Atlantic

POND & LAKE MANAGEMENT

P&L

Aeration, bacteria, and treatments can help clean, clear, and balance larger ponds and lakes. This guide explains why and how they work and what you need to specify.

WHY AERATION?

Oxygen is essential to the biology of a healthy pond or lake, but it's often in short supply. When there isn't enough oxygen, fish and other aquatic animals can suffocate, wastes generate noxious gases and water may foul.

Subsurface aeration brings oxygen levels up, dissipates toxic gases and evens out temperature and saturation levels throughout the water column. Aeration is also the most efficient way to circulate water, moving 10 times as much per watt as water pumps.

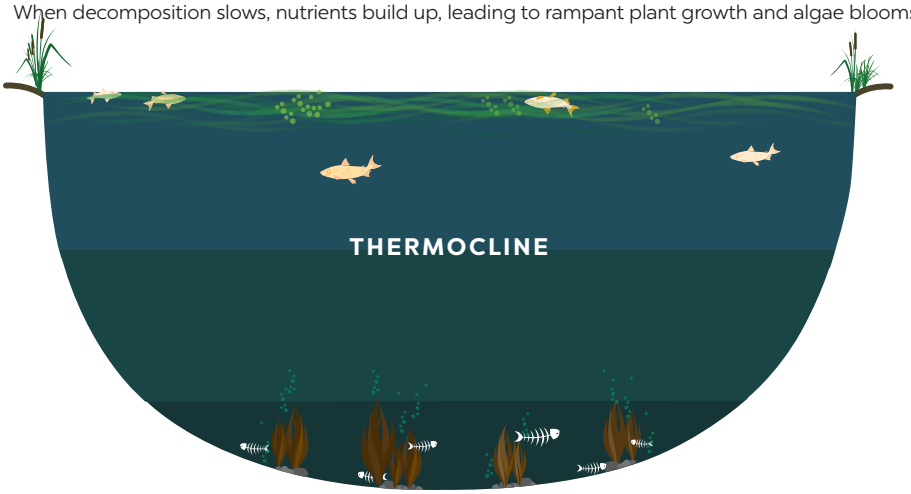
Finally, aeration greatly accelerates the decomposition of solid and dissolved wastes. Although smaller water features may respond to other strategies, aeration is the only way to effectively manage nutrient removal, algae, water quality and clarity in larger lakes, and may help control pesky pathogens, too.

WITHOUT AERATION:

Lakes and ponds need to "breathe", diffusing oxygen in from the air to replace what is consumed by aquatic animals, and exhaling toxic gases produced by plants and decomposition. Natural gas exchange is often compromised. Stagnant water exchanges gases more slowly than circulating water. Dust, pollen and debris collect on the 'skin' at the surface, impeding diffusion.

Dissolved oxygen is temperature dependent so warmer water at the surface holds less oxygen than cooler, denser water below. Between the two a physical barrier called a thermocline can develop, cutting the depths off from surface oxygen. The lower the level of oxygen at the bottom, the more 'anaerobic' the process of decomposition becomes. Organic wastes decompose more slowly and produce toxic compounds like methane and sulfur dioxide.

When decomposition slows, nutrients build up, leading to rampant plant growth and algae blooms, which deplete oxygen during the night, potentially killing fish.



SIGNS OF IMBALANCE:

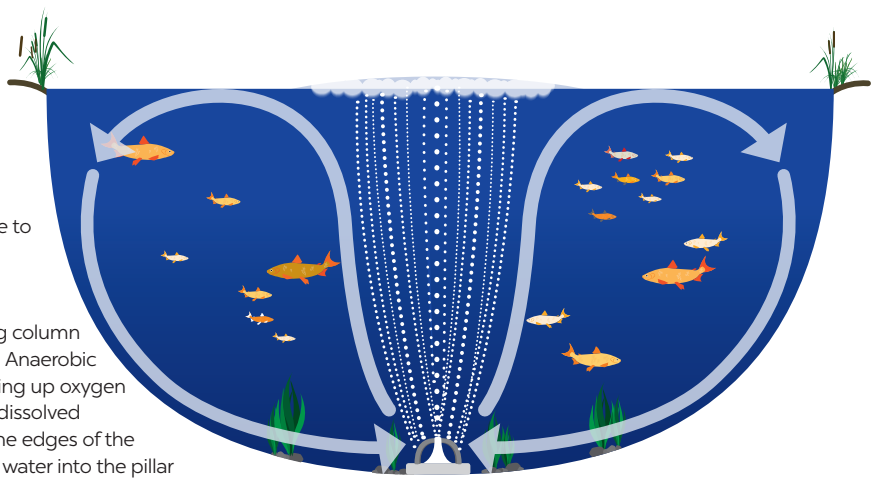
- Algae, opaque green water or excessive growth of string or blanket weed
- An excess of submerged vegetation and rampant marginal aquatic plant growth
- Dead fish, especially after a storm or a change to cooler weather
- Small, few or no live fish at all
- Foul smelling water

CAUSES OF IMBALANCE:

- Insufficient total dissolved oxygen levels
- Excessive nutrients in the water and the sediment
- Stratification and thermoclines that cut off surface oxygen

WITH AERATION:

Aeration helps lakes breathe, not by "injecting" oxygen, but by vastly increasing the surface area of air in contact with the water. The greater the surface area, the faster oxygen in the air can diffuse into deoxygenated water, and conversely, other gases – carbon dioxide, methane, sulfur dioxide – can diffuse out.



A compressor pumping air through tubing to air diffusers on the bottom discharge the smallest bubbles possible. The surface area of those tiny bubbles effectively doubles or triples the unassisted rate of gas exchange to maximize and maintain the highest possible level of oxygen.

Aeration is also the most cost effective means to circulate large ponds and lakes. The friction of millions of bubbles rushingupwards pulls a rising column of cool denser water to the surface, creating a raised "boil" at the surface. Anaerobic water rushes outward away from the boil, shedding toxic gases and picking up oxygen on the way. The surface cools, and because cooler water can carry more dissolved oxygen, O_2 levels rise all the way to the bottom. The flow up and out to the edges of the pond creates a counter current inwards along the bottom, feeding more water into the pillar of rising water and bubbles.

A single diffuser in a bowl shaped pond 10 feet deep can effectively aerate and circulate a surface acre of water for pennies a day.

WHY FINE BUBBLES WORK BETTER:

Fine Bubble Aeration is the most efficient way to oxygenate and circulate bodies of water over three feet in depth. Air compressors matched to the depth of the pond or lake force air through diffusers placed on or near the bottom of the pond, creating millions of tiny bubbles that push and pull the cooler, denser water from the depths upwards as they rise to the surface.

The smaller the bubbles, the more cumulative surface area they have, so fine bubbles work best. The huge surface area of even a modest volume of air helps transfer oxygen directly to the water it contacts, as if the surface of the pond were multiplied many times.

More importantly, millions of bubbles rising from the bottom of the pond every minute move tremendous volumes of water to the surface efficiently and inexpensively.

LAKE MANAGEMENT:

Along with greater volume, large ponds and lakes present a greater variety of management issues than smaller ponds. In addition to the algae that can affect any water feature, larger bodies of water may have rampant submerged and emergent weed growth. Uncirculated, excessively warm waters at the surface accelerate unwanted plant and algal growth. Stagnant water breeds mosquitoes; anaerobic muck harbors pathogenic and parasitic organisms.

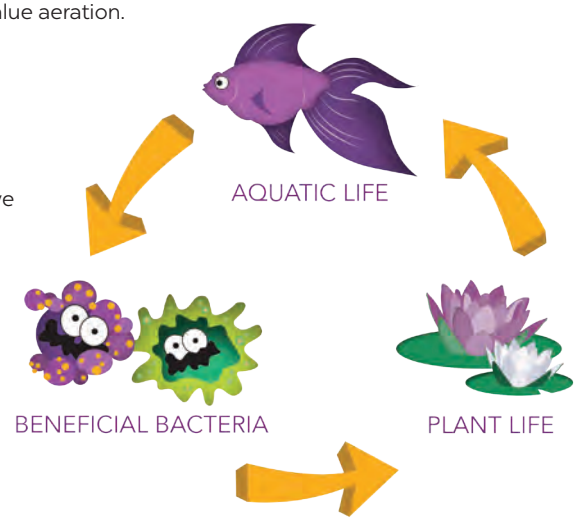
Depth greatly influences both temperature and oxygen levels. Deeper ponds and lakes experience thermoclines and stratification, where cooler bottom waters are cut off from oxygen, promoting the buildup of nutrients in the muck and killing fish. Even simple issues of cloudy water and off-odors require different strategies when managing huge volumes. When larger ponds and lakes can no longer be circulated economically by water pumps, effective aeration becomes critical.

The growth rate of algae and weeds accelerated by excessively warm surface waters slows as the pond cools down. The ample oxygen speeds up the consumption of wastes by bacteria, removing excess nutrients from the water column. Without nutrients, algae and weed growth drops further. Zooplankton, insects and the fish that eat them repopulate the entire water column, no longer excluded from very warm surface waters that held little oxygen, nor from oxygen poor depths that had been cut off by thermoclines. With the improvement of environmental conditions and food sources, fish quickly increase in both size and number.

THE ROLE OF BACTERIA:

There are two broad groups of bacteria that are useful in keeping a pond or lake clear and clean. The first group are the ammonia reducing nitrifying bacteria that process liquid animal and fish wastes. Naturally occurring, these bacteria turn toxic urea and ammonia first into nitrites, then into relatively harmless nitrates (plant food) if there is enough oxygen present, yet another good reason to value aeration.

These ‘nitros’ need only be present in small amounts since ammonia is usually measured in parts per million. Slow growing, nitrifying bacteria cannot survive drying and are only available in liquid form, but are not typically needed for lake management. Their colonies develop naturally, over time, wherever water, ammonia and oxygen are present.



The second group is much more important for lake management. Technically called “facultative anaerobic bacteria”, these ‘goop eaters’ decompose wastes with or without oxygen present.

Anaerobically, without oxygen present, they create methane and hydrogen sulfide; but give them enough oxygen, their metabolism speeds up and they attack the sludge at the bottom of the pond. Unlike nitrifying bacteria, this group of microbes are able to survive drying in spore form.

Formulations are rated by the number of colony forming units (CFU) per gram, typically one billion per gram (1b CFU) or more. Under optimal conditions, with the frequent addition of bacteria to keep populations artificially high and a constant supply of oxygen to accelerate aerobic decomposition to the maximum, these ‘goop eaters’ can consume up to 6" of organic ooze in a single season.

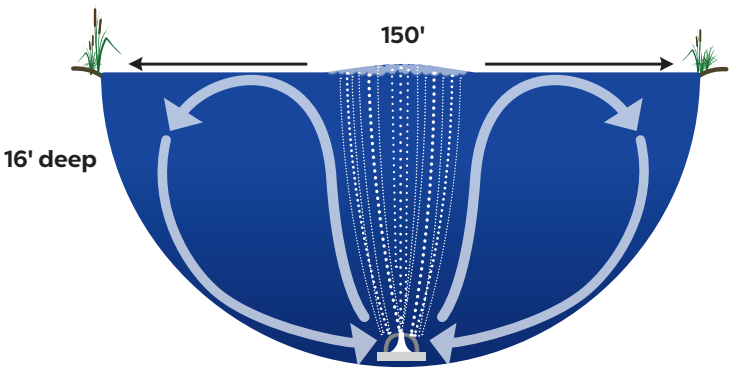
THE KEYS TO SPECIFYING AERATION SYSTEMS:

The three keys to sizing aeration are Depth, Shape and Profile.

DEPTH

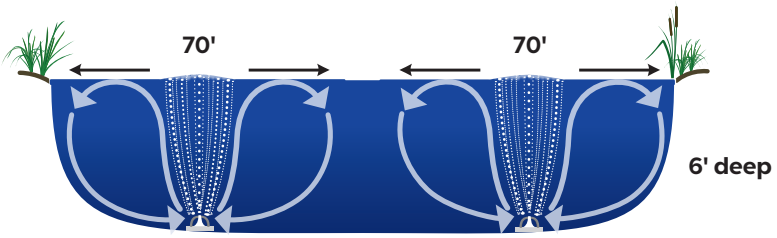
Circulation is directly proportional to depth. The deeper the water, the longer the path to the surface for the rising bubbles and the more water each bubble can pull upwards with it. The rising water has to be replaced by water sweeping in towards the diffuser, so a relatively small amount of air rising from deep water can circulate a tremendous volume. Shallow water doesn't provide as much 'fetch', or time for the bubbles to act on the water column, so circulation is reduced and more air needed per given area. The water welling up from a deeply set diffuser has a great deal of inertia, which causes it to flow outward in all directions once it reaches the surface. The diameter of the circle of aerated water created is proportional to the depth. The same diffuser set in shallow water will aerate a smaller area.

Figure 1.



Deep Water Aeration System with 1 Deep Water Diffuser – TPD100S-87R6

Figure 2.



Shallow Water Aeration System with
4 Shallow Water Diffusers – TPS400S

SHAPE

The shape of the water feature also affects circulation. A simple circle can typically be circulated with just one diffuser, while more complex shapes with coves and peninsulas that impede flow will require more diffusers, and more air. All four lakes below have the same area, but their different layouts require a different number of diffusers.

Figure 3.

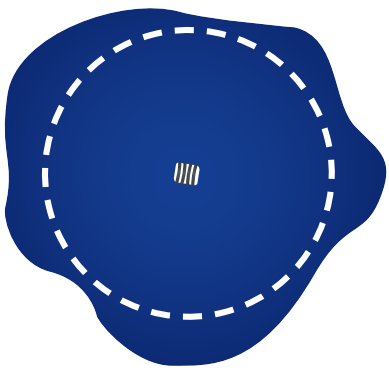


Figure 4.

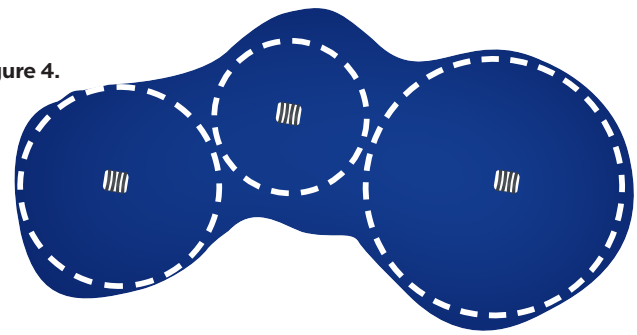


Figure 5.

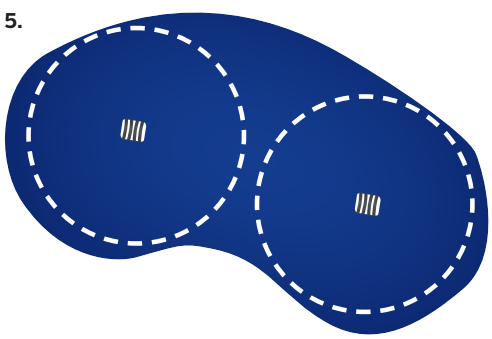
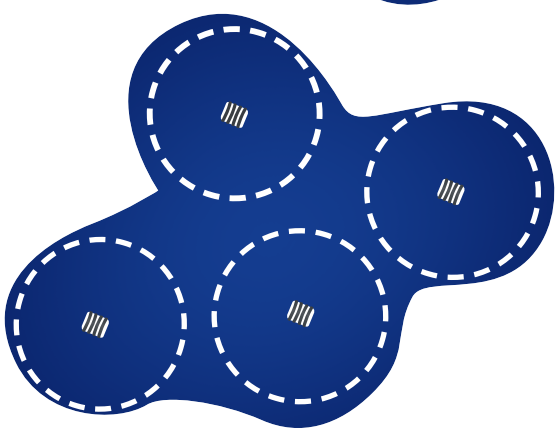


Figure 6.



PROFILE

Smooth sides and a bowl-shaped profile facilitate aeration and circulation, while lakes with many ledges and changes in depth will require more diffusers to aerate them efficiently. The bowl-shaped pond in Figure 1 can be aerated most easily. Wide, flat bottomed features like the pond in Figure 2, or shallow lakes with debris and vegetation everywhere will be more difficult to aerate and circulate effectively.

SIZING YOUR SYSTEM:

USE SURFACE AREA FOR LAKES WITH SIMPLE SHAPES AND SINGLE DEPTHS

Step 1. If your pond is roughly rectangular, square or circular, find the area and convert the square footage to acres by dividing by 43,560. (1 acre = 43,560ft²)

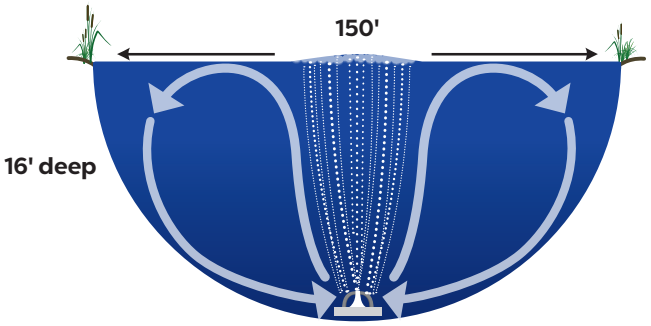
Step 2. Find the Depth of your pond and use the Chart below to determine the correct system or number of systems.

EXAMPLE:
For a pond roughly 150 feet on a side and 16 feet deep:
Multiply 150' x 150' to find the area and divide by 43,560 to convert to surface acres.

150' x 150' = 22,500 ft²

22,500 ft² ÷ 43,560 ft²/acre = .52, about ½ surface acres

Find the column corresponding to 16' and locate the matching surface area. In this case the correct system is a TPD100S-87R6. In the case of lakes larger than the surface areas listed, multiple systems will be required.



SYSTEM	No. of Diffusers	Coverage @2'	Coverage @4'	Coverage @6'	Coverage @8'	Coverage @12'	Coverage @16'	Coverage @20'
TPS200S	2	⅛ acre	⅙ acre	¼ acre	---	---	---	---
TPS400S	4	¼ acre	⅓ acre	½ acre	---	---	---	---
TPD100S-87R6	1	---	---	---	¼ acre	⅓ acre	½ acre	1 acre
TPD200S-87R6	2	---	---	---	½ acre	⅔ acre	1 acre	2 acres
TPD300S-72R6	3	---	---	---	¾ acre	1 acre	1½ acres	3 acres
TPD400S-72R6	4	---	---	---	1 acre	1½ acres	2 acres	4 acres

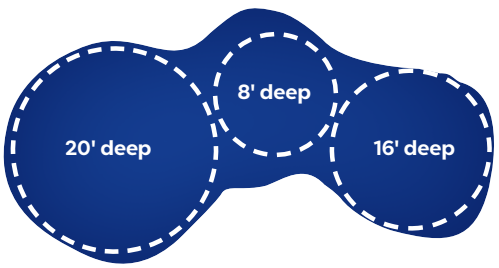
USE DIAMETERS FOR LAKES WITH COMPLEX SHAPES AND MULTIPLE DEPTHS

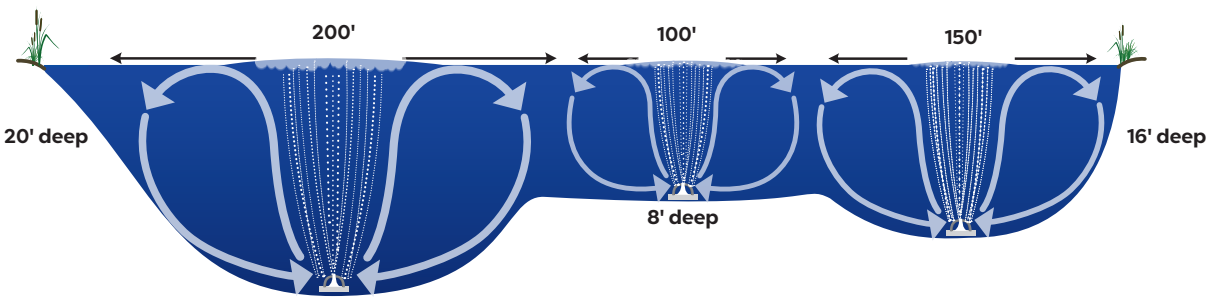
Step 1. Draw the perimeter roughly to scale or download a satellite image.

Step 2. Determine the depth(s) and find the corresponding size circle from the tables below.

Step 3. Draw circles to scale, covering the surface without overlapping. Each circle equals one diffuser.

Step 4. Find the appropriate shallow or deep water system(s) with the correct number of diffusers.





EXAMPLE:
The lake above is 200' wide and 20' deep at one end, 150' wide and 16' at the other, with a shallower 8' deep section 100' wide in the middle. From the depths on the chart below, draw the three circles to scale on your sketch. In this example, three circles are sufficient, so you will need a deep water system with three diffusers. The second column of the chart above indicates the required system with three deep water diffusers is the TPD300S-72R6. In the case of larger lakes requiring more than four diffusers, use multiple systems to cover the entire surface area.

AREA COVERED BY SHALLOW WATER DIFFUSER			
DEPTH	@2'	@4'	@6'
Circle Diameter	40'	55'	70'
Diffusers per Surface Acre	16	12	8

AREA COVERED BY DEEP WATER DIFFUSER				
DEPTH	@8'	@12'	@16'	@20'
Circle Diameter	100'	120'	150'	200'
Diffusers per Surface Acre	4	3	2	1

SYSTEM COMPONENTS:

AIR COMPRESSORS

Air compressors, the heart of the aeration system, provide a constant flow of oil-free air for years of continuous duty use. They are sized to deliver the correct volume of air at the correct depth to one or more air diffusers.

SHALLOW WATER COMPRESSORS
Linear piston compressors utilize a magnetically driven piston sliding back and forth on a cushion of air to deliver constant, high volumes of air to the bottom of ponds and lakes to 7' in depth. With only one moving, and one replacement part, linear piston compressors are simple to service and easy to rebuild, for years of trouble free use. Two models, with 6' power cords, carry a two-year warranty.

DEEP WATER COMPRESSORS
For deeper applications, Gast rocking piston compressors provide greater volumes of air to greater depths. With two alternating pistons and a heavy duty motor, these compressors provide a steady flow of air to the bottom of the deepest lakes. Also fully rebuildable, with silicone seals and titanium rods, rocking piston compressors will provide years of constant, dependable air flow. Two models, with 6' power cords, carry a two year warranty.

AIR DIFFUSERS

Air diffusers emit tiny bubbles through specially designed tubing, moving more water with less energy. The innovative diffuser tubing of extruded EPDM offers tremendous longevity and resistance to fouling. Bubble sizes that decrease as pressure rises to maximize surface area for extremely efficient gas diffusion. Easy to fill with on-site sand or gravel, diffusers ship empty to save weight and freight.

1. Heavy-walled diffuser tubing produces ultra-fine bubbles with little back pressure, for greater circulation and gas exchange
2. Diffuser shape accelerates the rising water column for more efficient circulation
3. Full flow manifold evenly distributes air to the diffuser tubing
4. Push-Lock manifold connection simplifies servicing and maintenance
5. Integrated strain relief for ½" and ⅜" weighted tubing keeps tubing in place while lifting diffuser for service
6. Includes ¾" check valve, ⅜" insert fitting and stainless steel strain relief bracket

CABINETS

Specially designed to house and protect the compressor while muffling the sound of the unit, insulated Cabinets enhance longevity, security and access for maintenance. A ventilating fan keeps the compressor from overheating, while a pressure gauge, pressure relief valve and manifold regulate the air output to the diffuser(s).

TUBING

DIRECT BURIAL TUBING
Our Direct Burial Tubing allows for installation of our Aeration Cabinets away from the shoreline of your pond or lake. Tubing is made of UV-stabilized PVC for long life under the harshest conditions.

WEIGHTED TUBING
Typhoon Pond and Lake Weighted Tubing quickly and easily attaches compressors to underwater diffusers without weights or ugly floating airlines. Designed to sink fast, stay out of sight and remain on the bottom to avoid accidental snagging. High density black PVC formulation remains flexible in a wide range of temperatures for worry-free delivery of air to pond aeration systems.

AERATION SYSTEMS

SHALLOW WATER SYSTEMS

Complete Shallow Water Systems for ponds up to 7' deep include Aeration Cabinet assemblies, Shallow Water Diffusers, Weighted Tubing and all necessary fittings. Available in two diffuser and four diffuser configurations.

DEEP WATER SYSTEMS

Complete Deep Water Systems for lakes up to 35' in depth come with Aeration Cabinet assemblies, Deep Water Diffusers, Weighted Tubing and all necessary fittings. Available in one, two, three and four diffuser configurations.

*For ponds shallower than 2 feet, see the Professional Aeration Kits in the Maintenance section of our catalog.

WATER TREATMENTS

Control unwanted plants and algae by limiting the nutrients or sunlight needed for growth. Regular weekly, bi-weekly or monthly applications of Bacteria consume organics in the water and on the bottom, starving out weeds and algae. Regular applications of dark blue or black Pond Dye block the sunlight needed for photosynthesis. Spot applications of Sludge Tablets to beach and wading areas keep shorelines muck and odor-free. All products are safe for fish, plants, livestock and pets.

POND CLARIFIER

Custom bacterial strains clear pond water by consuming dissolved organics. Simply toss in appropriate number of 8 ounce water soluble packets each month for clear, clean water year round.

MODEL	SIZE	DOSAGE	TREATS
TPWCP06	12 Packets - 6 lbs.	1 packet per ¼ acre every two weeks	¼ acre pond for 6 months
TPWCP24	48 Packets - 24 lbs.	4 packets per acre every two weeks	1 acre pond for 6 months

POND CLARIFIER+TM

Concentrated bacteria in 3 ounce slow release tablets with double the colony forming units (CFUs) per gram, Pond Clarifier Plus Trace Minerals accelerates organic removal and improves overall pond health.

MODEL	SIZE	DOSAGE	TREATS
TPWPP06	32 Tablets - 6 lbs.	2 tablets per ¼ acre every two weeks	¼ acre pond for 8 months
TPWPP24	128 Tablets - 24 lbs.	8 tablets per acre every two weeks	1 acre pond for 8 months

SLUDGE REMOVER

Easy to throw ½ ounce sludge eliminating tablets rapidly dissolve muck comprised of decomposing vegetation and fish waste. Plant and fish safe, perfect for wading and swimming areas. When regularly applied as directed to the shoreline, tablets can remove up to 5 inches of sludge per year.

MODEL	SIZE	DOSAGE	TREATS
TPWSR06	192 Tablets - 6 lbs.	16 tablets per 1,000 sq. ft. every two weeks	1,000 sq. ft. for 6 months
TPWSR24	768 Tablets - 24 lbs.	64 tablets per 4,000 sq. ft. every two weeks	4,000 sq. ft. for 6 months

POND DYE

Whether you prefer liquid or solid, easy to apply dissolvable packets, Typhoon Pond Dye shades the water to eliminate plant growth below the surface. Available in both blue and black, dye can be mixed to create your own favorite shade.

MODEL	SIZE	DOSAGE	TREATS
TPWDBLU2 TPWDBLK2	2 Packets	1 packet per acre-foot	½ acre 4'- 6' deep
TPWDBLU4 TPWDBLK4	4 Packets	1 packet per acre-foot	1 acre 4'- 6' deep
TPWDBLUG TPWDBLKG	1 gallon	¼ gallon per acre-foot	1 acre 4'- 6' deep

TECH TALKS:

FUN WITH BUBBLES

For you fellow bubble geeks out there, here are the numbers that we used to reach the conclusions in the illustrations below.

- The volume of a bubble 1mm in diameter = 5.24×10^{-7} liters
- The number of 1 mm Bubbles in 1 liter = 1,908,396 bubbles
- The surface area of a bubble 1mm in diameter = 3.14×10^{-6} m^2
- The surface area of 1 liter's worth of 1mm bubbles = 5.99 m^2

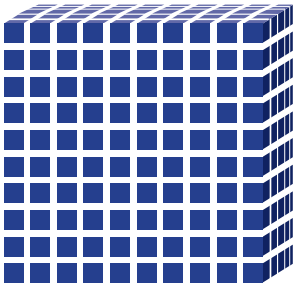
FORMULAS:

Area of a Sphere = $4/3r^3\pi$
Surface Area of a Sphere = $4r^2\pi$
1 m^2 = 10.764 ft^2

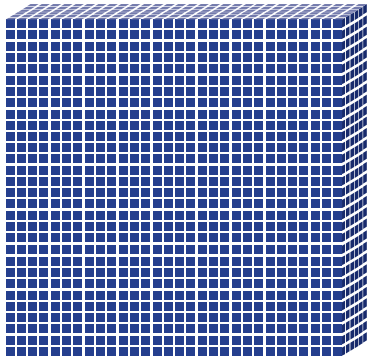
TO MAXIMIZE DIFFUSION AND CIRCULATION, BUBBLE SIZE MATTERS.

Reducing bubble volume by ten increases surface area by ten. In the example below, a cube containing a single liter of air has a surface area of 600cm^2. The same liter in 1cm cubes has an surface area of 6,000cm^2. The same liter expressed as one million 1mm cubes has a surface area of 60,000cm^2, almost 65 square feet! **In a single hour, a 30 liter per minute diffuser will create 2.5 surface acres available for gas exchange!**

1 liter cube = 10cm per side
SURFACE AREA = 600cm^2



1 liter = 1000 cubes x 1cm per side
SURFACE AREA = 6000cm^2



1 liter = 1,000,000 cubes x 1mm per side
SURFACE AREA = 60,000cm^2

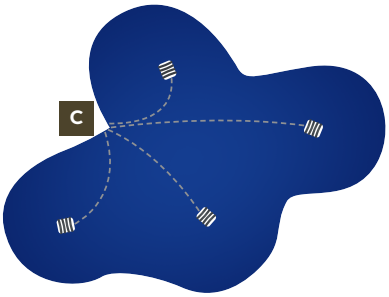
1 = 2 = 4

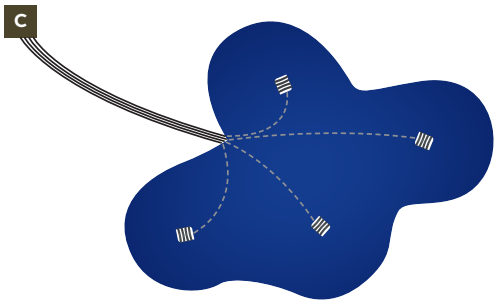
The largest Deep Water Diffuser handles the same amount of air as two Shallow Water Diffusers, which handles the same as four of the smallest Typhoon Air Diffusers. This makes substitutions for shallower or deeper depths easy.

50 LPM at 10' = **25 LPM at 6' each** = **12.5 LPM at 2' each**

TYPICAL LAYOUT

The adjoining diagrams show two typical layouts. The diagram on the left shows the Cabinet Assembly right at the lake edge. The diagram on the right shows the Cabinet Assembly near a remotely located electrical supply, with Direct Burial Tubing to the lake edge and Weighted Tubing to each Diffuser.





START UP PROCEDURE

Aeration is a powerful tool. There are times when full implementation without an acclimation period can lead to disaster. In warm weather it is best to start slowly to avoid a "turnover", where deoxygenated bottom water is mixed in so quickly that total dissolved oxygen levels plummet to lethal levels. To be safe it's best to run the system for only 15 minutes the first day, 30 minutes the second, 1 hour on the third day, doubling the running time each day for the first week. This will also allow methane and hydrogen sulfide to dissipate slowly and safely.

DAY 1 | DAY 2 | DAY 3 | DAY 4 | DAY 5 | DAY 6 | DAY 7 | DAY 8

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1.330.274.8317 | www.ATLANTICWATERGARDENS.com | info@atlanticwatergardens.com