



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 5, May 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

DESIGN & DEVELOPMENT OF SOLAR POWER AERATION SYSTEM

Tanmay K. Bagul¹, Gagan D. Rumne², Rohit V. Rao³, Utkarsh L. Falak⁴, Prof. N. B. Dole⁵

B.E. Student, Department of Mechanical Engineering, Matoshri College of Engineering And Research Center, Eklahare, Nashik, India^{1 to 4}

Associate Professor, Department of Mechanical Engineering, Matoshri College of Engineering And Research Center, Eklahare, Nashik, India⁵

ABSTRACT: Oxygen was vital to all livelihoods and lives. A life required oxygen to maintain various processes in the body for growth. If oxygen did not exist or existed too little, a life was unable to continue. Amount of oxygen dissolved in water was necessary to aquatic animals' beings. Moreover, it was also an indication of water condition. As the amount of oxygen dissolved in water was diminished, the water became polluted. Therefore, it was essential to increase the oxygen level in water by using an aerator. In general, such aerator used power supply by electricity. Nonetheless, the project is design & development of solar power aeration system. Electricity generated from the solar energy was utilized to supply the aerator. According to the solar cell generated electricity for the aerator gave electric power to a water pump as well as an electricity charge to a battery to efficiently supply while there was no sunlight. The solar cell generated electricity approximately 6-8 hours per day. From the initial use, the aerator using the power from the solar cell increased oxygen amount dissolved in water.

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

I. INTRODUCTION

Aeration systems improve the air-water contact within a process liquid, providing for the necessary oxygen transfer to maintain biological processes. Mechanical aeration uses impellers, propeller aspirators, or rotors that are propelled by motors and work at the liquid surface to feed DO to the aeration tanks. The propeller aspirator injects ambient air into the liquid, while the impeller and rotor transmit oxygen by mixing the liquid surface. The equipment used during treatment procedure is controlled by the setup. Mechanical aeration systems can be set up in four different ways: Aspirating devices, radial flow low speed, axial flow high speed, horizontal rotors. Flow in both directions axial flow and low speed Impellers designed at the liquid surface or buried at varied depths are used in high-speed applications. Horizontal rotors agitate the liquid surface and give oxygen to the aeration tanks using horizontal impellers (rotors). Oxygen was vital to people's livelihoods and lives because it aided in the growth of all body processes. The level of dissolved oxygen was inversely proportional to the temperature and mineral concentration in the water. The less dissolved oxygen there is, the higher the temperature and the more minerals there are in the water. Furthermore, the dissolved oxygen level was inverse with air pressure. The higher the water, the lesser the dissolved oxygen within [1]

II. PROBLEM STATEMENT

There was a huge Biofloc/Artificial Pond located in all 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 ponds such as various fish. Due to this issue, aerators were installed all over the pond areas. [2] This resulted in enormous monthly electrical costs that they were forced to incur in order to maintain and enhance the oxygen level in the pond. To overcome that problem it is need to make aerator system using solar energy use.

III. OBJECTIVE

The followings are some of the objectives behind development of solar power aeration system given below,

- The primary goal of this study is to determine the feasibility and economic viability of using solar-based standalone power distribution systems to satisfy aeration system load needs.
- To make nonconventional system which will give continues & sufficient power in all working conditions for aeration system.
- To make energy efficient aeration system as a low cost alternatives to conventional one.
- To optimize usage of electricity by substituting its mode of generation for aeration system

IV. LITRATURE REVIEW

[1] Mohammad Tanveer, Subha M Roy, M Vikneswaran, P Renganathan and S Balasubramanian, done the work on, Surface aeration systems for application in aquaculture: A review, according to his work, Surface aeration systems viz., paddle wheel and spiral aerators are the most commonly used aeration systems in intensive aquaculture practices. Use of aerators in intensive aquaculture is 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 maintain 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 easy availability.

[2]L.B. Bhuyar, S.B. Thakre¹, N.W. Ingole, done the work on, Design characteristics of Curved Blade Aerator w.r.t. aeration efficiency and overall oxygen transfer coefficient and comparison with CFD modeling, according to his work, The main objective of this work is to design a high efficiency curved-blade-surface mechanical aerator for oxidation ditch, which is used to treat municipal and domestic sewage.

[3]Samsul Bahri, Radite P.A. Setiawan, Wawan Hermawan & Muhammad Zairin Junior, done the work on, Design and Simulation of Paddle Wheel Aerator with Movable Blades, according to his work, The development of movable blade is based on fact that power is required only when blade of paddle wheel aerator entering water and in contrary action of aeration effect only when the blade is about leaving the water. This study was carrier out to design and simulate paddle wheel aerator with movable blade which will open when entering water and close when leaving water. Wheel closed at quadrant I to IV (entering water surface) and was about to open at quadrant III to II (leaving water surface). The blade was designed referring to commonly used Taiwan wheel type. The component of movable blade mechanism consisted of cam and shaft, velg, velg cap, blade holder, follower, spring and bearing.

[4]Jayraj P, Subha M. Roy, C. K. Mukherjee and B. C. Mal, done the work on, Design Characteristics of Submersible Aerator, according to his work, Aeration experiments were conducted on original and modified submersible aerator to evaluate its performance and to optimize the aeration efficiency. The angular position of the propeller (α) and submergence depth of the propeller (d) were varied to study their effects on standard aeration efficiency (SAE). Preperformance evaluation of the original design without having a provision to vary α and d was done and resulted in an SAE of 0.320 kg O₂/ kWh. The aerator was modified to have a provision to change α and d of the aerator. To evaluate the optimum α , experiments were conducted at different α : 0°, 15°, 30°, 45°, 60°, 75°, keeping the rotational speed (N) = 2900 rpm and d = 450 mm as constants. The optimized α was 75°. In the same way to optimize d, experiments were conducted at different d: 300, 350, 400, 450, 500, 550, and 600 mm, keeping N = 2900 rpm and α = 75° as constants. The optimized d was 350 mm. Finally the optimized value of SAE of 0.616 kg O₂/ kWh was achieved at α = 75° and d = 350 mm. The percentage increase in efficiency after modification was found to be 92.50 %

[5]J. Štigler, M. Haluza, M. Bílek, done the work on, Preliminary Design Of Basic Parameters Of The Aerator, according to his work, The method of preliminary design of the basic runner parameters of the hydrodynamics submersible aerator is presented in this very brief paper. The problem of these parameters design is in the fact that flow rate (discharge) of the liquid (water) flowing through the aerator is unknown. The discharge is crucial parameter for a runner design. Therefore some basic ideas and basic expressions which can help with a preliminary design of the runner are outlined in this paper. After setting of the basic parameters of the aerator runner, this problem can continue with using some CFD code

[6]Sunil Jayant Kulkarni, done the work on, Review on Aeration: Studies and Investigations Across Various Applications, according to his work, Various biological treatment methods include aerobic and anaerobic methods. Aerobic methods include advanced oxidation methods, aerobic digestion methods. Anaerobic methods for treatment of wastewater include anaerobic digestion. Anaerobic digestion of wastewater has advantage of additional value added product, biogas. Aeration is one of the important aspects of biological treatment methods. Modification of basic method includes tapered aeration, diffused aeration, deep shaft aeration etc

[7]Samitkumar R. Patel¹, Dattatraya Subhedar, done the work on, Design of Pond Water Aeration Systems: A Review, according to his work, During the past decade, pond/lake aeration systems have been developed which will sustain large quantities of fish and water impurities. Aeration-performance testing is an important procedure in selecting design

features to provide a cost 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 necessary in water.

[8] Anamika Yadav, Avinash Kumar, Sudipto Sarkar, done the work on, Design Characteristics of Venturi Aeration System, according to his work, The crucial phenomenon of air and water mixing together is called aeration. The venturi aeration is mainly responsible to transfer air directly through the atmosphere into the flowing water attribute to its simplicity and reliability. A water tank of 1000 litres capacity having dimensions $100 \times 100 \times 100$ cm³ was used to conduct the experiments for aeration for the purpose of studying the characteristics of venturi aeration system design. Venturi having three significant sections i.e. inlet, constricted and outlet section, used as a differential pressure producer basis on Bernoulli's theorem where the middle section of the venturi often called as constricted section is responsible for the energy conversion, which transfers oxygen by aspirating air into the constricted section and producing interfacial area between the air and water. On the basis of dimensional analysis, non-dimensional numbers associated with geometric, dynamic and process parameters were analysed. The non-dimensional geometric parameters like throat length (tl), hole distance from beginning of throat (hd), throat hole diameter (th) were optimized and additionally conducted at constant flow rate ($v_w=0.396$ m/s). To assess the performance of designed venturi, the selection of different tl as 20, 40, 60, 80 and 100 mm, with varying number of holes inserted, depends on the tl and keeping th constant at 2 mm. The SAE values were initiated more with increasing tl.

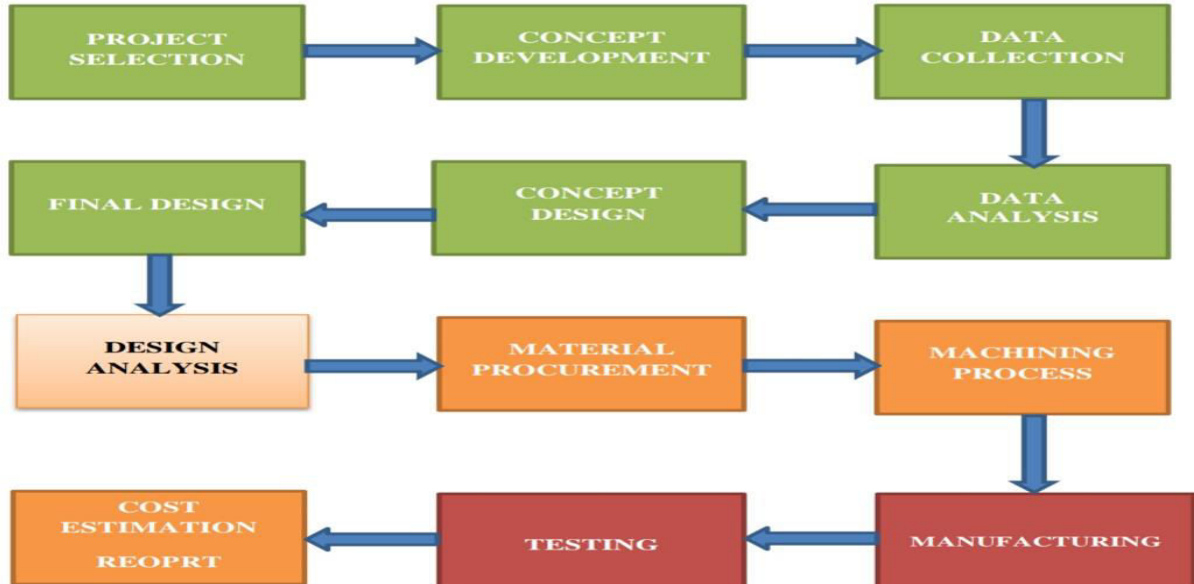
[9] Jayraj P, Subha M. Roy, C. K. Mukherjee, B. C. Mal, done the work on, Design Characteristics of Submersible Aerator, according to his work, Aeration experiments were conducted on original and modified submersible aerator to evaluate its performance and to optimize the aeration efficiency. The angular position of the propeller (α) and submergence depth of the propeller (d) were varied to study their effects on standard aeration efficiency (SAE). Preperformance evaluation of the original design without having a provision to vary α and d was done and resulted in an SAE of 0.320 kg O₂/ kWh. The aerator was modified to have a provision to change α and d of the aerator. To evaluate the optimum α , experiments were conducted at different α : 0°, 15°, 30°, 45°, 60°, 75°, keeping the rotational speed (N) = 2900 rpm and d = 450 mm as constants. The optimized α was 75°. In the same way to optimize d, experiments were conducted at different d: 300, 350, 400, 450, 500, 550, and 600 mm, keeping N = 2900 rpm and $\alpha = 75^\circ$ as constants. The optimized d was 350 mm. Finally the optimized value of SAE of 0.616 kg O₂/ kWh was achieved at $\alpha = 75^\circ$ and d = 350 mm. The percentage increase in efficiency after modification was found to be 92.50 %.

V. SCOPE OF THE WORK

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

VI.METHODOLOGY

A methodical way to completing a comprehensive task is called methodology. The following items is included



VII.ADVANTAGES

- Overcoming disadvantages of conventional system by using standalone renewable electrical energy generation for running aeration system.
- The cost of maintaining an aeration system is significantly decreased, and it is simple to do so.
- There is no waste because renewable energy sources are used.
- Within certain time period the installation cost gets covered.
- Improves the aesthetics and overall health of ponds and lakes.
- Eliminates the need for harmful chemicals.
- Improves Water Quality and Clarity

VIII.CONCLUSION

- Solar Aeration can be useful method in improving the quality of water in biofloc.
- Many farms which suffer loss due to bad water quality can use this method to improve not only the water quality but also improve the productivity of fish.
- The usage of a solar-powered aerator can be an effective device for boosting dissolved oxygen levels in water, hence increasing fish growth, survival, and overall production, according to the findings of this study.
- The daytime operation raises the oxygen level in the water and breaks thermal stratification, resulting in a homogeneous dissolved oxygen profile in the pond.

REFERENCES

- [1] 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.
- [2] L.B. Bhuyar, S.B. Thakre, 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.
- [3] 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.



[4] 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.

[5] 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.

[6] 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.

[7] Samitkumar R. Patel, Dattatraya Subhedar, Design of Pond Water Aeration Systems: A Review, International Journal of Engineering Technology Science and Research IJETSRS, Volume 4, Issue 8, August 2017, pp.1203-1208.

[8] Anamika Yadav, Avinash Kumar, Sudipto Sarkar, Design Characteristics of Venturi Aeration System, International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-11, September 2019, pp.63-70.

[9] Bhandari V.B., Design of machine elements, eighteenth edition, MC Graw-hill companies, 2003. [10] PSG college of Technology, Coimbatore design data, first edition Kalaikaikathir Achchagam, 2003.



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.118



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details