Monitor TOC and VOC to Avoid Downtime and Equipment Damage, and Maximize Operating Efficiency

Problem

The effectiveness of a cooling tower is largely dependent on water management. Maintaining a healthy cooling water cycle presents many challenges, from regulatory obligations to maintenance issues. Leakage, a common problem, can result in corrosion, deposition, and scaling, which can lead to equipment damage, environmental non-compliance, and safety hazards.

Solution

Monitoring organic contaminates and fugitive VOC emissions early in the water cycle is the best way to prevent system damage. An analyzer, such as the Hach® BioTector B3500c analyzer, which detects, identifies, and measures all organic contaminants before system damage occurs is an ideal solution for cooling water applications.

Benefits

Hach's BioTector B3500c offers highly accurate and reliable online analysis of water containing low concentrations of organic contaminates. The analyzer is highly sensitive, with a fast analysis time and low maintenance requirements. With minimal energy and chemical requirements, it offers a low total cost of ownership and a fast return on investment.

Background

Many industrial facilities, such as chemical plants, refineries, power plants, and pulp and paper mills, incorporate cooling systems that include cooling towers for heat transfer from heat exchangers.

Heat Exchangers and Cooling Towers

A heat exchanger permits heat transfer between two liquids, such as steam (a thermal liquid) and glycol (a process liquid) which are separated by a solid barrier that prevents the two liquids from mixing. Heat exchangers can be used to remove heat from a process stream, as it does with a cooling tower.

A cooling tower releases heat into the atmosphere by cooling a water stream to a lower temperature and passing its process stream through a set of heat exchangers to draw the heat away from the process.

As long as this process is working well, the system needs little or no attention. Cooling water monitoring areas are often located in remote or hard-to-access areas, so equipment that requires minimal attention is best. When problems do occur within the system, they can be significant and costly.

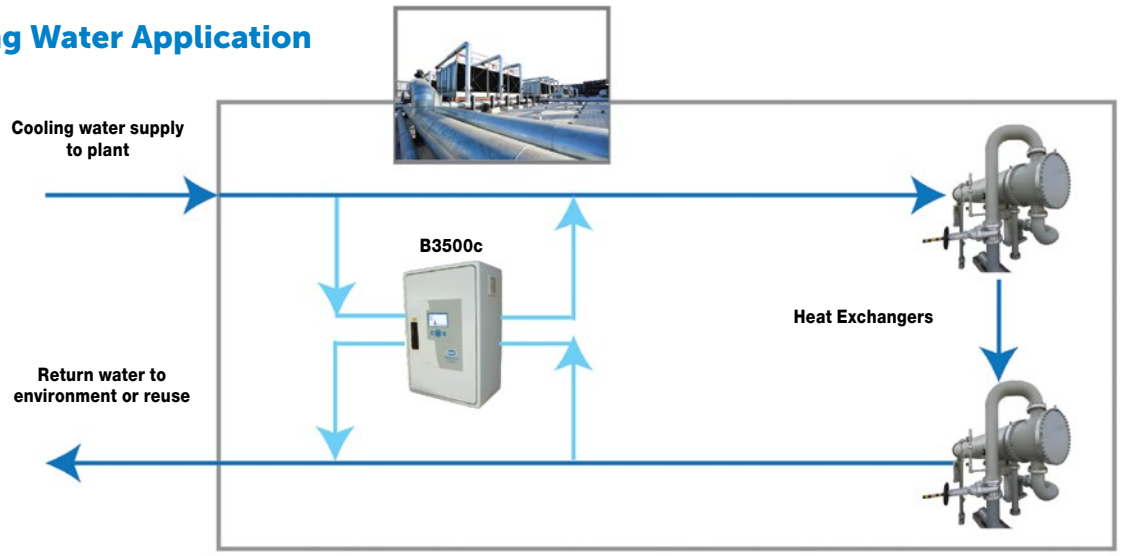
Potential Problems with Heat Exchangers and Cooling Towers

A common problem, known as process organic breakthrough, is a result from system failure. It occurs when seals, gaskets, or tubes fail, permitting the process and thermal liquids to mix. This type of system failure can be very hard to detect, until it leads to another related issue, such as:

- Loss of product
- Reduced water quality
- Reduced cooling efficiency resulting from cooling tower contamination, scaling, and build-up
- Environmental compliance violations and possible fines from the release of volatile organic carbons (VOCs) or organics from the cooling tower

Many customers monitor the cooling tower for signs of organic contamination and fugitive emissions of VOCs, but many of the technologies commonly used do not detect potential problems until process organic breakthrough has led to further consequences. However, once the contamination has reached this point, the damage can be severe.

Cooling Water Application



Common Methods of Cooling Water Analysis

Common methods to detect problems include flame ionization detectors (FID), infrared (IR) imaging, UV persulfate systems, oil-in-water (OiW) analyzers, optical sensors, and high-temperature oxidation total organic carbon (TOC) analyzers.

FIDs use a simple technology, but are known for sample delivery system problems, including biological growth in the sample tubes. This method also requires frequent re-lighting of a pilot flame to ensure correct operation.

Likewise, IR imaging presents challenges, as it can only detect VOCs once they have escaped the liquid and are in a gaseous form, which can create a health risk or even a fire hazard in situations of high concentration. Both methods, FIA and IR, may lead to process shutdowns.

OiW analyzers and optical sensors are susceptible to foiling, prone to drift, and limited to what compounds will leak through. UV persulfate systems are commonly used in cooling water applications. However, these systems do not have the ability to break down the majority of hard-to-oxidize compounds, and they are unable to perform VOC measurements. They are also prone to drift and require frequent calibration.

High-temperature oxidation TOC analyzers do not reliably measure at low sub-ppm levels, because their low sample injection volumes limit their signal-to-noise ratio, resulting in poor accuracy at low levels. They are also sensitive to ccumulation in saline environments and require frequent calibration.

The BioTector Method of Analysis

Hach's BioTector B3500c analyzer uses a patented two-stage advanced oxidation (TSAO) process to measure a wide range of organics, TOC, and VOC. For the measurement of organic contamination breakthrough in cooling tower water and heat exchangers, the BioTector B3500c analyzer solution is ideal.

There are two standard system configurations of B3500c analyzers in cooling water applications. The first option is to install one unit with two sampling points. Larger processes or facilities may require a configuration using two analyzers with single or multiple points of measurement, commonly with one analyzer at the influent of the cooling tower, prior to the divert valve, and another analyzer upstream to identify where breakthroughs originate in a process area.

Moving the point of analysis upstream to the heat exchangers provides additional time to react and divert any contaminated liquid stream away from the cooling towers, which helps to establish a process for early detection and preventative maintenance.

The BioTector Solution

Multi-parameter analysis, as undertaken by the BioTector B3500c analyzer, is highly useful in heat exchanger and cooling water applications, where both TOC and VOC pollutants are capable of entering the water system.

In a B3500c configured as a VOC system, it is possible to configure both TOC and VOC parameters in a cycle time of up to six-minutes. The system includes standard alarm signals sent at the end of each analysis cycle for programmed parameter results. In the event of high total carbon detection, the alarm point will help to identify where the increase in total carbon originates. Even in operations where organic and inorganic concentrations vary widely, the BioTector can measure the samples accurately.

In addition to offering standard alarm signals, the B3500c also incorporates a predictive CO_2 alarm feature that permits fast alarming when detecting high carbon concentrations in the sample within approximately three minutes of analysis time (application dependent). This predictive CO_2 alarm feature can be activated in the BioTector software to provide very early warnings of unusually high total carbons or TOC levels.

Hach's BioTector B3500c TOC analyzers provide maximum uptime and reliability due to their patented two-stage advanced oxidation process.

Benefits

The BioTector B3500c is a compact, efficient analyzer that can monitor two streams at the same time, reducing the expense and operational cost of a second analyzer. Reagents only need to be replenished every six months, instead of biweekly, as is common with traditional TOC and VOC measurement technologies. The analyzer also accommodates large sample volume injections – up to 10-12 mL – which permits a maximum signal-to-noise ratio. This means B3500c 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 B3500c demonstrates low total cost of ownership. Continuous online monitoring provides early leak detection, reducing the compliance fines, loss of product, and downtime, for a fast return on investment.

While the BioTector B3500c is the standard solution for cooling water applications, other models are available to accommodate unique needs or requirements.

Conclusion

The cooling water cycle in industrial plants is critical to the health of the process. Process organic breakthrough is a common problem in the cooling water process, and can result in costly repairs or unplanned downtime. Traditional methods of monitoring can be limited by the need for sample filtration, extended cycle times, and maintenance requirements, and often do not identify problems until system damage has occurred.

Even problems that appear simple, such as a leaking seal or punctured tube, can lead to significant issues, like equipment damage, reduced efficiency, regulatory fines, and even process shutdown. Hach's BioTector B3500c analyzers deliver early detection and problem identification, to help end users prevent serious problems.

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