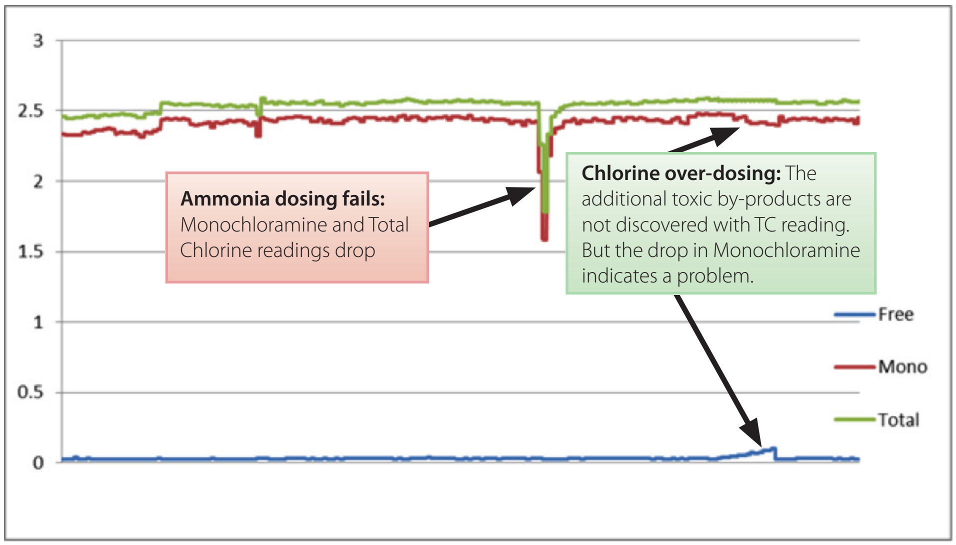
10 Tips For Accurate Disinfection

Disinfection can rightly be called the "ultimate" stage of drinking water treatment — typically occurring at the end of the process, and acting as a final step before water is sent out of the plant, through the pipes, and into the world. It may come last, but it's certainly not least.

Besides the obvious water quality and safety implications, proper dosing (or lack thereof) during disinfection can have severe regulatory and economic implications. To help municipalities keep in compliance and on budget, Water Online asked Randy Turner, technical director at Swan Analytical USA, to answer 10 important questions about disinfection monitoring.



As utilities adopt chloramination (as opposed to chlorination) for disinfection, what new monitoring parameters come into play?

Historically, utilities only monitored the free chlorine residual as required by the U.S. EPA. Utilities that chloraminate must monitor the monochloramine concentration. However, monitoring the free and total chlorine provides the operator with a more complete picture to control the disinfection process. A typical control method is to add sufficient ammonia to reduce the free chlorine to ≤ 0.05 ppm to avoid free ammonia in the distribution system. Trending free chlorine, monochloramine, and total chlorine allows the operator to quickly detect chemical feed issues such as underfeed of ammonia or overfeed of chlorine.

What are the most common mistakes or oversights when it comes to adding and controlling disinfectant?

Systems that manually dose their disinfectant and control the feed by grab sample analysis have a great risk of underfeeding or overfeeding the disinfectant. If using chlorine as the disinfectant, many systems only monitor the free chlorine as required by the EPA. However, monitoring of the free chlorine, monochloramine, and total chlorine provides the operator with a much more complete picture of the overall disinfection process by calculating the combined chlorine and di-chloramine concentration. This provides the operator ability to rapidly identify changes in water quality that may impact taste and odor.

What are the repercussions of dosing errors?

Dosing errors result in poor disinfection, with repercussions such as impacts to public health, undesirable taste and odor, nitrification, and non-compliance with federal and state drinking water regulations. Non-compliance can result in public notifications, consent orders, and fines.

What particular problem(s) does excess ammonia in finished water present?

Excess ammonia in the finished water can result in the excess ammonia undergoing a process called nitrification, which is the oxidation of the ammonia by two types of autotrophic nitrifying bacteria to form nitrites and nitrates. Nitrification increases nitrite and nitrate levels; reduces alkalinity, pH, dissolved oxygen, and chloramine residuals; promotes bacterial regrowth; and can increase corrosion, thereby potentially increasing iron and copper levels.

What compliance issues need to be considered when monitoring disinfection?

Federal and state regulatory agencies have established regulations regarding maximum chlorine, monochloramine, and chlorine dioxide concentrations. The maximum concentration for chlorine and monochloramine is 4.0 mg/L. The maximum concentration of chlorine dioxide is 0.8 mg/L. Regulatory agencies have also established limits regarding the presence of potential pathogens that the disinfectants are utilized to kill. Therefore, it's critical to maintain the disinfectant concentration within regulatory limits and to ensure pathogens are killed to maintain public health. Continuous monitoring and control rather than grab-sample monitoring reduces the risk of non-compliance and negative impacts on public health.

What parameters can be measured with Swan Analytical's AMI Codes-II CC colorimetric chlorine analyzer?

The Swan AMI Codes II CC continuously monitors free chlorine, total chlorine 1 (TC1), and total chlorine 2 (TC2). TC1 is the sum of free chlorine and monochloramine, allowing the monochloramine concentration to be accurately calculated; total chlorine 2 (TC2) is the sum of free chlorine, monochloramine, and combined chlorine. The combined chlorine is determined by subtracting the free chlorine from TC2. The dichloramine concentration is calculated by subtracting TC1 from TC2. The frequency of measurement of free chlorine is user-selectable from 1 to 12 minutes. The total chlorine measure frequency is user-selectable from 10 to 60 minutes.

How does colorimetric analysis work? How does it compare to alternatives?

The most common colorimetric method for chlorine monitoring uses N,N-diethyl-p-phenylenediamine, or DPD. DPD reacts with chlorine when buffered at the appropriate pH to form a magenta color, the intensity of which is proportional to the chlorine concentration. The reaction occurs rapidly, in 3 to 5 seconds, therefore rapid mixing and analysis is necessary for accurate analysis. Delays in measurement can result in a potential positive bias if monochloramine is present. TC1 is determined by the addition of the pH buffer, DPD, and potassium iodide; again, the reaction occurs in 3 to 5 seconds, so rapid mixing and analysis is required. Once TC1 is determined, the reaction is allowed to continue for a total time of 2 minutes when TC2 or the total residual chlorine is determined.

An alternative method employed to monitor chlorine is amperometric. Some amperometric methods are reagentless, such as the Swan AMI Trides free chlorine analyzer. Amperometric measurement is also used to measure total chlorine. The amperometric measurement method is influenced by pH, so it requires pH compensation to provide the most accurate measurement. Measurement of free chlorine, monochloramine, and total chlorine each requires a separate sensor — thus three transmitters or a multi-input transmitter — to measure the species of interest. Therefore, calculating combined and di-chloramine is more challenging to perform by amperometric monitoring systems.

How do operators interpret the data to optimize performance, safety, and efficiency? Is SCADA incorporated?

It is very common to incorporate the data from online monitoring into the SCADA system. The operator can monitor and trend the data to evaluate the disinfection process efficacy; identify undesirable trends and take action prior to a non-compliance issue; and detect changes in water quality that impact disinfection, such as increased chlorine demand. By monitoring the free chlorine, monochloramine, and total chlorine, the operator can rapidly see trends that require action to prevent degradation of drinking water quality.

What short-term and long-term cost savings can be achieved through continuous, online chlorine measurement?

Continuous online measurement provides for much better control of disinfectant dosing, thereby reducing the risk of over or underfeed and the repercussions. Also, automatic dosing with an online analyzer can reduce disinfectant cost by avoiding overfeeding. When manually dosing, if the chlorine is manually checked every 4 hours or 6 times a day — using the typical cost for the portable colorimeter and reagents, and assuming 1 hour of labor per day at $15 per hour for manual testing — it would cost $7,770 per year. The annual cost for online monitoring using a 4-minute measurement frequency and 10-year service life of the analyzer would cost $1,885 per year.

What is a typical or average payback period for investment in an online chlorine monitoring system?

Based on the above scenario the payback for investment in an online chlorine monitoring system would be 12 to 13 months, or basically one year. ■

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