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About the Author
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Aeration for Ponds and Cisterns

Using oxygen for the natural cleansing of water is becoming a viable alternative for pond and cistern owners in reducing the use of chemicals to fight the bacteria and algae that can become a nuisance. An aerobic bacterium needs oxygen in order to maintain the balance of nature. The "good" bacteria need oxygen in order to work and decompose plant material in the water. As they work they burn up the oxygen, and when this oxygen is exhausted, they become anaerobic bacteria or "bad" non-oxygen using bacteria that cause smell and promote microbial growth.

There are different methods used in administering the oxygen into the water and Henry's Law exhibits properties that only allow so much dissolved oxygen to be absorbed into the water. Biological oxygen demands (BODs) and chemical oxygen demands (CODs) determine how much of the O_2 is consumed, plus temperature plays a big role in O_2 content. This article will take a look at some methods for increasing oxygen content, Henry's Law and applications that benefit from increased levels of O_2.

There are several ways to increase oxygen content, with some methods being better and less costly than others. Air compressors are one method that has been used to pump O_2 into the water, but this method can become costly because of repairs or replacement of the compressor. The compressor wears out from the continuous running and is subject to regular maintenance and servicing. However, there are newer compressors in the market that require no oil that have fewer problems and maintenance requirements. There also are other ways of increasing oxygen content. Everyone has seen the effects of a waterfall or river rapids in regard to cleansing water naturally. Nature's methods over the centuries can be observed at Niagara Falls, Cumberland Falls, Colorado River, etc. This rapid movement of water helps oxygen to be transferred into the water. Another such example would be a wave crashing against the rocks of a shoreline or high winds causing whitecaps on a small lake. Man has tried to imitate this phenomenon by using fountains or creating waterfalls in fish and ornamental ponds. This method works to a certain extent, but depending on the amount of water in these ponds, it does not work as effectively as desired, because the mass transfer of O_2 may not be great enough to overcome the BODs and CODs that are being subjected to the body of water.

Oxygen added to drinking water that is stored in cisterns will help deter bacterial growth.

A very inexpensive method for injecting or shall we say educing oxygen into water is using an air eduction system to suck ambient air into the water stream. There are several companies that manufacturer this type of system for increasing oxygen levels. Systems designed for oxidizing iron and hydrogen sulfide have been used successfully in water treatment for years. Pumping water through some hoses and back into a pond or cistern that has this eductor can help increase the oxygen levels. Something to note here again would be the fact that the transfer of O_2 to the water may not be great enough to overcome the demands put on the water.

Windmills and electric aeration devices are other cost-effective methods for increasing oxygen levels. Windmills have seen resurgence on our countrysides over the past several years, but this time it is not for pumping water, but for dispersion of air. Pond and cistern owners have found products that can help keep their ponds and cisterns healthier without the cost of electricity, and the initial startup costs are affordable with a return on investment quickly recouped from chemical reduction and maintenance. These windmills turn at low wind speeds and produce enough oxygen for small ponds and cisterns. The use of an air stone to diffuse the air and create micro-bubbles that rise slowly through the water get a better transfer of air to water than most fountains or waterfalls. Electric aerators use the same method of pumping, only they use a small motor, which is economical to run and requires very little maintenance. Unlike the compressor, this small motor and diaphragm work seamlessly and last a long time. Aesthetics and the use of electricity make the choice of using a windmill or aerator up to the land owner, as both work very well.

Henry's Law determines the amount of dissolved oxygen in water. This law states that a body of water can contain only the amount of oxygen that is proportional to the pressure above the liquid. Other gas laws such as Boyle's, Charles' and Dalton's Laws also determine how much dissolved oxygen can be present in any given source of water. Temperature is another factor that will decrease O_2 levels. Higher temperatures reduce the amount of dissolved oxygen present in any given water source. Water at a temperature of 0˚ C can contain 14.6 ppm of dissolved O_2, whereas there is only 7.6 ppm at a temperature of 30˚ C. As stated earlier, BODs and CODs also play a part in how much dissolved oxygen is present. Salt water, for example, cannot contain as much O_2 as freshwater. These simple chemistry laws cannot be changed or altered, but when used to design treatment methods, these laws can help reduce the trial and error methods so often employed by

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beginners and inexperienced water treatment professionals.

The applications for aeration are numerous and the following are only a few examples where increased oxygen can be beneficial. Ponds can benefit greatly from increased oxygen levels in controlling algae, bacteria, fungi and molds. When an aeration system is properly applied, the overall health of the pond will be enhanced. Fish will grow faster and stay healthy. In addition, the water movement will keep the pond from freezing in the winter, thus keeping oxygen-robbing fish and plant life sustained. The freezing of a pond in the winter can be the biggest detriment to pond owners since algae forms on the bottom of the pond during the colder temperatures, and then as the pond turns over in the spring the algae surfaces. Cisterns that store water can utilize oxygen to combat various contaminants and keep the water from becoming stagnant. Oxygen added to water stored for drinking will help deter bacterial growth. Reclamation tanks used in greenhouse flood floors can benefit from higher levels of oxygen. Plants will receive more oxygen to the root zone, which will enhance growth and retard disease.

One of the downfalls of using aeration is that ambient air could introduce airborne bacteria, mold or mildew into the water. In an enclosed environment such as a greenhouse, transmission of these spores could be detrimental to the crops. One way to combat this issue would be to use an air purification process for the incoming air to make sure these spores are eradicated before they enter the water. This can be done with a germicidal UV bulb or ozone production system. These methods work in order to reduce the amount of pathogen pressure that could be put on the plants and ozone disperses more readily into the water.

Aeration is an efficient way to control algae in a pond, cistern or any other standing water source that is open to the atmosphere. This method of oxidizing will help precipitate iron, sulfur and manganese faster so contaminants from well water can be dealt with in an easier fashion. With proper filtration afterwards, the water is cleaner since these contaminants are flocculated and filtered more efficiently. Aeration makes it possible to reduce the chemicals used for killing bacteria, fungi, mold and algae and also reducing the labor caused by removing these contaminants. WQP