Monitor TOC in Drinking Water Sources to Optimize Chemical Usage and Minimize DBPs

Problem

The intake/raw water taken from rivers, lakes, aquifers, and reservoirs contain organic contamination and naturally occurring organic matter (NOM). When raw water is chlorinated for the disinfection process, residual chlorine can react with the organics, and potential carcinogens, known as disinfection by products (DBPs), such as trihalomethanes (THMs), can be formed.

Solution

By measuring the organic matter in raw water using total organic carbon (TOC) analysis, it is possible to optimize chemical usage and minimize the formation of DBPs that can result from improper chemical application. Hach's BioTector B3500dw online TOC analyzer accurately and reliably detects organics to optimize the monitoring and removal of organics based on real-time TOC measurements.

Benefits

BioTector's reliable TOC analysis leads to efficient TOC removal from raw water and helps optimize the chlorination and the coagulant/flocculant feed within the water treatment process. BioTector's efficient oxidation process, accurate analysis, and rapid response provide stability in the treatment process, prevent overdosing and unnecessary treatment, and deliver cost savings.

Background

Raw water comes from many different sources such as rivers, lakes, aquifers, and man-made reservoirs. One of the most prevalent impurities in source water is organic material. Organics in source water come from naturally occurring organic matter (NOM) and pollution. Water contamination can also occur when water is exposed to bacteria as it travels through the network of raw water sources. To ensure the safety of drinking water, the typical water treatment process involves adding disinfectants like chlorine, hypochlorite, ozone, or chlorine dioxide to the water.

Unfortunately, while disinfecting the water, these chemicals can react with the NOMs in the raw water supply, which can then result in the creation of disinfection byproducts, such as trihalomethanes.

Humans can be exposed to DBPs through drinking, showering, and even inhaling water vapors. DBPs, especially trihalomethanes, are thought to be carcinogenic and could potentially lead to adverse health affects to humans. For this reason, the amount of DBPs permitted in drinking water is tightly regulated in most world areas.

Compliance with chemical standards for drinking water is an important requirement for water treatment plants. Because there is a direct correlation between the amount of TOC and NOMs in raw water, online TOC measurement is an efficient method to determine and control the NOM to prevent the formation of DPBs. By lowering the organic levels in the raw water and controlling the TOC removal through accurate and reliable TOC analysis, it is possible to increase the efficiency of the treatment plant, reduce operational costs, and provide safe drinking water to the public.

A Comparison of TOC Methods

	BIOTECTOR B3500dw	UV PERSULFATE	HIGH TEMPERATURE COMBUSTION
Oxidation	*Two Stage Advanced Oxidation (chemical oxidation)*	*UV Persulfate Oxidation (chemical oxidation)*	*Thermal Combustion (high-temperature combustion)*
Analysis	*At ambient pressure and room temperature conditions*	*Typically at ambient pressure and temperature conditions*	*At temperatures between 680°C and 1200°C*
Reactor Discharge	*Analyzed liquid is discharged from the reactor in Liquid Phase without any build up*	*Material can build up on UV lamp and inside the Reactor*	*Combustion process inevitably forms salts and ashes inside the reactor*
Reactor	*Self-cleaned and self purged*	*Scaling of the UV light impacts oxidation and requires reactor cleaning*	*Development of salts and ashes inside the combustion reactor require frequent reactor cleaning or reactor replacement*

Common Methods of Analyzing Drinking Water

The traditional methods to analyze TOC in raw drinking water include UV persulfate and high-temperature combustion TOC analyzers.

UV persulfate systems, while used in drinking water applications, often have problems with scaling and buildup in the reactor, which leads to increased maintenance and cleaning requirements. High-temperature combustion oxidation TOC analyzers do not reliably measure at low sub-ppm levels, because their low sample injection volumes create a low signal-to-noise ratio, resulting in poor accuracy at low levels. These systems are also sensitive to build up, and require frequent calibration.

Hach's BioTector B3500dw analyzer offers a more reliable method of analysis. Approved by the US EPA within the Federal Register, the BioTector B3500dw uses an advanced oxidation process and non-dispersive infrared spectroscopy to measure a wide range of organics and TOC.

In this method, ozone and a high pH reagent are added to water to produce hydroxyl radicals. The hydroxyl radicals oxidize organic carbon to produce carbon dioxide and sodium oxalate. The sodium oxalate is further oxidized to carbon dioxide using acidification and a manganese catalyst. The carbon dioxide produced by the oxidation process is then measured using non-dispersive infrared spectroscopy. Unlike the conventional oxidation methods, such as Method 5310 C-00 [APHA 2000b], which may not completely oxidize certain organic compounds, BioTector's method uses a more efficient advanced oxidation process to ensure more complete oxidation.

Why BioTector is Better

Some drinking water treatment plants monitor organics in intake water manually, by sending a sample to a lab every 4-6 hours. With this method, results are known in 4-6 hour increments, but any changes to the water that occur in between the samples are missed. Many conventional TOC analyzers installed in drinking water plants were initially designed as laboratory systems, and then converted to online analyzers that use the same TOC technologies. Such technologies have the same limitations, including long cycle times, large footprint, high maintenance requirements, and frequent downtime.

Hach's BioTector B3500dw analyzer is designed and developed as a true online analyzer, specifically for the needs and requirements of the drinking water treatment industry.

BioTector utilizes a chemical oxidation process, which takes place at atmospheric pressure and at ambient temperatures. The analyzer is built from robust materials such as Teflon, Hastelloy, and stainless steel. The analyzed liquid is discharged from the reactor in liquid phase without any build up. The reactor is self cleaned by the oxidation process.

BioTector provides stable and accurate response on samples containing high levels of inorganic carbon. It has a certified 99.86% uptime and only requires minimal maintenance every six-months. The significant cost savings in maintenance, the low cost of ownership of the analyzer, the self-cleaning technology, and the superior uptime, makes the system the most reliable TOC analyzer in the market.

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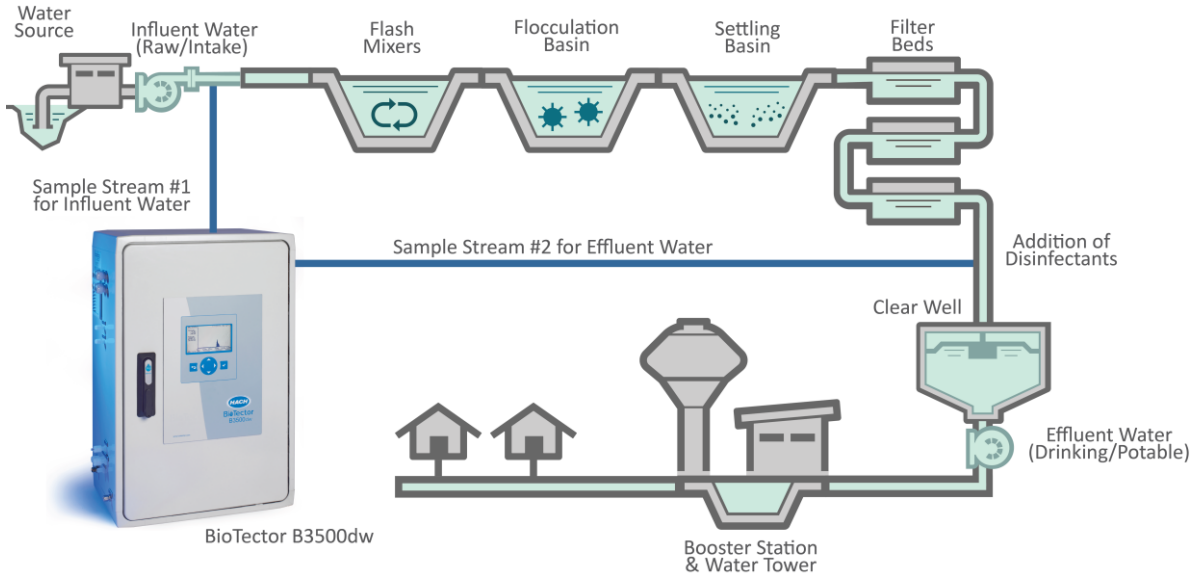
Typical Installation of a BioTector B3500dw



For many drinking water treatment plants, a two-stream B3500dw can be used to measure both influent (raw/intake) water and the effluent (drinking/potable) water.

Benefits

The BioTector B3500dw is a compact, efficient analyzer that can monitor two streams consecutively, reducing the expense and operational cost of a second analyzer. Reagents only need to be replenished typically every six months, instead of biweekly, which is common with traditional TOC technologies. The analyzer also accommodates large sample volume injections – up to 10ml – which permits a high signal-to-noise ratio. This means B3500dw delivers the highest accuracy and precision, with an unparalleled repeatability.

With an uptime of 99.86%, maintenance requirements are minimal. No calibration or ongoing maintenance is required in between the recommended six-month service intervals. By reducing energy usage, chemical requirements, and waste, the B3500dw demonstrates low total cost of ownership.

Continuous online TOC monitoring by Biotector B3500dw analyzer help detect changes in NOM levels in raw water, which helps to optimize chemical usage and reduce DBPs.

While the BioTector B3500dw is the standard solution for drinking water applications, other models are available to accommodate unique needs or requirements.

A typical installation of Hach's BioTector B3500dw TOC analyzers including a six-month supply of reagents and an instrument filter pack.

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Conclusion

Water treatment plants can optimize their use of chemical disinfectants by measuring the amount of TOC in raw water at the point of intake using the BioTector B3500dw online TOC analyzer. By using only as much disinfectant as is required for the amount of TOC in the water supply, it is possible to reduce the amount of harmful BPDs that are formed. The BioTector B3500dw helps to optimize the disinfectant feed, provide stability, deliver cost savings in the water treatment process, and ensure a safe water supply to the public.

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