 and early 1994 but failed to adequately control the problem and the city still received complaints. The city began looking for an alternative treatment approach in 1994.

Solution

A recommendation was made to the municipality to treat the raw water with chlorine dioxide, produced using a two-chemical chlorine/ chlorite generator. A chlorine dioxide feed rate of 0.4 - 1.2 mg/L was recommended for treatment during the late spring and summer with a lower maintenance dose of 0.4 - 0.5 mg/L for the fall and winter months.

Results

Chlorine dioxide effectively removed manganese from the raw water at a ratio of 0.6 mg/L of manganese for every 1.0 mg/L of chlorine dioxide fed. The incidence of 'brown water' complaints has been reduced or eliminated. The addition of chlorine dioxide at the plant influent, as a pre-oxidant, under EPA guidelines allowed the plant to receive a CT credit through the plant basin.

The turbidity of the effluent was reduced from 0.04 in 1993 to < 0.01, and THM levels have also dropped by 20 µg/L since the program began in late 1994. Other benefits include improved taste and odor control, improved plant atmosphere, and a reduction in the chlorine demand in the effluent from 1.7 mg/L to 1.2 mg/L. The implementation of chlorine dioxide to the treatment train at this plant has exceeded expectations with respect to its effectiveness for manganese as well as improving overall treatment efficiencies.

Courtsey by : Siemens

Use of Chlorine Dioxide Enhances Corrosion Control Program at Major Southwestern Petroleum Refinery

Challenge

This cooling system had unacceptably high corrosion rates: 8 - 10 mpy on carbon steel and 1 mpy on admiralty. The cause of the corrosion was a small, light hydrocarbon leak. Increased chlorine feedrates were required to keep the system in microbiological control, but also aggravated admiralty corrosion rates. Increased feedrates of azole copper corrosion inhibitor were also required since azole creates a demand for chlorine, further increases in chlorine feedrate were required. Chlorine reacts with azole, making it ineffective as a copper inhibitor, increasing requirements for azole.

Solution

Chlorine dioxide was fed continuously for 3 days to 'cleanup' the system. Treatment was then optimized to a twice per week frequency.

Results

Carbon steel corrosion rates dropped to around 0.5 mpy. Admiralty corrosion rates were < 0.1 mpy. Azole requirements were greatly reduced due to the non-reactivity of chlorine dioxide with azole and the fact that chlorine dioxide is far less aggressive to admiralty than free chlorine.

Courtsey by : Siemens

Chlorine Dioxide Improves Operating Efficiency in Process-Contaminated Tower

Challenge

A processing unit in this petrochemical plant utilized a cross flow cooling tower with conventional wood slat fill, and a recirculation rate of 45,000 gallons per minute for process cooling. Chlorine gas was used at an average rate of 600 pounds per day, supplemented with sodium bromide. A chronic leak of process contaminants into the cooling water caused rapid microbiological growth. The high chlorine/ bromide feedrate coupled with a healthy biofilm throughout the system resulted in excessive corrosion rates of around 10 mpy on carbon steel with a pitting index routinely > 20, frequently reaching 50-60, as measured by an in-line corrator. The algae-biofilm mat blocked many of the distribution nozzles allowing the water to short-circuit through the tower. The drift eliminator was also heavily fouled with algae/ biofilm, restricting airflow throughout the tower, causing poor heat transfer and inefficient cooling. Foaming and odors resulting from hydrogen sulfide produced by sulfate reducing bacteria (SRB's) present in the biofilm were also problems. The customer required an effective alternative treatment program at no additional cost to the plant.

Solution

A two-month chlorine dioxide trial was proposed. The treatment program included three phases: cleanup, optimization, and maintenance. During the cleanup phase, chlorine dioxide was fed continuously for 72 hours at 1-2 mg/L based on recirculation rate. The system was then treated intermittently for several hours on a daily basis. A maintenance treatment of 5-hours/ day, 3 times/ week was initiated once the tower was clear of biofilm and algae.

Results

Corrosion rates of < 5 mpy were observed after the chlorine dioxide program was fully implemented. The pitting index was reduced to < 1 mpy, consistent with a well-treated cooling system. Within 48 hours of commencement of the cleanup phase, the basin temperature dropped 10°F and a small decrease in the condenser temperature was observed. Plant personnel also observed a slight increase in amps of the fan motors, providing confirmation of improved cooling. The foaming and odor problems were also eliminated. The annual program cost is less than the original chlorine program. The trial was converted to a permanent installation and the customer continues to be extremely satisfied with the program.

Courtsey by : Siemens