

Rev. 5/98

ChemScan® Application Summary #99 Chlorination Control

Statement of the Problem

Chlorination of water or wastewater is performed to destroy microbiological organisms and also to oxidize nitrogen or sulphur compounds, metals and organic substances. Chlorine will form hypochlorous acid (HOCl) and hypochlorite ion (OCl^-) upon introduction to water. The relative percentage of these forms of free chlorine are pH dependent, as shown in Figure 1.

Apparatus

Although the object of disinfection is the destruction of pathogenic organisms, the dosage of chlorine available for disinfection may be affected by the presence of other oxidizable matter that may exert a demand above the demand from pathogens.

Surface water treatment plants may experience a variable incoming concentration of natural organic matter (NOM) in the form of organic acids. These organic acids may only be partially removed during the treatment process, leaving a variable concentration in the water entering the primary disinfection process. Flow pacing alone may not assure that the necessary free chlorine residual has been established for the required contact period.

Control Strategy

Analysis of free chlorine in the effluent from the primary chlorine contact basin is one strategy for control. This information is fed back to a controller, which adjusts the chlorine feed rate to maintain a target concentration in the effluent. It is important that the analytical technique be able to detect free chlorine (as opposed to combined chlorine). If there is a long contact time, feed back control may not provide a satisfactory response to variable demand conditions.

Where there is a variable demand from oxidizable material other than pathogens, another strategy is to monitor the incoming concentration of oxidizable material and use this information for feed forward or compound loop control of the chlorine feed rate.

In water, NOM can be detected directly by ChemScan. In wastewater, substantial demand can also be exerted from nitrite (NO_2), which is another parameter ChemScan can detect without reagents.

Hypochlorite ion has a strong absorbance signature in the ultraviolet wavelength range with a peak absorbance at 292 nm, while Hypochlorous acid has a weaker absorbance signature with a peak at 236 nm. As the pH of the sample is altered, the absorbance signature will rotate at 254 nm as the form of free chlorine is exchanged between HOCl and OCl- forms, as shown in Figure 2.

The ChemScan Process Analyzer uses multiple wavelength light absorbance data to characterize the concentration of free chlorine in a sample of known or stable pH. If the pH is not known or is variable, sample pH can be adjusted to the 4-5 range, where HOCl is 100% of the form or to the 10+ range where OCl- is 100% of the form.

Multiple wavelength absorbance can also be used to measure organics, nutrients or metals that may be present in the influent to chlorination process in order to calculate the effect that these constituents may have on the chlorination process.

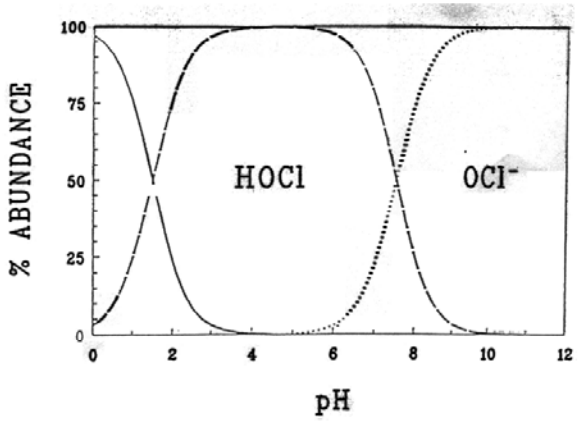

Figure 1

Percent Distribution of Aqueous Chlorine Species with Changes in pH

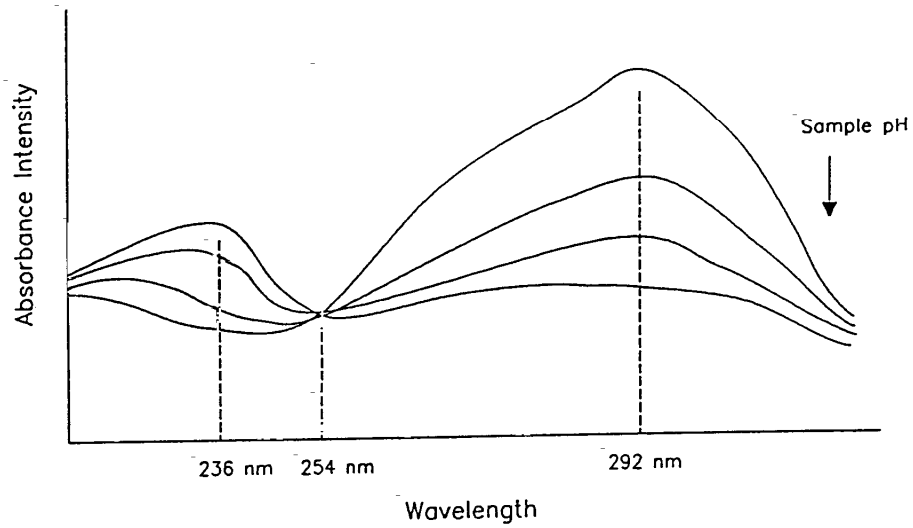

Figure 2

Spectral Shift of Free Chlorine Absorbance with Change in Sample pH