agent. It effectively eliminates many parasites as well as bacteria and fungi from the external surface of fish. It is caustic to epithelial surfaces, however, and should never be used more than once a week. Potassium permanganate should be delivered at a concentration of 2 mg/L as a prolonged bath. Delivery of the chemical to aquarium systems is best accomplished by using a stock solution. For $KMnO_4$, a stock solution that will deliver the desired concentration (2 mg/L) can be prepared by dissolving 285 g of the chemical into 1 gallon of distilled water and dispensing a dose of 2 drops per gallon. This concentration should change the water to a light pink color. If the water color changes from pink to brown, or clears, in less than 4 to 6 hours, the treatment may not have been effective. Potassium permanganate is quickly deactivated in water that has a heavy organic load. To compensate for this, the treatment can be repeated, in 2 mg/L increments, until a concentration of 6 mg/L has been achieved. If it is still not possible to maintain a pink color for 4 hours (from the time of the first application of $KMnO_4$), the system should be cleaned and the problem reevaluated. A short-term bath of $KMnO_4$ can be delivered by using 10 mg/L for 30 minutes.

Copper sulfate is extremely effective against protozoans and is inexpensive. Although not FDA approved for this purpose, it is EPA approved as an algicide and has been used extensively in commercial aquaculture for many years. Copper sulfate is very toxic to fish and so must be used carefully in a system containing live fish. For freshwater systems, a safe way of achieving this is to titrate the concentration of $CuSO_4$ based on the total alkalinity of the water. Total alkalinity (TA) can be quickly measured with a test included in the Hach kit (#FF-1A). If TA is less than 50 mg/L, $CuSO_4$ is contraindicated. If TA is between 50 and 250 mg/L, the concentration of $CuSO_4$ should equal TA/100. For example, if TA is 100 mg/L, then the desired concentration of $CuSO_4$ is 100/100 = 1 mg/L. If TA is greater than 250 mg/L, the concentration of $CuSO_4$ delivered should not exceed 2.5 mg/L. A stock solution can be made by dissolving 285 g $CuSO_4$ into 1 gallon of distilled water. The stock solution mentioned above will deliver 1 mg/L $CuSO_4$ for every drop per gallon dispensed. Copper sulfate must be used with caution in ponds because it is a powerful algicide and can cause a catastrophic oxygen depletion. Aeration must be provided when treating fish with any chemical.

Determining how much chemical to add to a system to achieve a specific concentration is fairly straightforward as long as the volume of the system is known. Most aquarists determine volume in gallons, and 0.0038 grams of anything, dissolved in one gallon of water, is equal to 1 mg/L. Table 4 gives several examples of how this information can be used to calculate the amount of chemical to deliver in an aquarium system.

Table 4. Examples of calculations used to determine amount of chemical required to deliver a specific concentration of compound to an aquarium system.

To treat a 125 gallon freshwater aquarium:

Chemical	Desired Concentration	Formula
Formalin	25 mg/L. (2 drops/gal.)	125 gal X 2 drops/gal = 250 drops (12.5 ml)
Potassium Permanganate	2 mg/L	125 gal X 2 mg/L X 0.0038 = 0.95 gram
Copper Sulfate	Total alkalinity/100, if tot. alk. = 50-250 mg/L. (Assume tot. alk. is 220 mg/L.)	125 gal X 220/100 X 0.0038 = 1.0 gram
***Masoten* 80% wettable powder**	0.25 mg/L. (For a product that is only 80% active, use 100/%AI = 100/80 = 1.25.)	125 gal X 0.25 mg LX 0.0038X 1.25 = 0.15 gram
Salt	0.2% = 2 ppt = 2000 ppm = 2000 mg/L	125 gal X 2000 mg/L X 0.0038 = 950 grams = 2.1 lbs