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FABRICATION OF SOLAR-BASED AERATOR AND CONTROLLER FOR AQUACULTURE

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ABSTRACT:

The rapid growth of aquaculture production has required a huge power demand, which is estimated to be about 40% of the total energy cost. However, it is possible to reduce this expense using alternatives such as renewable energy (i.e., solar energy) instead of non-renewable energy. Solar energy is one of the cleanest energy sources and is touted as a potential renewable energy source for the world with benefits such as reducing CO2 emissions, reversing global warming by being eco-friendly, and bringing innovation to sustainable aquaculture and potential cost-efficiency for manufacturing.

INTRODUCTION

China is one of the largest agricultural countries in the world. Fishery occupies a large proportion of the national economy, and the culture and consumption of aquatic products play important roles among them. The aquaculture of aquatic products needs to seek the maximum benefit in the limited land resources, which results in the aquaculture practitioners increasing the density of aquaculture ponds. It is very easy to cause anoxia of fish when the weather changes suddenly, and even cause the death of fish.

At the same time, the fish pond aerator provides sufficient oxygen for high-density aquaculture ponds and makes full use of the water to promote the speed of material circulation in the pond. These can effectively avoid the death of fish caused by insufficient oxygen supply for high-density aquaculture. Moreover, it can improve and stabilize the water quality at the same time.

The rapid development of the fishery is inseparable from the contribution of natural energy. The traditional fish pond aerator uses municipal electricity as its power source, which needs to be connected to the power grid. However, aquaculture is mainly located in the outskirts of the sparsely

populated field ponds or lakes, which brings a lot of trouble to the power supply of fish pond aerator. The traditional fish pond oxygen supply device not only consumes more electricity and costs more, but also has the disadvantages of trouble accessing the power grid and unsafe electricity consumption.

Solar-based aerators represent an innovative and sustainable approach to water aeration, harnessing the power of the sun to enhance the health of aquatic ecosystems. Traditional methods of aerating water bodies, such as ponds, lakes, and reservoirs, often rely on grid electricity or fossil fuels, which can be costly and environmentally damaging. Solar- based aerators offer a compelling alternative by utilizing clean and renewable solar energy to power aeration systems.

DISADVANTAGES:

Computational Complexity: Simulating explicit crash scenarios with varying materials and speeds can be computationally intensive, requiring significant computational resources and time.

Modelling Assumptions: Simplifications and assumptions made in the simulation model may impact the accuracy of results, requiring validation against experimental data or real-world tests.

Material Characterization: Accurately representing material behavior, including nonlinearities, strain rates and failure modes, requires detailed material characterization, which can be challenging and time-consuming.

Skill and Expertise: Effective implementation of explicit analysis techniques requires specialized knowledge and expertise in finite element analysis, material science and crashworthiness principles.

Interpretation of Results: Interpreting and translating simulation results into actionable design changes can be complex, requiring careful analysis and understanding of the underlying physics and engineering principles.

ADVANTAGES:

Solar-based aerators offer several advantages compared to traditional aerators powered by grid electricity or fossil fuels. Here are some of the key advantages:

Environmental Sustainability: Solar-based aerators utilize renewable solar energy, reducing reliance on non-renewable fossil fuels and lowering carbon emissions. By harnessing the power of the sun, they

contribute to a cleaner and more sustainable environment.

Cost Savings: Once installed, solar-based aerators have minimal operating costs since they use free solar energy. They eliminate ongoing expenses associated with grid electricity or fuel consumption, resulting in long-term cost savings.

Energy Independence: Solar-based aerators operate independently of the grid, making them suitable for remote or off-grid locations where access to electricity may be limited or unreliable. They provide energy independence and resilience to power outages.

Ease of Installation: Solar-based aerators are relatively easy to install compared to traditional aerators that require electrical wiring or fuel storage. They can be deployed quickly and without the need for extensive infrastructure, reducing installation time and costs.

Low Maintenance: Solar-based aerators typically have fewer moving parts and require less maintenance compared to traditional aerators. With simple and robust design, they are durable and reliable, reducing the need for frequent servicing and repairs.

Quiet and Odor-Free Operation: Solar-based aerators operate quietly and produce no emissions or odors, creating a pleasant and peaceful environment for humans and wildlife. They are ideal for recreational areas and residential settings where noise and air pollution are concerns.

Scalability and Versatility: Solar-based aerators come in various sizes and configurations, making them suitable for a wide range of applications, from small decorative ponds to large aquaculture facilities. They can be scaled up or down to meet specific aeration requirements.

Promotion of Aquatic Health: Solar-based aerators enhance water quality by increasing oxygen levels in water bodies, supporting the health of aquatic organisms such as fish, plants, and beneficial bacteria. They help prevent issues like oxygen depletion, algae blooms, and fish kills.

LITERATURE SURVEY

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.

Samit Kumar 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

RELATED WORK

The specifications of a solar-based aerator can vary depending on factors such as the type of water body, desired aeration capacity, and specific manufacturer. However, here are some common specifications you might encounter when considering a solar-based aerator:

Solar Panel Capacity: The power output of the solar panels, typically measured in watts (W) or kilowatts (kW), determines the amount of energy available to operate the aerator. This specification may vary based on the size of the aerator and the amount of sunlight available in the installation location.

Aeration Capacity: The aeration capacity of the aerator indicates the volume of water that can be effectively aerated within a given time frame. It is often expressed in terms of gallons per minute (GPM) or liters per minute (LPM) and depends on factors such as the aerator's design, pump capacity, and aeration method.

Pump/Fan Specifications: Solar-based aerators may include pumps or fans powered by solar energy to agitate the water surface or inject air into the water. Specifications for these components may include parameters such as flow rate, pressure, motor power, and efficiency.

Battery Backup: Some solar-based aerators come with battery backup systems to store excess solar energy for use during periods of low sunlight or at night. Specifications for the battery system may include capacity (measured in ampere-hours or watt-hours), voltage, and charging/discharging characteristics.

Floatation/Installation: Specifications related to the aerator's flotation or installation method, such as float size and buoyancy, anchoring system, mounting hardware, and overall dimensions, are essential for ensuring proper installation and functionality.

Materials and Construction: Information about the materials used in the construction of the aerator, such as corrosion-resistant metals, UV-stabilized plastics, and durable seals, helps assess its durability and suitability for the intended environment.

Environmental Ratings: Specifications related to environmental ratings, such as ingress

protection (IP) rating and temperature range, indicate the aerator's ability to withstand exposure to water, dust, and extreme weather conditions.

Monitoring and Control: Some advanced solar-based aerators may include monitoring and control features, such as sensors for water quality parameters (e.g., dissolved oxygen, temperature) and remote monitoring capabilities, providing real-time data and control options.

SAMPLE RESULTS

CONCLUSION

solar-based aerators offer a sustainable and environmentally friendly solution for water aeration needs across various applications. Harnessing renewable solar energy, these systems promote aquatic health, improve water quality, and contribute to ecosystem sustainability. By eliminating reliance on grid electricity or fossil fuels, solar-based aerators offer cost savings, energy independence, and resilience to power outages, particularly in remote or off-grid locations. Their low maintenance requirements, quiet operation, and scalability make them suitable for a wide range of environments, from residential ponds to commercial aquaculture facilities. With their long-term durability and minimal environmental impact, solar-based aerators represent a promising technology for enhancing water management practices and supporting ecological balance. As the demand for sustainable water solutions continues to grow, solar-based aerators emerge as a viable option for promoting environmental stewardship and ensuring the health and vitality of aquatic ecosystems now and in the future.

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