Internal-circulation moving bed bioreactor

Technical Field

The utility model relates to a moving bed bioreactor and particularly to an internal-circulation moving bed bioreactor efficient in nitrogen and phosphorus removal.

Background Art

Urban sewage treatment plants are required to have not only a function of removing organic pollutants but also a function of removing nitrogen and phosphorus. Of various sewage treatment methods, biochemical method, for its advantage of low energy consumption, light secondary pollution and low operation cost, etc., has been most widely used. Moving bed biofilm reactor is especially an efficient sewage treatment process using a biochemical method. Moving bed bioreactor, which is a kind of water treatment process using a biofilm method, employs microbial carrier having a density approximate to that of water so that the microbial carrier flows and collides with a water flow under an aeration or agitation condition to prolong a mass transfer route, improve a mass transfer effect and, meanwhile, enable a biofilm attached on the carrier to be thin and highly active so as to have a strong organic substance absorption and degradation capability, and remove the ammonia nitrogen contained in sewage effectively, however, the conventional moving bed bioreactor is inadequate in phosphorous removal. In recent years, sewage treatment technologies flourish in small towns, and various integrated water treatment process emerge. Not efficient in nitrogen and phosphorous removal by denitrification, the conventional moving bed bioreactor is limited in its popularization.

Contents of the Utility Model

To overcome the defects above, the utility model is intended to provide a compactly-structured internal-circulation moving bed bioreactor having a strong nitrogen and phosphorous removal function.

To realize the purpose above, the internal-circulation moving bed bioreactor provided in the utility model includes a reactor body in which an anaerobic zone, an aerobic zone and a sedimentation zone are arranged; a certain amount of carrier is filled in the anaerobic zone and the aerobic zone; an annular water distributor, a carrier lifting and distributing device and an input water overflow weir communicated with the aerobic zone are sequentially arranged in the anaerobic zone from down to top; the annular water distributor is connected with a water inlet; a submerged agitator and aeration devices are arranged in the aerobic zone; the aerobic zone is communicated with the sedimentation zone; a water outlet is arranged in the sedimentation zone; a carrier backflow inlet is arranged at the bottom of the anaerobic zone and connected with a carrier recycling device, and a guide plate is arranged on an internal eave of the carrier backflow inlet.

Wherein, an outlet is arranged at the rear end of the aerobic zone and communicated with an output water overflow weir, the outlet of the output water overflow weir is connected with a water collection tank, and the water collection tank is communicated with the sedimentation zone through a communicating pipe.

The lower end of the carrier recycling device is connected with the upper eave of the backflow inlet and inclined upwards by an angle, and the upper end of the carrier recycling device is higher than the water surface. A spraying faucet is arranged nearby the upper end of the carrier recycling device.

By means of the structure above, the sewage to be treated enters the anaerobic zone 1 from the annular water distributor 4, as the carrier lifting and distributing device 5 is arranged in the anaerobic zone 1, the carrier backflow inlet 6 is arranged at the bottom of the anaerobic zone 1, and a carrier and input water overflow weir 7 is arranged at the top of the anaerobic zone 1, the carrier 15 and the input water returning to the anaerobic zone 1 enter the aerobic zone 2 through the overflow weir 7. The aeration devices 8 and the submerged agitator 9 are arranged at the bottom of the aerobic zone 2 along a water flow direction, the carrier recycling device 11 and the spraying faucet 10 are arranged at the rear end of the aerobic zone 2 to separate the carrier 15 from a sludge-water mixture; and the output water overflow weir 13 and the water collection tank 12 are arranged. The water collection tank 12 is connected with the sedimentation zone by a communicating pipe 14 through which the sludge-water mixture enters the sedimentation zone. The sedimentation zone 3 is arranged with a wall thereof shared with the aerobic zone 2, thus reducing the construction cost.

Advantaged in high efficiency, energy conservation and simple and convenient operation and maintenance, etc., the moving bed bioreactor is especially suitable for the sewage treatment plants in small towns. Capable of providing a better growth environment for microorganisms, the moving bed, on one hand, has advantages of the conventional moving bed bioreactor, on the other hand, has an enhanced denitrification function and an additional phosphorous removal function, and is therefore beneficial to popularize the process.

Description of Figures

Fig. 1 is a schematic view illustrating the structure according to a detailed embodiment of the utility model.

Fig. 2 is a schematic cross-sectional view of the structure shown in Fig. 1 taken along a line A-A.

Fig. 3 is a schematic cross-sectional view of the structure shown in Fig. 1 taken along a line B-B.

Description of Figures: 1 anaerobic zone; 2 aerobic zone; 3 sedimentation zone; 4 annular water distributor; 5 special carrier lifting and distributing device; 6 carrier backflow inlet; 7 carrier and input water overflow weir; 8 aeration devices; 9 submerged agitator; 10 spraying faucet; 11 carrier recycling device; 12 water collection tank; 13 output water overflow weir; 14 communicating pipe; and 15 carrier.

Specific Mode for Carrying Out the Utility Model

The utility model is further described below in detail with reference to accompanying drawings in combination with embodiments.

As shown in Figs. 1 to 3, the internal-circulation moving bed bioreactor provided in the utility model includes an anaerobic zone 1, an aerobic zone 2 and a sedimentation zone 3, and carrier 15 is filled in the anaerobic zone 1 and the aerobic zone 2. An annular water distributor 4 and a special carrier lifting and distributing device 5 provided with a one or multi-stage lifting impeller are arranged in the anaerobic zone 1. A carrier backflow inlet 6, the length of which is 1/4-1/2 of the perimeter of the anaerobic zone, and the width of which is 0.5m-2m, is arranged at the bottom of the anaerobic zone 1. A guide plate is arranged on an internal eave of the carrier backflow inlet 6. A carrier and input water overflow weir 7, the length of which is 1/2-1 of the perimeter of the anaerobic zone, is arranged at the top of the anaerobic zone 1.

The length-width ratio of the aerobic zone 2 is 1:1-3:1, and aeration devices 8 are arranged at the bottom of the aerobic zone 2 to provide oxygen and a hybrid power. The head end of the aerobic zone 2 is connected with the overflow weir 7 of the anaerobic zone 1, and the rear end of the aerobic zone is connected with the carrier backflow inlet 6 of the anaerobic zone 1. The outlet of the aerobic zone 2 is arranged at the rear end of the aerobic zone, and a sludge-water mixture enters a water collection tank 12 through an overflow weir 13 and flows into the sedimentation zone 3 through a communicating pipe 14. A perforated plastic plate or a fiber fabric is installed in an area between a position close to the head end of the overflow weir 13 in the aerobic zone 2 and the backflow inlet 6 as a carrier recycling device 11 for separating the carrier from output water, and the carrier recycling device 11 is arranged slantwise with its upper end higher than the liquid surface of the aerobic zone 2 and its lower end connected with the upper eave of the backflow inlet 6, and a spraying faucet 10 is arranged at a position close to the upper end of the carrier recycling device 11 so that the carrier 15 accumulated on the head end of the carrier recycling device 11 is dispersed by the pressure water sprayed from the spraying faucet. A submerged agitator 9 is arranged in the aerobic zone 2 or not, depending upon the actual situation. One side of the sedimentation zone 3 in form of a horizontal sedimentation tank is shared with a wall of the aerobic zone 2.

In the embodiment, the carrier 15 is filled in the anaerobic zone 1 and the aerobic zone 2 of the reactor and moves circularly in the anaerobic zone and the aerobic zone, and a great quantity of microorganisms are attached on the surface of the carrier 15. The anaerobic zone 1 functions to enhance denitrification and phosphorus release effect, the aerobic zone 2 functions to degrade organic substances, realize a nitration effect, an incomplete denitrification effect and a phosphorus removal effect and separate the carrier 15 from the water flow; and the sedimentation zone 3 functions to separate residual sludge from the output water.

The working process is as follows: sewage flows into the reactor from the annular water distributor 4 in anaerobic zone 1, to be mixed with the carrier 15 which is lifted by the special device 5 after flowing into the reactor from the bottom of the anaerobic zone 1, and a biofilm absorbs organic substances to realize a denitrification reaction. As the water flow rises and the special device 5 lifts the carrier 15, the oxygen and the nitrate nitrogen in the anaerobic zone 1 decrease as the height increasing, consequently, an absolute anaerobic environment is generated in the anaerobic zone 1, and phosphorus is released efficiently by microorganisms. After lifted to the top of the anaerobic zone 1, the sewage and the carrier flow into the aerobic zone 2 with the help of the distributing device 5. Aeration devices 8 are densely arranged in the aerobic zone 2 to provide sufficient oxygen for the microorganisms to degrade organic substances and accelerate the mixing of the carrier 15 with the water flow so that the content of the organic substances, the ammonia nitrogen and the phosphorus contained in the sewage is reduced, an incomplete denitrification reaction occurs and the biofilm on the surface of the carrier 15 is updated rapidly. After the water flow and the carrier 15 enter the carrier recycling device 11 at the rear end of the aerobic zone 2, the carrier 15 descends, and the water flow rises, as a result, the carrier 15 flows back to the bottom of the anaerobic zone 1, and the water flow is distributed to the sedimentation zone 3 through the overflow weir 13, thereby realizing a sludge-water separation, and the residual sludge and the output water enter the subsequent processing units, respectively. The material of the said carrier recycling device 11 employs perforated plastic plate or fiber fabric.

Compared with the prior art, the internal-circulation moving bed bioreactor having the foregoing structure has the following advantages:

Although higher than common activated sludge process in organic substance removal efficiency, the conventional moving bed bioreactor is disadvantaged in poor nitrogen and phosphorus removal effect, especially in the phosphorus removal aspect, the conventional moving bed bioreactor cannot reach a sewage treatment standard without using a physic-chemical method. The internal-circulation moving bed bioreactor keeps the high-efficiency organic substance degradation performance of the conventional moving bed bioreactor and creates, for phosphorus-accumulating bacteria, a growth environment in which an aerobic environment and an absolute anaerobic environment alternate, as the growth environment is beneficial to the growth of phosphorus-accumulating bacteria, the phosphorus release and the phosphorus accumulation, the phosphorus removal performance of the reactor is significantly improved, and the denitrification performance of the reactor is enhanced.

A partition wall is arranged between the aerobic zone and the anaerobic zone of the internal-circulation moving bed bioreactor, thus obviously reducing the damage to the anaerobic environment of the anaerobic zone caused by oxygen transfer and the oxygen loss in the aerobic zone caused by the oxygen transfer, meanwhile, improving the working efficiency of the aerobic zone and the anaerobic zone, and reducing the volume of the reactor.

By integrating an anaerobic zone, an aerobic zone and a sedimentation zone in a same device, the internal-circulation moving bed bioreactor is lowered in occupied floor area and construction cost, simplified in process and reduced in hydraulic loss and running cost.

The utility model is not limited to the foregoing embodiment, any modifications on the shape or structure of the foregoing internal-circulation moving bed bioreactor as long as employing the foregoing internal-circulation moving bed bioreactor are transformations of the utility model, and should be deemed as falling within the scope of protection of the utility model.

Claims

1. An internal-circulation moving bed bioreactor, comprising: a reactor body, characterized in that, an anaerobic zone, an aerobic zone and a sedimentation zone are arranged in the reactor body; carrier is filled in the anaerobic zone and the aerobic zone; an annular water distributor, a carrier lifting and distributing device and an input water overflow weir communicated with the aerobic zone are sequentially arranged in the anaerobic zone from down to top; the annular water distributor is connected with a water inlet; a submerged agitator and aeration devices are arranged in the aerobic zone; the aerobic zone shares a wall with the sedimentation zone and is communicated with the sedimentation zone; a water outlet is arranged in the sedimentation zone; a carrier backflow inlet is arranged at the bottom of the anaerobic zone and connected with a carrier recycling device, and a guide plate is arranged on an internal eave of the carrier backflow inlet.

2. An internal-circulation moving bed bioreactor according to claim 1, characterized in that, an outlet is arranged at the rear end of the aerobic zone and communicated with an output water overflow weir, the outlet of the output water overflow weir is connected with a water collection tank, and the water collection tank is communicated with the sedimentation zone through a communicating pipe.

3. An internal-circulation moving bed bioreactor according to claim 1 or 2, characterized in that, the lower end of the carrier recycling device is connected with the upper eave of the backflow inlet and inclined upwards by an angle, the upper end of the carrier recycling device is higher than the water surface. and a spraying faucet is arranged nearby the upper end of the carrier recycling device.

Abstract

The utility model discloses an internal-circulation moving bed bioreactor to solve the problem of low nitrogen and phosphorus removal efficiency in existing moving bed technology. The internal-circulation moving bed bioreactor includes independent anaerobic zone, aerobic zone and sedimentation zone. A water flow enters the reactor from the anaerobic zone in which an annular water distributor, a special carrier lifting and distributing device, a carrier backflow inlet and a carrier and input water overflow weir are arranged. Aeration devices and a submerged agitator are arranged at the bottom of the aerobic zone, a carrier recycling device and a spraying faucet are arranged at the rear end of the aerobic zone to separate the carrier from the water flow, and an output water overflow weir and a water collection tank are arranged. The sedimentation zone is arranged with a wall thereof shared with the aerobic zone. Advantaged in high efficiency, energy conservation and simple and convenient operation and maintenance, etc., the structure above is especially suitable for the sewage treatment plants in small towns. Capable of providing a better growth environment for microorganisms, the moving bed, on one hand, has advantages of the conventional moving bed bioreactor, on the other hand, has an enhanced denitrification function and an additional phosphorous removal function, and is therefore beneficial to popularize the process.

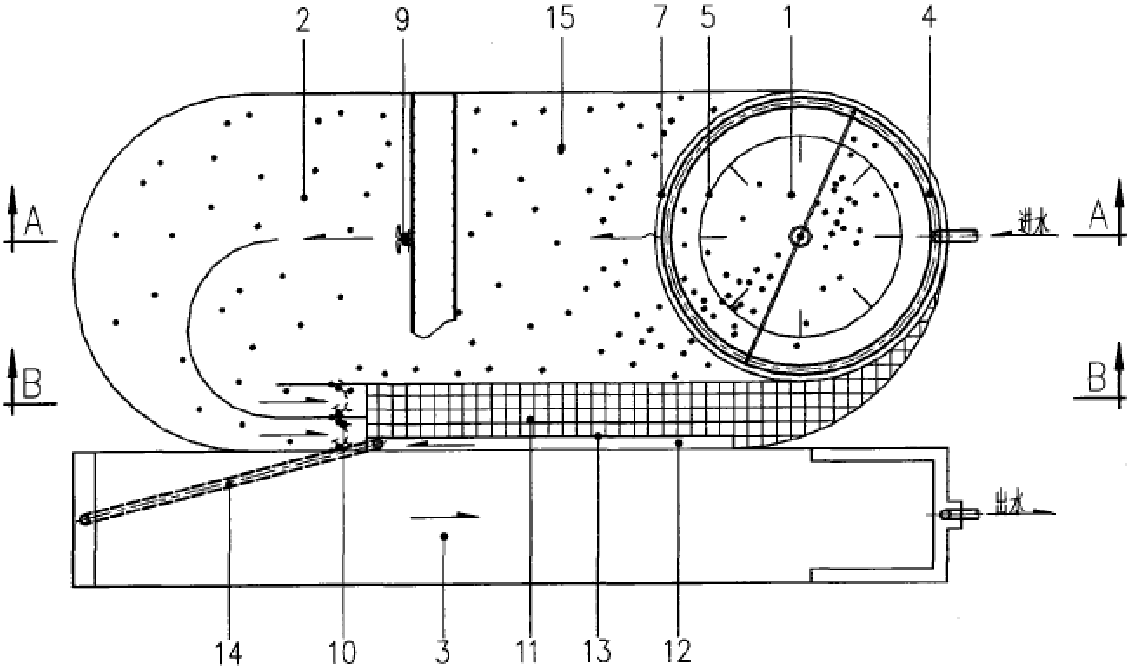

Fig. 1

Input water

Output water

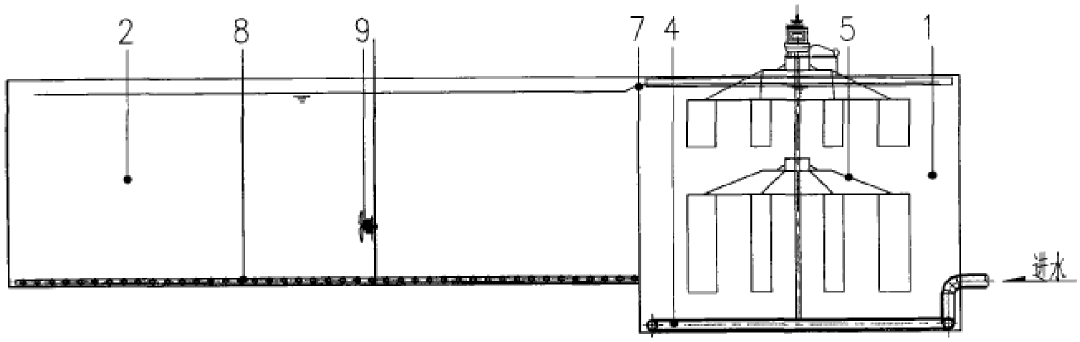

Fig. 2

Input water

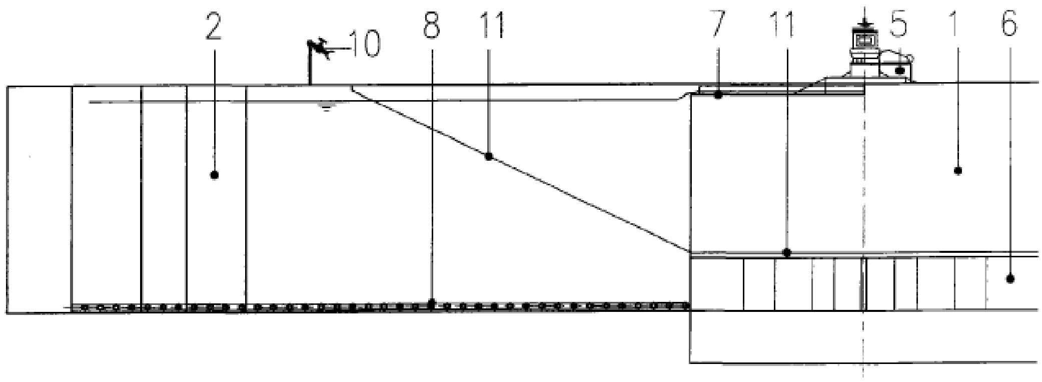

Fig. 3