by Lonnie Boller, KRWA Surface Water Tech

# Maintaining combined chlorine residuals is often a challenge

During the summer of 2008, many water systems in Kansas had trouble maintaining adequate chlorine residuals. Many of the affected systems purchase water from adjacent cities or water districts. And, most of the affected systems with residual loss problems were systems with combined chlorine residual.

With regulations requiring maximum contaminant levels (MCLs) for disinfection byproducts and also a maximum chlorine residual of 4.0 mg/l, some water systems do not believe they can send out highly chlorinated water due to these regulations. However, high residuals are needed in order to help maintain adequate residual in the distribution system.

## Re-chlorination

Combined chlorine residual is a residual where chlorine has been combined with ammonia. Combined chlorine residuals are much more difficult to re-chlorinate than water containing free chlorine residual that does not contain ammonia.

The difficulty in re-chlorinating combined chlorine residual water is that the chlorine being added can only be the amount of chlorine that can react with the "free" ammonia in the water; thus producing additional combined chlorine in the water. The free ammonia is the ammonia in the water that has not reacted with previously added chlorine.

If chlorine is added during re-chlorination in amounts greater than can react with the free ammonia in the water, then the excess free chlorine will react with the combined chlorine. In this reaction both the free chlorine and the combined chlorine will be destroyed; thus, the total chlorine residual will decrease. The free chlorine and the combined chlorine in the water will continue to destroy each other until only one remains. In short, if re-chlorination is too high, the chlorine residual in the water will decrease.

Systems that have difficulties maintaining adequate residuals should install online chlorine analyzers to help determine the extent and severity of the problem.

It is important when re-chlorinating to ensure that the chlorine addition is not too high. Systems that have difficulties maintaining adequate residuals should install online chlorine analyzers to help determine the extent and severity of the problem. Having that information would be helpful in determining when re-chlorination should be used, or when water line flushing or overflowing the storage tank is needed.

## Maintaining residuals and "burnouts"

It is important to make sure that a 2.0 mg/l combined chlorine residual or greater is maintained in water storage tanks. The loss or reduction of residual encourages biofilm growths in the tanks which can then spread to the distribution lines The loss of residual can be lessened and may be controlled by fluctuating the water levels in the tanks, maintaining a greater than 2.0 mg/l chlorine residual, and re-chlorinating the water.

The losses of chlorine residual in the summer months are primarily due to bacterial growths in storage tanks and distribution lines. These growths are not harmful to the customer and most likely do not show up in regular bacterial testing of the water.

Many systems that have significant loss of combined chlorine residual do a "burnout" in the summer; this occurs when the systems discontinue ammonia addition and go to free chlorine residual for four to six weeks. However, if adequate combined chlorine residuals can be maintained in the storage tanks, then it is likely that the residuals will also be adequate in the distribution system (other than on dead-end lines where flushing can address the problem) and a burnout will not be needed.

The free chlorine is very good at destroying the bacterial growths contributing to the combined chlorine residual loss. The burnout usually occurs during the warmer water temperature months of late July thru September. Overflowing the storage tanks and flushing lines will speed the progress of the burnout. It is most important to get the free chlorine throughout the storage tanks or the burnout process will not be complete.

## Water system examples

Some of the systems with whom I have worked need to consider re-chlorination. When constructing a re-chlorination building, it is important to allow enough space to add ammonia feed equipment if needed. Ammonia should be added in most cases when

**Mark Gaskell, with Horton Metal Products in Horton, KS, begins framing of the rechlorination building for Kansas Rural Water Association. The structure will be all aluminum including the frame and sheeting. Mark has also worked on other water plant projects such as basin covers. KRWA will use the station to speed correction of a system's water quality issues and also as a demonstration unit.**

re-chlorinating to ensure that the resultant residuals are high enough.

Over the summer I worked with a small town that had difficulty maintaining combined chlorine residuals even after we bypassed the water tower. The water is purchased from a wholesale district, sold to a rural water district, and then is purchased by the small city. They are several miles of pipelines and several storage tanks between the wholesale district and the city that purchases the water.

By the time the city receives the water, the combined chlorine residual is already low even before the loss in the city's distribution system. This city should re-chlorinate and also add ammonia when needed. In most cases, this would require a building and a metered flow to determine how much chlorine and ammonia should be added.

I have also been working with Atchison Consolidated RWD 5 in northeast Kansas in setting up re-chlorination facilities at the district's main booster station. The chlorination is working fine but due to not having enough free ammonia in the water we cannot increase the chlorine residual to the desired level. If we were to add ammonia, we could increase the chlorine to whatever level is needed to discourage bacterial growth and residual loss.

## New portable rechlorination station

The Kansas Rural Water Association is constructing a portable re-chlorination and ammonia addition building. This building will have an online chlorine analyzer, flow meter that will pace the chemical feed pumps. For example, if the flow increased from 50 GPM to 100 GPM, the feed pumps will automatically adjust to accommodate the higher flows. The unit will also have 30 feet of 2-inch Schedule 80 piping, static mixers, and sample taps before and after ammonia and chlorine addition. The static mixers ensure good mixing of chlorine and ammonia.

The building will be constructed of all aluminum and will be for small systems to re-chlorinate and add ammonia, if needed. We will be using liquid sodium hypochlorite and ammonia sulfate. The building will be wired with a 30-amp entry box for the power supply.

We intend to have the system on display at the annual conference March 24 –26 in Wichita. I encourage you to stop by the KRWA booths in EXPO Hall at the conference and take a look at it and also visit about water quality issues.

*Lonnie Boller is Surface Water Tech at KRWA. He has been employed by KRWA since 2001. Lonnie is a Class II certified operator; he previously was Water Plant Supervisor for the City of Horton. He has also attended and completed training at the University of Kansas Law Enforcement Training Center.*