Improved Control of Pre-Oxidation Variables in Drinking Water Treatment

Maintaining adequate disinfection levels during the water treatment process is a constant challenge for municipalities. While much of the focus is placed on chlorine residuals, the final polishing step before water hits the distribution system, issues can also occur upstream.

A part of preliminary treatment — also known as primary disinfection, or pre-oxidation — involves adding chlorine and/or other oxidants to raw water to neutralize pathogens as well as remove organic materials and dissolved metals, such as iron and manganese. Additional benefits include preventing biogrowth on filter media, equipment, and pipes; improving water taste and odor; and minimizing the formation of disinfection byproducts.

Using sodium permanganate or potassium permanganate can provide adequate pre-oxidation to remove organics and/or dissolved metals, such as manganese and iron, from the water. However, this typically presents operational challenges in calculating and maintaining the correct feed rate of permanganate, especially when it is used along with chlorine.

For a relatively small investment, instrumentation is available to help water quality managers reliably monitor and control the process.

The Root Of The Problem

The delicate balancing act in pre-oxidation takes place between underfeeding permanganate — therefore not achieving the goal of removing organics and/or metals — and overfeeding that may lead to an unwanted pink color in finished water. Additionally, over-oxidizing of manganese leads to its dissolution and therefore defeats the purpose of the treatment. Finished water with excessive dissolved manganese may also end up causing staining as well as taste and color issues for customers.

Without continual monitoring, it's nearly impossible to consistently walk that tightrope as well as understand how much chlorine is going to the filters. Depending on the filtration method, chlorine can be damaging. In other cases, chlorine can help control biogrowth on filter media while promoting additional manganese removal by filters. (This is positive because manganese in finished water can cause staining of customer fixtures in the distribution system after post-chlorination or booster stations.) However, the amount of chlorine in those instances is only positive to a certain point and should be tightly controlled along with permanganate residual.

Maintaining tight control of pre-oxidation allows both the filters and the overall process to be as efficient and effective as possible while dramatically reducing the potential for disinfection byproducts to form downstream. To accomplish this, the analysis of treated water must be constantly conducted in process with online instrumentation that is both robust and provides accurate results.

A colorimetric chlorine analyzer that can also perform permanganate residual measurements — such as the Hach CL17 or its successor CL17sc, which is built on the same DPD technology — can help control the feed of oxidants throughout the pre-filtration treatment process. It is important to use total chlorine DPD method of analysis to achieve the expected results.

Assessing The Technology

When comparing these types of analyzers, it's important to look for multiple features, including:

Is the analyzer reliable for both chlorine and permanganate residual measurements?Laboratory and field studies should demonstrate the analytical capabilities of the instrument to determine permanganate concentration in water and help differentiate between multiple oxidants, if needed. This should be a robust solution and a good tool for the control of challenging water treatment processes (variable water quality and demand).

- Is routine maintenance, including changing reagents and cleaning the colorimetric cell, quick and easy (with no special tools required?)
- Is the technology accurate without additional calibration?
- Does the analysis method occur independently of changes in chlorine concentration, sample pH, temperature, flow, or pressure, thus offering more reliable and accurate measurement with less operator interventions?
- Can the equipment operate unattended for at least 30 days and provide results compliant with U.S. EPA regulations?

By making the switch to online monitoring of the pre-oxidation process and selecting the proper equipment, water quality managers can ensure their source water is in optimal condition when it reaches the final disinfection stage.

DOC043.53.30608.Nov19

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