requires injecting a supply mixture at the proper rate to maintain the desired concentration level. The following equation or Tables 2 and 3 can be used to determine the injection rate necessary to maintain the desired concentration of a chemical X.

$$Q_i = \frac{(ppm_x)(Q_w)(8.3)}{[(\%X)(S_x)(10000)] - [(ppm_x)(S_x)]} \qquad (3)$$

where Q_i = Injection rate in gallons per minute (gpm),
Q_w = Water supply flow rate (gpm),
8.3 = Specific weight of water (lb. /gal.),
ppm_x = Desired ppm level of chemical X,
%X = Percentage of chemical X in the stock solution, and
S_x = Specific weight of the stock solution mix (lb. /gal.).

For example, chlorine is to be injected to provide 10 ppm of free chlorine into a micro-irrigation system which has a system flow rate of 550 gpm. The chlorine stock solution contains 5% free chlorine (sodium hypochlorite source, NaOCl) and has a specific weight of 9.1 lbs. per gallon. Therefore,

$Q_w = 550$; $ppm_x = 10$; $\%X = 5$; $S_x = 9.1$; and

$$Q_i = \frac{(10)(550)(8.3)}{[(5)(9.1)(10000)] - [(10)(9.1)]} = 0.100 \text{ gpm}.$$

Therefore, the injector should be set to provide 0.10 gallons per minute of stock solution into the irrigation system in order to maintain an injected free chlorine level of 10 ppm. The actual ppm of free chlorine throughout the system will depend on how much free chlorine is used by organics in the water supply and in the irrigation system.

If the specific weight of the chemical is close to that of water, Equation (3) can be simpified. The simplified approximation to Equation (3) is:

$$Q_i = \frac{(ppm_x)(Q_w)}{(\%X)(10000)} \qquad (4)$$

where Q_i = Injection rate in gallons per minute (gpm),
Q_w = Water supply flow rate (gpm),
ppm_x = Desired ppm level of chemical X, and
%X = Percentage of chemical X in the stock solution.

In repeating the above chlorine example we get:

$Q_w = 550$ gpm; $ppm_x = 10$; and $\%X = 5$; and

$$Q_i = \frac{(10)(550)}{(5)(10000)} = 0.10 \text{ gpm}$$

This result is consistent with the previous example. In most cases, Equation (4) may be used. However, if greater accuracy is needed, then use Equation (3).

Some injectors are operated to inject on a gallons-per-hour (gph) basis. Therefore, the injector rate determined above must be converted using the following equation:

$$Q_i(\text{gph}) = (60)(Q_i[\text{gpm}]). \qquad (5)$$

For example, a flow rate of 0.10 gpm is equal to a flow rate of 6.0 gph.

Injection Volumes and Periods

Chemical mixtures may be injected directly from the stock supply tank or from an injector feeder tank. Injector feeder tanks are useful for injecting a specific volume of liquid, regardless of the injection rate. When the tank is empty the desired volume of chemical mixture has been injected. This procedure eliminates excess applications of chemicals which may occur due to pump or controller failure.

The size of the required feeder tank will depend on the volume of chemical mixture to be injected, which in turn will depend on either the total amount or volume of chemical to be applied or on the length of the injection period. Volumetric applications can be based on area applications or the sum of individual applications. For example, a pesticide may require that X pounds of a chemical be applied per acre; a vegetable grower may want to apply a certain mass of fertilizer per acre or per 1000 bedded feet of plant row; or a citrus or nursery operator may want to supply a certain amount of fertilizer per irrigated plant. In addition to the desired level of fertilization, these situations require knowledge of the irrigated acreage per set, total feet of bedded production area irrigated per set, or the number of plants or trees irrigated in each set.