

How ATP Monitoring Ensures Safe Drinking Water



Objective

- Process monitoring and regulatory compliance

Parameters

- ATP measurements as indicator for microbiological growth

Solution

- Hach EZ7300 ATP Analyser



Problem

A Drinking Water production plant in Sweden had a challenge: Due to a long and complex distribution network, there is risk of microbiological growth which would need to be detected as soon as possible to guarantee early warning and that the finished water meets the limits of the European legislations.

Solution

With the use of the EZ series online ATP analyser, microbiological levels are monitored in real-time. The outputs of the results are connected to the customers Scada system, giving early warnings and logging compliance data.

Benefits

The Hach[®] EZ analyser ensures compliance with regulatory limits, as well as replacing frequent manual grab samples and laboratory testing. The analyser also provides real-time information, providing a clearer picture of the process.

Background

The Drinking Water company provides drinking water to the residents of a city in Sweden. To ensure there is future groundwater capacity, a portion of the treated water is pumped back into the ground. Microbiological incidents rarely occur, nevertheless the customer wanted to monitor in real-time and ensure early warning of any occurrences.

The presence of microorganisms in water represents a problem for a wide variety of industries where water purity is a priority. This is because the proliferation of microorganisms can affect plant efficiency, and when released into the air, affect human health. Water handling systems, particularly those involving recirculation, provide a favourable environment for the growth of microorganisms, resulting in the development of biofilms and slime. A biofilm is the collection of organic and inorganic material on a surface. These biofilms can lower the levels of disinfectant residuals, increase bacteria levels, lower dissolved oxygen, and cause taste and odour problems where the water is destined for human consumption. Biofilms can include bacteria, fungi and higher organisms such as nematodes, larvae, and even crustacea.

Biofilms can accumulate and cause the clogging of filters and other systems. The presence of a biofilm, however, also changes the environment at the fouled surface causing anaerobic and anodic conditions. This creates differences between colonised and uncolonised sites, which promotes an electrochemical differential that can cause corrosion.

Biofilms often create local areas of low oxygen in which fermentative microbes produce organic acids and lower pH. In addition, sulfide by-products may be corrosive or may contribute further to the electrochemical differential between fouled and unfouled areas. High levels of microbial load can result in the dissipation of tiny water droplets (aerosols) containing pathogens, such as Legionella. Legionella bacteria are widespread in natural water systems but rarely cause disease. However, outbreaks of Legionellosis can occur from exposure to legionella caused by poorly managed cooling towers and evaporative condensers. Legionellosis is a potentially fatal disease and in most countries, regulations require employers to make a suitable and sufficient assessment of the risks from any work liable to expose employees to any substance hazardous to health, and for other people not in their employment, who may be affected by the work activity. In many applications, biocides are added to water to prevent the build-up of such microorganisms, and the effectiveness of this process must be monitored – to ensure both effective and optimised treatment.

Early detection of microbiological contamination in a water source enables further investigation to pinpoint the contamination source using specific detection methods, allowing timely corrective actions. Perhaps the most crucial reason for monitoring is to mitigate the risks associated with the absence of monitoring. **Microbial proliferation can cause asset damage and even trigger a plant shutdown**, resulting in significant financial loss. Even more concerning, it can also represent a **threat to human health** with potentially enormous reputational risk.

Solution and Improvements

The ASTM D4012-81 'firefly method' was developed as a faster, more effective alternative to traditional microbial tests such as cell tagging, plate counting and turbidity. It involves a rapid, sensitive determination of viable biomass of bacteria in water, wastewater, cleaning and hygiene applications, by monitoring levels of Adenosine triphosphate (ATP). ATP is the energy currency of life, and as such provides a reliable indicator of a living organism.

The measurement of ATP mimics the chemical reaction undertaken by fireflies, whereby ATP and luciferin generate light in a reaction catalysed by the firefly luciferase enzyme. This light generated is proportional to the amount of ATP in the sample. The **Hach EZ7300 ATP analyser** continually pulls samples with an analysis cycle of 10–15 minutes, and up to 8 sample streams are possible per analyser. In the first stage of the measurement process the level of ATP in the 'raw' sample is measured – this represents extra-cellular (or 'non-living') ATP. In the second stage, an ultrasonic (non-chemical) method is used to lyse the cells in the sample and free the 'live' ATP. A second measurement is then taken, giving the 'total ATP' in the sample. The difference between these two measurements represents the 'live' ATP and is proportional to the amount of live microorganisms in the sample. With a detection limit of 0.05 picograms of ATP per mL. The EZ7300 is able to measure at very low levels (0.05 pg \approx 50 *E. coli* sized bacteria), with a wide measurement range extending to over 200 pg/mL*. Portable instruments have been developed to take advantage of the ATP method, but the Hach EZ7300 is the first instrument to successfully deliver this technique in a continuous monitor.

Conclusion

By implementing the EZ analyser, the drinking water treatment plant ensures real time monitoring of ATP, enabling early detection of potential issues and continuous compliance data logging.

