

Design of A New Microbial Monitoring Drift Ball

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Abstract

This paper introduces a new type of floating ball which can monitor the microbial content of water in real time. The water sampling module of the floating ball can sample the monitored water, and can also be used as a storage device for bacterial agents or algae removers. The stirring dial component of the floating ball can better make the spread of drugs evenly distributed. This design provides a new scheme for water monitoring, sampling and water restoration.

Keywords

Water pollution; Water monitoring; In-situ repair.

1. Introduction

A large number of nitrogen, phosphorus and other elements in agricultural production and domestic waste enter rivers and lakes under the influence of natural factors such as rainwater, which will cause eutrophication of water bodies. Eutrophication of water body will cause the decrease of dissolved oxygen in water body and the deterioration of water quality, resulting in a large number of deaths of fish and other organisms [1]. Eutrophication is a phenomenon of water aging, which is characterized by slow and irreversible [2]. Eutrophication of water body threatens the balance of water ecosystem and makes good water quality become inferior water body, which is of great harm.

There are many direct solutions to water quality problems, such as physical method of sediment dredging or mechanical aeration, biological ecological method and microbial method [3]. Among them, the microbial remediation method uses nutrients in polluted water as carbon sources for metabolism and transformation through microbial decomposition and metabolism [4]. This method has the advantages of good repair effect and no secondary pollution, and is an economical, environmentally friendly and environmentally sustainable technical method [5]. The microbial remediation method is divided into in-situ remediation and ectopic remediation. Its mechanism is to isolate, purify, domesticate and screen the strains from the contaminated environmental components, and then use the immobilization technology to prepare the strains and carriers into algae removers and bacterial agents [6]. The algae remover and bacteria remover are applied to the remediation of polluted water, and the effect is significant and targeted. The static or partial static water bodies often occur eutrophication and high pesticide concentrations, so in-situ microbial remediation is considered. However, the primary problem is how to fix microbial agents and algae removers in water bodies to achieve in-situ remediation. The common equipment to complete the placement of bacterial agents and algae removers is usually floating ball. However, the existing water microbial environmental monitoring floating

balls still have the problems that it is not easy to sample and retain the microorganisms in water, and lack the function of promoting stirring. Therefore, a new microbial monitoring floating ball was designed to solve the existing problems.

2. Structure Design of Floating Ball

The overall structure of the floating ball for water microbial environmental monitoring includes the monitoring floating ball, fluorescent coating, sealing cover, solar panel, controller, water sampling tube component, mixing dial rod assembly, connection arc plate, first lithium battery, second lithium battery, positioning ring, hoisting ring, connection rope, counterweight anchor, draft line, conductive sensor, protective cover, chlorophyll sensor, sealing cover, supporting partition plate and supporting stereotype frame. The overall structural distribution is shown in Figure 1.

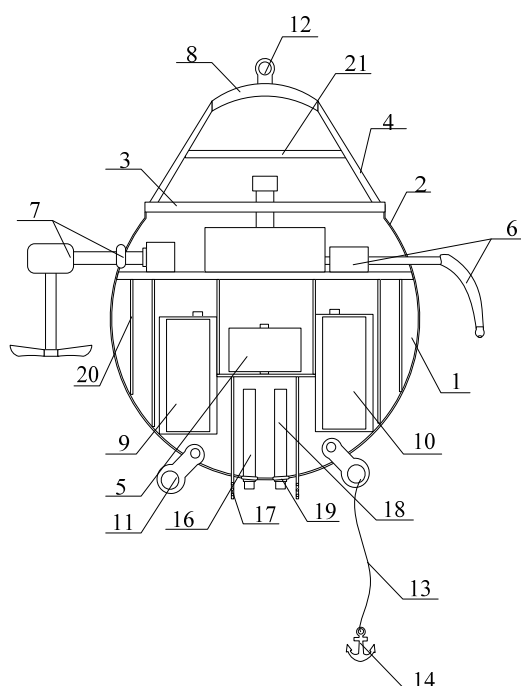


Figure 1. Overall structure

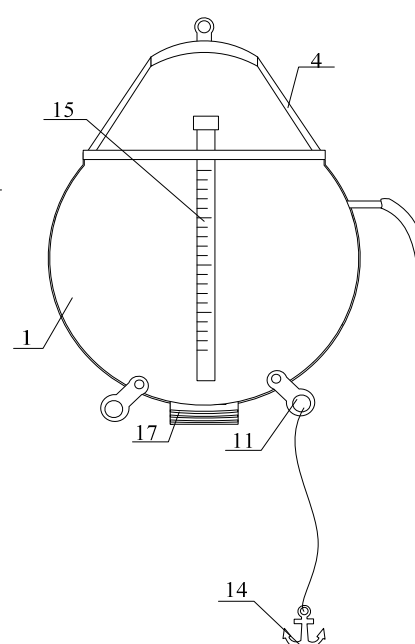


Figure 2. Sphere surface figure

Figure 1: 1 Monitoring floating sphere, 2 fluorescent coating, 3 sealing cover plate, 4 solar panels, 5 controller, 6 water sampling tube assembly, 7 stirring dial rod assembly, 8 connection arc plate, 9 first lithium battery, 10 second lithium battery, 11 positioning ring, 12 hoisting ring, 13 connection rope, 14 counterweight anchor, 15 draft line, 16 conductive sensor, 17 shield, 18 chlorophyll sensor, 19 sealing sleeve, 20 support separator, 21 support frame.

The design scheme of the floating ball can monitor the conductivity, chlorophyll and other microbial information of the measured water environment in real time. The conductive sensor and the chlorophyll sensor run through the middle position of the lower part of the floating ball and are connected with the controller. In order to protect the sensor from collision, the shield screw is connected to the lower cover of the monitoring floating ball outside the conductive sensor and the chlorophyll sensor, and the GPS / Beidou satellite navigation system is used to realize positioning monitoring and real-time back transmission of monitoring data, so as to obtain real-time continuous water environment parameters.

The specific design scheme is as follows: solar panels are arranged on the upper part of the floating ball. The stirring rod assembly is connected to the upper side of the monitoring floating sphere to play a stirring role. The lower left and right sides of the first lithium battery and the

second lithium battery sphere can not only ensure sufficient battery capacity, save internal space, but also help to balance the floating sphere. The positioning rings are respectively axised at the lower part of the monitoring drift sphere and symmetrically set. The positioning ring separates the two sides of the floating ball to better locate the floating ball and keep the ball balanced. The lower part is connected with a counterweight rivet, and the floating ball can be placed in a fixed water area for in-situ remediation of water. The existence of GPS / Beidou satellite navigation system module can locate the floating ball, which can not only make us get the water area where the floating ball is located, but also prevent the loss of floating ball caused by human factors to a certain extent. A protective cover is set at the bottom of the drift ball to protect the sensor. The floating ball has a perfect power supply system, and there are solar panels placed on the upper part of the floating ball. With lithium batteries, the power supply of the system is stable and sustainable. The floating ball has been working in a water environment for a long time, and high requirements for waterproof and antifouling. The structural design and connection of the floating ball ensure the waterproof requirements. The fluorescent coating provides a high antifouling ability for the floating ball.

3. Key Components

3.1. Water Sampling Tube Assembly

The water sampling tube assembly is the core component of the floating ball to complete the sampling and storage functions, and the structure is shown in Figure 3. This part takes the suction pump as the power source, and the water sample is inhaled through the suction tube and stored in the tank. The water sampling tube assembly is placed on the upper side of the sphere, and the suction tube is downward as a whole to facilitate the sampling of the inhaled water. The conical copper nozzle is selected for the suction nozzle. The copper texture is due to the strong corrosion resistance of copper, which can better adapt to the underwater environment. The conical nozzle is considered as the possible blockage phenomenon in the suction process. The storage tank and suction pump are placed on the same plane and placed on the isolation plate to ensure that the inlet and discharge conduits are not deformed and blocked. The upper side of the storage tank has an outlet to facilitate the extraction of the stored water sample, and the sealing device on it can ensure the drying of the internal floating ball when there is water sample in the storage tank.

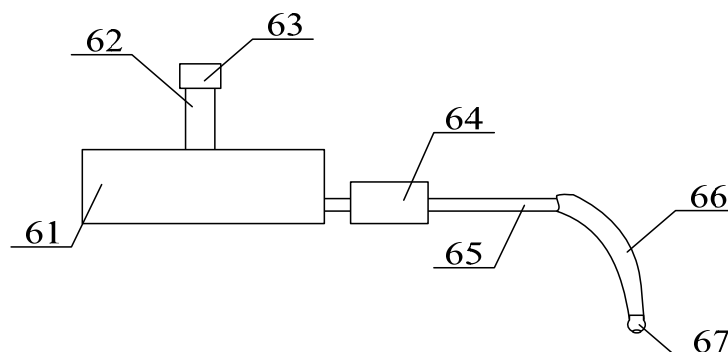


Figure 3. Sample tube components

61 storage tank, 62 discharge conduit, 63 seal cover, 64 suction pump, 65 inlet conduit, 66 suction conduit, 67 suction nozzle.

3.2. Stirring Rod Assembly

The common microbial agents or herbicides are generally dissolved in water by powder or diluted to liquid by high concentration of microbial agents, which leads to the separation of drugs from water in a static state, which is often precipitated at the bottom of the storage tank.

This makes the concentration of microbial agents or algaecide discharged during in-situ remediation of water body different, or the microbial agents or algaecide at the bottom of the storage tube cannot be discharged, resulting in waste. When the water sampling tube assembly completes the water quality collection or the storage carrying bacteria or herbicides, after the bacteria or herbicides are discharged, there are insufficient mixing with the surrounding water or there are signs of upward floating or downward movement of bacteria, leading to drug waste and difficult to achieve the purpose of in-situ remediation of water. In order to prevent the above problems, increasing the stirring function is essential. When the floating ball is in situ repaired, the task of repairing and putting the floating ball in a certain water area will be completed within a certain period of time. The radiation range of bacteria and other drugs is small, and it is time-consuming and laborious to manually adjust the position of drug delivery. Therefore, it is of great significance for the floating ball to increase the stirring rod assembly to improve the efficiency of water restoration. (Figure 4 shows the structure diagram of the mixing dial rod assembly).

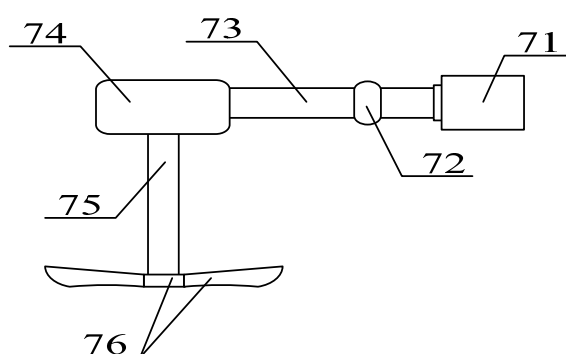


Figure 4. Mixing rod assembly

71 Stirring motor, 72 Sealing gasket, 73 Drive shaft, 74 Steering Turbine, 75 Drive shaft, 76 Stirring Turbine

4. Conclusion

With the development of China, the problems of water pollution and water eutrophication will always exist, and coping with water pollution and eutrophication will become an important research direction. The service life and safety of the floating ball are improved by improving its waterproof and antifouling ability. The continuity of detection is ensured by constructing perfect power supply system. By adding the water sampling tube assembly and the mixing dial rod structure, the floating ball has the functions of water sampling and water quality restoration. The design scheme has high feasibility, and the operation of delivery and later maintenance is also very convenient.

Acknowledgments

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