WHY ACCURATE DISSOLVED ORGANICS MEASUREMENT MATTERS FOR OPTIMUM DRINKING WATER QUALITY

Natural Organic Matter (NOM) exists in all sources of fresh water and, if not properly removed, can affect the efficiency of potable water treatment and the quality of the treated water. In this article, Julian Edwards, Product Manager for Continuous Water Analysers for ABB Measurement & Analytics in the UK, explains why the removal of NOM is crucial for optimizing process efficiency and personal safety. He also looks at for the best ways to accurately measure NOM levels throughout the potable water treatment cycle.

What is NOM and why is it a problem?

NOM is caused when decayed vegetation mixes with water. It's a problem that must be closely monitored and controlled throughout potable water treatment processes to ensure the end result meets the highest levels of quality and safety for human use and/or consumption.

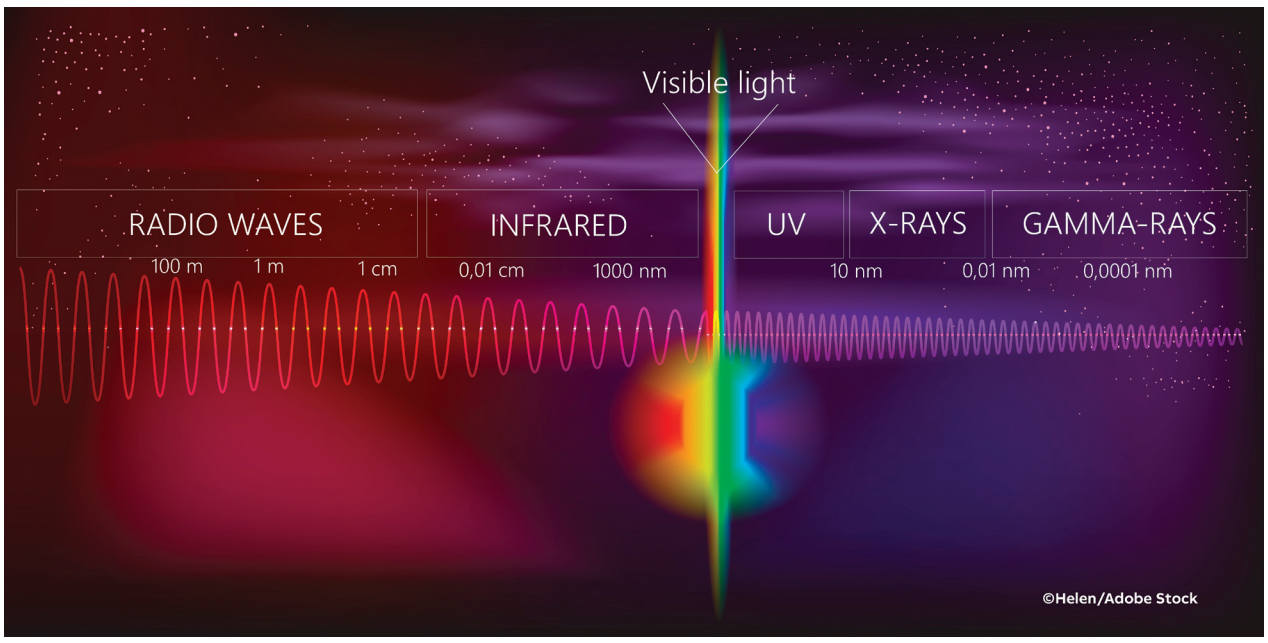
Most NOM is comprised of humic and fulvic substances that in most cases not in involving industrial pollution originates from soil coupled with decomposing plants and animals that enter streams, rivers, and lakes as well as aquifers. These substances are responsible for turning water from yellow to brown. They also provide an environment for bacteria and fungi to thrive in a way that can add to microbial growth in a water distribution system. Failure to adequately remove these NOM can increase the risk of pathogen-induced diseases, unpalatable taste and oppressive odor.

The importance of effective treatment

The central challenge for water utilities is their ability to accurately detect the wide variations of potential issues in the vast quantities of water passing through their plants to enable effective treatment. To protect people from the harmful effects of trihalomethanes (THMs), there must be highly accurate detection methods in place. Previously, to detect THMs required costly and time -consuming laboratory tests.

Various NOM elements are usually removed during the coagulation, flocculation, and filtration stages of the water treatment process prior to the final chlorination treatment. It is particularly important to remove humic substances in particular prior to chlorination because any remaining NOM can chemically react with the added chlorine to create undesirable disinfection by-products (DBPs) such as. THMs are known as possibly carcinogenic by-products that can be formed when organic material in water reacts with chloramines. Therefore, if pH and temperature conditions combine in the right recipe, a reaction

AV400



with the disinfectant used to make the water safer can potentially have the opposite effect of making it more detrimental to health.

For example, the presence of THMs in drinking water has been linked to heart, lung, kidney, liver, central nervous system damage and bladder or colorectal cancer. Several studies have also associated high levels of THMs in drinking water with an above average risk of miscarriages. Because of this, THM levels in public water supplies are strictly controlled and the controls are getting even tighter to ensure that THM levels in public water supplies remain within demonstrably safe limits.

To achieve that, water treatment processes must be able to maximize the removal of NOM safely, efficiently, and consistently from water sources. To minimize the risk of DBP formation, utilities use modified conventional processes such as enhanced coagulation and softening to ensure that organic materials are dissolved and reduced to levels that fall within indisputably safe limits. Many processes also use an activated carbon stage as an additional means capturing any dissolved organic matter that may escape processing during the coagulation stage.

The benefits of continuous online monitoring

Any issues with water treatment must be caught and resolved early to ensure public safety and health. Continuous on-line monitoring is essential to provide early warnings of any changes to the treatment process, enabling timely and well-informed decision-making. Until recent years this testing was done using manual means, either in the field or at processing facility. Quality control was broadly maintained, but any issues were slow to materialize until a potential hazard had been identified through visual inspection or an incidence of ill health. This level of manual process control is not sustainable given today's demands Potentially important events that must be identified and rectified immediately to preserve safety can be missed, and any manual test results will only be indicative of a particular moment in time rather than the present circumstances.

Tests done in the present must offer immediate and accurate results. And when it comes to detecting the presence of dissolved organics in raw water throughout the range of potable water treatment processes, there are two methods that can be used, specifically colour and UV detection.

Colour monitoring

Colorimetric measurement is, as the word suggests, the observation of colour as a measurement of a chemical in a solution. Colour determines the levels of either the absorption or concentration of a certain chemical based on the degree of colour depth and change and the ability of light to pass through it. With the exception of organics monitoring, many of the substances that need to be measured are colourless because

Aztec 600

they do not absorb light in the visible spectrum. To overcome this restriction and enable the substances to be measured, chemical reagents are used to create a reaction and form a coloured complex that can be read and measured.

The Aztec 600 Colour analyser has been designed specifically for the measurement of colour through the drinking water treatment process for coagulation optimization. It does that by measuring the absorbance of a water sample at 400 nm. The result of that absorbance test is then expressed as a colour that corresponds to the Platinum-Cobalt Scale (Pt-Co) or Alpha-Hazen Scale. Devised by chemist Allen Hazen in 1892, the Hazen colour scale compares a water colour to known concentrations of platinum-cobalt, ranging from 0 at the light end of the scale to 500 at the darkest.

All the sample and chemical fluid handling for measurement, mixing and disposal is precisely controlled by the Aztec's patented fluid handling system, which cleans the measuring cell every time it moves.

Capable of measuring up to 12 streams per hour, the Aztec 600 uses a patented fluid handling system that precisely controls the handling, measurement, and disposal of samples, thus ensuring highly accurate and reliable analysis of the colour of surface and treated waters up to 500 Hazen units.

Among others, one typical application of this method is to measure the effectiveness of the coagulation process, i.e., ensure that water is sufficiently dosed and treated to reduce dissolved organics concentrations to approved safe levels. Additionally, by monitoring raw water colour prior to the coagulation process, colour analysers can be used to provide predictive coagulant control, therefore ensuring that sufficient coagulants are administered throughout the process, minimizing the potential for inadvertent breakthroughs. Installing colour analysers at the final treated water storage stage will also help to verify that the treatment process is working properly and that established water quality standards have been met.

One important factor to consider when measuring colour is the impact of turbidity. Turbidity is the quality of being cloudy or opaque and can cause issues when differentiating between true and apparent colour because it is a key test of water quality. For analytical purposes 'true colour' is attributed to dissolved matter, whilst 'apparent colour' is what arises from the presence of suspended matter in a sample. The unwelcome impact of turbidity is that it can result in the 'apparent colour' having a much higher value than the 'true colour', which can affect colour determination and, therefore, accurate results. That is why, whenever turbidity is a factor, it is imperative to properly filter a water sample prior to introduction to the analyser to obtain a true colour intensity and, therefore, accurate result.

Moreover, Aztec 600 Colour users also benefit from low maintenance costs, ease of use, auto-calibration, adjustable measurement frequency and proven chemistry methodology.

UV detection

UV monitors can measure the absorption of ultraviolet light at 254nm commonly known as UV254, which is directly related to the levels of organic matter in the water. The levels of dissolved organics in a body of water are calculated by measuring a pulse of light at two wavelengths. One wavelength that provides a reading from a turbidity photodetector, and another from a UV photodetector. Put simply, in addition to the absorption measurement at 254 nm, a second measurement at 400 nm enables the monitor to compensate automatically for fluctuations in turbidity. The benefits of a straight-through system, without the need for expensive and maintenance-intensive sample filter systems, ensures long-term reliability, essential for on-line control.

Many manufacturers, including ABB, also offer UV monitors that can be configured to measure UV transmission, or %UVT. In contrast to UV absorption, which measures the properties of a sample according to the amount of UV light it absorbs, UV transmission measures the light that passes through a sample, enabling it to produce a %UVT value for levels of key parameters such as colour, turbidity, particulates, and organic and non-organic matter present in a water sample.

In potable treatment processes, measuring %UVT can be used for checking the quality of treated water and assessing the efficiency of the coagulation, flocculation, sedimentation, filtration and carbon adsorption stages. Checking water quality for %UVT can also help to detect any residual dissolved organics that could result in the formation of disinfection byproducts at the chlorination stage.

Online analysers can detect dissolved organics much faster and more effectively than traditional methods, in most cases eliminating the need for laboratory testing. This leads to savings to the water utility through effective treatment and enhanced active monitoring of the water supply. These advances in detection devices are helping to reduce the likelihood of contamination by dissolved organics, leading to even safer supplies of drinking water.

ABB's low range AV400 monitors, for example, provide a resolution of 0.01 milligrams per liter of dissolved organics over a range of 0-20mg/l. The transmitter incorporates the latest technology to provide a highly reliable yet flexible, feature-packed device that is designed to satisfy a diverse range of process monitoring and control applications. The AV400 series of monitors are designed for optimizing the performance of potable water treatment plants, providing significant cost savings, and ensuring the quality of the final treated water.

In particular, they can be used to monitor the quality of the outlet from sand and carbon filters to provide a THM precursor measurement. Moreover, long term field trials have shown that maintenance demands on these applications are minimal. When the UV lamp is flashed every two seconds the measured value is updated and calculated from more than 200 readings that are taken during the brief flash duration, which delivers far greater accuracy than conventional colour testing technology.

The AV400 can detect dissolved organics faster and more effectively than traditional methods and can therefore help save costs and improve safety and treatment process performance because it substantially improves the active monitoring of a water supply.

Like colour analysers, UV analysers can be used to help reduce the formation of THMs by ensuring optimum performance during the coagulation treatment process. Designed for measuring dissolved organics concentrations of 0 to 100mg-1C, ABB's high range AV400 UV dissolved organics analyser can be used as a surrogate colour monitor where humic and fulvic acids form the major colour constituents of raw water because these acids readily absorb ultraviolet light at 254nm, making them easy to detect and measure by the AV400. These acids can also be used at the activated carbon stage to capture any dissolved organic materials that may break through the coagulation process, or at the final treatment stage to enable corrective action to be taken the moment any increases in dissolved organics levels are detected.

Summary

Controlling dissolved organics have historically been a problem for the water industry and the presence of NOM-based THMs in the public water supply remains a daily challenge for many water treatment operators. The mandate to maximize the removal of natural organic matter while ensuring adequate microbial control is an important health consideration. However, as technology improves and the health risks continue to be identified, standards of drinking water are steadily improving with it. Technology is also progressing to a point that it has enabled water companies to invest in even more safety measures at a lower cost than ever before. The steady march of a new generation of water monitors is already making clear, timely and accurate testing easier, therefore considerably reducing the risks of drinking water containing improperly dissolved organics

Using almost instantaneous online analysers to measure dissolved organics levels throughout the extensive potable water treatment process can play a major role in mitigating any health or efficiency issues presented by the presence of contaminants. By providing an understanding of dissolved organics levels in real or near-real time, colour and UV analyser technologies can each make a major contribution to ensuring that water quality continues to consistently meets the required standards, and that any issues are identified, examined, and resolved well before they escalate to become a widespread public health problem.

For more information about ABB's solutions for dissolved organics monitoring, visit https://bit.ly/ABBCWA_DOC.

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