

# Revitalizing Lake Egypt



By Perry Musgrave

Water district eliminates chlorine gas & reduces THMs

Lake Egypt Water District serves more than 4,500 customers in and around Williamson, Johnson and Union counties in Illinois. The district also sells water to Lick Creek Water District, Devils Kitchen Water District, the village of Creal Springs, the village of Goreville, and Burnside Water District.

Lake Egypt Water District has struggled at times with high trihalomethanes (THMs) like many other surface water treatment plants that use chlorine gas. The district was unsure where the THMs were being formed—possibilities included the rapid mix, the clarifiers, the filters, in the clear well, or out in the distribution system. In 2009, it completed a study to find out where its THMs were being formed and found that 75% of them were forming in the rapid mix. Part of the reason was that, at times, the district experienced raw water manganese as high as 1.8 mg/L and one spike of 3.6 mg/L.

In order to oxidize that much manganese, the district had to feed as much as 15 mg/L free chlorine dose in the rapid mix. It was able to oxidize the manganese at this rate, and its finished water quarterly average in the past two years has not been more than 0.15 mg/L. Even with that type of treatment, however, it continued to receive brown water calls—59 calls in 2009, 44 calls in 2010 and 41 calls in 2011. The district was under a constant flushing program to keep complaints at a minimum.

## Solving the Problem

The Lake Egypt Water District board, managers, engineers and water plant operators took a proactive approach and began looking at other treatment systems, including visiting other water plants to help devise a solution to the THM and manganese problem. They performed an evaluation on using potassium permanganate to oxidize the manganese and found that there was not enough detention time for it to work properly. Other water plants were using chlorine dioxide in pretreatment with great success. Additionally, other plants were using mixed oxidants for post-chlorine treatment.

Mixed-oxidant solution (MOS) is produced by an on-site generation of salt water and power. The process involves water going through a softener, after which it is split into two lines. One line feeds directly into the electrolytic cell while the other is used to fill the brine tank. The brine tank stores a concentrated salt solution, prepared by having an excess of salt in the tank, so that the solution is near-saturated brine, which is then injected into the softened water stream entering the electrolytic cell. When the dilute salt solution is inside the electrochemical cell, a current is passed through the cell, producing the oxidant (sodium hypochlorite or other oxidants) solution. The mixed oxidants are produced by an

electrolysis of sodium chloride brine in an electrolytic cell that has been optimized for disinfection efficacy. After leaving the electrolytic cell, the oxidant solution is stored temporarily in the oxidant tank and then is metered into the water moving through the treatment process.

For the past 15 years, MOS has exhibited microbial inactivation properties that are superior to bleach alone. In MOS, free available chlorine (FAC) is the primary analyzable oxidant constituent. The chemical produced from MOS generators, however, shows demonstrable differences from bleach in both field and laboratory studies, indicating the presence of other oxidant species beyond FAC alone.

## Upgrading the Plant

The Lake Egypt Water District board decided to upgrade the water plant, including adding chlorine dioxide and mixed oxidants, for approximately \$580,000. This allowed the district to eliminate chlorine gas all together.

In September 2011, the district began feeding mixed oxidants for its post-chlorine treatment. After about a week of working out a few bugs, the chlorine residual leaving the plant was stable. It also had plumbed the mixed oxidant line to the front of the plant so mixed oxidants could be used in the rapid mix while the district was taking out the chlorine gas and installing the chlorine dioxide.

THM concentrations went down significantly, with an average chlorine dioxide feed rate of 0.87 mg/L. THMs measured 46 µg/L in 2010; 41 µg/L in 2011; and 8 µg/L in 2012.

The district has not had any brown water calls since making these changes. It has a 3.5 mg/L chlorine residual leaving the plant. Another benefit has been in total organic carbon (TOC) removal. When feeding chlorine gas, the district's TOC reduction levels for 2010 and 2011 were 39% and 27%, respectively. With the chlorine dioxide and mixed oxidants generated on site, it no longer has safety concerns due to having a large amount of chlorine gas on hand.

Lake Egypt Water District has not hit historically high months for THMs or manganese since the plant upgrade. Chlorine dioxide has 2.6 times the oxidizing capacity of chlorine. Chlorine gas is a cost-effective disinfectant for many water plants, but the district had to do something different. The chlorine dioxide and mixed oxidants upgrade has proven to be a good answer to its issues. **WWD**

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