

Oxygen, Carbon Dioxide, and PH

In every pond or even the simplest recirculating water feature you will find all kinds of aquatic life of some kind. I will discuss koi ponds since this is where the information is most important to us today. If a person understands these basics it will go a long way in obtaining more enjoyment out of our hobby.

Let's think of our ponds as a collection of living creatures, fish, plants, algae, frogs, bacteria and tiny insects. All of these breathe like you and I and all need oxygen (well almost all). All the flora and fauna (green stuff) breath oxygen and exhale carbon dioxide. Think of your pond as breathing in oxygen during the day, breathing out carbon dioxide at night.

Carbon dioxide problems in the pond can be controlled by aeration, by waterfalls, aeration using simple fountains and UV lights which will reduce those tiny suspended algae cells that make water go green and use oxygen.

Carbon dioxide in pond water results from a number of sources including:

1. Waste products decaying at the bottom of the pond. (*Keep your pond clean*)
2. Respiration by pond inhabitants.... fish, insects, plants, algae. (*Keep your pond clean*)

Of course all of us know first and foremost that oxygen in pond water is essential. Carbon dioxide is also of critical importance. Oxygen and carbon dioxide also work in concert with each other. In simple terms as carbon dioxide levels increase in a pond then oxygen levels tend to decrease. This follows a natural pattern from dawn to dusk (daytime) oxygen levels in the pond increase and decrease again from dusk to dawn (night). Carbon dioxide concentrations in water act in reverse - falling during daylight hours and rising during the night. Oxygen levels are at their highest at dusk and carbon dioxide levels are highest at dawn. This means You MUST Beware of algae blooms in ponds. Dawn is the critical time in a pond. If something is going to go wrong it is often just before first light because at this stage the oxygen level dissolved in the pond water will be at the minimum. Often people wake up to find dead fish... and ask what happened? Such deaths could be associated with very low oxygen levels coinciding with high carbon dioxide levels. When ponds are full of suspended algae such problems can arise quickly. If there is a very small amount of algae bloom in the pond then you will find oxygen and carbon dioxide levels will not change significantly between early morning and late afternoon. On the other hand dense pea soup type water will show very significant variations.

Seasonal Impacts upon carbon dioxide problems.

The first thing to realize is that oxygen concentrations are highest in winter because water is cooler. Because oxygen concentrations are high the oxygen reserve is not depleted as quickly during the night. Plant and animal life has also slowed down significantly.

On occasions fish in ponds with no fountains or waterfalls may look listless in winter due to carbon dioxide levels being excessive but this is normally associated with a long run of calm dull days - in these circumstances there is no natural wave action to allow oxygen to be transferred to the water. The problem quickly sorts itself out when windy and bright weather returns.

In summer water will hold much less oxygen and the animal and plant life (algae) is also thriving due to higher temperatures along with more nutrients in the water associated with feeding fish. The living organisms are therefore emitting more carbon dioxide in a situation of potentially disastrously low oxygen levels. Fish then die from lack of oxygen and suffocate.

PH and Carbon Dioxide

Carbon dioxide dissolves in water to form carbonic acid which has a pH of less than 7, so pH will tend to fall when carbon dioxide is high. This is what happens during the night with a reversal during daylight hours.

There is some quite complex chemistry involved here which I will ignore and save to point out that when pond water pH levels fall below 7 then the potential for carbon dioxide problems increases. Pond pH should ideally be around 7.0 to 8 but don't panic if it is 8.5. What we are looking for is a very stable pH with very little swing from daylight to dusk.

In practice this means that measuring pH can give very erroneous results depending upon time the sample is taken. If you do like to measure water properties then do this on a continuous basis at the same time every day and keep a graph or log of results so you can monitor changes. Individual results can be quite misleading. Your pH readings will fluctuate from early AM reading to late evening readings. Do not get caught chasing your PH.

Aeration of ponds

Experts advise that all ponds should be aerated using either a simple fountain or waterfall at least. One of the best and most economical ways to aerate is the use of venturi's. You can never have too much additional aeration.

Aeration of pond water achieves two things both of which are very good for pond water and your fish:

1. Oxygen levels increase.
2. Carbon dioxide is "blown" out of the water and this tends to push up and stabilize pH levels with proper buffering.

3. ORP and water quality increases.

Remember there should only be 3 things in your pond, water, fish and air. Oh yea, you may add plants to this list too.

Aeration also protects against those algae blooms and their dying - when they die they rot and release carbon dioxide by using up the oxygen resource in the water. Last year there were many people in our local area without UV's utilizing so-called safe chemical controls to rid their ponds of the "green". Major fish kills took place due to oxygen starvation. They suffocated their little fishes to death. Not nice.

In conclusion please remember it is very difficult to over-aerate a pond and aeration has all round major advantages in a pond. The only downside is the minimal cost of a special aerating pump. All top koi keepers' ponds bubble with air as do their filters.

Deeper ponds without waterfalls and/or fountains as the means of creating circulation or mixing during calm periods could be more prone to carbon dioxide problems.

Aeration and water mixing (waterfalls and venturis) are the MOST effective methods of controlling potential carbon dioxide problems.

Beware of algae blooms (green or brown cloudy water) especially in summer and especially during calm periods and when there is no waterfall, fountain or aeration. If you can not hear your water and if your water is not moving you are not adding enough oxygen.

Joe