Overcoming Challenges To An Optimal Chlorine-Ammonia Balance

Drinking water quality is heavily dependent on the ability of municipalities to apply consistent and reliable disinfection. Many water utilities across the country rely on chloramination — a combination of chlorine and ammonia, most notably in the form of monochloramine — to extend the life of disinfectant residual throughout the distribution system while mitigating the formation of disinfection byproducts. The process, however, is fraught with challenges, as a variety of variables must be addressed to keep it under control.

One of the biggest headaches for water treatment plant operators is maintaining the proper balance of chlorine and ammonia that produces monochloramine.

The approach to monitoring — including the choice of technology, deciding what to monitor, and setting parameters — is critical to understanding if overdosing or underdosing of either ingredient is occurring at any time. And success boils down to achieving sustainable and stable concentrations of the target disinfectant, monochloramine.

For water quality managers who struggle with the chlorine-ammonia balance, here are answers to some of the most pressing questions from chemical expert Dr. Vadim Malkov of Hach Co.

Q: How extensive are the consequences of not getting the chlorine-ammonia balance correct?

A: Overdosing ammonia can lead to nitrification in the distribution system. Nitrification occurs when water disinfected with chloramine travels across the long set of pipes in a distribution system on its way to customers. Several variables — including temperature, water age, and excess free ammonia — contribute to the occurrence of nitrification. Excess ammonia present during chloramination serves as food for the ammonia-oxidizing bacteria that grow in clusters and tend to accumulate in sediment and along pipe walls. This will lead to a drop in the concentration of chlorine residual in the water and many unwanted consequences. Any utility that has ever had nitrification would not want to repeat such an experience.

On the other hand, overdosing chlorine or underdosing ammonia can cause dichloramines to form. As a result, customers experience taste and odor issues.

So, the balance needs to be tightly kept to avoid problems downstream, and the key is monitoring. Measuring the concentrations of the main ingredients is important to implement both better process control (monochloramine) and regulatory reporting (total chlorine).

Q: What's the biggest reason water quality managers have issues with maintaining the chlorine-ammonia balance?

A: The most common problem is using a deficient approach that involves taking two different types of chlorine readings. This happens because, in theory, the difference in total and free chlorine readings would provide the monochloramine figure. Water quality managers take readings for both, then calculate the difference. Maintaining the free chlorine variable at a low rate provides slight over-chlorination but not enough to create issues. However, there are hurdles to this being a sustainable method because you really can't tell what your total chlorine readings are depicting. Which part of the chloramination curve is your system currently in? The process isn't linear, and the curve can change for a variety of reasons, such as changes in pH levels.

Q: What other factors contribute to ongoing disinfection issues?

A: Another big reason that water quality managers fail to stay ahead of problems is the lag time from sending water samples to a lab instead of online process monitoring for real-time results. This is problematic for several reasons. First, dosing pumps that deliver the chemicals aren't as stable as the operators may believe. In those cases, samples should be taken much more frequently. An online process analyzer with closed-loop control will close that gap and alleviate the concern. Second, as pH impacts the chloramination curve, those readings should be constantly monitored upstream prior to disinfection.

Q: Are there any good solutions?

A: For more accurate analysis, water treatment personnel should measure monochloramine and free ammonia to have a better grasp of where the process of chloramination falls on that curve at any given time. Equipment is available that uses two colorimeters to conduct direct measurement of monochloramine and total ammonia simultaneously every 4.5 minutes. More frequent analysis is achieved without increasing reagent use — again contributing to reliability and lower cost of ownership. A greater measurement frequency provides better data for improved process control. Hach, for example, offers the 5500 sc Ammonia Monochloramine Analyzer for real-time monitoring.

DOC043.53.30609.Nov19

HACH World Headquarters: Loveland, Colorado USA

United States:	800-227-4224 tel	970-669-2932 fax	orders@hach.com
Outside United States:	970-669-3050 tel	970-461-3939 fax	int@hach.com

hach.com

HACH®
Be Right™