

Aeration



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What Aeration Can Do For You

In the past decade or two, ponds have become very popular with an increasingly wide variety of people, and with that, so has the demand for new, environmentally friendly techniques for the maintenance and rejuvenation of these ponds. Considering the costs of constructing a pond, it makes good economic sense to prolong the life of your pond. One of the simplest and most economical ways of doing this is to use aeration.

Aeration is the process of adding oxygen to water. Maintaining healthy levels of dissolved oxygen (DO), one of the most, if not the most important water quality parameter, in your pond aids in the breakdown of decaying vegetation and other sources of nutrients that enter your pond. This breakdown of bottom silt is carried out by microorganisms at the water/soil interface and continues to proceed a few centimeters deep in the soil. This decomposition can be carried out in two ways, aerobically and/or anaerobically. Aerobic decomposition requires a continuous supply of oxygen and proceeds more rapidly as dissolved oxygen concentrations near saturation levels. The rate of degradation of organic matter in anaerobic conditions is not as rapid as under aerobic conditions, and the end products are organic compounds, such as alcohols and foul-smelling organic acids (the sulfury pond muck smell!). In other words, the decomposition is slower and less complete in anaerobic environments than in aerobic habitats where the primary end product of decomposition is carbon dioxide. So what we can learn from this is, the more decomposition we can facilitate, through the addition of oxygen with aeration, the less nutrients there will be available for algae blooms and excess aquatic plant growth.

Mother Nature supplies, at times, sufficient amounts of aeration and dissolved oxygen through wind, rain, splashing of water from an incoming stream or waterfall, and by photosynthesis carried out by aquatic vegetation within the pond. However, as nutrients are added to the pond or body of water from sources such as runoff, dust from construction sites, grass clippings, and leaves from nearby trees, the demand for oxygen increases. When you add that to the fact that warm summer water holds less dissolved oxygen, and the demand for it increases during this time, you have a formula for fish kills, algae blooms, foul odors, and the build up of stagnant vegetation.

Aeration can help Mother Nature keep up with the demand for dissolved oxygen and prolong the life of your pond. Aeration increases the level of dissolved oxygen so normal biological processes in a pond system can become balanced. It also helps to move water in low circulation areas (which otherwise can build up undesirable levels of algae), and facilitates mixing throughout the pond if chemical treatment is necessary. In short, aeration provides a way to help clean up stagnant ponds and improve water quality for irrigation purposes.

Affects on Dissolved Oxygen

Barometric pressure, altitude, salinity, water purity, and biological oxygen demand all affect the amount of naturally occurring dissolved oxygen levels in water. The amount of additional oxygen water can hold through the aeration process is a function of temperature, altitude, and salinity. Colder water holds more oxygen than warm, water in higher elevations or with higher salinity levels has a decreased saturation level of oxygen. Once you have reached the saturation level, oxygen cannot be added without the help of photosynthetic activity or the introduction of pure oxygen.

In ponds, the introduction of oxygen via some type of aeration device can:

- Allow for greater densities of fish

- Eliminate the potential for Spring and Fall turnover
- Prevent winter kills caused by low oxygen levels
- Improve overall water quality
- Speed up the rate of organic decomposition
- Reduce the amount of phosphorus, which would otherwise be available for plant growth
- Thermally and chemically destratify the water
- Cause circulation currents that might create favorable conditions for more desirable algae to out compete blue green algae
- Decrease the severity of algae blooms and algae die-offs
- Shift the level of carbon dioxide by venting it into the air, which could limit the amount available for plants

Aeration Efficiency

There are many types of methods to introduce oxygen to water through the process of aeration. Most manufacturers of equipment have tested their aeration devices for efficiency under standard conditions. One test gives the result as the Standard Oxygen Transfer Rate or SOTR. The unit of measurement is kilograms or pounds of oxygen per hour. Another measure is the Standard Aeration Efficiency or SAE, which is the SOTR divided by power. The resulting measurement is pounds of oxygen per horsepower per hour.

It is unrealistic to be able to take the Standard Aeration Efficiency rate and apply it to a pond situation because there are many other oxygen consumers in ponds besides fish. Quite frankly, these numbers should be viewed more from the standpoint of the relative efficiencies of each device. There will also have to be some seat of the pants experimentation to figure out what works best for your application.

Aeration Devices

The following are the most common methods for introducing oxygen through aeration. Each description includes advantages (+) and drawbacks (-) of each method.

Fountain Type (SAE rates of 1.5-2.5)



These units shall be defined as any device that splashes the water into the air to create an aesthetically pleasing display. There is a wide range of fountains on the market. Some are designed more for display than aeration and some that mix more aeration with the display. When looking at Kasco's equipment, these models are known as Aerating Fountains.

- + Can have beautiful displays and add beauty to the body of water or pond
- + Some aeration benefit is seen
- + Works fairly well in small ponds that are relatively shallow
- + Very good at venting off unwanted gases
- Typically will only draw water from the surface to 10'
- Not as efficient at aeration because energy is used to create the display

Wind Aerators/Circulators (SAE rate is not calculated because electricity is not used)



Wind powered units will either drive a small compressor that pushes air to a diffuser membrane or will be connected to some type of paddle that enters the water and moves as the wind blows.

- + No electricity is required so they can be used in remote areas

- + Visually pleasing piece of equipment
- Will not work in no-wind conditions
- Not portable and installation time makes it necessary that the right installation point is decided the first try
- Will not work when they are needed most in the lazy, hazy days of late summer with little to no wind and overcast skies

Vertical Pump Surface Agitators (SAE rates of 2.6-3.2)



These units will employ a float, motor, and prop to splash water at the surface. When looking at Kasco equipment, these models are known as Pond Aerators.

- + Ideal for smaller ponds
- + Fairly decent oxygen transfer rate
- + Portable and lightweight
- + Inexpensive for the water movement
- Not as efficient at moving water at depths greater than 10'

Paddlewheels (SAE rates of 2.5-4.0)



Paddlewheels are just as they sound, a shaft with blades that is spun by a motor or a PTO from a tractor. As the blades spin, they enter and exit the water and splash the surface. Paddlewheels have come a long way in the past 10 years. Past designs had inherent problems that caused premature wearing of the gear boxes. New designs have better balancing and less wear. A note of caution, most imported motors have a spline shaft that does not match up with American-made motors and can cause repair difficulties.

- + Most efficient surface aerator
- + Can cause directional flow while aerating
- Will not be efficient in deeper ponds
- Units are typically bulky and not very portable

Horizontal Aspirators (SAE rates of 1.8-2.3)



These units employ an above water level motor, extended shaft, propeller, and draft tube to suck in air. They can be adjusted to point the propeller in several angles.

- + Cause directional flow to address dead spots
- + The ability to angle the prop into the water makes these units more effective at moving water in deeper ponds
- Oxygen transfer is not quite as good as other devices
- Some units have premature failure in the area of the extended shaft

Horizontal Prop Units (SAE estimated rates of 1.5-2.5)



These units operate similar to aspirators without the extended shaft nor do they suck air. You can position them to point in any direction and angle them similar to an aspirator. When looking at Kasco equipment, these are known as Water Circulators.

- + Excellent for causing water movement
- + Great for keeping ice off ponds and preventing winter kills
- + Can be mounted at variable water depths and can mix deep water
- Not as efficient as other devices at Oxygen Transfer

Pumping or Cascading Water (SAE rates vary)



This method is designed after Mother Nature. If water has to be pumped into a pond or body of water, you might as well splash it to take advantage of the oxygen transfer from the air/water contact.

- + Free aeration
- + Natural look to the pond or body of water
- Not as efficient as some mechanical devices

Pure Oxygen (SAE rates vary)



Pure oxygen is typically added to high-density aquaculture systems. This can be accomplished via an oxygen generator as well as through purchasing oxygen in cylinders.

- + If the concentration of the oxygen is close to the saturation level, this is the best method to add more oxygen
- Expensive and elaborate set up
- Nitrogen supersaturation can result and cause fish stress or mortality analogous to humans getting the "bends"

Diffused Air (SAE rates of 1.0-4.0 depending on who you believe)



This type of aeration will typically employ either a compressor or blower. A simple way of keep track of what is what is that a blower is high in volume of air produced but cannot pump air very deep. A compressor is low in air volume but can push air much deeper. In deep ponds, a compressor with a diffuser assembly can be very effective at moving the water and transferring oxygen at the air/water interface.

- + Most efficient in deeper ponds
- + No electricity in the water
- + Not much surface movement
- Not very portable
- Not great for emergencies
- Not as efficient in shallower ponds

Purchasing Criteria

Each pond, lake, or body of water is unique and not each method or application of aeration will work in each pond. It is important to talk to someone who has experience and knowledge of aeration devices to help decide which method is best for you. Often times, situations vary by geographic region, so talking with a local pond management expert is very helpful. Below are a few items to consider when purchasing aeration devices.

- Maintenance - How much work are you going to have to do to keep this running properly?
- Safety - Many of these devices have electricity in the water. Make sure to check all safety recommendations and buy equipment that is approved by organizations such as UL, CSA, or ETL.
- Simple - Some devices can be very difficult to use and time consuming to assemble and install. Make sure you know what you are getting into.
- Timing - Check with your supplier of the aeration device on lead times for equipment. Some equipment can include substantial lead times which could cause problems when your fish and pond need aeration badly.
- Support & Assistance - Choosing an aeration device from a company that provides knowledgeable and helpful information on CORRECT sizing, maintenance, technical support, etc. is a major benefit when deciding on aeration.
- Costs - Some equipment can be quite costly, not only with initial purchase, but operating costs. Make sure you budget properly and find out how much the equipment will cost to buy and operate.



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