

AERATION

When choosing which type of aerator to use for aquaculture and ponds, it is helpful to know some basic facts about aeration.

Without sufficient oxygen, aquaculture animals will become stressed, sick, and possibly die. Even when a good quality water source is available, the large inputs of nutrients and organic matter that result from feeding and animal waste can lead to a low level of dissolved oxygen in the pond. Good mechanical aerators can effectively replenish the level of dissolved oxygen in ponds.

Aerators perform two basic functions: they oxygenate water and induce water circulation. Both functions are important in pond aquaculture. Pond water normally contains plenty of dissolved oxygen during daylight hours, but in ponds with high feeding rates and abundant phytoplankton blooms, dissolved oxygen concentrations may decline to dangerously low levels at night. Aeration can be used during the night to stabilize dissolved oxygen concentrations within safe ranges.

A moderate degree of water circulation in ponds is beneficial: it prevents stratification of the water to provide more uniform water quality. Also, organic matter from uneaten feed, feces, and dead plankton settles to pond bottoms and decomposes. This can lead to anaerobic conditions in the superficial layers of bottom sediment with the release of toxic microbial metabolites in the overlying pond water. Induced circulation of pond water increases water flow and delivery of dissolved oxygen to the surface of the sediment to lower the possibility of anaerobic conditions at the sediment-water interface.

"Because of better water and soil quality in response to aeration, fish eat better, have greater resistance to diseases, suffer less mortality, and achieve better feed conversion efficiency in aerated ponds than in ponds without aeration."

An aerator has two basic functions:

1. Oxygenation

Aquaculture farmers understand the importance of using aerators, and as a result an increasing number of farmers are using them. However, many do not use a sufficient number of aerators and do not realize that they must use them every day. If farmers wait until aquatic animals demonstrate a lack of oxygen, such as fish coming to the pond surface to breathe, it is often already too late to prevent health risks. Fish growth will very likely already have been stunted, and resistance to disease greatly diminished.

Results of controlled experiments illustrate the tremendous financial benefits of using adequate aeration.

·One experiment used continuous aeration in catfish ponds. Catfish production in the daily-aerated ponds was double what it was in the ponds using occasional emergency aeration only. An economic analysis of the data showed that nightly aeration results in greater profits than in ponds with lower stocking and feeding rates and only occasional emergency aeration.

In another experiment some catfish ponds were aerated 6 hours per night, while other ponds used emergency aeration only. The harvest weights from the ponds that were aerated every night were 32% higher than in the ponds that used only emergency aeration. The net returns to land, management, and equity capital were 92% higher for daily-aerated ponds than for emergency-aerated ponds.

2. Circulation:

The greatest influence of water circulation on oxygen concentration is the blending of surface water with subsurface water. During daylight hours, surface waters in ponds are often supersaturated with dissolved oxygen, while water at greater depths often have little dissolved oxygen. Oxygen produced by photosynthesis of the phytoplankton at the surface can be conserved by mixing it and distributing it equally throughout the pond water. In this way, mixing pond water can unify the amount of dissolved oxygen at all levels of the pond. In addition, because of numerous biological factors, the total net-dissolved oxygen content of a pond can even be slightly increased from water circulation alone. Water circulation prevents thermal, oxygen and chemical stratification, helping to make the entire pond volume habitable for aquatic animals.

Choosing which type of aerator to use is very important, however, because numerous studies show that certain types of aerators are better than others

Membrane diffuser/aerator mixes pond water much more thoroughly and effectively than do vertical-pump aerators (commonly known as mushroom, or impeller-type aerators) and paddle wheel aerators. A vertical-pump aerator does not create a horizontal flow, and therefore "re-circulates water in the zone immediately around it." Paddle wheel aerators create a flow on the pond surface only, making them much less effective than efficient as the membrane diffuser/aerator at mixing surface water with subsurface water.

Another important result of circulation is to treat the pond bottom soil. Clean pond bottom soil is one of the essential ingredients for successful aquaculture. Even when a good quality water source is available, the large inputs of nutrients and organic matter that result from feeding and animal waste can lead to poor bottom soil conditions.

Soil condition in aquaculture should be given the same degree of consideration as water condition. Just as there is a condition of equilibrium between the water and the air, there is also a condition of equilibrium between the water and the soil. Water quality can be greatly affected by its interaction with the soil. Many of the suspended particles found in the water are derived from its contact with the soil.

Solids in the water settle to the bottom, creating a layer of sediment. This layer of sediment is different than, and should be distinguished from, the original pond bottom soil. If this sediment is allowed to accumulate at the pond bottom, the organic matter contained in it will decompose and create anaerobic conditions at the soil surface (the soil-water interface). Toxic metabolites such as hydrogen sulfide will then be released into the water. A method of aeration that "produces uniform, gentle water currents over pond bottoms to suspend fresh organic particles without suspending mineral soil particles" is ideal. If suspended in well-oxygenated water, organic particles will decompose aerobically without the associated production of toxic metabolites.