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Turbidity's Role In EPA Compliance

Turbidity measurement is both a nebulous, oft misunderstood concept and the master link in a chain of events affecting U.S. EPA drinking water compliance. It can influence, or be influenced by, almost every other link in a water treatment process. Here is a quick overview of turbidity's relationship to drinking water compliance standards and some tips for keeping a water treatment process in balance.



Understanding Turbidity's Role

In layman's terms, turbidity would appear to be a measure of the aesthetics of water. Cloudy or murky water is definitely less appealing than a sparkling, see-through glass of water. Unfortunately, that supposedly clear glass of water could be hiding a number of harmful pathogens smaller than 10 microns in size. Beyond aesthetics, turbidity readings give water treatment plant (WTP) operators a higher degree of confidence in the healthy quality of treated water and provide early indication of filter breakthroughs.

Turbidity readings do not literally "count" the number of Giardia cysts or Cryptosporidium oocysts in a process stream, but they can indicate the relative likelihood of potential problems. Staying below the regulatory compliance limit of 0.15 nephelometric turbidity units (NTUs) provides a high degree of confidence in the integrity of WTP pretreatment and filtration processes.

Assuring A Reliable Frame Of Reference

The first step in any monitoring effort is demonstrating the quality of the data. With respect to turbidity measurements in drinking water, EPA requirements do a good job of ensuring that status. They regulate both the quality of water being produced and the legitimacy of the testing methods, along with the maintenance, calibration, and verification processes required to sustain water quality readings at a high degree of reliability.

The EPA Guidance Manual for Turbidity Provisions cites the following points related to keeping turbidity readings relevant and reliable:

- "EPA recommends that on-line turbidimeters have calibration verified on a weekly basis, if being utilized for combined filter effluent monitoring. Less frequent verification may be more appropriate for turbidimeters monitoring individual filter turbidity, but EPA recommends verification be conducted with a frequency of **at least** once per month.
- "Calibration verification can be completed using primary standards, secondary standards, or by comparison to a properly calibrated turbidimeter. If verification indicates significant deviation from the standard (true) value (greater than ± 10 percent), the instrument should

be thoroughly cleaned and recalibrated using a primary standard. If problems persist, the manufacturer should be contacted. Regardless of calibration results, turbidimeters should be thoroughly cleaned and calibrated with primary standards **at least quarterly**.

- **“EPA does not recommend calibrating on-line instruments by comparison with a bench- top turbidimeter.** It has been determined that this procedure is likely to introduce unacceptable levels of error into the calibration.” (This can be due to the effects of time, handling, temperature changes, degassing, combined flocculation, etc.)

It is important to distinguish between “calibration verification” and “calibration.” Calibration verification is a quick check against a qualified frame of reference — a primary standard, secondary standard, or another properly calibrated turbidimeter. If the device reads within +10 percent of the expected reading, calibration has been verified. If the device is outside the +10 percent range, however, it needs to be recalibrated according to manufacturer instructions. Calibration is typically performed using a 20 NTU formazin primary standard — i.e., a solution with a precisely controlled volume and size- distribution of suspended particles that provides a consistent common point of reference — and adjusting the unit's electronics until the unit's reading matches that reference value.

While some aspects of EPA calibration regulations seem overly cautious in light of the sophistication of today's turbidity instrumentation, they remain in effect to assure the proper performance of many instruments in the field that are still functioning with 1980s and 1990s technology.

Compliance By The Numbers

With turbidity instrumentation reliability ensured by the EPA calibration guidelines, the two key milestones of EPA turbidity compliance for treated water are as follows:

- For the stream of water coming out of any individual filtration line, maintain a turbidity reading of < 0.15 NTU, with no exception lasting longer than 15 minutes. (In practice, WTPs typically aim a lot lower than that maximum standard, closer to 0.050 NTU or better.)
- For the combined effluent stream of an entire WTP, maintain a turbidity reading of < 0.30 NTU, without exception.

Using modular filtration design, with a turbidimeter on each filtration line, is a good way of monitoring independent filtered streams to satisfy the < 0.15 NTU standard. It also enables WTP personnel to service any noncompliant line without shutting down more of the filtering operation than absolutely necessary.

WTPs using membrane filtration have yet another requirement designed to protect filtered water quality. Direct membrane integrity testing — mandated once every 24 hours — confirms the membrane filtration system's ability to filter out potential pathogens. Methods for monitoring membrane integrity, including air pressure testing and bubble point testing, are covered in Chapter 3 of the EPA's Membrane Filtration Guidance Manual. This testing is required regardless of whether or not the plant exceeds the < 0.15 NTU limit on turbidity readings.

Practical Tips For Turbidity Control And Compliance

While being able to check off all EPA compliance requirements is important, turbidity readings also provide WTP operators with insight to perform their jobs more reliably and more efficiently. Here are several practices that can simplify the process of meeting or exceeding EPA compliance requirements:

- **Source Water Testing**

Modern nephelometer designs that reduce the surface area needing to be cleaned by 98 percent can cut overall cleaning time from 10 minutes to just 1 minute or less and may be carried out automatically. Those same designs can cut verification time in half and reduce operator involvement for calibration from 15 minutes to just 1 minute per quarter.

- **Real-Time Tracking**

Regardless of the type of filtration system used, logging real-time turbidity readings and tracking their trends is a good way to forecast when it is time to shut down a filter system, backwash it, and bring it back on-line before a catastrophic failure occurs. This preventive approach can be more efficient than simply setting an alarm for turbidity readings exceeding the 0.15 NTU limit. This is especially true during seasonal extremes, when rising nitrogen levels can generate blooms of diatoms that can plug filter media. Turbidimeters can also be used to monitor water used in the backwash process to ensure that sufficient cleaning takes place without keeping the system off-line any longer than necessary.

- **Working With Regulators**

While the EPA establishes the national drinking water standards, [state inspectors](#) are responsible for enforcing those federal standards and/or their own more stringent state standards for water quality. Working with those inspectors can help WTPs understand how to interpret turbidity readings and develop appropriate real- world responses that can keep them off the EPA's [Enforcement and Compliance List](#).

Staying Informed. There are numerous resources available for WTP operators and personnel to address turbidity monitoring, certification, and a variety of other water treatment topics. Among them are the [AWWA](#), [The National Rural Water Association](#), [Water University](#), and various state [government](#) and [association resource](#)s. Smaller water treatment systems operating in rural areas can also ask for special assistance from the [Circuit Rider Program](#).
