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Online Analyzers Improve Control of Chloramination Processes in Milwaukee

By Dave Marsh

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The Milwaukee Water Works is a national leader in providing high quality drinking water and monitoring water quality. Since 1998, it has invested $227 million in its infrastructure, from treatment plants to distribution systems, to ensure high quality drinking water and reliable supply. The Milwaukee Water Works treats Lake Michigan water with Ozone gas as a primary disinfectant because it destroys microorganisms, reduces chlorinated disinfection byproducts, and removes taste and odor. It then further treats its water with coagulation, settling, and filtration to remove additional particles, and adds Chloramine as a secondary disinfectant.

Chloramine is a more stable disinfectant than Chlorine and better extends the disinfectant residual throughout the distribution system. It also reduces the formation of trihalomethanes and Halogenic Acetic Acids and the taste and odor problems associated with Chlorine. However, producing Chloramine can be a challenge because it requires precise control of a complex process.

In 2004 the City of Milwaukee invested in a ChemScan UV-2150S online Chloramine analyzer in its Howard Avenue Water Treatment Plant to improve control of its Chloramination process. Chloramine has been used as a secondary disinfectant since the 1990s when the plant's primary disinfection process was converted to Ozone in what was then the world's largest retrofit project of its kind. The original design of the Howard Avenue plant adds an additional degree of complexity to controlling the Chloramination process because the sample point is so close to where the ammonia is added. As a result the ammonia may not be mixed as thoroughly as it would have been had it been located further downstream, making it even more critical for plant operators to have timely access to accurate information about the process.

"Our challenge had been mixing the ammonia and maintaining our ratios," said John Gavre, Howard Avenue Plant manager. "We wanted a more accurate instrument than our current one and an instrument that works online so we can get the results faster. That would allow us to more closely monitor the process and adjust it."

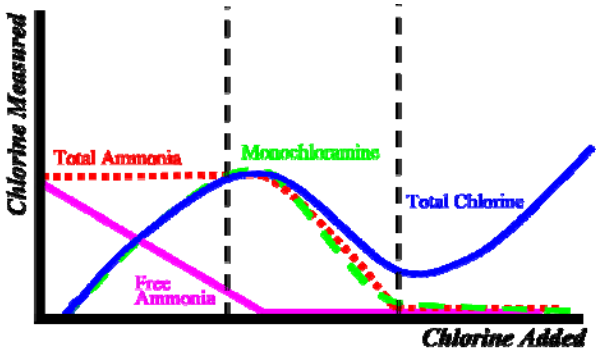
The ChemScan UV-2150/S Chloramination Analyzer is the only Analyzer capable of monitoring all four key parameters, Monochloramine, Free Ammonia, Total Ammonia and Total Chlorine from two sample points.

Chloramine is formed by mixing Ammonia with Chlorine. It's a complex process often depicted by the breakpoint curve that separates the Chloramination process into a series of steps. In the early stages of the Chloramination process, Ammonia added to free Chlorine produces Monochloramine. All of the Ammonia and available Chlorine are combined to form Monochloramine when the process is in control. However, when the process begins running out of control, an imbalance occurs between the amounts of Ammonia and Chlorine. When excess Chlorine is present it continues to combine with Monochloramine, converting it to Dichloramine. Additional

Chlorine then combines with Dichloramine to form Trichloramine. Unfortunately, this can result in drinking water tainted with unpleasant tastes and smells.

The other type of chemistry imbalance is excess free Ammonia, which is serious and difficult to detect. It will eventually cause problems such as nitrification, algae growth, dissolved oxygen deficiency and corrosion if it is allowed to enter the distribution system.

To produce a specific concentration of Monochloramine without also forming Dichloramine, Trichloramine or accumulating excess free Ammonia, operators must be able to detect the actual Chlorine to Nitrogen ratios and make any necessary adjustments before Dichloramine forms. This is best accomplished using an online analyzer to monitor four key process parameters instead of monitoring just one. Relying on a single parameter may not be adequate since it is possible for the same total Chlorine reading to be obtained at different locations on the breakpoint curve. Monitoring free Ammonia, total Ammonia, Monochloramine and total Chlorine detects the actual Chlorine to Nitrogen ratios, the concentration of total Chlorine and the amount of total Chlorine that is actually in the form of Monochloramine which allows the operator to adjust chemical addition accordingly.



When Monochloramine production is maximized, Free Ammonia is minimized to near zero. Total Ammonia can be used to monitor ammonia feed. A decrease in Total Ammonia means Dichloramine is being formed.

The ChemScan UV-2150/S Chloramination Analyzer is the only Analyzer capable of monitoring all four key parameters, Monochloramine, Free Ammonia, Total Ammonia and Total Chlorine from two sample points. The analyzer maintains the right ratio, and the equipment provides the representative samples needed in a relatively short time. The accurate and reliable analysis of free ammonia at concentrations as low as 0.02 mg/l allows operators to tightly control the ammonia feed and minimize excess ammonia in the distribution system. This greatly reduces the potential development of nitrifying bacteria in the reservoirs and distribution system.
The ChemScan UV-2150S Analyzer is a self-contained unit about the size of a file cabinet. It may initially be more expensive than other units but it is a complete system that does not require additional sample conditioning equipment or supplemental sensors for a complete analysis suite, which would have added to the cost. It can also save on chemicals because reagents can be mixed from common chemicals purchased from local distributors. The unit is much more reliable because it doesn't have all of the pistons, parts and the many components that could stick or simply wear out.

Bernard Beemster, president of ASA Analytics, the company that manufactures the ChemScan UV-2150S Analyzer, says all ChemScan analyzers are built for use on the treatment plant floor. "These are rugged process analyzers, not delicate instruments that must be used in a protective laboratory environment." said Beemster. "For example, they feature ¼" ID tubing that resists clogging, so it's unnecessary to prefilter samples. The instruments are

enclosed in a heavy-duty steel box that separates the processor from the sample compartments and provides protection from the hazards of the plant floor."

"ASA Analytics and the City of Milwaukee are members of the Milwaukee 7 Water Council," said Beemster. "And we're particularly proud that our technology is benefitting another Water Council member.

The Milwaukee 7 Water Council pursues its mission to make the Milwaukee Region the world water hub for freshwater research, economic development and education. Developed in 2007, the Water Council consists of members from business, academia and government working in collaboration to accomplish the mission and vision.

The Milwaukee Water Works policy prohibits the endorsement of products or services.

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