Chlorine Conservation

By Don Van Veldhuizen

In this time of ever tightening budgets many systems need to scrimp and save where ever possible. Chlorine may be one area where dollars may be saved. Knowing what is happening to the chlorine in each stage of your system may give you a better handle on how to most effectively manage the chlorine throughout the system while maintaining the residual at the customer's tap. Let's take a trip through the chlorine life cycle once it is delivered to your treatment plant.

Ideally, once the chlorine reaches your plant, store it in a cool dark place until ready to be used. Both light, and warm ambient temperatures, are culprits in decreasing the potency of your chlorine especially sodium hypochlorite. It is best to store your chlorine in the concentrated form as it will maintain most of it strength for months. It is recommended that you maintain a minimum of 30 days supply at the treatment plant.

When it comes time to dilute your chlorine (if that is what your system does), the amount of solution in your day tank is critical. Diluted chlorine loses a significant amount of it's effectiveness in two to three weeks when the dilution water is at a pH between 6 and 8. Also, the rapid change in pH will cause off-gassing which will decrease strength and cause a few headaches with the metering pumps also. Ultra-pure water will loose its effectiveness faster than typical potable water. You can increase the life of any of your dilutions by raising the pH with sodium hydroxide. Chlorine is less reactive as the pH increases therefore increasing the shelf life. Even a pH of 11 in your day tank will not affect the pH in your system because it is such a small amount of the diluted chlorine as compared to the water you are delivering. Once again, light and temperature are a factor.

The chlorine solution is then pumped into the water being disinfected. There is an immediate demand placed on the chlorine once it enters the water as well as a demand if ammonia is present or used in the system.

Reducing agents such as iron and manganese, along with hydrogen sulfide and nitrates can place a high demand on the chlorine. Treating hydrogen sulfide alone can require a ratio of 8.3 mg/L chlorine to 1.0 mg/L hydrogen sulfide.

Organics and ammonia are then oxidized by the chlorine. Ammonia is reduced to chloramines which also have some disinfecting power (about 20% of free chlorine). To oxidize ammonia to chloramines, a typical dose is 5 mg/L chlorine to 1 mg/L ammonia. Some water systems find it beneficial to use chloramines for disinfection such as those with very large distributions systems because it does not dissipate quickly. The state requires a total chlorine residual between 2.0 and 4.0 mg/L for those systems. It is also used for wastewater systems.

For most drinking water systems in the State of Oregon, a free chlorine residual is desired. Therefore in these systems, additional chlorine is required to oxidize the chloramines to nitrates and then oxidize the nitrates. A dose of 7.6 mg/L chlorine to 1 mg/L ammonia is required for this to occur. Keep in mind that these ratios are typical after the initial demand from other reducing agents needs have been met; additional chlorine is required to meet the demand for the killing bacteria and other pathogens. As a side note, most chlorine taste and odor complaints occur when the chloramines are not completely oxidized.

Now let's consider the water in your reservoir prior to being sent to the distribution system. By now, the chlorine is highly diluted and the depletion of the residual occurs quite rapidly. Typically, with pH of around 7, most of your residual will be depleted in around seven days. It is recommended for a system to have three to five days of water storage. These numbers are for a tank that is cleaned every two to three years and is in overall good shape. The more buildup of sediment in the tank, the faster the chlorine will be lost, not to mention a higher likelihood that you may fail a bacti sample.

Last, but certainly not least, is the distribution system. A couple considerations must be considered when dealing with chlorine in your distribution system. The first has to do with flow. Dead ends and overly large piping for the flow will allow the water to remain in the line for days and maybe even weeks. This is more than enough time

to deplete whatever residual you may have in the system. Lack of maintenance will further reduce the life of the chlorine residual.

The State of Oregon has required many systems throughout the state to chlorinate. Their concern is to have safe and palatable drinking water. To provide safe water to the community is the responsibility of each system. Responsibly managing chlorine goes a long way to meet the directives of both the State and your community. For assistance in evaluating areas of possible chlorine inefficiencies, please contact OAWU at (503) 873-8353.