

A REVIEW ON DESIGN AND DEVELOPMENT OF SOLAR POWERED AERATION SYSTEM FOR AGRICULTURAL FISH POND

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ABSTRACT

Oxygen is vital to any or all or any livelihoods and lives. A life requires oxygen to stay up various process within the body for growth. If oxygen didn't exist or existed deficient, a life wasn't able to continue. Amount of oxygen dissolved in water is crucial to aquatic animals. Moreover, it is also an indication of water condition. because the quantity of oxygen dissolved in water was diminished, the water starts to pollute. Therefore, it absolutely was essential to increase the amount of oxygen in water by using an aerator. In general, such aerator used power supply by conventional means. Nonetheless, the project is design & development of other energy aeration system. Electricity obtained from the solar energy was utilized to provide the aerator. per the cell generated electricity for the aerator gives wattage to a pump additionally as an electricity charge to battery to efficiently supply when there was no sunlight. the electrical cell generates electricity approximately 6-8 hours per day. For the initial use, the aerator using the ability from the cell increased the amount of oxygen dissolved in water.

Keyword : - Non-Conventional Energy, Solar PV System, Dissolved Oxygen (DO), Mechanical Aeration System, Fish Pond.

1. INTRODUCTION

Biological treatment of organic material requires sufficient oxygen to facilitate degradation. However, some amount of Dissolved Oxygen (DO) is usually present in raw wastewater, and must be added to the treatment process to strengthen biological removal of organic material. Water Resource Recovery Facilities (WRRFs) rely upon aeration systems to transfer oxygen from a gaseous state to a dissolved liquid form that's available to support biological treatment. Aeration is provided through mechanical agitation of the liquid surface to entrain knock off the aeration

tanks (mechanical aeration) or through introducing oxygen into the aeration tanks through porous devices (diffused aeration).

Aeration systems are intended to increase the air-water interface within a process liquid, with sufficient oxygen transfer required to support the biological processes. Mechanical aeration consists of motor-driven impellers, propeller aspirators, or rotors that generally operate at the liquid surface to produce DO within the aeration tanks. The impeller and rotor transfer oxygen by rotating the liquid surface while the propeller aspirator injects atmospheric air into the liquid. The equipment used depends on which configuration was utilized for the treatment process.

There are four general configurations for mechanical aeration systems: radial flow low speed, axial flow high speed, horizontal rotors, and aspirating devices. Radial flow low speed and axial flow high speed utilizes impellers which will be designed at the liquid surface or submerged at varying depths. Horizontal rotors utilize horizontal impellers (rotors) to agitate the liquid surface and deliver oxygen to the aeration tanks. Aspirating devices utilize a propeller aspirator which could be positioned at various angles to attain distinct levels for aeration mixing. Oxygen is incredibly important to livelihoods and lives as oxygen empowered all body processes for all times growth. only if there was insufficient amount of oxygen, lives couldn't survive. Likewise, aquatic animals were in need of dissolved oxygen (DO) in water. In general, it absolutely was derived through atmosphere and photosynthesis performed by aqua plants. the amount of dissolved oxygen was inverse with temperature and intensity of minerals dissolved within the water. the upper the temperature and more the intensity of the minerals within the water, the lesser the dissolved oxygen. Furthermore, the dissolved oxygen level was inverse with force per unit area.

Water in nature came with a dissolved oxygen value of 5-7 mg/L. If it absolutely was but 3 mg/L, the water was considered polluted. As mentioned above, the researcher planned the foundations by inventing a prototype energy aerator. Electricity from the alternative energy was brought into use to drive the functionality of the aerator and this was used within the pond. Such practice was aimed to mitigate the electricity bill cost and also to deploy the choice energy which was natural renewable energy resource..

1.1 Problem Statement

There was a huge closed pond located in all Nashik cities. In the pond, there was no ventilation. As time went by, water in the pond had become polluted due to the deduction of the oxygen in the water. There were aquatic lives in the pond such as various fish. Due to this issue, aerators were installed all over the pond areas. The recent water treatment devices obtained electricity supplied by the Electricity Authority MSEB Board. This stemmed in significantly huge expenses on a monthly basis electricity cost that they had to bear with in order to maintain and increase the oxygen level in the pond. To overcome that problem it is need to make aerator system using Solar energy use.

1.2 Objectives

- The main objective of this project is to assess the feasibility and economic viability of utilizing solar based standalone power supply systems to meet the load requirements for aeration system.
- To make nonconventional system which will give continues & sufficient power in all working conditions for aeration system.
- To make energy efficient aeration system as an low cost alternatives to conventional one.
- To optimize usage of electricity by substituting its mode of generation for aeration system.
- To develop a small aeration system scale model for assessing feasibility of system.
- To design the aeration system this is cost effective, reliable and also efficient.

1.3 Scope

This system has motivated for use of renewable energy resources i.e. power generation & to work aeration system efficiently without consuming extra power form outside.

2. LITERATURE REVIEW

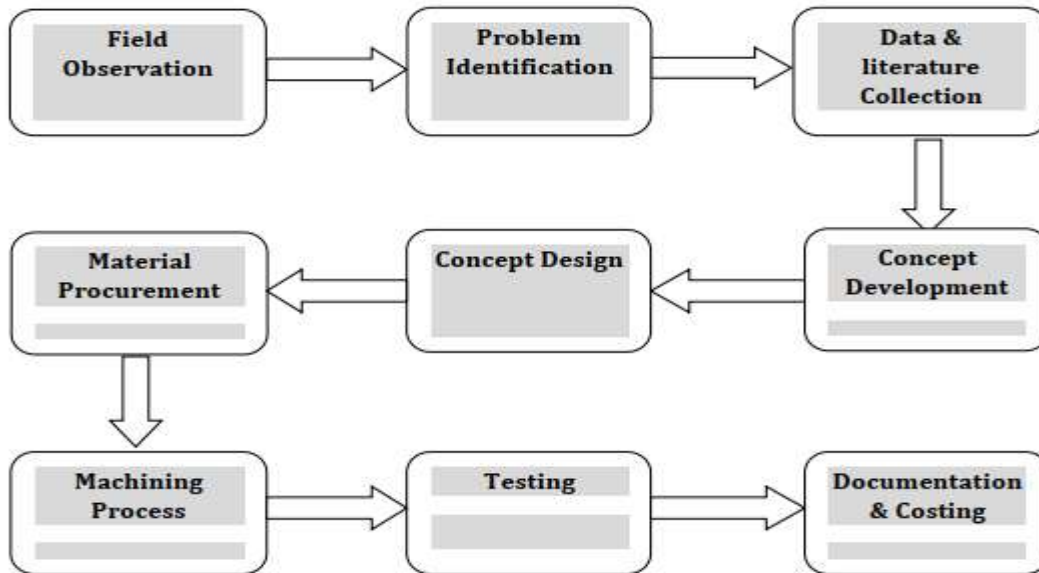
Mohammad Tanveer et.al. (2018) has done a review on Surface aeration systems for application in aquaculture: A review, in line together with his work, Surface aeration systems viz., paddle wheel and spiral aerators are the foremost commonly used aeration systems in intensive aquaculture practices. Use of aerators in intensive aquaculture is extremely important for ensuring better survival, optimal oxygen supply, higher production, and disease free environment. Hence, selection of properly designed and high efficient aerators is necessary to require care of adequate and continuous supply of dissolve oxygen (DO) in semi-intensive and intensive aquaculture and keep the energy consumption (operating cost) to minimum. Paddle wheel and spiral aeration systems have advantage of cost effectiveness, low maintenance and straightforward availability.

Sunil Jayant Kulkarni (2017) Review on Aeration: Studies and Investigations Across Various Applications, per his work, Various biological treatment methods include aerobic and anaerobic methods. Aerobic methods include advanced oxidation methods, aerobic digestion methods. Anaerobic digestion of wastewater has advantage of additional value added product, biogas. Aeration is one in every of the important aspects of biological treatment methods. Modification of basic method includes tapered aeration, diffused aeration, deep shaft aeration etc. Various investigators have studied aeration and its advantages. Also applications of aeration in some specific applications like oil aeration, aeration of boiled sweets, aerated lightweight concrete are investigated by various researchers.

Samitkumar R. Patel et.al. (2017) Design of Pond Water Aeration Systems: A Review, per his work, During the past decade, pond/lake aeration systems are developed which may sustain large quantities of fish and water impurities. Aeration-performance testing may be a crucial procedure in selecting design features to provide a price effective system without affecting the performance of the aeration system. Paddlewheel aerators and propeller-aspirator pumps are widely used for aeration system. Aerators usually are placed in ponds to provide maximum air circulation in water. Supply of DO (dissolved oxygen) is critical in water. This method includes designing of the system using mechanical components and renewable source of energy that's solar energy to regulate the system. With the recent increase in awareness of energy depletion, energy cost, the look of an aeration system has become the foremost important parts of the design of the activated sludge process. A neat system can significantly save energy, cost and perform better operation.

Samsul Bahri, et.al. (2015) Design and Simulation of Paddle Wheel Aerator with Movable Blades, per his work, the event of movable blade relies on undeniable fact that power is required only blade of paddle wheel aerator entering water and in contrary action of aeration effect only the blade is about leaving the water. This study was carrier resolute design and simulate paddle wheel aerator with movable blade which is in a position to open when entering water and shut when leaving water.

3. METHODOLOGY



In this chapter introduction of the project as well as the problem definition are discussed. To solve all the problems discussed above we are producing a new machine, as our project under this topic in our academic year 2021 – 2022, we are preparing a working scale model of this machine. We have proposed a methodology to solve the problems. Our methodology is divided in different parts, under different titles. Sequence of proposed methodology is as follows –

1. Proposed Methodology 1 – Basic Information & Literature survey.
2. Proposed Methodology 2 – Design of Machine Components.
3. Proposed Methodology 3 - Selection of Components for Machine.
4. Proposed Methodology 4 – CAD modelling & Fabrication of Machine parts.
5. Proposed Methodology 5 – Assembly, Testing & Documentation of Machine.

4. CONSTRUCTION AND WORKING

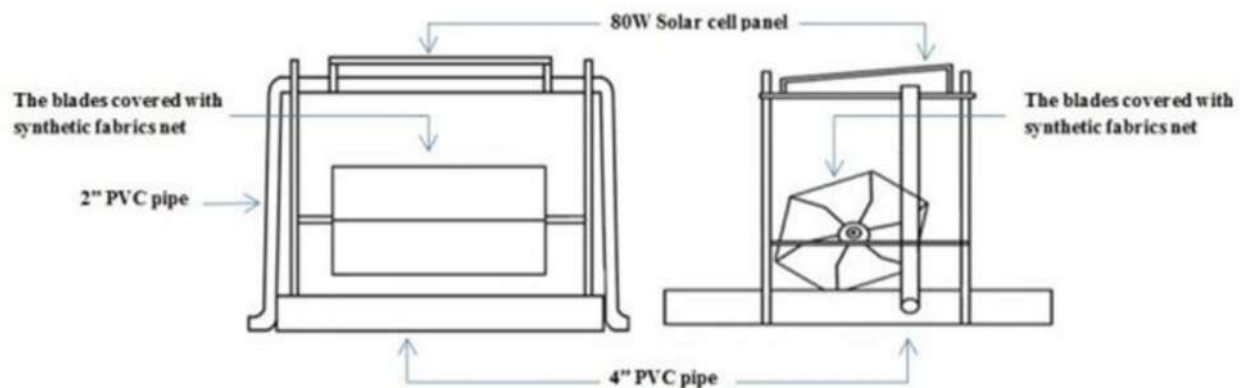


Fig. 4.1. Concept of solar power aeration system

As seen in the image above, the main part of the project is the supporting or the base frame which will hold the solar panel, a dc motor, chain drive and an aerator pump. To help the base frame float in water, a pvc float is made and placed at the bottom. The energy obtained from the solar cell will be used to power the dc motor and aerator pump. With the help of chain drive. the shaft consisting of impeller blades will rotate and hence the assembly will be able to move over the free surface of water, ensuring oxygen is not concentrated at one part of the pond.

Table.4.1: List of component of solar power aeration system.

Sr. No	Components	Quantity
1	Solar Panel	1
2	Solar Charger Unit	1
3	Storgae Battery	1
4	DC Motor	1
5	Ball Bearings	2
6	Shaft	1
7	Chain Drive	1
8	Fasteners	20
9	Supporting Frame	1
10	DC Pump	1
11	PVC Pipe	8 foot
12	PVC Elbow	4

5. ADVANTAGES

- Overcoming disadvantages of conventional system by using standalone renewable electrical energy generation for running aeration system.
- The system doesn't have complexity of system testing and understanding became easy in terms of difficulties
- Renewable energy sources are utilized so, no waste production.
- The installation of system is easy.
- Improves the aesthetics and overall health of ponds and lakes.
- Eliminates the need for harmful chemicals.
- Reduces maintenance, saving money and time.
- Improves Water Quality and Clarity.

6. LIMITATIONS

- If weather is bad, then efficiency of system is low.

7. APPLICATIONS

- For aquatic environments ranging in size from small ornamental ponds to lakes up for filtration.
- Remote areas installation
- Environmentally beneficial landscaping / aqua scaping

8.CONCLUSION

With the help of this review paper regarding the topic, we got to know about the aeration process, how it is important for aquatic life, the types through which it is carried out and research done in the previous years which describes its advantages and shortcomings.

9.REFERENCES

- Mohammad Tanveer, Subha M Roy, M Vikneswaran, P Renganathan and S Balasubramanian, Surface aeration systems for application in aquaculture: A review, *International Journal of Fisheries and Aquatic Studies* 2018; 6(5): pp.342-347.
- L.B. Bhuyar, S.B. Thakre1, N.W. Ingole, Design characteristics of Curved Blade Aerator w.r.t. aeration efficiency and overall oxygen transfer coefficient and comparison with CFD modeling, *International Journal of Engineering, Science and Technology*, Vol. 1, No. 1, 2009, pp. 1-15.
- Samsul Bahri, Radite P.A. Setiawan, Wawan Hermawan & Muhammad Zairin Junior, Design and Simulation of Paddle Wheel Aerator with Movable Blades, *International Journal of Engineering Research & Technology (IJERT)*, Vol. 4 Issue 02, February-2015, pp. 994-999.
- Jayraj P, Subha M. Roy, C. K. Mukherjee and B. C. Mal, Design Characteristics of Submersible Aerator, *Turkish Journal of Fisheries and Aquatic Sciences*, ISSN 1303-2712 DOI: 10.4194/1303-2712-v18_9_01, pp.1-13.
- J. Štigler, M. Haluza, M. Bílek, Preliminary Design Of Basic Parameters Of The Aerator, 17th International Conference Engineering Mechanics 2011, Svratka, Czech Republic, 9 – 12 May 2011, pp. 603-606.
- Sunil Jayant Kulkarni, Review on Aeration: Studies and Investigations Across Various Applications, *International Journal of Research & Review (www.gkpublication.in)* Vol.4; Issue: 4; April 2017, pp. 57-63.
- Samitkumar R. Patel1, Dattatraya Subhedar, Design of Pond Water Aeration Systems: A Review, *International Journal of Engineering Technology Science and Research IJETS*, Volume 4, Issue 8, August 2017, pp.1203-1208.

