ChemScan® Process Analyzer

Title: Strategies of Using an Online Analyzer for Water Chloramination Process Monitoring and Control

ASA Publication Number: 191

Published in:
WaterWorld, May 2009

STRATEGIES OF USING AN ONLINE ANALYZER FOR WATER CHLORAMINATION PROCESS MONITORING AND CONTROL

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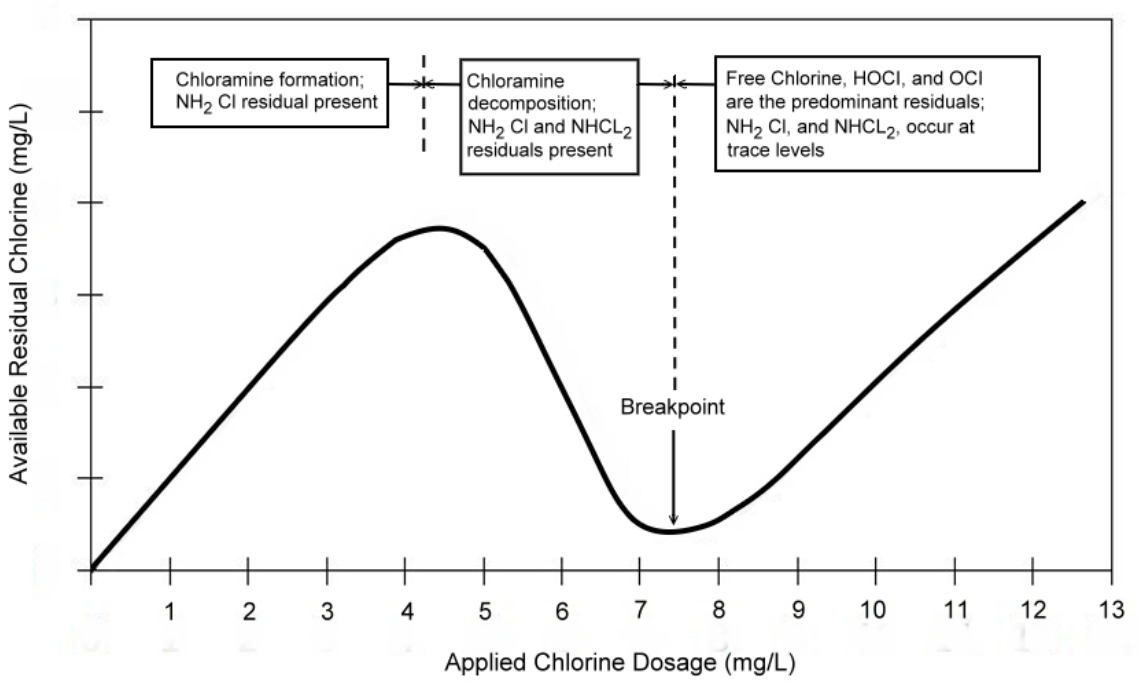
Chlorine has been used for over 100 years as a potable water disinfectant. Chloramine has been used as a disinfectant in the U.S. since the 1930's. Chloramine is formed by mixing chlorine with ammonia in a precise ratio. In most cases, chloramine is used as a secondary disinfectant while chlorine serves as the primary disinfectant. Use of chloramine has been shown to reduce the formation of trihalomethanes (THMs), while also reducing certain taste and odor problems. Another advantage is that chloramine is more stable, therefore extending disinfectant residual throughout the distribution system. The use of chloramination is increasing in popularity throughout North America.

Control of chloramination chemistry is difficult because the ideal chlorine to ammonia reaction is not a simple 1 to 1 combination. As the Cl_2 to N ratio increases, the combined species transform from monochloramine to dichloramine to trichloramine and finally to free chlorine and nitrogen gas. Monochloramine is the preferred species of disinfectant, while dichloramine and trichloramine, which create serious taste and odor problems, are undesired forms. As Cl_2 to N ratio decreases, there is extra free ammonia left in the water and it eventually enters into the distribution system (because there is not enough chlorine to react with it). See a typical Break Point Curve below.



Theoretical breakpoint curve showing increasing amounts of chlorine added to a fixed amount of ammonia.

Free ammonia in the distribution system can cause many problems, such as nitrification, algae growth, DO deficiency and corrosion control, etc. Maintaining appropriate chlorine to ammonia ratio is an unavoidable challenge to every chloramination water treatment plant.

Three online chloramination monitoring and control strategies are summarized below:

1. Chlorine to Ammonia Nitrogen Ratio Control

This is often referred to as "Ratio Control". In this method, the chlorine to nitrogen ratio is controlled at or below 5:1. Many water treatment plants try to maintain the ratio between 3:1 and 5:1 in the hope that the predominant chlorine species produced is monochloramine. The problem of controlling in this manner occurs when the applied ratio increases to more than 5:1. At this point (Cl_2 : N > 5:1), increasing chlorine dosage results in a decrease of Cl_2 : N ratio. This is because the dichloramine and trichloramine, which form at a ratio of greater than 5:1, are not considered to be effective disinfection chlorine species.

2. Free Ammonia Residual Control

Another popular control strategy maintains a very small (at the ppb level) free ammonia concentration to ensure that monochloramine is the predominant species. This method can also be explained as to operate at left, but very close to the top of the Break Point Curve. If the free ammonia concentration is kept very low, the potential of nitrifying bacteria developing in the distribution system is minimized. However, in practicality, the control of free ammonia at the low ppb level is difficult. Using an online analyzer is essential for this type of control strategy.

3. Peak Point™ Chloramination Monitoring & Control

Recently, a new approach has been developed by ASA Analytics called Peak Point™ Control. This strategy maximizes the development of monochloramine while simultaneously minimizing the free ammonia and dichloramine concentrations. Peak Point™ relies on the observation that when free ammonia is present, the ammonia is being overfed relative to chlorine and when dichloramine is present the ammonia is being underfed relative to chlorine and that under normal treatment conditions these two conditions cannot coexist.

The ChemScan Model UV-2150/S on-line process analyzer, manufactured by ASA Analytics, is designed for chloramination process monitoring and control. It is capable of monitoring multiple parameters and multiple sample streams in one centralized analyzer. Many chloramination water treatment plants have had successful experience for either ratio control or residual control with this analyzer. The four parameters offered are free ammonia, total ammonia, monochloramine and total chlorine. Output signals for each parameter are sent from the analyzer to the plant SCADA or other type of central control system, where control decisions are made based on the ammonia to chlorine ratio or other type of control strategy used.

BENEFITS OF USING AN ONLINE ANALYZER FOR CHLORAMINATION PROCESS CONTROL

Control of chloramination chemistry is always a challenging task. An appropriate online analyzer can definitely help in this process, by providing a rapid automatic analysis of the key chloramination control parameters including free ammonia, total ammonia, monochloramine and total chlorine. There are many small or midsized surface water treatment plants using chloramination throughout North America. Many of them attempt to operate based on grab samples. Experience shows that several water quality problems may occur during run off season, when run off carries a large amount of animal waste and organic matter into surface water. Groundwater may also be affected by fertilizers and other contaminants, creating a high background ammonia concentration in the water. When problems such as this occur, a real-time analysis allows the plant operator to adjust the water chemistry promptly. The same adjustment process can be accomplished automatically using a plant SCADA. A daily grab sample is just not sufficient for proper water chemistry control.

Chloramination process optimization is even more challenging. To operate at the right chlorine to ammonia nitrogen ratio, the process needs to be constantly monitored with the *right parameters*. No matter which control strategy is adopted (Ratio Control or Residual Control or Peak Point™ control), a single parameter may not be adequate. For example, the same monochloramine reading can be obtained at different chlorine to ammonia ratios. The best way is to use multiple parameters (such as free ammonia, total ammonia, monochloramine and total chlorine) to detect what the real ratios and concentrations are and to adjust chemical addition accordingly.

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