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Design of Wave Generator and Pumping Aerator

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Abstract: Aquaculture, also known as aquafarming, is the farming of aquatic animals like fishes, prawns etc. The farmers, particularly in coastal areas are dependent upon aquaculture. In the processes of Aquaculture, farmers need to face several problems. One of the main problems is the death of aquatic animals due to lacking oxygen levels in water. In order to provide sufficient oxygen to the aquatic animals, many aerator machines were developed. But the costs of these machines being very high, the farmers aren't able to afford it. Therefore, in order to provide the farmers with cost-efficient technology, we have designed the wave generator and pumping aerator. These aerators enhance the water with more dissolved oxygen in an economically feasible methodology.

Keywords: Aquaculture, Aeration, Wave Generator, Pumping Aerator.

INTRODUCTION

Aquaculture is the controlled development and collects of sea-going creatures and plants. There are numerous similarities amongst aquaculture and farming, yet there are some essential contrasts also. Aquaculture, like agriculture, is necessary in order to meet the food demands of a growing global population with diminishing natural fisheries' stocks. Unlike land under cultivation, the world's oceans, lakes, rivers, and streams are usually public or common resources. Managing these common resources is often problematic.

Although aquaculture has been around for thousands of years, many people are still unclear about the nature of aquaculture and its place in the society. Only a small percentage of global fish production stems from aquaculture; the overwhelming majority is wild capture. Now, with many commercial fisheries in decline, we must turn to alternative food technologies. Aquaculture research and development may provide a partial answer to the difficult problem of managing a dwindling natural resource. In order to understand how our fisheries predicament evolved, we must turn to the global commons. As global population increases, more and more pressure is put on our diminishing natural fish stocks because the oceans are a common public resource to which everyone has access.

The importance and functions of aeration process are:

- ✓ it reduces the concentrations of ammonia, nitrites and carbon oxide
- ✓ it increases pH level of pond water
- ✓ it increases the carrying capacity of an aquaculture system
- ✓ it reduces fish mortality
- ✓ it enhances fish reproduction systems
- ✓ it increases pond productivity
- ✓ it increases fish growth
- ✓ it regulates water temperature especially as this can affect dissolved oxygen (DO) of aquatic and
- ✓ it is used to control thermal stratification[1]

WAVE GENERATOR

I. Design

The wave generator helps in producing waves in water at a certain frequency. Generally, waves when generated, reach until the end of ponds, lakes, oceans etc. Due to the generation of waves, temperature doesn't increase and also more amount of air gets dissolved in water thus making aquatic animals feel that they are in floating water. This is the main concept behind the design of the wave generator.

The Hardware materials used to design the Wave generator are DC square gear motor, L-metal plate, L-shafts, Metal poles, acrylic box, and Plastic pipe.

At First, the supporting vertical poles are connected to the four ends of the base. At the center of the base, a hole is drilled and a cylindrical rod is fixed over it. Then, the DC square gear motor is placed on the base. The DC square gear motor is used so as to convert motor rotatory motion into linear motion. DC square gear motor requires a 12V and 2AMP power supply. The L-shaft is fixed to the motor shaft. The flat surface acrylic box is connected to the motor shaft with the help of a freely rotating rod.

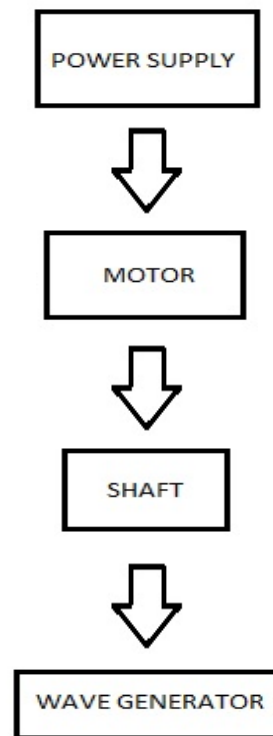


Figure 1. Block Diagram of Wave Generator

II. Working

The entire setup has to be placed at the center of ponds over the surface of the water. When power is supplied, the motor shaft starts rotating. This rotatory motion is converted into linear motion and the acrylic box, which is at the surface of the water, will help to produce waves on the water at a certain frequency. A wave that is generated, will reach until the end of the water body. Such waves are generated continuously.

This is a kind of water aeration methodology which is possible by continuous transverse (up and down) wave motions. Apart from aeration, this methodology also reduces the temperature of water. Even if not reduced, temperature level is prevented from increasing rapidly. Also, during continuous wave motion, high peak waves turn up being low peak waves, which in turn produces a sort of disturbance on the surface of the water. Due to the disturbance, a certain amount of air gets dissolved into the water. This will increase the oxygen level in the water, thus the aquatic animals come to the surface of the water and it seems that they are in floating water.

Thus, on the whole, aeration removes the low oxygen levels zones in water (often called dead zones). Thereby, preventing from the death of aquatic animals.

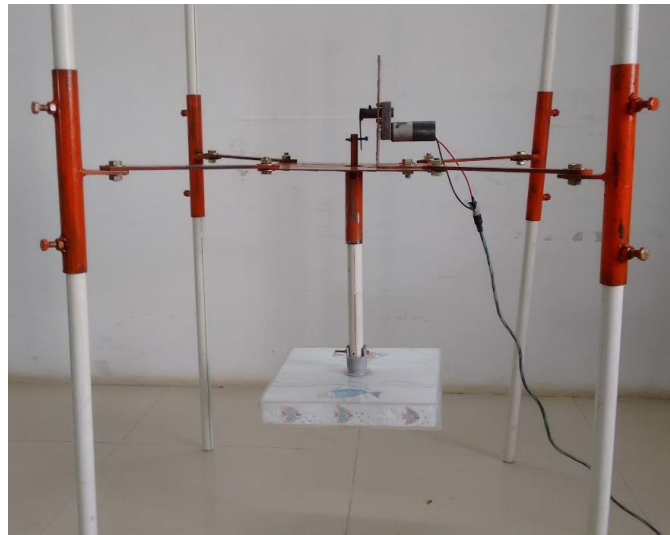


Figure 2. Wave Generator Module

PUMPING AERATOR

I. Design

A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps operate by some mechanism (typically reciprocating or rotary) and consume energy to perform mechanical work by moving the fluid.

This module is designed in such a way that more oxygen gets dissolved into water. The hardware materials used in this module are Dual shaft DC motor, L-shafts, Metal poles, Boot (Rubber effluent), PVC pipe, and Plastic pipe.

II. Working

This module works on the basis of compressing and releasing technique. Aeration is provided with the help of air that is produced using air piston. In this module, four pistons are connected to the dual shaft DC motor. This design will prevent from the requirement of additional motors. Also, the advantage of using DC motor is that it consumes less power. The air piston has a compression chamber with an inlet and an outlet. Compression is done with the help of a Rubber boot, which is connected to the motor shaft. When the motor rotates, the shaft moves in forward and backward motion. During forward motion, the rubber boot compresses the air and in backward motion, rubber boot sucks air into the compression chamber through the inlet. Check valves are connected to inlet and outlet. These check valves allow air flow in any one way. The air flows in through the inlet and comes out through the outlet. The air flow is restricted to either way. Suppose air flow is forced through both ways simultaneously, either of the flow is blocked. This procedure remains same for all four pistons. When the motor shaft rotates, two pistons are in forwarding motion (air flows out) and the other two pistons are in backward motion (air flows inside).

This kind of aerator helps in the production of more air. And that is because the motor shaft dissolves air into the water through pipes on one hand and on the other hand it helps in the dissolving of air through the bubbles. Thus, it can be said that Pumping aerator helps in providing more dissolved oxygen into the water.

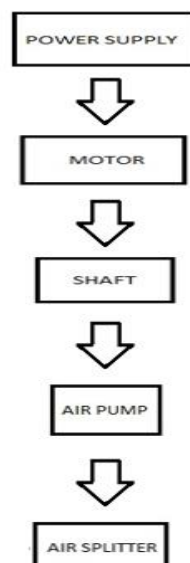


Figure 3. Block Diagram of Pumping Aerator

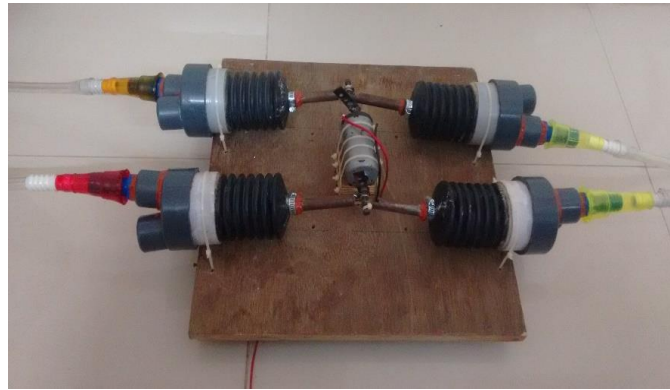


Figure 4. Pumping Aerator Module

ADVANTAGES

- ✓ This process requires little time for preparing the site as the plants are manufactured as pre-engineered and packaged units
- ✓ This process proves to be reliable under sufficient supervision
- ✓ Initial investment and maintenance costs are less
- ✓ Land area required for setting up the plant is minimal
- ✓ The end result effluent is of a higher quality than many other processes

DISADVANTAGES

- ✓ It produces noise and vibration
- ✓ Extended aeration plants do not achieve denitrification or phosphorus removal without additional unit processes

CONCLUSION

Our study and design helps in creating a module which is used to generate waves and create aeration in water. This can prevent the death of aquatic species, which is considered to be one of the main issues in aquaculture. The temperature of the water in contact with air plays a very important role in the flow of liquid. Indeed, the humidification is favored by the temperature and contact with water. Apart from saving the aquatic species, the module also helps in controlling temperature.

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