The University of Georgia College of Agricultural & Environmental Sciences
Cooperative Extension Service

Drip Chemigation: Acid

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Acidification to Remove Mineral Deposits

Acid Injection

Mineral precipitates can form deposits (scale) that clog emitters. The most common deposits are calcium or magnesium carbonates and iron oxides. Since precipitation occurs more readily in water with a high pH (above 7.0), precipitation of these compounds can be prevented by continuous injection (whenever the system is operating) of a small amount of acid to maintain water pH just below 7.0.

A more popular control method is to remove deposits as they are formed by periodic injection of a greater volume to acid. Enough acid should be injected continuously for 45 to 60 minutes to reduce the water pH to 4.0 or 5.0.

Phosphoric acid (which also supplies phosphate to the root zone), sulfuric acid, or hydrochloric (muriatic) acids are commonly used. The selection of a specific acid depends on cost and availability, water quality, the severity of clogging, and nutrient needs of the crop.

The amount of acid required to treat a system depends on (1) the strength of the acid being used, (2) the buffering capacity of the irrigation water and (3) the pH (of the irrigation water) needed to dissolve mineral precipitates in lines and emitters. The required pH of the irrigation water (target pH) depends on the severity of mineral deposits. Experience is helpful when estimating target pH.

To determine the volume of a selected acid needed at a specific site, estimate the target pH and run a “titration” test (as described below) using the selected acid and irrigation water from the site. This test will indicate the volume of acid required to lower the pH of a selected volume of water to the target pH. Titration provides an acid volume:water volume ratio that can be used in conjunction with the system flowrate to determine the appropriate acid injection rate. The acid injection rate is determined by dividing the volume of water by the flowrate of the irrigation system and multiplying the result by the volume of acid added to reach the target pH.

Titration

A water container, a non-corrosive measuring cup, beaker or pipette calibrated in small increments such as milliliters, and a portable pH meter are needed to run the titration test. The volume of the container may be as small as 10 liters (about 3 gallons) or as large as 55 gallons. In general, the smaller the increments used when measuring and dispensing the acid into water, the smaller the required container.

To run the titration test, put a known volume of water (from the site) into the container and check the pH. Add a small amount of acid (1-3 ml for 3 gallons, 4-8 ml for 30 or more gallons) to the water, stir and re-check the pH. Continue this process until the target pH is attained. As the acidity of the water nears the target pH, add acid in very small increments (1 ml); otherwise, the pH may quickly drop below the target pH and necessitate repeating the test. Always add acid to water. Caution: Never add water to acid.

The following example illustrates how to determine the required volume of acid and the appropriate acid injection rate.

Example: For a system with a flowrate of 200 gal/min.

- Based on the severity of mineral deposits in the system, a target pH of 4.5 and an injection period of one hour are selected.
- Put 50 gallons of water into a 55-gal drum. Check the pH. Meter indicates pH of 7.4.
- Add 8 ml phosphoric acid. Check the pH. Meter indicates pH of 6.9.
- Add 7 more ml phosphoric acid. Check the pH. Meter indicates pH of 6.0.
- Add 4 more ml phosphoric acid. Check the pH. Meter indicates pH of 5.3.
- Add 1 more ml phosphoric acid. Check the pH. Meter indicates target pH of 4.5.
- 20 ml (8+7+4+1) of phosphoric acid were required to lower the pH of 50 gal of water to the target pH of 4.5.
- Divide 50 gal by the system flowrate of 200 gal/minute and multiply the result by the ml of phosphoric acid required to reach the target pH. 200 gal divided by 50 gal = 4. 4 x 20 ml = 80 ml phosphoric acid. Therefore, the required acid injection rate is 80 ml per minute.
- Multiply 80 ml per minute by the injection time to determine the required volume of acid needed during the 1 hour injection period. 80 ml x 60 min = 4,800 ml (approximately 1.3 gal, since there are 3785 ml in 1 gallon)

Note: Acid injection rates are usually very low (ml/hour). Although injection pumps with low flowrates may be suitable for acid injection, they may not have enough capacity for injecting fertilizers.

After the desired amount of acid has been injected and distributed throughout the irrigation system, turn the system off and let the low pH water remain in the lines for several hours, preferably overnight. This allows sufficient reaction time for the acidified water to dissolve mineral precipitates. After the setting period, flush the lines to remove dislodged and solubilized materials. To flush the lines, bring the system to full charge by running the irrigation pump (injection pump off) until the system reaches normal operating pressure. With the irrigation pump running, begin sequentially opening the ends of the PVC lines and emitter lines to flush the system. To ensure proper flushing, do not open so many lines at one time that system pressure drops below normal levels. If too many lines are opened at one time, the pressure drops too low and the system will not flush adequately. Improperly flushed lines after acidification will likely result in severe clogging problems. Keep in mind that routinely flushing lines with non-acidified irrigation water will also help remove mineral precipitates from the system.

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