

Design for a Solar Powered Water Aerator

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Abstract— This analysis was conducted to see the impact of blowing type solar aerator on dissolved oxygen. Water aerators are various devices used for aeration, or mixing air with another substance, such as soil or water. These devices are used to add oxygen to the water. Solar aerators used solar energy for the aeration process. This blower is used for supplying air bubbles in artificial water ponds. And this blower is run with the help of a solar plate.

Keywords: Solar Powered Water Aerator, solar plate

I. INTRODUCTION

In 21st century global systems the main problem is for aquatic animal's effect due to the decreasing rate of dissolved oxygen given to the fish.

And also there's sludge active on base of the pond due low level of oxygen present in underwater. The artificial pond making by carrying a solar aerator contain the pond in acres or Hectare. The environment for different kind of fish is also considered, so they will live in such type of climate or not.

The solar aerator is used for solve the dissolved oxygen rate and also reduces the sludge active in the under water. It also provides oxygen at required pressure and all the energy provided to the blower is through the solar panel by solar energy produced in it. Due to global warming the oxygen rate is reduced due to the other particles increase in the atmosphere. Also, the process for dissolving oxygen in the water also reduces, so the rate for fish to live in desired oxygen gets them to die by reduced oxygen.

So, a solar aerator produces desired oxygen by aerating the water for fish to live.

II. LITERATURE REVIEW

During the past decade, pond aeration systems have been developed which will sustain large quantities of fish and invertebrate biomass. Aerators work by increasing the area of contact between air and water. Aerators also circulate water so fish can find areas with higher oxygen. Recent studies suggest that heavy aeration to provide the greatest possible production is less portable than moderate aeration. Water aeration is the process of increasing the oxygen saturation of the water.

Matthew gray, Steve Kestel, Tilo Stahl (2011) works on Diffused Air Aeration in which Successful operation of the system depends on the successful operating of all components of the system. The paper describes that a well-designed aeration system can save up to 25 to 40% of energy consumption.

Claude e. Boyd (1998) used Paddle wheel aerators in Which Production cannot be increased by ignoring the economic consideration of the system as high ammonia concentration will impose a limit even through there is adequate amount of DO concentration.

Brain kirke Ahmed EI Gezawy (1996) have study in vertical impeller and Horizontal Impeller which use if the

circulation is turned on before the thermocline is established there will be no density difference that will oppose the pumping of water. Mixing is not necessary the main key to prevent stratification is circulation of water.

Moeinjazayer works on solar output relation with sun in which direct relation exists between the sun's height and the solar angle of incidence. As the sun grows higher the power input also increases. The panels should be placed accordingly.

Connie d. Demoyer, Erica I. Schierholz have study Submerged air aeration in which The result of the model indicate that the surface transfer coefficient in a 9.25m tank is 59-85% of bubble transfer coefficient. Bubble concentration is also greater the air water concentration.

III. TYPES OF AERATOR

There are many types of aerators available in the market.

- 1) Gravity Aerators
- 2) Spray Aerators
- 3) Diffused Air Aeration Systems
- 4) Mechanical Aerators

A. Gravity Aerator:

In the cascade aeration system water falls down by a series of steps that time the contact between air and water is increased. Its use for water treatment processes. And it's not suitable for fish farming.

B. Spray Aerator:

Spray aerator is known as fountain aerator and has a special type of nozzle to produce spray. The main objective of spray aerator is to remove foul odors, taste and color from water.

C. Working of spray aerator:

The water is entered into each nozzle and leaves in fine spray and fall through the surrounding air and increase contact between air and water. Each nozzle has a diameter of 2.5 cm to 4 cm and water is discharged about 18 l/h to 6 l/h.

D. Diffused Air Aeration Systems:

Diffused air is a simple concept which entails pumping air through a pipe or tubing and releasing this air through a diffuser below the water's surface.

E. Mechanical Aerators:

Mechanical aerators are of two general types; surface aerators and turbine aerators. Surface aerators consist of submerged or partially submerged impellers, which are centrally mounted in the aeration tank.

1) Type of mechanical aerators:

- 1) Turbine aerator
- 2) Paddle wheel aerator.
- 3) Vertical pump aerator.
- 4) Propeller pump aerators.
- 5) Surface aerator.

6) Submersed aerator.

Water aerators are various devices used for aeration, or mixing air with another substance, such as soil or water. These devices are used to add oxygen to the water. Aerators reduce the water coming through the faucets by mixing it with air. The aerator acts as a sieve, sending a separating a single flow of water into many tiny streams. This introduces the air into the water flow. Starting new farming it is important to improve water quality for better production of fish. It requires when reduces the likelihood of excessive algae growth. When it is important to remove foul odors.

When it is required to reduce accumulation of bottom sediment. It is necessary to control mosquito control at fish farming. The health and subsequent growth of fish are directly related to the quality of water in which the fish are raised. In general factors affecting fish growth and production in freshwater aquatic systems can be classified as physical, chemical, biochemical, or a combination thereof. Physical properties of water that are important to fish production and growth include temperature and the concentration of suspended and settle-able solids. Chemical parameters include pH, alkalinity, hardness, and metals.

Ambient Dissolved Oxygen acts a limiting factor of metabolism and growth. Therefore, while often oxygen level in the water body may be quite above the lethal point oxygen might be restoring activity and growth.

Proper pond and water quality management is essential to successful and quality shrimp production. Maintaining a good culture environment through use of proper management practices will reduce the risk of disease and increase production, shrimp quality, and marketability. Only one chemical, formalin, used to treat certain protozoan parasites, is approved for shrimp production by U.S. Food and Drug Administration (FDA). Therefore, it is essential to implement and follow good aquaculture management practices to ensure shrimp quality.

During air diffusion the air is supplied by various types of compressors or blowers into the water where it is diffused through a variety of diffuser. When the air is diffused through a perforated pipe large bubbles of up to 10 mm in diameter are formed and when the diffuser is a porous material fine bubbles of 2-5 mm in diameter are produced. When the bubbles emerge and pass up to the water surface a part of their oxygen content is dissolved in the water, and also a secondary upwards water movement is generated, creating a mixing effect.

IV. COMPONENTS FOR THE MODEL MAKING

A. Solar Panel:

The function of Solar panel is to absorb the sun rays as a source of energy for generating electricity. In an aerator device it provides power to the system. And this energy can be also saved into the battery.

Dimension: 335 Watt
Output power: 2.35 to 6.23 feet
Weight : 20 Kg

B. Air Blower:

A centrifugal fan is a mechanical device for moving air or other gases in a direction at an angle to the incoming air.

Voltage: 220 V
Max Pressure: 0.65 K Pa
Max Air Flow: 4.5 m³
Speed: 2800 RPM
Size: 357 x 280 x 315
Net Wight: 10 Kg
Rated Power: 15 to 75 W

C. HDPE Float:

It is the main part of the paddle wheel aerator. With the float, the whole paddle wheel aerator could be floating on the water surface and not sink down. The material is HDPE (High-density polyethylene), a very light weight material. It can resist sun exposure, pressure, and friction and acid-base water.

Weight: 5 to 7 KG
Size: 1600 mm x 280 mm x 200 mm

D. Frame:

A shelf is made from 304 stainless steel and the air blower with panel is mounted on a float by help of a shelf.

E. End Pipe:

The end pipe is connected with the blower. The function of a pipe is to transfer high pressure into a water pond.

1) Proposed Design of Solar Water Aerator

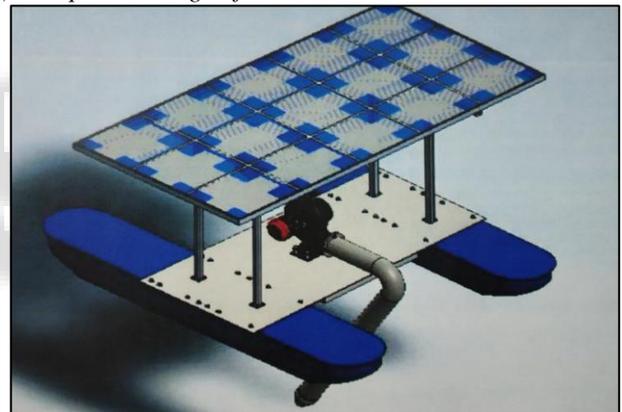


Fig. 1: Solar Water Aerator

V. WORKING

The working of the product is shown in a single line diagram.

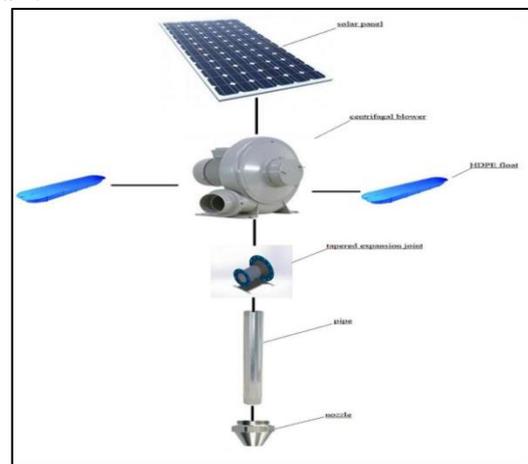


Fig. 2: Component of Solar Water Aerator

As shown in figure. The solar panel is generating the electric power from sun energy. And this panel transfers the energy into the motor which is connected to the blower and the blower is taken from the environment and compresses the air. And by pipe reducer the compressed air is moved into the end pipe and by the end pipe the air is entered into water and generate the bubble and this bubble discharges from the upper surface of water and it increases contact between air and water. By this process the oxygen level is increased into water.

VI. DATA COLLECTION AND CALCULATION

Pond surveying calculation:

In this calculation we surveyed the fish's different pond water capacity.

A. Pond Water Capacity:

Nursery pond= 20,000-50,000 liter

Rearing pond =80,000-2,00,000 liter

Stocking pond = 2,00,000-2000000 liter

Marketing pond = 50,000-1,00,000 liter

Brood stock pond = 2,00,000-4,00,000 liter

Quarantine pond = 20,000 liter

B. Calculation Water Capacity of Pond:

The pond area is measured into a hectare. Then convert hectare into square foot. i.e. 1 hectare = 107640 square foot.

Capacity of water measured into liter of water is filled in to pond: 1 liter water is filled in to 0.1076ft² so; we can easily find the capacity of water from area of the pond.

C. Calculation of Pond Pressure:

1) Method 1:

Pressure fully depends on how tall the 1litre column of water. Suppose, if the column is 10mm tall then the pressure will be 1bar but only over an area of 100mm². i.e.,

$$1\text{gm/cm}^2 = .001\text{bar}$$

$$= 98\text{ Pascal}$$

$$= .014\text{ psi}$$

$$\text{If } 1\text{gm/cm}^2 = .001\text{bar}, 10\text{gm/cm}^2 = .01\text{bar}$$

2) Method 2:

By mathematical equation,

$$\text{Pressure} = 0.433 \times \text{height of water in feet} = \text{pressure in PSI}$$

3) Method 3:

Pressure = density x depth, and density of water is found by the =Mass/volume.

D. Blower CFM Calculation:

CFM of blower = velocity of air * discharge area

CFM of blower = 3.14* discharge area*feet

Discharge area = area of discharge blower.

Feet = From RPM

E. CFM To RPM Calculation:

1 RPM = 8 Inch

1 Inch = 0.83 Feet

Selected Blower CFM: 534 m³/hr.

F. Water circulation Calculation:

Water volume is measured in gallons.

1 CFM = 6.28 gallons

534 CFM = 4000 gallons.

1 gallon = 3.78 liters.

4000 gallon = 15000 liters.

The solar power water aerator is circulating 15000 liters water in one minute.

VII. CONCLUSION

By studying the types of aerators and its various design function we conclude that the aeration of water can be carried out by various processes like paddle wheel aerators (type of mechanical aerator) diffused air aeration etc. To obtain a better effect we can change the design of the system as discussed above in paper.

The modifications are rate of transfer of oxygen in water, proper selection of material should also be considered. Best way to transfer oxygen in water is fine bubble generation. By using renewable source energy, it affects the eco-friendly environment. Solar panels have to be fixed at a proper tilt angle to obtain better efficiency. With aeration water is also good for aquatic life. It can be a suitable idea for farmers who look for aquatic life to obtain a better result using aeration technique. Overall the aeration system is good for water purification as well as aquatic life as it improves the quality of water and life of aquatic life.

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