Injection Volumes

To determine the required injection volume for bulk applications, the mass of the desired chemical or compound dissolved per gallon of stock solution must be known. This can be determined by using Table 4 or Equation (6) as follows:

$$Sm_x = \frac{(\%X)\,(S_x)}{100} \qquad (6)$$

where S_{mx} = Mass of chemical X per gallon of stock solution (lb/gal),
$\%X$ = Percentage of chemical X in the solution (%), and
S_x = Specific weight of the stock solution (lb/gal).

Then by knowing the mass of that chemical contained per gallon of stock solution, the required volume can be determined using Table 5 or the following equation:

$$V_m = \frac{(M_x)}{(S_{mx})} \qquad (7)$$

where V_m = Required mixture volume (gal),
M_x = Mass of chemical required (lb), and
S_{mx} = Mass of chemical per gallon of mixture, (lb/gal; from Table 4 or Equation 6).

For example, a vegetable grower wishes to apply 4 lb. of N per 1000 bedded feet of plant row each week; the N is to be applied in 3 applications per week; 20 acres are to be irrigated per set; and the system has 4500 bedded feet per acre. What size feeder tank is necessary for injecting a 4-0-8 fertilizer solution which has a specific weight of 9.55 lb per gallon?

The weekly production requirement of total N is:
(20 acres) (4500 ft/acre) (4 lb of N/1000 feet) =
= 360 lb of N per week.
The application requirement of N (3 applications) is:
(360 lb of N per week) / (3 applications per week) =
= 120 lbs of N per application.

Using Equation (6)

$$S_{mx} = \frac{(4)(9.55)}{100} = 0.38 \text{ lb of N per gallon of solution.}$$

The injection volume per application is (Equation 7):

$$V_m = \frac{120 \text{ lb of N per application}}{0.38 \text{ lb of N per gallon of solution.}}$$

$$= 316 \text{ gallons.}$$

Therefore, the feeder tank must be at least 316 gallons to provide room for this fertilizer application.

Sometimes chemicals are injected on a periodic basis to maintain a certain injected concentration of that chemical during that period. In this case, the required injection volume of stock solution depends on the length of the injection period, and the injection rate. The required stock solution volume can be determined from Equation (8) as follows:

$$V_m = (Q_i)\,(T_i) \qquad (8)$$

where V_m = Required mixture injection volume (gal),
Q_i = Injector flow rate (gpm), and
T_i = Injection period (minutes).

For example, a micro irrigation system manager desires to inject 10 ppm of free chlorine into his irrigation system for a period of 40 minutes. The irrigation system delivers water at a rate of 550 gpm, the chlorine stock solution weighs 9.1 lbs. per gallon and contains 5% of free chlorine. From a previous example using Equation (3), the required injector flow rate was 0.10 gpm. Therefore, the required injection volume is:

$$V_m = (0.10 \text{ gpm})\,(40 \text{ minutes})$$
$$= 4 \text{ gallons of stock solution.}$$

Therefore, only a small feeder tank is required for this application.

Injection Periods and Calibration

The length of the injection cycle is important from an irrigation management viewpoint. With respect to the injection period, several criteria may need to be addressed, such as the frequency of