Using Chemicals in Pond Management

Cooperative Extension Service • The University of Georgia
College of Agricultural and Environmental Sciences • Athens

Chemicals are applied to ponds and lakes to control aquatic weeds; to control fish diseases; to eliminate undesirable fish; to control undesirable insects and aquatic invertebrates and to correct undesirable water quality problems. Pond owners are often confused by terminology, units of measure, and formulations. This confusion makes it difficult to select the right chemical, to calculate the proper amount to be applied, and to apply it to the pond in a correct and safe manner.

THE RIGHT CHEMICAL

Will the chemical achieve the results desired? This question may seem too obvious, but it is one that is often overlooked by pond owners. For example, no single aquatic herbicide is capable of controlling all kinds of weeds that are potential pond management problems. Most chemicals used to control weeds, diseases, and other aquatic pests are expensive and are effective only on certain pest organisms. For this reason, it is important to accurately identify the aquatic pest or the water quality problem before purchasing and applying a chemical to a pond. Your county Extension agent or state fisheries biologist can assist you in identifying the pest or the water quality problem.

Once you have accurately identified the problem, then select the most effective control measure. This does not mean that a chemical can or should be used to correct every pond management problem. The best approach is to consider preventive measures first. If they are not practical or do not produce the desired results, then other control methods should be considered. It is always easier and more economical to prevent a problem than to cure one. Even when preventive measures are only partially successful, they quite often facilitate the effectiveness of other control measures. Preventive measures may or may not include the use of chemicals.

Matching the management problem with an effective chemical is not enough. You must also consider the effect that chemicals may have on non-target organisms. For example, some chemicals used to treat diseases in fish are also toxic to plants. Use of these chemicals during the summer months may cause oxygen depletion. Also, the water chemistry and its effect on the chemical may need to be considered. Some chemicals break down rapidly in the presence of sunlight, high pH, and high temperature and are less likely to be effective during the hot summer months. Be sure to consider other water uses and effects the chemical may have on them. For example, aquatic herbicides applied to a pond used for irrigation may have a disastrous effect upon the irrigated crops. Also, consider the effects the chemical may have downstream from your pond.

Whenever you use a chemical in a pond, it must be applied properly and all warnings and precautions concerning use must be understood and observed. Fortunately, all of this information is on the label for most chemicals approved for use in ponds. Anyone who uses a chemical in a pond should always thoroughly read and understand the chemical label before purchasing and applying it.

Obviously the effectiveness of some chemical treatments can be quite variable. If you are not certain of the identification of the aquatic pest or the best control method, consult your county Extension agent or state fisheries biologist.

Assuming you have selected the most effective chemical for use, the following information should be used to determine the proper amount to apply and to determine the best and safest way to apply it.

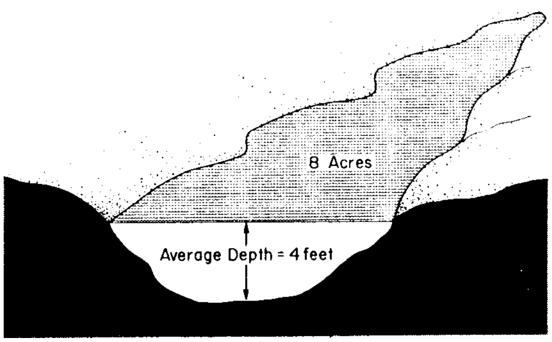
CALCULATION OF CHEMICAL TREATMENTS APPLIED TO POND WATER

The following information is essential in computing the amount of chemical to apply to a pond: the pond water volume, the chemical formulation, and the effective concentration of the chemical needed in the pond water to correct the problem.

Pond Water Volume

Every pond owner should know the water volume of his pond. Volume can be expressed as cubic feet, cubic meters, gallons, liters, etc. However, because of the rather large numbers involved with these units, the common measure used for pond water volume is acre-feet. For example, a pond eight surface acres with an average depth of four feet would contain 10,432,000 gallons of water. This equals 32 acre-feet of water.

An acre-foot is one surface acre one foot deep. Acre-feet are computed by multiplying the area (in acres) by the average depth (in feet). In the example above, eight surface acres times the average depth of four feet equals 32 acre-feet of water.

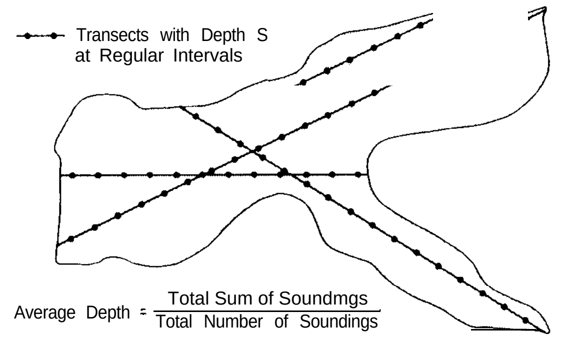


Most Natural Resources Conservation Service offices can assist pond owners in determining the water volume of their ponds. The surface acreage of most ponds can also be determined by county Farm Service offices.

Assuming the surface acreage of a pond is known, the following method can be used to determine the average depth of a pond.

Average depth can be determined by use of a sounding line at regular intervals along several transects of the pond. Both deep and shallow areas of the pond should be included in the transects. Average depth is computed by adding all of the depth measurements and dividing by the number of measurements. The average depth multiplied by the surface area should give an accurate estimate of the pond water volume.

Know the water volume of your pond before a treatment is needed. You can lose valuable time if the determination must be made after a problem has arisen. Table 1 can be used to convert acre-feet into other measures of water volume.



$$\text{Average Depth} = \frac{\text{Total Sum of Soundmgs}}{\text{Total Number of Soundings}}$$

$$\text{Example: } 3.5' = \frac{1'+2.5'+4'+4.5'+4.5'+4'+6'+4'+4'+4'+2.5'+1'}{12}$$

Table 1. Equivalents of 1 acre foot of water

1 acre-foot =	43,560 cubic feet
=	4,840 cubic yards
=	326,000 gallons (approximately)
=	2,780,000 pounds (approximately)

Chemical Formulations

Chemical formulations vary in the amount of active ingredients present. The active ingredients actually are the chemicals which kill the pest or correct the undesirable water quality problem. Inert ingredients are added to improve the convenience, safety and handling of the chemical.

For a particular chemical, the application rate is based upon the amount of active ingredient in the chemical formulation. Fortunately, the amount of active ingredients contained in the chemical formulation and the application rate are printed on most product labels. This is one reason why it is important to read the information printed on the label.

Effective Chemical Concentration

In treating a pond, chemicals are added to the water to produce an effective concentration of active ingredients that will eliminate the pest or correct the water quality problem. Desired concentrations are usually expressed as parts per million, usually written as ppm.

One part per million is equivalent to the ratio of one pound of chemical to 999,999 pounds of water or one gram of chemical to 999,999 grams of water. In other words, one part per million equals one pound or one gram in one million pounds or grams of a solution or mixture, respectively.

Notice that parts per million is a weight-to-weight relation. Units of volume cannot be used directly. This is because an equal volume of two different chemicals may have considerably different weights. F-v example, one cubic-foot of lead weighs much more than one cubic-foot of water.

Calculation of Pond Water Treatments

The following formula can be used to determine the amount of chemical needed to treat a pond:

Amt of Chemical = Volume x CF x ECC x Al
Needed

Where:

Volume = Volume of water to be treated. Although the unit of measure can be in gallons, liters, cubic feet, cubic yards, etc., when treating ponds, the more common and easier to use expression of volume is acre-feet.

CF = Conversion factor, a figure that equals the weight of a chemical to be used to give one part per million (ppm) in a given unit volume of water. Table 2 lists conversion factors (CF) for various measures of volume. For example, select the CF that corresponds to the unit of measure used for pond volume. For example, if the pond volume is measured in acre-feet, the appropriate CF is 2.72 if the chemical weight is measured in pounds or 1,233 if weight is measured in grams.

Table 2. Conversion Factors (CF) - Weight of Chemical in One Unit Volume of Water to Give One Part Per Million ppm.

2.72 pounds per acre-foot	=	1 ppm
1,233 grams per acre-foot	=	1 ppm
0.0283 grams per cubic foot	=	1 ppm
0.0000624 pounds per cubic foot..	=	1 ppm
0.0038 grams per gallon	=	1 ppm
0.0584 grains per gallon	=	1 ppm
1 milligram per liter	=	1 ppm
0.001 gram per liter	=	1 ppm
8.34 pounds per million gallons of water	=	1 ppm

ECC =
Effective chemical concentration of active ingredients needed in the pond water to eliminate the pest or correct a water quality problem. This unit of measure must be in ppm.

Al =
The total amount of active and inert ingredients diuided by the amount of active ingredients. Products, which are liquid formulations, usually list the amount of active ingredients as pounds active per gallon. For such products Al = 1 gallon divided by the pounds per gallon of active ingredients. A few chemicals are liquids in their pure form and their specific gravity must be known to calculate Al. See Example 4 to calculate Al using specific gravity. Nonliquid formulations usually list active ingredients as a percentage of the total formulation. For nonliquid formulations, Al = 100% divided by the percentage of active ingredients.

The following examples illustrate how the equation previously mentioned can be used in calculating pond water treatments.

Example 1. How much chemical A is needed to treat a pond that has **4** surface acres and an average depth of 3 feet with 2 ppm active ingredient? Chemical A is 100% active.

Volume	= **4** acres x **3** feet
	= 12 acre-feet
CF	= 2.72 pounds (from Table 2)
ECC	= 2 ppm (active ingredient needed in the water)
Al	$= \frac{100\%}{100\%}$ (chemical A is 100% active)

The amount of chemical A needed is found by substituting the above values in the formula:

Volume x CF x ECC x Al

Thus:

12 acre-feet x 2.72 pounds x 2 ppm x $\frac{100}{100}$ =

65.3 pounds of chemical A are needed to treat the pond.

Example 2. How much chemical B (80 percent active) is needed to treat a pond measuring 1,000 feet long by 500 feet wide by 5 feet deep with a concentration of 0.25 ppm active ingredient?

Volume	= 100 feet x 50 feet x 5 feet
	= 25,000 cubic feet
CF	= 0.0000624 pounds/cubic foot (from Table 2)
ECC	= 0.25 ppm (active ingredient needed in the water)
AI	$= \frac{100\%}{80\%}$

The amount of chemical B needed is found by substituting the above values in the formula:

Volume x CF x ECC x AI

Thus:

25,000 cu. ft. x 0.0000624 pounds/cu.ft. x 0.25 ppm x $\frac{100}{80}$ =

0.49 pounds of chemical B (80 percent) are needed to treat **the pond.**

Example 3. How much chemical C (2 pounds active per gallon) is needed to treat a pond that has 6 surface acres and an average depth of 4 feet with 0.5 ppm active ingredient?

Volume	= 6 acres x 4 feet
	= 24 acre-feet
CF	= 2.72 pounds/acre-foot (From Table 2)
ECC	= 0.5 ppm (active ingredient needed in water)
AI	$= \frac{1 \text{ gal.}}{2 \text{ lbs.}}$

The amount of chemical C needed is found by substituting the above values in the formula:

Volume x CF x ECC x AI

Thus:

24 acre-feet x 2.72 pounds/acre-foot x 0.5 ppm x $\frac{1 \text{ gal.}}{2 \text{ lbs.}}$ =

16.3 gallons of chemical C (2 lbs. active/gallon) are needed to treat the pond.

Example 4. How much chemical D is needed to treat a pond measuring 180 feet long by 90 feet wide by 4 feet deep with a concentration of 25 ppm active ingredient. Formalin is a liquid and is 100 percent active.

Volume	= 180 feet x 90 feet x 5 feet
	= 81, 000 cubic feet
CF	= 0.0000624 pounds per cubic foot
ECC	= 25 ppm
AI	$= \frac{100\%}{100\%}$

The amount of chemical D needed is found by substituting the above values in the formula:

Volume x CF x ECC x AI

Thus:

81,000 cu. ft. x 0.0000624 pounds/cu.ft. x 25 ppm x $\frac{100}{100}$ =

126.4 pounds of chemical D

However, chemical D is a liquid and 126.4 pounds must be converted to a unit of volume. Since (ppm) parts per million is a weight-to-weight relation, it is necessary to know how chemical D compares in weight with water. Chemical D is heavier than water, thus a smaller amount of chemical D is needed to equal 250 ppm in water on a chemical D to water weight-to-weight ratio. Chemical D weighs about 9 pounds per gallon and water 8.34 pounds per gallon; or formalin is 1.08 times as heavy as water (9 divided by 8.34). This figure is called the specific gravity (SG) of chemical D. If the weight of chemical D is computed in grams, the weight divided by the specific gravity equals the number of cubic centimeters required. If the weight (as in this example = 126.4 pounds) is computed in pounds, divide by 8.34 times the specific gravity to convert it to gallons. In this example the amount of chemical D needed is:

$$\frac{126.4 \text{ pounds}}{8.34 \text{ lbs/gal} \times 1.08 \text{ SG}} = 140 \text{ gallons}$$

TREATMENT METHODS

Selection of the best treatment method depends upon the specific situation and the chemical used in treatment. The following treatment methods can be used.

TREATMENTS APPLIED TO POND WATER

1. Surface - applied treatments
Contact pesticides, inorganic fertilizers, lime and a few other water quality control chemicals are applied to ponds at a rate based upon the surface acreage of the pond - not the pond's water volume. Generally, these chemicals are either sprayed or broadcasted over the pond surface.

2. Total water column water treatments
This is the most common technique of chemical treatment used in a pond. The whole volume of water (water column) in the pond is treated. The pond water volume is calculated and the chemical is added to reach a specific dilution in the water column. An alternative is to calculate the entire volume and then treat only one-fourth or one-third of the total water column, based on surface area, confining the treatment to selected sections of the pond where the pest infestation may be more intense. Specific application techniques include injection directly into the water with undiluted chemical, or some dilution of the chemical sprayed or cast upon the surface of the water. With either method, further dispersal throughout the water column is dependent upon water currents.

3. Bottom acre-foot treatments
This is a specialized application technique which is intended primarily for control of submersed aquatic vegetation. A boat carrying application equipment drags a hose or boom over and just above the pond bottom. The chemical is dispersed through nozzles, and the specific gravity of the chemical causes the treatment to remain near the bottom and in proximity of the rooted submersed weeds.

SPECIALIZED TREATMENTS

Generally, the treatment methods described below require either the fish to be removed from the culture area treated and then returned, or instead of treating the culture water to remove a pest, the fish themselves are treated with a chemical usually incorporated into their feed.

1. Dip Method
This involves exposure of the fish to a strong solution of chemical for a short period of time. Fish are usually netted and dipped into a chemical and returned to the culture area.

2. Flush Method
This method is only applicable in tanks, raceways, or egg incubators. A stock solution of a chemical is applied in the upper end of the unit and allowed to flush throughout the system. The chemical must flush through the system in a predetermined time.

3. Bath Treatments
Bath treatments involve application of a chemical directly to the culture area and after a specified time, flushing it from the rearing unit. Bath treatments may be commonly used in culture tanks but are difficult to apply in ponds because most managers do not have an adequate water supply to flush the pond after treatment.

4. Feeding Method

Feeding involves the incorporation of a drug or medication in a feed, or in some other way introduces the chemical into the stomach of the fish. This treatment is the most common method used in treating bacterial infections and internal parasites of fish.

5. Injection Method

Some medications and drugs can be injected into a fish for effective control of a disease. It is generally not practical in pond or intensive culture systems unless the fish have a high economic value.

Table 3. Conversions for Units of Volume

FROM \ TO	CM^3	liter	M^3	IN^3	ft^3	fl. oz.	fl. pt.	fl. qt.	gal.
CM^3	1	0.001	1×10^{-6}	0.0610	3.53×10^{-5}	0.0338	0.00211	0.00106	2.64×10^{-4}
liter	1000	1	0.001	60.98	0.0353	33.81	2.113	1.057	0.2642
M^3	1×10^{6}	1000	1	6.1×10^{4}	35.31	3.38×10^{4}	2113	1057	264.2
IN^3	16.39	0.0164	1.64×10^{-5}	1	5.79×10^{-4}	0.5541	0.0346	0.0173	0.0043
ft^3	2.83×10^{4}	28.32	0.0283	1728	1	957.5	59.84	29.92	7.481
fl. oz.	29.57	0.0296	2.96×10^{-5}	1.805	0.00104	1	0.0625	0.0313	0.0078
fl. pt.	473.2	0.4732	4.73×10^{-4}	28.88	0.0167	16	1	0.5	0.125
fl. qt.	946.2	0.9463	9.46×10^{-4}	57.75	0.0334	32	2	1	0.25
gal.	3785	3.785	0.0038	231.0	0.1337	128	8	4	1

Table 4. Conversions for Units of Length

FROM \ TO	cm	m	in.	ft.	yd.
cm	1	0.01	0.3937	0.0328	0.0109
m	100	1	39.37	3.281	1.0936
in.	2.54	0.0254	1	0.0833	0.0278
ft.	30.46	0.3048	12	1	0.3333
yd.	91.44	0.9144	36	3	1

Table 5. Conversion for Units of Weight

FROM \ TO	gm.	Kg.	gr.	oz.	lb.
gm.	1	0.001	15.43	0.0353	0.0022
kg.	1000	1	1.54×10^{4}	35.27	2.205
gr.	0.0648	6.48×10^{5}	1	0.0023	1.43×10^{-4}
oz.	28.35	0.0284	437.5	1	0.0625
lb.	453.6	0.4536	7000	16	1

Table 6. Miscellaneous Conversion Factors

1 acre-foot	43,560	cubic feet
1 acre-foot	325,580	gallons
1 acre-foot of water	2,718,144	pounds
1 cubic-foot of water..	62.4	pounds
1 gallon of water..	8.34	pounds
1 gallon of water..	3,785	grams
1 liter of water	1,000	grams
1 fluid ounce	29.57	grams
1 fluid ounce	1,043	ounces

Helpful Formulas for Determining Volume

1. Volume of a square or rectangular container = length x width x depth

2. Volume of a circular container = 3.14 x $radius^2$ x depth

3. Volume of a pond = surface acres x average depth = acre-feet

Abbreviations

cm	=	centimeter
cm^3	=	cubic centimeter
fl oz	=	fluid ounce
fl pt	=	fluid pint
fl qt	=	fluid quart
ft	=	foot
ft^3	=	cubic foot
gal	=	gallon
gm	=	gram
gr	=	grain
in	=	inch
in^3	=	cubic inch
kg	=	kilogram
lb	=	pound
m	=	meter
m^3	=	cubic meter
oz	=	ounce
yd	=	yard

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Wellborn, T.L. 1979. Control and Therapy in Principal Diseases of Farm-Raised Catfish. Southern Cooperative Series No. 225. Southern Regional Research Project S-83. Pages 61 - 89.

ATTENTION!
Pesticide Precautions

1. Observe all directions, restrictions and precautions on pesticide lables. It is dangerous, wastefu! and illegal to do otherwrse.
2. Store all pesticides in orginal containers with labels intact and behind locked doors. KEEP PESTICIDES OUT OF THE REACH OF CHILDREN.
3, Use pesticides at correct label dosages and intervals to avoid illegal residues or injury to plants and animals.
4. Apply pesticides carefully to avoid drift or contaimination of non-target areas.
5. Surplus pesticides and containers should be disposed of in accordance with label instructions so taht contamination of water and other hazards will not result.
6. Follow directions on the pesticide label regarding restrictions as required by state and federal laws and regulations.
7. Avoid any action that may threaten an endangered species or its habitat. Your county Extension agent can inform you of endangered species in your area, help you identify them and through the Fish and Wildlife Service Field Office identify actions that may threaten endangered species or their habitats.

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