How To Calculate The Amount Of
Phosphoric Acid
Needed To Neutralize Water Of A Known Alkalinity

by

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A very common problem in the upper midwest is pH management. Often crops are grown in what would be considered alkaline media. As a result, crop growth is often depressed due to, among other things, nutrient deficiencies.

One way to manage pH is to simply neutralize you water prior to watering a crop. High pH water is neutralized by adding an acid to the water. To determine the amount of acid which must be added to neutralize water a water sample must be taken prior to adding fertilizer and sent to the soil testing lab to determine the 'alkalinity' of your water. Once the alkalinity of your water has been determined, the following computations can be done to determine the amount of acid you must add per gallon of water to result in a pH of 7.0. The most common acid used to neutralize water is phosphoric acid.

I. Basic Information:

Strength of phosphoric acid: Stock solution is 44.4 normal.
75% solution is 33.3 normal

Alkalinity is reported as milligrams of calcium carbonate ($CaCO_3$) per liter of water

Molecular weight of $CaCO_3$ is 100
Equivalent weight of $CaCO_3$ is 50

General formulas for equivalents, volumes, and normalities:

milliliters (ml) x normality (N) = ml x N
since ml x N = milliequivalents

ml x N = millieqivalents

mg/equivalent weight = milliequivalents

II. Example problem:

Given, 1 liter of water that has an alkalinity of 270 mg $CaCO_3$/liter

What volume of a 75% phosphoric acid solution (33.3 N) is required to neutralize the 270 mg $CaCO_3$ in 1 liter of water?

III. Solution:

270 mg $CaCO_3$ (alkalinity) / 50 (equivalent weight) = 5.4 milliequivalents $CaCO_3$/ liter.

ml x 33.3 (normality) = 5.4 (milliequivalents $CaCO_3$/liter)

ml = 5.4 (milliequivalents $CaCO_3$/liter) / 33.3 (normality) = 0.1622 ml phosphoric acid (H_3PO_4).

Therefore, 0.1622 ml of 75% phosphoric acid is needed to neutralize 1 liter of water with an alkalinity of 270 mg $CaCO_3$/liter. To determine the amount of acid required per gallon, multiply the amount of acid required per liter by 3.785. In our example, 0.61 ml of phosphoric acid would be required per gallon of water.