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Factors Involved in the Aeration of Pond

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SUMMARY

Aerators are typically placed in ponds to maximise water circulation. By using this method, it is possible to cause erosion of pond bottoms and interior slopes of embankments as well as deposition of sediment piles in the middle of ponds where water currents are weaker. According to recent studies, moderate aeration to improve water quality and increase feed conversion efficiency is more profitable than using intense aeration to offer the maximum feasible productivity. Aerators can now be started and stopped automatically in response to daily variations in dissolved oxygen (DO) concentrations, although these devices are still pricey and unreliable. These techniques include adding fertilizer to encourage aquatic plants to produce more oxygen through photosynthesis, adding substances that release oxygen through chemical reactions, releasing pure oxygen gas into pond waters, and aerating water with mechanical devices that either splash water into the air or release air bubbles into the water. This article goal is to provide an overview of the "state of the art" in mechanical aeration for aquaculture ponds.

INTRODUCTION

The broad phrase "aquaculture" refers to the breeding, raising, and harvesting of plants and animals in various kinds of aquatic habitats, such as ponds, rivers, lakes, and the ocean. Similar to agriculture, aquaculture can be practiced either in a natural setting or in a controlled one. Researchers and the aquaculture sector are "growing," "producing," "culturing," and "farming" a variety of freshwater and marine species using aquaculture methods and technologies. Numerous finfish, shellfish, and crustacean species are raised commercially in the United States for use as ornamental fish for aquariums, baitfish for recreational fishing, and food fish. Most freshwater aquaculture operations concentrate on fish and shellfish species such trout, salmon, bass, catfish, tilapia, prawns, and carp.

The most prevalent aquaculture technology in use in the US is ponds. Pond management needs to be proactive and effective in order to sustain maximum production levels and guarantee high-quality products. To address problems with water quality, illness and infections, aquatic vegetation, sedimentation, and predator control, a variety of management techniques are required. Pond managers are very concerned with controlling the dissolved oxygen (DO) levels in their ponds because doing so frequently necessitates the employment of expensive, often custom-built equipment.

Dynamics of dissolved oxygen in ponds

All aerobic aquatic species require a steady supply of DO to thrive, making DO the most crucial component of water quality in any aquaculture operation. In order to help aqua culturists manage pond growth systems effectively, it is vital to have a fundamental understanding of the mechanics of oxygen production, transfer, and depletion. Despite the fact that pond managers may not be able to easily change some elements impacting DO dynamics; there are many things that may be changed to enhance the water quality conditions for productive growth.

Dissolved oxygen sources

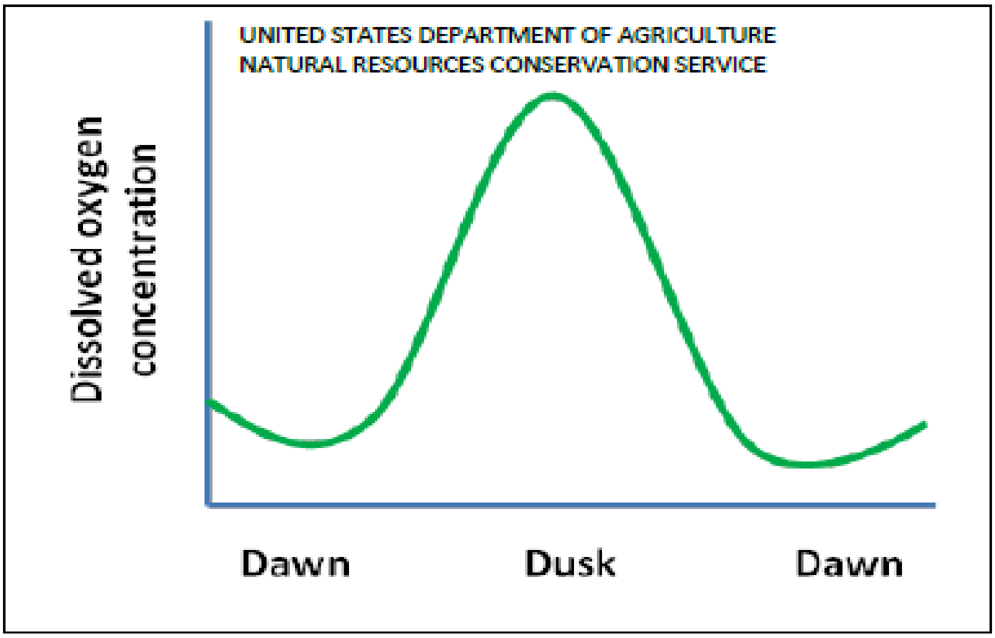
The atmosphere is a natural environment's biggest source of oxygen. Any particular amount of the air we breathe is made up of roughly 21% oxygen, 78% nitrogen, and 0.9 percent argon, with the remaining portion containing a variety of other gases, most of which are inert. Both the atmosphere and the end product of photosynthesis by aquatic plants, algae, and some bacteria are the two main sources of oxygen that dissolve into water.

Diffusion or turbulence brought on by the physical agitation of surface water is how atmospheric oxygen enters water. Because oxygen is very slightly soluble in water, direct diffusion is an extremely sluggish process. Therefore, the most efficient approach to introduce atmospheric oxygen into the water column is surface agitation by wind or other mechanisms that mixes air and water together. Aeration is the process of combining air and water to raise the DO content.

The main source of DO in pond aquaculture systems comes from the photosynthesis of aquatic plants and organisms. Sunlight energy powers photosynthesis in an aquaculture pond. As long as light is present,chlorophyll-containing aquatic organisms such as submergent and emergent plants, phytoplankton, and photosynthetic bacteria deliver oxygen into the water column.

Balance of oxygen and stratification

By diffusion back into the atmosphere, respiration by aquatic life and plants, and breakdown of organic matter by bacteria primarily found in bottom sediments, dissolved oxygen in pond water is depleted. The biochemical oxygen demand, or BOD, is the quantity of oxygen needed for microbial activity. When photosynthesis is active, a pond's DO concentration is at its maximum during the day. At night, when respiration and BOD diminish oxygen levels, it is at its lowest. This largely predictable process, known as the diurnal oxygen cycle



A pond's upper layers absorb light and heat, and the depth at which light may enter the water column has an exponentially decreasing effect. Further reducing the intensity of sunlight at depth are additional issues like turbidity from suspended silt or excessive algal densities. In a pond, the water is normally warmest at the surface and gets colder as it goes down. The process of less dense warm water "floating" on top of denser cold water in a layering of pond water is called thermal stratification.

Higher latitude and elevation ponds

The characteristics of aquaculture ponds in northern climates and at higher elevations (3,000 feet and above) set them apart from those in southern climates. These variations, which can be mostly attributed to pond size and environment, have an impact on DO dynamics over the growing season. Greater maximum depths (6 to 12 feet) and lower average surface areas (1/4 to 10 acres) are possible in aquaculture ponds at higher elevations or latitudes than they are in the Southern States. The possibility that thermal stratification would occur during the summer is increased by greater depth and smaller surface area, and the strength of this stratification may lead to the creation of an anoxic (without DO) layer near the bottom of the pond. These physical and climatic variations also have an impact on DO management choices in higher latitude and higher altitude aquaculture ponds. The Midwest can see low DO events even if DO may not be as much of a problem in the summer as it is in southern ponds. Additionally, early-season variations in water temperature can be large and coincide with the spawning and early life cycles of many species that are raised in ponds in northern latitudes (such as walleye and baitfish). Under these circumstances, managing DO can be difficult, depending on the daily weather, the amount of organic matter in a pond, and the state and make-up of nearby buffers and uplands.

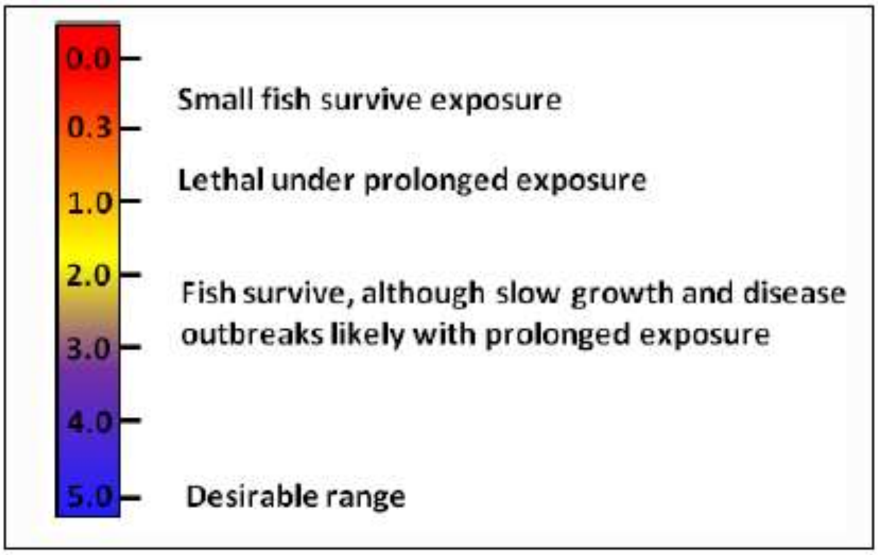
Dissolved oxygen measurement:

Pond managers frequently have to check the daily DO content of their fish ponds, especially in Southern States where productivity issues related to oxygen depletion can arise. When there are issues with DO levels, a prompt response is often required to take the necessary action. As a result, aquaculturists require a quick and accurate way to measure DO concentrations in order to guide management decisions. A dissolved oxygen metre is an essential piece of equipment in the majority of commercial fish farm setups as well as any other circumstance where routine DO measurement of numerous ponds or culture units is required.

DO levels needed for production

Maintaining DO within a range of values that encourage healthy, rapid growth is necessary for operating an aquaculture pond for the best production of shellfish, crustaceans, or fish. Aquatic species' metabolism and growth are controlled by the amount of dissolved oxygen in aquaculture ponds. Because cultured species may consume less feed, develop more slowly, convert feed less efficiently, be more prone to infections and illnesses, and even suffocate and die, persistently low DO concentrations can have a substantial impact on productivity.

The unit of measurement for dissolved oxygen is parts-per-million (p/m) or milligrams-per-liter (mg/L), and 5 p/m (5 mg/L) is equivalent to one drop of food colouring in a 55-gallon barrel. Depending on its stage of development, the chemistry of its surroundings, and other considerations, each species has slightly varied DO requirements.



In the late evening and early morning hours of the growing season, aquaculture ponds frequently experience critically low DO concentrations. Monitoring the DO levels in aquaculture ponds on a regular basis can assist identify potential oxygen depletion situations. The following observations and circumstances can be used to predict oxygen depletion in the absence of testing equipment for DO concentration

- Fish suddenly cease feeding
- The water's colour changes quickly to brown, black, or grey, indicating the loss of an algal bloom.
- A putrid odour emanates from the water
- Fish swim at or near the surface gulping air (a process known as piping).
- There is an extended period of hot, gloomy weather
- There is a strong summer breeze, a rainfall, or both

CONCLUSION

Any one of the six above mentioned circumstances suggests the necessity to modify the DO concentration in the water using any method at hand. Mechanical aeration is a practical technique to use in many aquaculture operations when oxygen shortage occurs. Although biological and chemical processes that result from natural pond dynamics produce the most DO for cultured organisms, other factors such as stocking density, the time of year, and weather patterns can make mechanical aeration the process of adding oxygen to water to improve productivity and necessary for the survival

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