

Chlorine Monitoring:

Continuous On-line or grab sample?

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Every operator knows what an important role the disinfection process plays in providing safe drinking water to the public. Ever since scientists discovered that particles in water could harbor microorganisms, and some of these microorganisms were disease causing pathogens, modern drinking water treatment systems have been focused on removing particles. With installation of filtration processes in public water systems (PWS), waterborne disease epidemics like typhoid, dysentery and cholera were reduced significantly. Disinfection made an even greater impact on reducing waterborne diseases and has helped to eradicate those diseases in many developed countries.

Among all available disinfectants, chlorine has been the most widely used for its affordability, disinfection potency and residual ability in a distribution system. However, chlorine comes with a price – it reacts with naturally occurring organic and inorganic matter in water and can produce unwanted disinfection byproducts (DBP). Due to lower disinfection by-product formation, disinfectants like chlorine dioxide and chloramines have gained in popularity. However, chlorine is still the choice of disinfectants for most PWS in New York State (NYS). A proper free residual chlorine level is one of the key factors in balancing DBP formation with the need for disinfection. Therefore, frequent monitoring is essential to maintain this balance.

The New York State Department of Health (NYSDOH) regulation, Sanitary Code Subpart 5-1, includes minimum monitoring frequencies for free residual chlorine level. Continuous monitoring of residual chlorine is required for all PWS that serve more than 3,300 people and use:

- surface water sources;
- groundwater sources under the direct influence of surface water; or
- groundwater sources and are required to perform 4-log treatment.

Grab sample monitoring is allowed for smaller systems in different frequencies – from 1 to 4 times a day – depending on populations served. Although not required, some small systems are opting for continuous on-line monitoring due to advantages over grab sample monitoring. These advantages include:

- less operator time for chlorine monitoring;
- better operational control to consistently meet the target residual chlorine level;
- built-in automated alarm functions for prompt response to unfavorable situations, e.g., low chlorine level or accidental chlorine overdose;
- convenient record keeping; and

- improved public health protection.

Several types of on-line chlorine analyzers using different analytical methods have been commercially available for many years, including DPD (N,N-diethyl-p-phenylenediamine) colorimetric, amperometric without titration, and potentiometric methods. Before November 10, 2009, however, only the DPD colorimetric method was approved in on-line chlorine analyzers for compliance monitoring. In November 2009, the United States Environmental Protection Agency (EPA) issued Method 334.0 “Determination of Residual Chlorine in Drinking Water Using an On-Line Chlorine Analyzer”. Unlike all other analytical methods that EPA developed and approved, Method 334.0 does not define any new analytical method by chemistry. Instead, EPA 334.0 establishes quality control (QC) criteria for all on-line chlorine analyzers to ensure that the analyzers, regardless of analytical method, provide data equivalent to the grab sample methods that are already approved in the regulations. The full description of EPA Method 334.0 is available online⁽¹⁾.

Using the flexibility provided by EPA, NYSDOH has approved using on-line chlorine analyzers in accordance with EPA Method 334.0 for compliance monitoring. This approval means that PWS can use any type of on-line chlorine analyzers when used in conjunction with a grab sample reference method approved by NYS Environmental Laboratory Accreditation program (ELAP). The full list of ELAP approved analytical methods is available online at the Department’s website⁽²⁾.

The basic idea of the required QC is to confirm the accuracy of on-line chlorine analyzers at the time of the installation and every five days thereafter using ELAP approved grab sample methods. The accuracy and precision of the reference grab sample method also needs to be confirmed. This requires some work for operators but once the initial accuracy is verified, routine QC is required only once every five days for on-line chlorine analyzers and quarterly for grab sample methods. Ultimately, automated continuous on-line chlorine analyzers will relieve operators from the burden of frequent sampling and manual data reporting.

Due to advantages described in this article, water systems operators may want to consider the use of on-line chlorine analyzers for compliance monitoring even when continuous chlorine monitoring is not required. NYSDOH has developed a guidance document for using on-line chlorine analyzers that is available at the Department’s website⁽³⁾. Operators at PWS that already have installed on-line chlorine analyzers for compliance monitoring or are considering doing so should review the guidance document. If you don’t have internet available or have questions regarding compliance chlorine monitoring, you can contact your county or district health office to obtain the document.

Acronyms

DBP	Disinfection Byproducts
DPD	N,N-diethyl-p-phenylenediamine
ELAP	Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
NYSDOH	New York State Department of Health
QC	Quality Control
PWS	Public Water System

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Notes:

- (1) http://www.epa.gov/safewater/methods/pdfs/methods/met334_0.pdf.
- (2) http://www.wadsworth.org/labcert/elapcert/certmanual/I180_1_06.pdf.
- (3) http://www.nyhealth.gov/environmental/water/drinking/chlorine_analyzer_guidance.htm. 