

# Consumer Aeration Report





## About the Author



**Darrell Rhoades** Has been in your shoes, from wanting a pond to caring and reviving ponds. Attending classes, conferences, hand on experience and working with the experts and manufacturers of aeration systems. One thing important to Darrell is finding the correct solution first. Not experimenting with this or that because it might work. That is just a waste of time and money. Do it right the first time and benefit from the start.

Darrell has been in the tool & die trade close to 30 years, a hardcore do it yourself kind of person and pond enthusiast finding management solutions for his pond and now sharing this information with other pond owners. With all the products to choose from it can become confusing, what size? How many? Will this work? Are some of the questions that come up. That is the reason for the report, to learn what aeration is about and the various ways to aerate a pond or lake.

If Darrell for some reason cannot answer your question right away he will investigate and research to find your answer. When you are ready to ad aeration please contact Darrell by filling out the [contact page](#) or send an email to [support@WhatPond.com](mailto:support@WhatPond.com)

More information can be found on his website as well, just check out the [About page](#).

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## **Introduction**

Aeration seems to be a mystery yet you hear folks talk about it and how aeration is good for the ponds health and the fish as well. But what size? Are they all the same? Do I need a hole in the ice or not?

These and more questions arise when it comes to adding aeration. As you'll read in the report aeration may or may not be what you think.

Many years ago when our first pond was built we found some articles about aeration and that was about it, why you need it and what it does. Not much to go on but we picked up a large aquarium compressor and tossed the stone into the pond. Yep it made bubbles and kept a hole in the ice but didn't do much more than that.

After researching and learning what aeration is the picture has really opened our eyes. But still there is some mystery out there where you can find the same aeration system, well maybe some of the parts are a little different but there \$500 bucks different in price. Both say it can aerate a 1 acre pond but be sure you will have support after the purchase. And that they can provide a calculation sheet to show your pond size, total gallons, turnover rate

## **Chapter 1 What is Aeration**

What is aeration? What does it do and the different ways to aerate. Wind, Solar and Electric.

Is aeration really what you think? Are they all the same? Is it just putting bubbles in the water?

Aeration is not just adding air bubbles to the pond. The bubbles are the work horse; they are not what add oxygen to the water.

The air we breathe has 20% oxygen, I guess really depends on where you live, but oxygen transferred from the bubbles rising from the diffuser at the bottom of the pond is less than a 5% oxygen transfer. Once the bubbles reach the pond water surface the water can release toxic gasses and absorb oxygen. Repeating this to the point of full pond turnover once a day essentially adding (stacking) dissolved oxygen from the top to the floor of the pond.

Ponds do have a life span; once they are built the process begins. The ponds goal is to fill back in and become a grassy meadow. This happens for a variety of reasons. First, the pond is located in a low spot on the property in order to catch rain water that keeps it full. Knowing this we can see the pond has become a catch basin for all that runs into it. Silt, grass clippings, fertilizers and animal waste (pets, live stock, decaying leaves and geese) will be washed into the pond, not to mention what can blow into the pond like leaves, pollen, twigs and any airborne particles. Then there is the pond itself and what happens beneath the water. Fish waste, algae and weeds all add to the filling in or we should say the ageing of the pond.

All of the above is called nutrient loading, nutrients are only one part of the growth process. Combining sunlight, warmth and water are the other two that actually make the growth or algae and weeds in our pond. Once the process starts it is like a never ending battle. First comes algae, the green cotton like strings that start at the bottom and grow to the top where mats are formed that look like a science project gone bad in the fridge. We can rake it out but it keeps coming back.

This is a cycle, as a pond ages it accumulates nutrients producing algae, weeds and muck. In the past these problems were dealt with by using chemicals but that is like taking a pain killer for pain, once it wears off the pain is still there. Using chemicals is a reactive approach just like the pain killer. Once the chemical is used the weeds and algae die, they fall to the bottom turning into muck and more nutrients for next year and sometimes the same year of new growth. There are a handful of states that do not allow the use of chemicals and more working towards banning the use.

The muck (bottom of the pond) has anaerobic bacteria they eat away at the muck but can never keep up with the muck build up as they are extremely slow. That is why it continues to build and fill up the pond. These anaerobic bacteria put out bad gasses, ammonia, hydrogen sulfide, and carbon dioxide which are toxic to fish and create the foul smells in the pond. As these gasses build they push the fish towards the surface of the pond looking for oxygen. If the gasses build too much they can choke and suffocate the fish. The last or emergency sign of oxygen depletion is the fish gasping for air at the water's surface, once this happens emergency actions need to take place to save the fish.

The pond does have a built in turnover rate, in spring and fall the pond flips, known as diurnal, where the bottom waters are sent to the top and top water goes to the bottom. Depending on the toxic gas saturation this is a prime time where a fish kills can take place the most.

Ponds can accumulate oxygen in other natural ways like the wind blowing over the surface, creating waves and breaking the surface tension of the water. Even a stream flowing to the pond can add oxygen if it has something like a waterfall and or water splashing over rocks to break the water to absorb oxygen molecules.

Alright back to proper aeration and how it works. To start with the proper amount of dissolved oxygen needed in the water is 5 ml per liter or put another way is 5 parts per million. An example is adding 5 drops of dye in a 5 gallon bucket of water. At 4 ppm fish are getting stressed, 3 ppm fish will start to die, usually the big fish die first. Cold water can hold or be saturated with more oxygen than warm water. This is important because as summer months warm the water it is losing oxygen which could be prevented by proper aeration. An example of this summer was the fish seemed sluggish when eating and the concern was raised why? Checking the water with the dissolved oxygen meter we found the water was 82 degrees and had 7.3 ppm dissolved oxygen which is almost the maximum that the water could hold at that temp. Moving into the cooler months we find 10.5 ppm at 52 degrees while being aerated using an electric type system.

With a shore mounted compressor, self weighted tubing, and the properly designed diffuser plate. Air is pumped from the compressor down thru the tubing and then exits out of the diffusers. The air leaving the diffuser is in the form of tiny little air bubbles, the smaller the bubble the better. The smallest size currently is 1/2 millimeter or .020" of an inch the bubble leaves the diffuser and races to the surface of the pond. As it is rising it creates lifting motion in the water pulling and pushing the water to the surface. As the tiny bubble rises it also expands creating more surface area to move the water. Imagine taking a ball under water, then letting it go. As the ball comes to the surface you'll see water displacement and a ripple form, but that's just one big bubble. Now imagine thousands of bubbles doing the same thing, a whole lot more water movement, up to 4,500 gallons per minute. This is where science and testing has helped

improve the technology along with research and development. In the past diffusers were made of stones, they would plug rather quickly, depending on the water chemistry and when they did you would have to pull them and clean them with muriatic acid. Not to mention the bubble that leaves the stone is rather large and inefficient compared to the small bubbles from today's membrane diffuser. When the rubber membrane diffuser receives air it expands to expose the ½ mm holes for the air bubbles to escape. When the air is turned off the membrane relaxes which makes cleaning of any build up flake off.

Size, shapes and setups of diffusers are also important to be able to lift water from the floor of the pond and move the maximum amount of water. Some diffusers shapes or setups don't start to affect, or start moving the water until 20-24" off the bottom others even up to 3' from the bottom. This leaves the toxic gasses at the bottom of the pond and provides no oxygen to the floor of the pond where beneficial aerobic bacteria can consume the muck and decaying matter. Leaving the bottom 20" or more of water unaffected by aeration also leaves a potential fish kill of non oxygenated and toxic gas infected water once the pond flips in spring or fall.

Back to the process of aeration, bubbles lift bad water to the surface to allow the gasses to escape to atmosphere. Once the gas leaves the water the water can now absorb oxygen. This process stacks oxygen from top to bottom of the pond, getting rid of bad water and gasses and locking up nutrients and phosphates to the bottom of the pond. This process should happen at least once a day (24 hour period) taking the bottom water to the surface allowing gasses to escape, then absorb oxygen and continues until the first layer of oxygenated water reaches the bottom again.

Here is where under sizing an aeration system come in. A pond without aeration is negative charged leaving nutrients suspended in the water column as a food source for algae and weeds; a pond with aeration is positively charge pulling the nutrients to the bottom of the pond locking them in the sediment so they can't be used and be consumed by the aerobic bacteria. Buying an aeration system that is under sized will not create enough water movement to expel the toxic gasses and only move the water enough to leave nutrients in the water column to be consumed by algae and weeds. True, the bubbles make it to the surface, some gasses can escape and some oxygen can be absorbed. The under sized systems, whether it is the wrong compressor, diffuser design, or not the correct amount of diffuser's leave the entire pond water volume un affected.

## Chapter 2 Fountains



This brings us to what types of aeration systems are available:

**Fountains**, there are decorative fountains and aerating [fountains](#) that are designed and built to do aeration and able to give a display above the water's surface, like a "V" or tornado shaped pattern, depending on the horse power can be around 6' high, called an aerator fountain or surface

aerator. Some have a small display only a foot or two high that looks like a big frothy bubble area while others have both options. As for size and shape of the displays, they vary depending on the size of fountain horse power and manufacturer, the frothy bubble pattern and the tornado are the only two spray patterns created for aeration, adding any other spray pattern will knock down the amount of water that passing thru the fountain and not creating sufficient aeration.

There is good and bad about the aerator fountains, one thing bad is electric usage, the other is only able aerate the water surface. Typically fountains are sized by surface acreage. A half horse can aerate a ½ acre pond. Knowing this we can figure one horse per acre, for a three acre pond it could be a 3 horse fountain or 3 one horse fountains. The good about the fountain is it gives an awesome display above the water and lighting can be added for nighttime appeal as well. Secondly the fountain is a great emergency aerator for the pond. In the event the pond is crashing, the fish are gasping for air at the surface a floating fountain can be put in rather quickly to create needed oxygen on the surface where the fish are at. But this brings up one bad part of the fountain; they only aerate the top of the pond. Some 12" deep others up to 30" deep of water can be affected by the water flowing up to the fountain. Yes some companies have the ability to add a draft tube which would pull water from deeper depths to affect the toxic zone of the pond.

The only other bad part about the use of fountains is there electricity consumption. While a ½ horse fountain can run at 6 cents an hour a 5 horse motor will consume more electricity.

Below we discuss different forms of bottom aeration. With a diffuser on the bottom we can affect our entire volume of water with much less horse power than the fountain. A combination of bottom diffused aeration and fountain can work in tandem like a turbo charged aeration system. Using the fountain only when you would like to see the display or as a spring start up to ensure the pond has

oxygen for the fish. Working together the bottom diffuser lifts the toxic water to the surface and the fountain will shoot that water into the air exposing the water to more atmospheric oxygen. The only other down side about the fountains is the part of spraying water into the air, this would promote more evaporation of the pond water. The bottom diffused aeration system only moves the water and not above the surface of the pond so much less chance of exposing the water into the air for evaporation.

## Chapter 3 Wind and Solar



So what about this bottom diffused aeration and what are the different ways to do it?

Let's start with **wind power**. Using a windmill is like having free electricity to provide air to the diffuser. But only works when the wind blows. The problem is, the pond during the day actually creates some oxygen from the plants and weeds but at night the pond respires and loses oxygen. Generally at night the wind is calm leaving the windmill disabled produce air. Depending on the windmill brand and what diffuser style used we can be leaving these toxic gasses in the pond and not effectively oxygenating water column. Just to show a little timely effect of a pond with a windmill we could see lilies taking over the ponds, water meal and duck weed as well as algae. This shows us the wind has not been effectively working the diffuser to maintain the correct amount of water flow to release the gasses and not able to lock the nutrients to the bottom of the pond.

The windmill needs to be placed in the open in order to work. A place with enough area to receive wind, and room behind the windmill for the air to pass thru, to keep the blades rotating to operate the diaphragm or bellows which provides the air to the diffuser. Diffuser plates or systems for the windmills vary. Some use a membrane while another may use a different diffuser setup not allowing water movement to start until 30" plus inches above the pond floor.

Next up is **solar aeration**, very good idea using the sun to charge batteries that operate the motor providing air to the diffusers. For limiting factors like the depth of pond is a concern that the air compressor can push air to. But generally the sticker shock even on the small system can turn folks off pretty quick. Again we are at nature's mercy to provide enough sunlight to keep the batteries charged so the compressor can continually operate.

## Chapter 4 Electric systems, diffusers & tubing



Then the **electric systems**, not because they are bad but more to talk about as there are different compressors that are used for different types of ponds. There are a lot of systems out there for sale, many claiming to aerate a one acre pond with bits and pieces from different manufacturers and few other manufacturers that actually did the testing to determine the amount of gallons per minute their systems actually move. And even other companies will do the calculations and map out your

pond for diffuser placement, tubing runs and compressor placement.

There are three type compressors, the linear diaphragm compressor, the piston type compressor and rotary vane. Motors operating the compressor can vary depending on the size and depth of the pond or lake and volume of the water needed to be turned over.

Starting with the shallow ponds and the system used for them, the linear compressor uses a diaphragm to create air that gets pushed down to the diffuser. The diaphragm cannot create enough pressure for the deeper depths but does create a lot of volume of air. Running a diaphragm compressor in too deep of water will do two things, one wear out the compressor prematurely and not provide enough air to the diffuser equaling not enough water movement leaving nutrients in the water column and insufficient water turn over. This is also known as under sizing the aeration system, by not moving the entire water volume in one day it just suspends the bad gasses and nutrients in the water column for algae and weeds to use and setting up for a potential fish kill.

Ok what depth can the linear compressor work efficiently at? Again there are variables depending on the manufacturer. The standard out there will list the max. Depth of course, but thinking you can add a couple feet of depth could harm your compressor and hurt your pond by not having enough aeration.

Remember the goal is to turn over the entire volume of the pond at least once a day. Falling short or using an under sized system will essentially act like fertilizing the pond by having just enough water movement to suspended nutrients in the

water column. Then being too deep adds strain on the diaphragm's due to the water pressure making the compressor work harder to reach those depths. Possibly burning out the motor or replacing diaphragms often. There are some shallow water compressors can reach up to 12' but that is the max on the linear diaphragm compressors.

Here's a quick example with a garden hose without a spray nozzle. Turn the valve on full blast, how far does the water shoot away from you? Now pretend you want to wash the 2<sup>nd</sup> story windows of the house. The water doesn't reach that height, pretty much falls short of the target. Now cover the opening partially with your thumb you'll see that the water can reach much higher. Knowing this should help to understand the difference between shallow water and deep water aeration systems, needing more pressure to reach the target.

If the pond is over 12 feet deep then the next system is the piston type compressor (needing more pressure to reach the depth) able to perform 30' or more. The smallest piston type compressor uses a ¼ horse electric motor able to aerate a one acre pond 12' deep such as an [AM30](#)

The shape of the pond is also a factor when sizing an aeration system and helps to determine the number of diffusers needed to turn the pond over once a day. A round one acre pond over 12' deep can be aerated with one diffuser and the piston type compressor, but what if the pond is like an oval or oblong in shape but still only one surface acre? Typically the pond would need two diffuser and move up to the next size compressor system which is a third horse. A two acre pond over 12' deep would use the same system. Once the pond size goes over 4 acres a second compressor will be added to the cabinet to accommodate the added diffuser's.

Ok but what if the half acre pond is shallow say 6' deep? Then we would need to add more diffusers in order to move the required amount of water once a day and use a linear piston type compressor.

A quick thought between the two types of compressors is the piston type uses a little more electricity, while the linear uses a lot less. Let's back down to a half acre pond 6 to 8' deep. The system, example an [AM20](#), would use a diaphragm compressor and four diffusers in order to turn over the pond once a day. There are differences in the diffusers at least the design and placement of the air tubes from the deep pond to the shallow pond.

The reason is the shape and formation of the bubble column they create. Whether it is a deep or shallow diffuser there is a maximum amount of air that can be pushed thru, which in turn affects the amount of water that can be moved. The deeper the pond the more water can be affected by the air leaving the diffuser. Shallow ponds need more diffusers in order to move more water.

What would be an ideal aeration system is a hybrid combination of electric, solar and wind power to charge the solar portion of the system. This is not available as of yet but ideas being researched. I did do a little research and pricing to add a solar system to the standard electric aeration system and came up with a cost of over \$8,000.00 which is the batteries, inverter and solar panel. In the mean time until a solar/wind system comes to market I feel electric is the best most reliable way to go in keeping our ponds healthy, preventing the dreaded fish kills and over all pond and habitat health.

As a quick side note if I did not cover earlier. There are systems out there claiming that it can aerate a one acre pond, really? You see there are two companies that manufacture the electric motors and compressors for the piston type compressor, even more companies that manufacture the linear compressors; self weighted tubing some completely with pvc, pvc and rubber and some may add led to sink the self weighted tubing. The inside of the self weighted tubing should also be smooth if it is not then friction loss will occur and the efficiency of the system drops.

Then the diffusers, stones were great in their day but with technology the rubber membrane diffusers that out performs and outlasts the stone diffusers and easier to clean if needed. Sizes, shapes and patterns of the diffuser do have an effect on water flow and at what depth they can get water to move from.

Self weighted tubing can be a big factor when purchasing a new aeration system. Some folks only sell 5/8" while others offer a choice of 5/8"-1/2" and 3/8" diameter. The reason for the different diameters is to best provide the diffuser with the most amount of air to perform most efficiently and depending on the friction loss on long runs of tubing. As a rule of thumb the shallow water ponds would use the 5/8" and the deep water uses 3/8" tubing. From there it is a calculation to determine the friction loss on the various size of tubing. Since we could place the compressor cabinet at the house and run anywhere from 300' to a ¼ mile of tubing to the pond instead of running electric line the friction loss is calculated for each specific run of tubing.

Some diffuser setups start at the floor of the pond and some not starting to affect the water column until 20" to 30" off the bottom.

Aeration seems to be getting a bad name, not because of what it can do but not knowing the full story and process of what it should do for the pond water. This is an investment, same as building the pond was an investment that you can enjoy, relax near, recreational activities and adding value to the property. Aeration is like an insurance policy protecting and cleaning the water for ourselves and the life living in the pond. There are plenty of systems, kits, pieces and parts out there to choose from, some with help once the system is installed others not so much help. It's a buyer beware as everything else in the world is today.

One last thing is the cabinets which houses the compressors. There are aluminum power coated, plastic, powder coated steel and so on, but the biggest downfall and failure on compressors is heat. Some of the cabinets come with a fan to help cool the compressor and others don't. Most all compressors do have an air filter before air enters the compressor and one cabinet filter the air before it enters the cabinet plus the filter on the compressor. The above is mostly for the piston type compressor. The shallow water/ linear compressors are generally built to hold up in any weather and have a built in air filter. One of the best and quietest cabinets to date is from [Airmax](#)

As you can see there are a few types of aeration systems and plenty of product lines out there, along with every pond depth, size and shape plus the pond owner's preference on management and whether or not to have a display above the water.

When you are ready to add an aeration system to your pond or lake send me an email, give me a call or click [contact us](#) and let's work together to save your pond, fish and bring back the fun and enjoyment to your water. We are here to help answer your questions.

If you haven't already head over to the [Pond Management](#) page for a free MP3 download on pond management and follow up email articles on pond management.

## Summary

Even with information this still can be confusing, which system, what size and other questions, please use the [contact us](#) link with your questions. As for any of the above systems we can make them available to you, pricing is set from the manufacturer and we'll do our best to get you the best deal.

After all the explanations and how the system works I still like the electric systems as long as they have been designed and calculated to fit your pond. Each system have a benefit and each have draw backs, some more costly on electricity and others depend on the weather to generate air.

## **Resources**

The main site is [WhatPond.com](http://WhatPond.com) there is a lot of information available throughout the site. One easy way to find what you need is to use the “search the site” on the left side of the website.

We also have another website which you can sign up to receive a recorded video all about the pond life, aeration and ways to aerate. If you can view video head over to [My Pond Aeration](#)

If you have this report and have been researching ponds and how to build a pond you'll also want to check out the [Pond Building](#) page, at the bottom you can sign up for the free Definitive Guide to Ponds to discover what the different types are and follow up emails on how to build a pond.

We also have a Fan page on [Face Book](#), there are 2 quick steps to the process, click Like button and download the free gifts.

[Pond products](#) page has separate categories and within each product there is a details button, click on the details to learn more about the product.

That's about it for pond resources. At some point darrellrhoades.com will be a site for more insights about the internet, linking, business and internet and much more.

For now the best thing I can offer is a couple videos about the history of money and how to protect and grow what we do have. This works for the super rich and the not so rich. It is thinking outside the box and not just conforming to what everyone else does. Makes sense and just thought I would pass this on. I joined and have learned a lot, but it does take time and need to take action. [90 minute video](#).