



"How To" Series: A Guide to Backyard Pond Water Quality

By Rick Smith, EasyPro® Pond Products

There are those times when we think we have done everything right and the results still come up short of the desired outcome. We have all experienced the frustration at one time or another.

When this happens to us in regards to our pond, we start to question ourselves to see if we missed something or maybe we question the guidance (product and/or application) we got from someone's opinion after a google search, reading a trade article, a published guide, or even guidance from someone we know with experience.

The fact is, when it comes to pond water quality (a balanced ecosystem) and clear water, there are so many contributing and constantly changing factors that it is not an easy topic to communicate in simple terms.

Some information is written in scientific technical terms, and unless we are fluid in the terminology it can be challenging to get your head around it all.

On the other hand, other articles present information in a simplified step by step – do this – do that – best practices format without the technical background to explain what makes it all work, or what's going on when it's not. This is like counting on your GPS to route you to your destination without the ability to recalculate if traffic forces you to make a wrong turn or run into some unplanned for detour. This can happen with our pond.

Part 1

We will outline what a living breathing balanced ecosystem relies on for a healthy environment and how everything interacts favorably for a balanced water quality condition.

Part 2

We will outline how to effectively use test kits to read desired levels from those that are detrimental to water quality and sound fish health.

Part 3

We will identify what will negatively impact this balance and specific corrective steps to take. By knowing what "negative impact conditions" to watch out for we can take corrective action most of the time before we visually see the results in the pond, which can take a couple of weeks to fully develop.



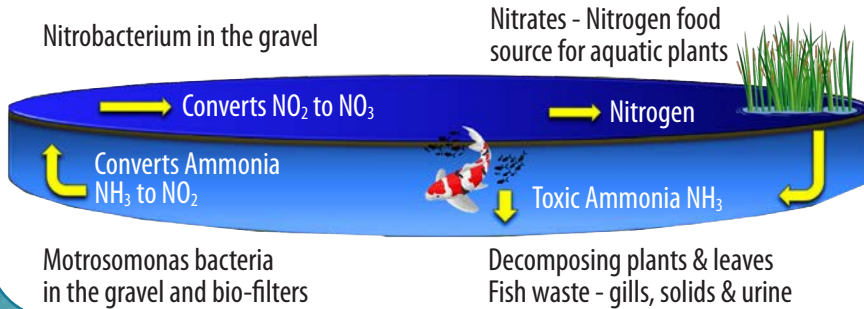
Part 1: "The Big Picture" - The Nitrogen Cycle

Ammonia, Nitrites & Nitrates

Maintaining a Natural Nitrogen Cycle

Excess nitrite (NO_2) prevents blood from carrying oxygen

Excess nitrate (NO_3) helps promote algae blooms



Fish waste, dead plant material (including dead algae) settle to the bottom and decompose. As the organic matter decomposes it creates **toxic ammonia**. **Beneficial bacteria, with the assistance of oxygen**, then converts the **toxic ammonia** into **nitrites** (still toxic) and then into **nitrates**. **Nitrogen** is then absorbed by plants as a food source.

This natural cycle is referred to as the Nitrogen Cycle.

How a Pond Lives & Breathes

Oxygen and Carbon Dioxide Exchange Process

Ponds can be thought of as taking a breath and exhaling once within a 24-hour period.

During the day plants take in carbon dioxide and as a byproduct of photosynthesis releases oxygen back into the water. With the help of the sun plant life goes through the process of photosynthesis to make glucose. Glucose is a form of sugar that plants need to survive.

During the night hours, when photosynthesis stops, beneficial bacteria uses the oxygen to process toxic waste and as a bi-product produces carbon dioxide (CO_2). All living organisms also take in oxygen and produce carbon dioxide.

When everything is in balance the creation and exchange of oxygen and carbon dioxide balances out within each 24-hour period.

Part 2: Why & How To Use Water Test Kits

Pond Water Quality Requires:

- A balanced exchange of carbon dioxide and oxygen
- A stable pH
- Proper levels of water hardness
- Minimum levels to no ammonia, nitrite and nitrate
- **NO chlorine or chloramines**
- Commonly found in city water
- **Heavy metals** - can be found in city and well water

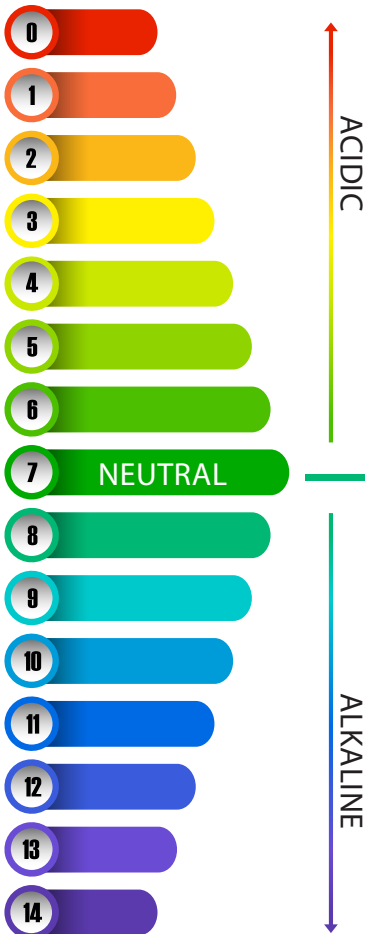
Whether one uses the API® Master Liquid Test Kit or the MICROBE-LIFT® 5 In 1 Test Strips, testing is the only way to know that one's pond water is "In Balance and Healthy."

The next page will show what we test for and what the readings mean.



Part 2: Why & How To Use Water Test Kits

The pH Scale



Stable pH

The mathematical transformation of the hydrogen ion (H⁺) concentration is pH (p refers to power of exponent. H refers to hydrogen ion). It conveniently expresses the acidity or basicity of water. It is the measure of the acidity in pond water. A pH of 7.0 is neutral; a pH reading higher than 7.0 is alkaline; and lower than 7.0 is acidic.

The pH should be considered primarily for the health of the pond. Later, we will cover what causes it to change and how it interacts positively or negatively with other elements and water conditions to impact water quality.

It is best to test for pH in the morning before plants become active when the photosynthesis process begins. Many recommend testing for pH levels a couple of time during the day over a couple of days.

Here's why:

The pH of a pond goes through a natural cycle fluctuating from day to night. Plants and algae, through photosynthesis, consume carbon dioxide that was created during the night as bacteria consumes decomposing material. This causes a temporary pH increase during the day. As sunlight diminishes, photosynthesis slows down, and the pH drops to the normal level. **Testing pH in the afternoon (not recommended) will consistently give a higher pH measurement, hiding a low pH condition that may arise in the evening and morning hours.**

- ✓ **pH range between 6.0 - 8.0** is acceptable for water gardens. A pH range between 7.0 - 7.5 is ideal.
- ✓ **pH levels less than 6.0** will stress fish and suppress the activity of the biological filtration.
- ✓ **pH levels above 8.0** will limit the ability of many plants to absorb necessary nutrients.
- ✓ **pH levels 9 plus** - fish become stressed and/or die (depending on other issues) and other water treatments (beneficial bacteria) and algae control products will NOT work.
- ✓ **pH level 5.0 or lower and levels 9.0 or higher** – immediate corrective action needs to occur.

Water Hardness

General Hardness (GH) – aids in fish health, measures calcium and magnesium ion concentrations dissolved in the water that are present in city and well water.

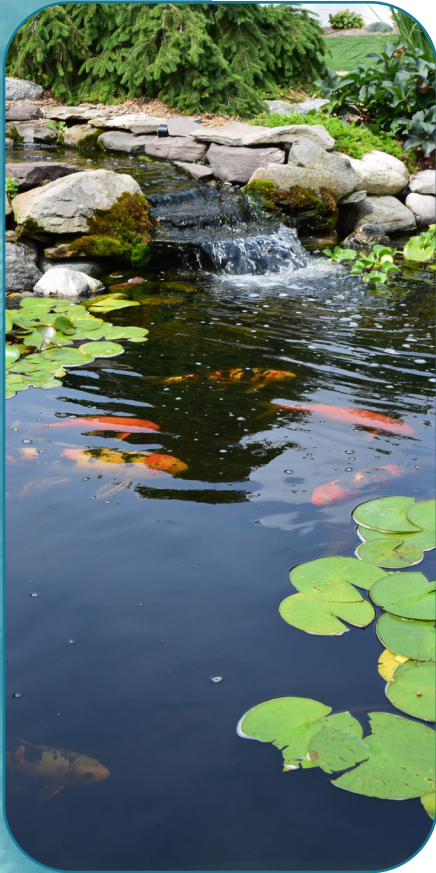
- ✓ **Desired Range – 60 – 180 ppm**

Calcium and magnesium (trace elements and electrolytes) are essential in the biological health of fish (bone and scale formation, and blood clotting). Calcium in the water helps fish reduce the loss of other salts like sodium and potassium, which are critical for normal heart, nerve and muscle function.

Carbonate Hardness (KH) – also known as **Alkalinity, aids in pH stability.** Measures the Carbonate and Bicarbonate ion concentrations dissolved in the water. Carbonates and bicarbonates are the most common and most important components of Alkalinity. Alkalinity is measured by the amount of acid (hydrogen ion) water can absorb (buffer–key word) to achieve a desired pH.

- ✓ **Desired range: 80 – 240 ppm**
- ✓ **Partial water change will add KH back to the pond**

Part 2: Why & How To Use Water Test Kits



Ammonia, Nitrites (NO₂) & Nitrates (NO₃)

Different strains of **beneficial bacteria** convert toxic ammonia to nitrites (still toxic) and then to nitrates. Nitrates then provide a nitrogen source for the growth of plants. Keep in mind that this is a sequential process. After beneficial bacteria finishes processing one element it starts processing the next phase. If one gets overloaded and is not addressed, at some point they will all become overloaded, and the quality of the water will quickly degrade.

A regular program of beneficial bacteria treatments along with oxygenation is very important. Beneficial bacteria in the filtration system will convert toxic ammonia into nitrites (still toxic) and then to nitrates.

Ammonia

Created by the accumulation and decomposition of waste from fish and plants, ammonia levels should be zero.

- ✓ **EasyPro® Water Conditioner Plus**
- ✓ **Removes ammonia, chlorine, and destroys chloramines**
- ✓ **Detoxifies nitrite and heavy metals**
- ✓ **Adds essential electrolytes, enhances skin slime coat and reduces stress**

Nitrite

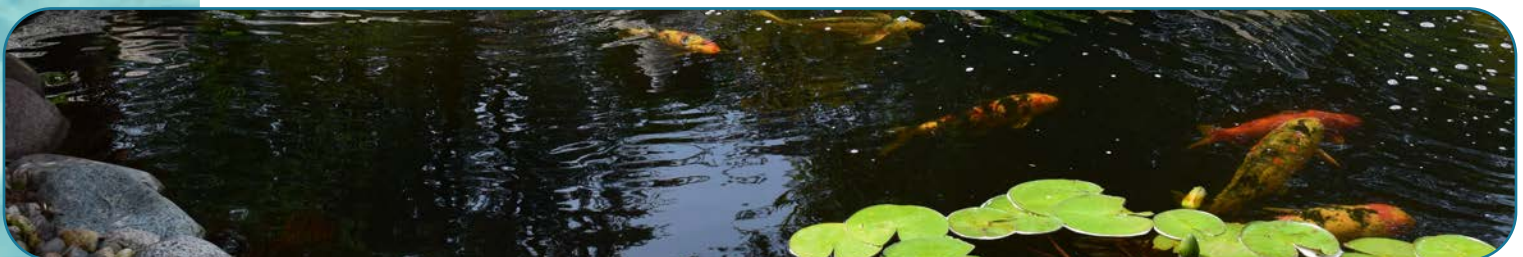
In the pond water interferes with fish respiration, increases their stress, can lead to fish diseases, and at high levels can quickly lead to fish death.

- ✓ **In an established pond, nitrites should read zero.**
- ✓ In a new pond, nitrites can climb to 5 ppm or more.
- ✓ After 4 to 6 weeks, Nitrites should read zero.

Nitrate

A high level of nitrates indicates a buildup of organic decomposing material, and fish waste. This causes poor water quality and contributes to a high possibility of fish disease. Nitrate also provides a Nitrogen source that promotes algae blooms resulting in green water.

- ✓ **In an established pond, the recommended Nitrate level should be 40 ppm or less.**
- ✓ In a new pond, it can gradually climb (4 to 6 weeks) until the biological filter becomes establish.



Part 3: Negative Events on the Quality of Pond Water



The four most common problems that contribute to poor water quality and clarity of pond water are:

1. **Overfeeding of fish**
2. **Over stocking of fish**
3. **Under filtration of pond water**
4. **Insufficient level of plants**

These four mistakes quickly increase the level of ammonia and nitrites (which are toxic) and then nitrates to an overload condition in the Nitrogen Cycle.

1. Overfeeding of Fish

Overfeeding is defined as feeding more than what the fish can consume within five (5) minutes. Overfeeding rapidly contributes to high levels of decomposing material (nutrients in the water) from an increase in fish waste and uneaten food. These additional nutrients quickly promote algae blooms and cloudy water conditions by the accumulation and decomposition of waste from fish and plants should be zero.

2. Overstocking of Fish

There are several general rules used as to how many fish a pond will safely support. For example: (1" per 24 sq. ft. of surface area), (150 gallons for each 18" to 24" koi), (500 gallons per koi), (250 gallons per koi). It really depends on the water quality resulting from effective bio-filtration, plants, oxygen, and a combination of best practices. If the filtration rate is filtering the water volume every hour, 500 gallons per koi should be fine. If the filtration rate filtering the water volume every 30 minutes, you probably will be able to support one koi per 250 gallons. Since Comets are not as big, or as big a waste producer as a koi, you can safely support above these levels. If there are more fish than the filtration can handle there will be an additional load of waste (decomposing waste and more nutrients in the water), exceeding what the bio-filtration can handle. The additional nutrients quickly promote algae and poor water quality.

3. Inadequate Filtration of Pond Water

Even if one is not over feeding the fish, or exceeds the recommended level of fish, particularly koi, (that produce 10 times the waste), being under filtered will produce the same negative results with water quality. Keep in mind, if the bio-filtration system is not maintained and cleaned as needed, it is the same as being under filtered. Basic rule: pond without fish, filter the water volume once every two hours. Ponds with fish filter the water volume once an hour. With koi, I would suggest every 30 minutes if possible.

4. Insufficient Level of Plants

The proper level of water plants play a significant role in the Nitrogen Cycle and a ponds ability to maintain healthy and clear water quality in four very important ways:

1. They directly take in the produced nitrogen
2. They shield the pond from the sun's UV that promotes algae growth
3. They help keep the water temperature cooler, which holds more oxygen
4. During the day their photosynthesis process utilizes the buildup of carbon dioxide and in exchange produces important oxygen. This allows the beneficial bacteria to do its job during the nighttime hours converting ammonia to nitrites (NO_2) and then to nitrates (NO_3). Each step adds an element of oxygen.



General Rule:

Plants should cover 1/3 of the pond surface and provide a mix of submerged plants (oxygenators), bog plants and floating leaf plants.

(See the EasyPro® Water Garden Guide to Plants for more information.)

Part 3: Negative Events on the Quality of Pond Water



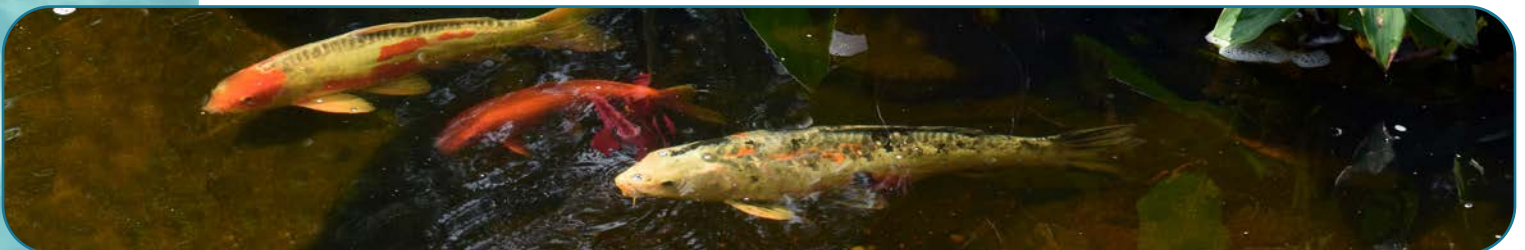
Here are several other, less thought of, causes that may be contributing to a single cell (planktonic) algae bloom and/or poor overall water quality as outlined by "Jamie Beyer's March 1, 2013 article, Water Quality - From Pea-Green to Pristine," in Pond Trade Magazine. Jamie holds a master's degree in Fish and Wildlife Biology in conjunction with over 50 years of water gardening experience.

For a more complete list visit - <https://www.pondtrademag.com/from-pea-green-to-pristine/>

Planktonic Algae

Is caused by an excess of nutrients in the water and not enough "critters" (bacteria, invertebrates and good algae. Most of these critters' homes are in a layer of life that I call the "patina of the pond." The patina referred to here is the bio-film or slime layer that grows on the liner, rocks and planting baskets.

- **The pond has been scrubbed or power washed** thereby drastically reducing the number of critters.
- **Aquatic plant fertilizer tabs** may not have been pushed completely down into the soil, thereby releasing some of the fertilizer directly into the water.
- **Runoff from the surrounding ground** has flowed into the pond after a rain. This can bring in all kinds of things that can create green water, including herbicides, fertilizers, soil and organic matter.
- **Certain pond additives have been used or overused.** Fish medications, algicides that contain copper, and other additives can kill the patina's critters.
- **Bird feeders are hanging NEAR or over the pond or stream,** allowing bird seed and bird droppings to accumulate in the water.
- **The pump output is restricted,** thereby reducing circulation. Inadequately sized outlet tubing can restrict the flow.
- **Lots of rain is falling on the surface of the pond.** This may cause an algae bloom due to the nitrogen that is dissolved in it. If this is the cause, the pond's ratio of critters to nutrients is too low anyway.
- **The pond was emptied and allowed to dry out.** If this is the case, then a lot of your patina (bio-film) layer died, and the critter population will have to rebuild itself. The addition of bacteria will speed up the process.
- **The pond is new,** and microscopic animals have not been able to reproduce and populate it yet. You can speed up the process by adding bacteria. However, a pond is not fully mature for at least two years, even when bacteria are added. A mature pond has a very diverse critter population that includes more than just bacteria. It takes time for them to show up.



Part 3: Negative Events on the Quality of Pond Water

High Temperatures & Intensity of Sunlight Impacts Photosynthesis

The rate of photosynthesis, specifically the enzymes that carry out photosynthesis, is critically dependent upon variables such as temperature, pH, and intensity of light.

- **32 to 50 degrees** - The enzymes **DO NOT** work efficiently.
- **50 to 68 degrees** - The enzymes **DO** work at their optimum.
- **68 degrees and higher** - The enzymes **DO NOT** work efficiently.

Best Practices to Maintain Water Temperature & Photosynthesis

- **Floating Plants to cover 1/3 of the pond surface.** This shields the pond water from the sun keeping the water cooler and helps the water to retain more oxygen.
- **EasyPro® “Seasonal Boost” Cold Water Bacteria** works in water as low as 38 degrees.
- **Use bottom diffused aeration to maintain oxygen levels** especially during extreme hot periods. During winter months it helps to keep the ice open to allow toxic gases to escape.

pH & Photosynthesis

So, what increases or decreases pH? Answer: The amount of carbon dioxide added or removed.

- ✓ **When carbon dioxide is created by the breakdown of waste materials each night,** it pushes the chemical reactions to form carbonic acid and hydrogen ions **causing pH to decrease.** Thus, the lowest pH readings will be in the morning hours.
- ✓ **Rainwater** is soft water, thus the pH will drop.
- ✓ **If the water source is well water,** it can also impact pH. If the water source is well water from a limestone rich aquifer the pH will consistently be high. In this case, one can use a pH Down water treatment to “slowly” bring the pH within acceptable range. Follow instructions to the letter. Do not bring the pH level down too quickly. Fish can handle a wide range of pH, but not rapid changes. And, if over applied, the pH can go down below 6.0, which is just as dangerous to the ecosystem and fish health.
- ✓ **When carbon dioxide is consumed by photosynthesis during the day,** it pushes the chemical reaction thus removing hydrogen ions and **causing pH to increase.** Thus, the highest pH readings will be in late afternoon.
- ✓ **If the water source is city water,** it may also have a high pH requiring the pH Down water treatment. As more municipalities work to deal with lead issue in the supply lines, they have increased the pH. As an example: Denver water treatment use to have a 7.5 to 8.5 range with a target of 7.8. Today, they have a range of 8.5 to 9.2 with a target of 8.8. The city of Ottawa, Canada adjust its water to a pH that is between 9.2 and 9.4, while San Francisco targets an average of 9.4.

Remember that pH levels above 8.0 starts to limit the ability for many plants to absorb nutrients, and pH levels above 9.0 are deadly to fish and water treatments usually stop working.

Why is this? Raising the pH of drinking water will make the water less corrosive. This change also strengthens an existing protective coating on the interior of the pipe. The coating reduces the likelihood of lead getting into the water.

Visit www.denverwater.org/your-water/water-quality/lead/pH. or your local water supply's website. In addition to water hardness, it will post the pH guidelines used.

What Can You Do?

Best Practices to Maintain Proper pH Levels



- **Proper fish stocking, adequate filtration, and aeration will correct carbon dioxide build-up and help stabilize pH.**
- **The rapid growth of algae is a common cause for a rise in pH.** As algae rapidly grows it removes large amounts of carbon dioxide causing an increase in water pH. Treat the algae first then check the pH again. Sometimes the removal of algae is enough to bring the pH down.
- **Use pH Down or pH Up where water source is consistently high or low.** The most commonly needed pH treatment is pH Down.
- **pH Down applies a safe amount of acid compound.** Apply and wait 24 hours, then retest. A second treatment can be done.
- **Remember it is important to bring the pH down slowly.**

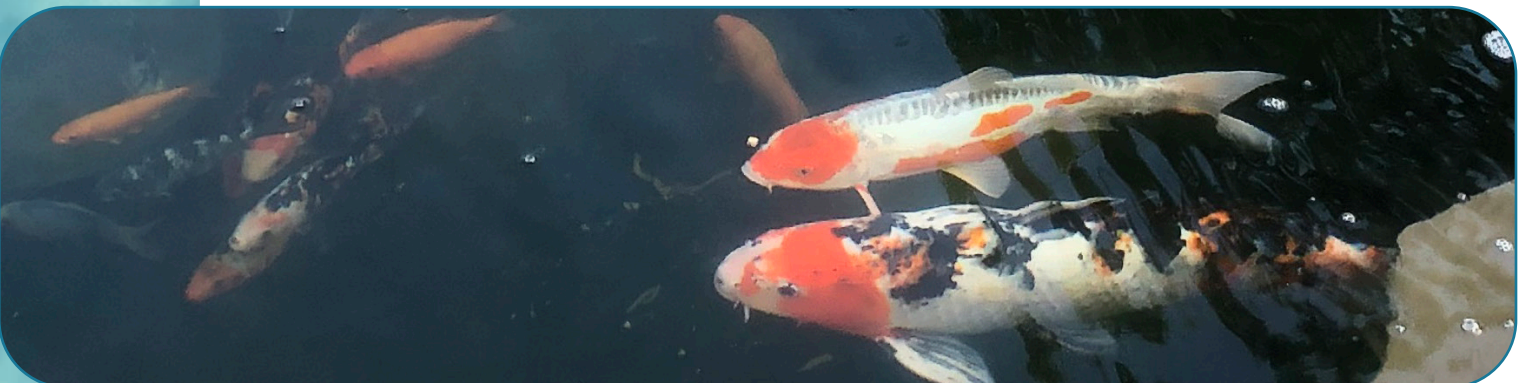
Water Hardness: General Hardness (GH) Aids in Fish Health while Carbonate Hardness (KH) Aids in pH Stability

For a base line check the reading from your water source.
Then check the readings in the pond water.

- **GH** – Hard water (200 mg/L) is high in calcium and magnesium. Soft water (50 – 100 mg/L) is low in calcium and magnesium. High levels are stressful to the fish.
- **KH** – A desired range is 80 to 240 ppm. A pond with low KH is prone to rapid pH swings. A pond with high KH tends to have a high pH.

Best Practices to Maintain Proper Water Hardness

- **Test water source for a base line reading.**
- **Partial water changes of 10% provide fresh water and add KH back to the pond.**



What Can You Do?

Using Algae Controls How They Work & What Else Happens

Algae forms in a pond when pH levels are favorable, and sunlight reacts with nutrients in the water. Some string algae (filamentous algae) is a good thing since algae is a living plant that produces that ever-important oxygen. However, when string algae and/or single cell algae overwhelms a pond, an algaecide does make sense.

Algaecides rupture the cell structure of the algae causing it to die. All good, right? But there is a trade-off to be aware of and additional steps should be taken to maintain healthy water quality. Remember that algae are living plants that are part of the oxygen producing cycle. When we kill off algae the oxygen supply in the water will drop and there will be a buildup of dead algae cells that will settle to the bottom of the pond to decompose or overload the filtration's mechanical pads. This will elevate the levels of ammonia, and nitrites, which are toxic.

So, never ever over apply an Algaecide!

Repeated applications of an algaecide, in a short period of time, can lead to a significant buildup of dead algae on the waterfall, stream beds, and surrounding rocks as well as the bottom of the pond. If not filtered out or removed by cleaning the pond a serious buildup can start to turn black with anaerobic conditions putting additional pressure on the quality of the water and health of the fish.

Other plant life may be impacted by stunting their growth. Water plants like, Water Hyacinth, Water Lettuce, and Lilies may show signs of going off color (turning yellow) and/or developing black spotting on their leaves.

Additional Practices to Maintaining Clear & Healthy Water Quality



1. EasyPro® Barley

In its different forms, EasyPro® Barley, is an excellent choice as an algae preventive treatment. Unlike an algaecide, barley is known to create conditions within the water that inhibit the growth of algae.



2. EasyPro® Rock and Waterfall Cleaner

Liquid or dry, this is a hydrogen peroxide based product. It adds oxygen to the water as it lifts debris from waterfalls, streams, and surrounding rocks, to the surface where it can be removed by a net or skimmer.



3. EasyPro® All Season Bacteria

Regularly scheduled applications of All Season Bacteria should be part of one's scheduled pond maintenance program. It is also beneficial to add when treating for algae to assist with the additional waste buildup.



4. EasyPro® KLC (Koi Loving Care) Aeration

The KLC system should already be in place for winter months. However, aeration is extremely important during hot summer days and while treating for algae blooms.

What Can You Do?

Best Practices When Controlling Algae



- **The #1 best algae control is implementing the best practices of good water quality:** Beneficial bacteria, sufficient filtration, aeration, a good mix of bog plants, oxygenator plants, and floating leaf plants covering 1/3 of the pond surface. Additionally, using barley products to assist in algae prevention and reduce levels is beneficial to your pond.
- Regularly check and maintain the mechanical filter pads found in most biological filtering systems.
- When applying an algaecide, Do Not apply more than the instruction say.
- When applying an algaecide, be sure to supplement the oxygen level with an aeration system.
- When applying an algaecide, remove dead and decaying algae as soon as possible.
- When using an algaecide, check and clean the mechanical filters shortly after application and check again over at least a two-day period to remove the dead algae buildup.
- If repeating an algaecide application within a short period time, you may want to move the more sensitive water plants to another location, free of chlorine and chloramines, for a couple of days.

Best Practices for a Healthy Pond



- Filter water volume once an hour if you have fish, or once every two hours if you do not have fish.
- Apply EasyPro® Water Conditioner when adding water.
- Apply EasyPro® All Season Bacteria 2 oz. per 1,000 gallons of water weekly, or for dirty water add 4 oz. per 1,000 gallons week to clear.
- Use aeration in the summer to maintain a healthy level of oxygen, and in the winter (placed in the shallow end) to keep a hole in the ice for toxic gases to escape.
- Make sure the pond has a third of its surface covered in plants. Have a mix of bog plants, submerged plants (oxygenators), and floating leaf plants. Water Hyacinths and Water Lettuce are great cleaners and efficient removers of nitrogen.
- When using an algaecide be sure to use aeration, add beneficial bacteria, remove the dead material as soon as possible with a net, and/or clean the filter pads frequently till the water is clear again.
- In early fall, cut back water plants and place baskets in deeper water, clean out all bottom debris, do a 25% water change, and place a leaf net over the pond to keep falling leaves out of the pond.

You may also find the following EasyPro® Newsletter Topics helpful:

- Water Treatments for Backyard Ponds
- Diagnosing Ailing Pond - Diagnosing an Ailing Pond Check List
- Water Temperature Action Guide for Ponds - Water Garden Plant Guide

We hope the information provided is helpful both in taking some of the mystery out of how to maintain quality clear water, and/or to address a specific concern you are currently experiencing. We are confident this will allow you to enjoy your pond more than ever.

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