by Lonnie Boller

Chlorine – public health protection No. 1

The world's most universal and reliable means of drinking water disinfection is chlorination. The two most commonly used chlorination chemicals are gas chlorine (Cl2), and liquid chlorine (NaOCl) also known as sodium hypochlorite. Chlorination was introduced as a commercial water purifier in 1908. Chlorination has since become the most commonly used method of water disinfection in part due to its ability to provide a measurable residual in the water distribution system.

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Chlorine safety

Last year the operator of a small northeastern Kansas town was overcome by chlorine gas and had to be rushed to the hospital emergency room. It took several weeks for the operator's voice to return to normal. Chlorine gas can be safe if all the safety features are in place and all safety procedures are followed. These include having more than one operator present before entering the chlorine room, having chlorine gas leak detection devices, operating chlorine ventilation system with the ventilation system close to the floor due to chlorine gas being heavier than air, and also having a self-contained breathing apparatus (SCBA).

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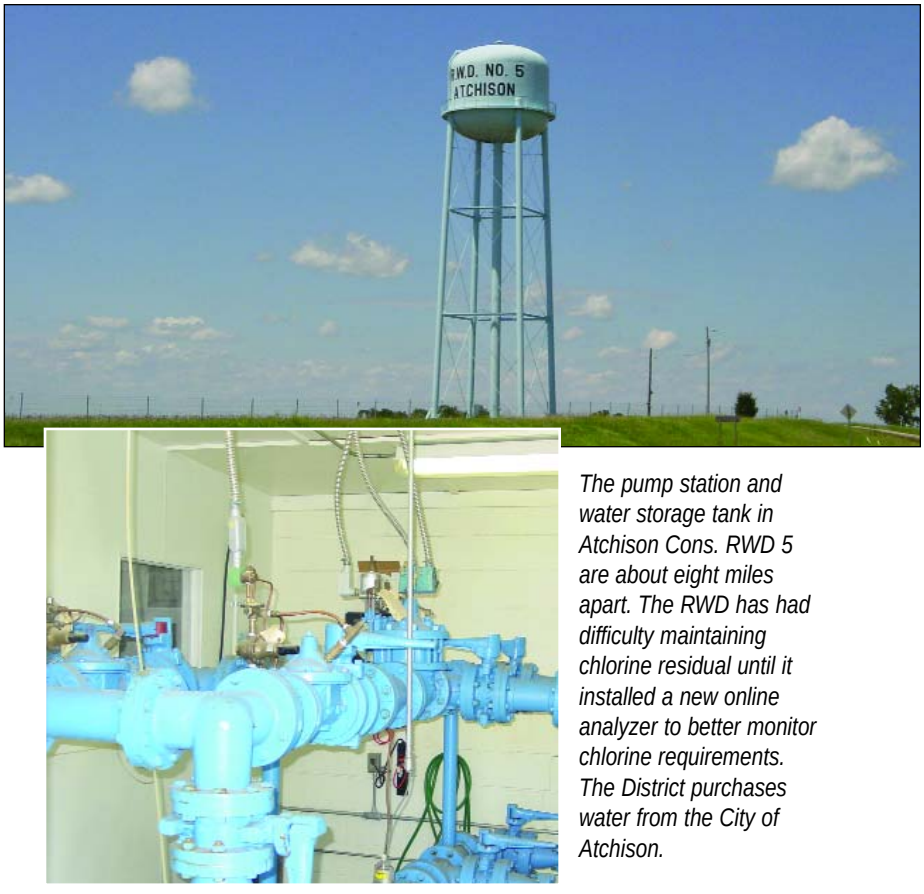
The SCBA needs to be similar to those that fire departments have. Some water suppliers have a small gas canister that has a two-year shelf life and a one-year shelf life after being opened. Canisters should only be used for immediate escape if a leak occurs; they should not be used when fixing an on-going leak. KRWA recommends using a SCBA when fixing a leak. Operators also must be knowledgeable in the SCBA equipment and procedures, and practice in its use.

A rural water district in northeast Kansas had some safety issues with gas chlorine. The RWD is a small system with one operator. Several months ago KRWA received a call from the



The pump station and water storage tank in Atchison Cons. RWD 5 are about eight miles apart. The RWD has had difficulty maintaining chlorine residual until it installed a new online analyzer to better monitor chlorine requirements. The District purchases water from the City of Atchison.

operator that they had a chlorine gas leak. I responded to assist them. After putting on the self-contained breathing apparatus , I entered the chlorination building to remove the regulator from the gas chlorine cylinder and move the cylinder outside. After checking the cylinder with aqua ammonia, I determined the bottle was not leaking. I then checked the stored gas chlorine cylinders and determined that one of them was leaking. I then moved all the cylinders outside. This is a big safety issue for small districts with only one operator. Anytime an operator is working with chlorine gas, there should be another person present for assistance if needed. Recently this district switched to sodium hypochlorite. There are still some safety issues with sodium hypochlorite but it is much safer than gas chlorine.

Chlorination with liquid sodium hypochlorite

In response to gas chlorine safety issues, some other small water suppliers are also switching to sodium hypochlorite (NaOCl, or common household bleach). Like gas chlorine, sodium hypochlorite is an excellent disinfectant. Yet sodium hypochlorite is safer than gas chlorine and more easily handled. Liquid spills can quickly be neutralized by simply diluting the spills with large amounts of water.

Sodium hypochlorite can be easily stored and transported. It can be purchased at a local grocery store or discount store as chlorine bleach at 5.25% solution or from a chemical supplier at 10 - 12 % solution. Sodium hypochlorite is as effective as chlorine gas for disinfection. Many systems in Kansas have used sodium hypochlorite for disinfectant and to maintain chlorine residuals in the distribution system.

Sodium hypochlorite is a dangerous and corrosive substance. While working with sodium hypochlorite, safety measures need to be taken to protect workers such as safety aprons, safety glasses, and protective gloves. Sodium hypochlorite should be stored in a closed container. Sodium hypochlorite will loose its strength slowly over a period of months.

Use of sodium hypochlorite for disinfecting water requires the use of metering pumps. The types of pumps commonly used are piston or diaphragm chemical solution pumps. Some water suppliers such as Atchison Consolidate RWD 5 use an online chlorine analyzer to control and adjust the chemical feed rate to ensure adequate chlorination.

Recently KRWA was asked to assist Atchison Consolidated RWD 5 in setting up a sodium hypochlorite system. The District purchases water from the City of Atchison. After the water goes

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Terms associated wtih chlorination process . . .

The following are three basic terms used to describe aspects of the chlorination process.

Chlorine demand (expressed in milligrams per liter, i.e. mg/L) is the amount of chlorine that will be consumed in the process of oxidizing impurities in the water. Chlorine demand also includes the chlorine destroyed by sunlight in outside, open-top basins. The chlorine demand can vary from as low as 0.1 mg/L for well waters to as high as 10 to 12 mg/L for surface water in flood conditions. The average chlorine demand for surface water is approximately 2.0 to 4.0 mg/L.

Chlorine dosage (also expressed in mg/L) is the amount of chlorine applied or fed into the water. The chlorine dosage is calculated using the weight of chlorine applied to a known amount of water; or is calculated using the rate of chlorine application and the flow rate of the water being treated.

Chlorine residual (expressed in mg/L) is the amount of chlorine remaining in water after the chlorine demand occurs. Chlorine residual equals the chlorine dosage minus the chlorine demand. The measurement of chlorine residual is the most commonly used and the most important method of determining adequate disinfection.

Most commonly, operators calculate chlorine dosage, measure chlorine residual, and then calculate chlorine demand. For example, if river water being treated has a chlorine dosage of 6.0 mg/L and a chlorine residual of 2.4 mg/L, then the chlorine demand is 3.6 mg/L (that is, 6.0 - 2.4 = 3.6 mg/L). Changes in chlorine demand indicate that the water quality can be changing or being exposed to more sunlight as during the summer.