

Temperature Solutions!



Temperature Topics

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Basics of Dissolved Oxygen

Have you ever swum in a pond or lake in late summer and noticed the top few feet of water is like bath water and below that, the water is cool and refreshing? This cooler water, although very refreshing to dive into, can be very dangerous to your pond and its inhabitants.

The ability of water to absorb and hold oxygen is vital to pond health and the health of your fish and other pond inhabitants. Dissolved Oxygen (DO) is the measure of the amount of oxygen dissolved in a body of water as an indication of the degree of health of the water and its ability to support a balanced aquatic ecosystem. The warmer the water, the less dissolved oxygen it can hold. As the water temperature increases during the summer months, the less oxygen it can hold.

The second factor for your pond to have oxygen is the ability to be in contact with the air, or more specifically oxygen, in order for the oxygen to dissolve into the water. Most oxygen is supplied naturally by wind and the photosynthesis process. As the wind blows, waves are created which mix the surface water and expose more surface area of the water to the air and oxygen is diffused into the water at the air/water interface. This process is more efficient on large lakes because there is a large open area for the wind to blow across the lake with less blockage from trees, hill, and buildings, and the larger surface area allows the waves

to travel further. Small ponds that are surrounded by trees or other obstructions that block the wind do not receive as much oxygen from wind.

Photosynthesis is the process plants use to create energy. The aquatic plants will use sunlight and carbon dioxide to produce energy in the form of cellulose and release oxygen as a byproduct. This is described in further detail in the Algae Solutions, Aquatic Plant Solutions, and Aeration pages, but more weeds is not always a good thing for your pond even though they are producing oxygen. During the daytime when the pond is receiving sunlight, photosynthesis can release oxygen into the water for the fish and bacteria to use. However, during the nighttime hours when there is no sunlight, photosynthesis stops and plants actually start to use some oxygen instead of producing it, and as the night progresses, the oxygen levels steadily drop. Also, once the plants die off, the extra decomposition taking place also uses up available oxygen

Introduction to Temperature Problems

Now that we understand some basics of dissolved oxygen, we can get back to the temperature problems in your pond. Temperature problems are a seasonal issue. As the sun exposure to the pond increases through spring and into summer, the water warms. As the summer progresses, the water at the surface continues to warm faster than the water below because not as much sunlight penetrates the lower portions of the water column. The area of the water column that receives sunlight is called the Euphotic Zone. The layer of warm water is known as an epilimnion. Also, warm water is less dense or lighter than cooler water, so warm water stays at the surface and colder water sinks to the bottom.

As the summer continues, this temperature difference expands. The surface water is very warm and the water below much cooler. The cold water layer is known as the hypolimnion. As stated earlier, the cooler the water the more oxygen it can hold. However, if the cool water has no exposure to the air or oxygen, it cannot hold the oxygen, no matter how cold it is. Therefore, the cooler water near the bottom does not have a continuous oxygen supply, and over time can turn anoxic or have all of its oxygen used up. When this occurs, organisms such as fish and bacteria need to move into areas of higher oxygen or end up dying. This limits the area your fish have to live and also greatly limits the amount of decomposition of organic matter at the pond bottom.

The transition area between the warm water and the cold water is called a Thermocline. The thermocline is very important to your pond health and can act as a barrier between aerobic and anaerobic areas, and prevent water mixing. For the organisms in your pond that require oxygen, the thermocline can mean life or death. Basically, the lower down the water column the thermocline is located, the better off they are.

Seasonal Pond Progression and Turnover

We'll start our seasonal progression in winter. The water temperature is fairly consistent throughout the entire water column. As stated earlier, warmer water is less dense than cold water and will float to the top. However, as water cools and gets gradually heavier, it is reversed at about 4 degrees Celsius and continues until the water is frozen (this is why ice floats). If you are in a northern climate that gets ice, there will be warmer water near the bottom of the pond that is warmed by the earth and will not float to the top because the surface water under the ice is cold enough to be lighter.

As the ice melts in late winter or early spring, that 4 degree Celsius less dense water warms to above 4 degrees. When this happens it is more dense or heavier than the warm bottom water. What then occurs is called Turnover. The heavier water is on top and all of a sudden will go to the bottom and the warm water will

do just the opposite and rise to the top. This mixes up the entire water column and the pond will typically look dirty with suspended debris. Spring turnover is much less severe than fall turnover because there are not as much oxygen problems in spring as in late summer.

As spring progresses, the water at the surface warms and the thermocline is very near the surface. As the water warms further down, the thermocline moves further down the water column, still usually a few feet from the surface and the cold water remains at the bottom because it is less dense even though it is warming slowly.

With fall comes cooler temperatures. The pond water will begin to cool throughout fall. The cooler temperatures will continue to cool the water until the water above the thermocline is actually colder than the bottom water. Now you have a situation where turnover could occur. The quicker turnover occurs, the more severe the effects. A cool fall rain or cold front with lots of wind can quickly cool the surface water and cause a rapid turnover. Once the cooler surface water becomes denser than the bottom water, it will sink and displace the warm bottom water. Again, the water column will be mixed and look dirty with suspended debris.

Fall Turnover is much more severe than Spring Turnover. As discussed earlier, the thermocline separates warm water from cold water and the bottom water does not have as much dissolved oxygen because it has not been in contact with the air all spring and summer. During turnover, the closer the thermocline is to the surface, the worse the effects will be on the pond. If there is a large volume of water below the thermocline that has very little or no oxygen when turnover occurs, the low oxygen water gets mixed with the rest of the pond, thus decreasing the dissolved oxygen throughout the entire water column. Also, the chances of turnover are greater in fall due to common fall rains and cold fronts. This decrease can be drastic enough to cause massive fish die offs as in the picture at the top.

Preventing Turnover and Temperature Problems

The effects of spring and especially fall turnover can be devastating to your pond. Turnover may not happen every year, but if turnover does occur, it could ruin a large investment in your pond. The best ways to prevent turnover or at least minimize its effects is to keep the water mixed and add supplemental aeration.

When wind and wave action fails to sufficiently mix the pond water and eliminate or push the thermocline further down in the water column, it is advised to physically mix the water in another way. There are three types of equipment that work best for mixing water, Horizontal Aspirators, Horizontal Circulators, and Bottom Diffusers (other methods of aeration described in the Aeration page.)

Horizontal Aspirators - This type of equipment uses a motor that is mounted above the water level with a float, extended shaft, propeller, and draft tube to suck in air. They can be adjusted to point the propeller in several angles. They are good at causing directional flow and can mix deeper pond water, plus by sucking in the air are adding some oxygen. One drawback is the extended shaft leads to premature failure of the unit.



Horizontal Circulators - This type of equipment works similar to the aspirators, but do not use the extended shaft or draft tube. They can be angled in several positions and can successfully mix deeper ponds and create directional flow, while providing some oxygen. They can also be mounted in variable water depths and used to prevent ice in winter. Kasco offers horizontal circulators known as Water Circulators.



Bottom Diffusers - This type of equipment uses a pump on the shore to push air through a weighted tube to an air stone or several stones on the bottom of the pond. The air then bubbles through the air stone and rises to the surface. The rising bubbles break through the thermocline and help to mix the water. These work best in deep ponds where a good circulation can be set up. In shallower ponds, they do not operate as efficiently.



Another way to limit the effects of turnover is to add supplemental aeration. Using an aeration device (discussed in more detail in the Aeration page), you can help mix the water as discussed above, plus add vital oxygen to the pond system. If an aerator is in place before turnover occurs, even if the pond turns over, the added oxygen will help to prevent a massive fish die off and create a buffer for major problems associated with turnover.

A Kasco Pond Aerator is a great option for adding oxygen to the water and it will also help to push the thermocline down to about 5-10' depending on size. The added oxygen will be great for your pond all season and the mixing will help limit the amount of water moved during turnover. If turnover still occurs, the aerator will help save your fish and your pond. Typically, it is recommended to have about 1hp of aerator per acre of water to properly aerate the pond.

Kasco also offers Aerating Fountains which will add some oxygen, mix some water, and also provide a beautiful display in the pond. These models do not add as much oxygen or move as much water as a Pond Aerator, but they do offer a great display. Typically, it is recommended to have about 1.5 to 2hp of aerating fountain per acre of water to properly aerate the pond.

By adding equipment to mix the water column and add vital oxygen to the pond, you can create a better pond ecosystem throughout the year and eliminate or limit the negative effects of spring and fall turnover, which can be devastating to your pond.



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