FA23

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The Use of Potassium Permanganate in Fish Ponds [1]

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Potassium permanganate, $KMnO_4$, is a chemical oxidizing agent that will react with any organic matter in a pond including algae, bacteria, fish, particulate and dissolved organic, and organic bottom sediments. It has been used in fish ponds to treat common fish pathogens such as gill parasites and external bacterial and fungal infections. Contrary to some reports, potassium permanganate does not add significant amounts of oxygen to water and can actually decrease dissolved oxygen concentrations by killing algae that produce much of the oxygen in ponds.

Treatment Rate

Common treatment rates are 2 parts per million (ppm) or milligrams per liter (mg/L) for an indefinite pond application or 10 mg/L for a 10-minute tank treatment. Actual treatment rates in ponds will vary depending on the amount of organic matter, or organic load, in the water. As with any chemical treatment, it is crucial to accurately estimate the volume of water that is to be treated.

How to Estimate Water Volume

Potassium permanganate is an expensive treatment. Therefore, it is important to properly estimate water volume to achieve both a cost-effective and biologically effective treatment. Underestimating water volume will result in an insufficient concentration of chemical, and retreatment would be necessary. Overestimating water volume can result in a greater-than-desired concentration of chemical, and may injure or even kill fish. Pond volume is measured in acre-feet (surface acreage multiplied by the average water depth in feet). One acre-foot is equal to one surface acre with a depth of one foot.

Estimating pond volume can be difficult when a pond has an irregular shape and varying water depth. The surface area of a square or rectangular pond can be easily estimated by multiplying the pond length by the pond width. Your local Soil Conservation Service or County Extension Service Office can provide assistance in determining pond acreage for irregularly- shaped ponds.

The average water depth for ponds with a sloped and flat bottom can be determined by averaging the

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shallowest and deepest water depths. For example, a pond with a sloping flat bottom that has a maximum depth of six feet and a minimum depth of four feet would have an average depth of five feet. Determining the average depth for ponds with uneven bottoms and widely varying depths requires measurement of water depth at multiple locations in the pond using a simple grid or zig-zag sampling approach, in which all areas of the pond are measured.

How to Calculate Amount of Chemical Required

An important factor to remember is that 1 ppm (or 1 mg/L) is equal to 2.7 pounds of dry chemical per acre-foot of water. A sample calculation to determine the amount of potassium permanganate required to treat a pond at a 2 mg/L concentration is as follows:

Example:

You have estimated a pond to be 5 surface acres, and the pond has an average depth of 5 feet.

1. 5 acres x 5 foot average depth = 25 acre-feet of water.
2. 25 acre-feet x 2.7 lbs/acre-foot = 67.5 lbs of potassium permanganate to obtain a concentration of 1 mg/L in the pond.
3. 67.5 lbs of potassium permanganate x 2 = 135 lbs of potassium permanganate to obtain a concentration of 2 mg/L in the pond.

A 2 mg/L treatment is usually effective for ponds with relatively clear water. Potassium permanganate reacts with organic matter and becomes neutralized and unavailable to treat the target parasite. The greater the amount of organic matter in a pond, the more potassium permanganate required to achieve the desired chemical concentration. Therefore, a pond with moderate to heavy algal blooms will require a higher treatment rate to neutralize the organic matter in the pond and still achieve the desired concentration of 2 mg/L.

One popular method of treatment is to begin with an application of 2 mg/L potassium permanganate. If the pond remains pink to purple in color for 8--12 hours, then an effective treatment is assumed to have occurred, and no additional chemical is required. However, if within a 12-hour period, the pond turns brown, then an additional 1--2 mg/L treatment is required, depending on how quickly the pond turned brown. It is recommended that treatment begin in the morning so that the pond can be watched for the next 8- to 12-hour period, and any color change can be easily detected.

How to Determine Permanganate Demand

Another method to estimate the amount of potassium permanganate required for effective treatment is to determine the potassium permanganate demand or amount of chemical required to react with all the organic matter in a water sample. This procedure measures the 15-minute demand. This value is then multiplied by 2 to give the recommended treatment rate. The 15-minute demand is determined as follows:

1. Prepare a 1,000 mg/L stock solution by adding 1,000 milligrams or 1 gram of potassium permanganate to 1 liter of distilled water and mix thoroughly.
2. Collect five 1-liter samples of the pond water.
3. Prepare a series of test treatments. Add 2, 4, 6, 8, and 10 milliliters (mL) of the stock solution (prepared in Step 1) into the five 1-liter samples. Mix thoroughly.
4. Wait 15 minutes.
5. The test treatment that has the slightest faint pink color after 15 minutes is the correct 15-minute potassium permanganate demand. If there is a question as to which rate has a faint pink color, choose the lower treatment rate.
6. Multiply the 15-minute demand treatment by 2 to get the proper treatment rate for the pond.

Example:

A series of 1-liter pond water samples was treated with potassium permanganate stock solution. After 15 minutes, the 2 mg/L treatment turned brown, but the 4 mg/L treatment still had a faint pink color. The 4 mg/L treatment is therefore the 15-minute demand. Multiplying the 4 mg/L demand treatment by 2 gives a recommended pond treatment rate of 8 mg/L.

How to Apply Chemical

Potassium permanganate is commercially available in crystal or powder form. it should be mixed with water before use, and then applied evenly over the entire pond surface to ensure an effective treatment. For small ponds (less than one acre), application of the chemical can be achieved by first adding a small portion of the total amount of chemical required for treatment to water in a five-gallon plastic bucket, and then broadcasting this solution over the surface of the pond while walking around the pond. This process is repeated until all of the required chemical is added to the pond. This method works well when the chemical can be dispersed evenly over the entire surface area of a pond from the shore. In larger ponds (larger than one acre), a boat equipped with a large take or container and motor is recommended for distributing the chemical. The chemical mixture can be applied by means of a submersible pump or gravity fed from the container into the prop wash of the boat motor. Uniform application can be achieved by driving the boar over the entire pond surface.

Precautions When Using Potassium Permanganate

A few helpful reminders and precautions before using potassium permanganate include:

- Be sure you have a problem that warrants treatment. Potassium permanganate is expensive. For example, it cost approximately $80 to treat a one-acre pond, with an average depth of 5 feet, at a 4 mg/L concentration. Have your fish properly diagnosed and carefully consider the cost.
- Potassium permanganate is a strong oxidizer and can burn skin, eyes, and other body parts. It will stain you and everything it touches brown. Always use safety protective gear including rubber gloves, goggles and old clothes. A dust mask is advisable to prevent irritation to your respiratory tract.
- Be sure to estimate water volume accurately, and disperse the chemical evenly over the entire pond to prevent hot spots, areas of the pond with excessive amounts of chemical.
- Potassium permanganate can kill algae. Low oxygen conditions can occur following treatment. Be prepared to aerate after treatment.
- Frequent treatment can harm fish. Wait at least four days before repeating treatment. If fish do not respond to treatment, reevaluate them to confirm the diagnosis.