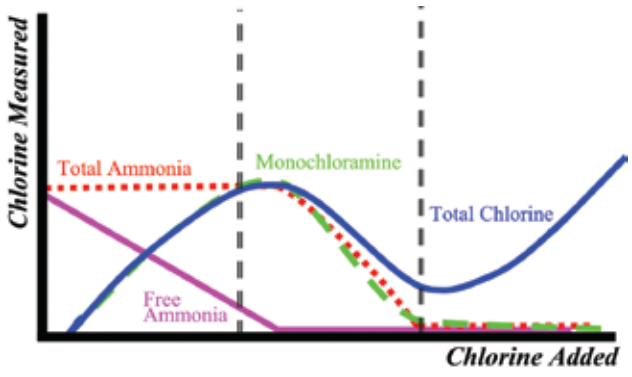
Cogent Chloramine Control

The Milwaukee Water Works (MWW) 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 a reliable supply. The MWW treats Lake Michigan water with ozone gas as a primary disinfectant because it destroys microorganisms, reduces risks posed by 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.

Online analyzers improve control of chloramination processes in Milwaukee

By Dave Marsh



When monochloramine production is maximized, free ammonia is minimized to near zero; total ammonia can be used to monitor ammonia feed; and a decrease in total ammonia means dichloramine is being formed.

The ChemScan UV-2150S chloramination analyzer monitors all four key parameters from two sample points.

Chloramine is a more stable disinfectant than chlorine and thus extends the disinfectant residual throughout the distribution system. It also reduces the formation of trihalomethanes and halogenic acetic acids, plus the taste and odor problems associated with chlorine. Producing chloramine, however, 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 (WTP) 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 WTP 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 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 WTP 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."

Chemistry Balancing Act

Chloramine is formed by mixing ammonia with chlorine. It is 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. When the process begins running out of control, though, 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 because 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.

Four-Parameter Analysis

The ChemScan UV-2150S 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 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 also can save on chemicals because reagents can be mixed from common chemicals purchased from local distributors. The unit is reliable because it does not have all of the pistons, parts and other components that could stick or wear out.

All ChemScan analyzers are built for use on the treatment plant floor, according to Bernard Beemster, president of ASA Analytics. "These are rugged process analyzers, not delicate instruments that must be used in a protective laboratory environment," he said. WWD

Author's Note: The MWW policy prohibits the endorsement of products or services.

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