Effects Of Chlorine

Hypochlorous acid is the effective agent that controls bacterial growths. The amount of HOCl that will be present in solution, and thus active, will be present at greater concentrations at lower pH levels (more acidic conditions). At extremely low pH levels (or high acidity) chlorine gas (Cl_2) will form. Therefore, for safety it is very important to store chlorine and acid sources separately.

Hypochlorous acid will react with iron in solution to oxidize the ferrous form to the ferric form, which will then become the insoluble ferric hydroxide as a precipitate. This reaction should take place prior to the irrigation filters so that the precipitates may be trapped. Chlorine will also react with hydrogen sulfide to form elemental sulfur. Because some of the chlorine is used up by reacting with the sulfide or ferrous ions, additional chlorine must be provided to supply enough residual to control the microorganisms such as sulfur or iron slimes, or algae, which can clog microirrigation systems.

Most microorganisms will be inactivated and controlled at free residual chlorine concentrations of 1 ppm. However, higher injection levels are needed due to the inherent chlorine demand of different water sources. As a start, use 2 ppm of chlorine for each part per million of hydrogen sulfide, plus 0.6 ppm of chlorine for each part per million of ferrous iron. A water test can be used to determine the levels of hydrogen sulfide or ferrous iron present in solution. Surface water sources such as lakes, ponds, or canals should be treated with approximately 5 to 10 ppm of chlorine. Higher levels may be needed for water with high amounts of microbial activity such as during the warmer months of the year.

The chlorine injection rate should be checked by testing the treated water at the most distant part of the irrigation system using a test kit designed to measure "free" residual chlorine. Residual concentrations of 1 to 2 ppm indicate that active chlorine still exists and that the water and system parts have been appropriately treated. Active chlorine may be tested using a color indicating test kit (D.P.D.) that measures "free" residual chlorine. Do not use a test kit that only measures total chlorine. While levels of total chlorine may appear appropriate, the "free" residual form may not. Therefore, ask for a D.P.D. test kit from either a pool or irrigation supplier.

Chlorine Application Amounts

After determining the desired chlorine concentration, the proper application amount must be determined. The amount of chlorine to apply per unit of irrigation water will depend on the desired concentration in the irrigation system and the concentration or strength of the chlorine source.

Liquid sodium hypochlorite is the most convenient and generally safest form of chlorine available to inject into irrigation systems. Stock solutions are available in concentrations of 5, 10, or 15 percent of available chlorine. Table 1 or the following equations may be used to determine the chlorine solution injection rate in gallons per hour (gph) for different desired part per million injection levels and irrigation system flow rates. Equations 1, 2, and 3 are specific for liquid chlorine injection and are designed for stock solution chlorine concentrations of 5, 10, and 15 percent, respectively.

For a 5% available chlorine stock solution:

$$\text{Inject. Rate}_5\text{, gph} = \frac{(\text{ppm}) \times (\text{Irr. Fl. Rate, gpm})}{925} \quad (1)$$

For a 10% available chlorine stock solution:

$$\text{Inject. Rate}_{10}\text{, gph} = \frac{(\text{ppm}) \times (\text{Irr. Fl. Rate, gpm})}{1850} \quad (2)$$

For a 15% available chlorine stock solution:

$$\text{Inject. Rate}_{15}\text{, gph} = \frac{(\text{ppm} \times (\text{Irr. Fl. Rate, gpm})}{2775} \quad (3)$$

For example, an irrigation system has a flow rate of 450 gpm and the water is to be treated with 8 ppm of available chlorine using a stock solution with 10% available chlorine. Using Equation 2, the injection rate of the stock solution should be approximately 2 gph [(8 ppm) x (450 gpm)/1850 = 1.95 gph]. If the stock solution had just 5% available chlorine, the injection rate should be about 4 gph.

Table 1 may be used for smaller irrigation system flow rates. For example, consider a microirrigation system with a flow rate of 80 gpm. The water is to be treated with a liquid chlorine stock solution with 5% available chlorine, and a 6 ppm treatment level is desired. Using Table 1, at a 6 ppm treatment level and a 5% stock solution concentration, the in-