

Specification

Oxidation Ditch Apparatus

Field of the Invention

The present invention relates to an oxidation ditch apparatus that shortens the time for maintenance and inspection of the aerator by diffused air, thus allowing efficient operation of the oxidation ditch apparatus.

Background of the Invention

An oxidation ditch apparatus that conducts treatment of wastewater using activated sludge is an apparatus that induces a circulation flow of a mixture of activated sludge and wastewater within a tank body that forms a horizontal circulation water channel, while supplying oxygen to the mixture, thus conducting the treatment of wastewater.

The aerator by diffused air for that type of oxidation ditch apparatus conventionally adopts a panel type ultra-fine bubble aerator by diffused air. As shown in Fig. 3A and Fig. 3B, the aerator by diffused air 5 has a combined structure of a base plate 2 made of a metal or a synthetic resin with a resin membrane 4 having fine throughholes 3 and being overlaid onto the base plate 2. When air 6 is introduced in between the base plate 2 and the membrane 4, the membrane 4 expands in pillow shape and generates fine bubbles therefrom. The fine bubbles have large gas-liquid contact area, and they ascend slowly through the water to provide very high oxygen transfer efficiency. When

air supply is stopped, the expanded membrane 4 shrinks to diminish the opening of the throughholes 3, and the membrane firmly attaches to the base plate 2 under water pressure, thus preventing the invasion of wastewater therebetween.

Since that type of aerator by diffused air is directly fixed to the bottom section (bottom face) of the water tank, according to common practice, inspection and maintenance of the aerator by diffused air require full draining of water (liquid) from the water tank, which results in long period of stop-operation. Particularly in the oxidation ditch process which has been adopted by many small scale sewage (sanitary water) treatment plants, the number of lines is small in many cases, thus a single line occupies large percentage of the total treatment capacity, so the stop of a single line gives significant influence on the operation of the total treatment plant.

Summary of the Invention

An object of the present invention is to provide an oxidation ditch apparatus that solves the above-described problems and that shortens the time for maintenance and inspection of the aerator by diffused air, thus allowing efficient operation of the oxidation ditch apparatus.

First, the present invention provides an apparatus, an oxidation ditch apparatus having a circulation water channel, a circulation water flow generator, and a aerator by diffused air mounted to the bottom section of the circulation water

channel, wherein the aerator by diffused air is detachably mounted thereto.

Second, according to the first apparatus, the present invention provides that the aerator by diffused air has a guide pipe and a hoist.

Third, according to the first apparatus, the present invention provides that at least one diffusing unit has been fixed to a base structure, and that each diffusing unit has a membrane having fine throughholes and a flat base plate.

Fourth, the present invention provides an oxidation ditch apparatus, which has a circulation water channel, a circulation flow generator, and a fine bubble aerator by diffused air mounted to the bottom section of the circulation water channel, wherein the fine bubble aerator by diffused air is positioned at distances of 1.5 m or more, apart from the circulation flow generator.

Fifth, according to the fourth apparatus, the present invention provides an oxidation ditch apparatus, wherein the circulation flow generator and the fine bubble aerator by diffused air are located in the same circulation water channel.

Sixth, the present invention provides an oxidation ditch apparatus, which has a circulation water channel, a circulation flow generator, and a fine bubble aerator by diffused air mounted to the bottom section of the circulation water channel, wherein the aerator by diffused air is detachably mounted thereto and the fine bubble aerator by diffused air is positioned at distances of 1.5 m or more apart from the circulation flow generator.

Brief Description of the Drawings

Fig. 1 is a perspective view of the configuration of aerator by diffused air and hoist, relating to the preferred embodiment for carrying out the present invention.

Fig. 2 is a plan view of the total configuration of oxidation ditch apparatus.

Fig. 3 illustrates the aerator by diffused air.

Fig. 4 shows a schematic plan view of one embodiment for carrying out the present invention.

Fig. 5 shows a schematic plan view of another embodiment for carrying out the present invention.

Fig. 6 is a graph showing the relation of the distance between the circulation flow generator and the fine bubble aerator by diffused air and the overall oxygen transfer coefficient.

Preferred Embodiments

(Preferred Embodiment 1)

The preferred embodiments for carrying out the invention are described below, referring to the drawings.

Fig. 1 is a perspective view of the configuration of aerator by diffused air and hoist, relating to the best embodiment for carrying out the present invention. Fig. 2 is a plan view of the total configuration of oxidation ditch apparatus. The oxidation ditch apparatus is provided with a tank body 1 that forms a horizontal circulation channel, a circulation flow generator (propeller propulsion unit) 7, and a aerator by diffused air 5 that is located at the bottom section of the tank

body 1 and that generates ascending bubbles in the circulation flow.

The aerator by diffused air 5 is a panel type ultra-fine bubble aerator by diffused air having a combined structure of a base plate 2 made of a metal such as stainless steel (SUS) or a synthetic resin such as polyvinylchloride (PVC) and polyamide (PA), and a membrane 4 made of a resin such as polyurethane and EPDM, having fine throughholes 3 and being overlaid on the base plate 2. (Fig.3A, Fig.3B)

Plurality of the aerator by diffused air 5 is located in parallel inside the base structure 13 of rectangular frame shape. Fig. 1 illustrates the case of three sheets of the aerator by diffused airs 5 mounted on the base structure 13 while keeping a specified gap therebetween. Fixation of each aerator by diffused air 5 to the base structure 13 assures the strength thereof, thus assuring the endurance of the aerator by diffused air against the shock of bring-up and bring-down thereof by the hoist.

Each of the aerator by diffused airs 5 has a connected air pipe 14. The air supplied from the air pipe 14 generates bubbles generated from the fine throughholes 3 of the membrane 4.

A guide pipe 15 is vertically attached to each side of the tank body 1. A guide rail may be adopted instead of the guide pipe. The base structure 13 is positioned by inserting the guide pipes 15, 15 through respective gaps between aerator by diffused airs 5, 5.

At upper part of the tank body 1, or above the water level, there is located a hoist 16. A lifting debit, a gantry crane, and the like may be applied as the hoist 16.

A chain 11 that is branched at lower section thereof is suspended from the hoist 16. Four chains 12 are attached to respective corners of the base structure 13. Each of the upper ends of the chains 12 is connected with each of respective lower ends of the branched chains 11. Thus, the base structure 13 is hung down from the hoist 16 by the chains 12 and the chains 11. By bringing-up and bringing-down the base structure 13 using the hoist 16, the base structure 13 (and the aerator by diffused air 5) is able to ascend and descend being guided by the guide pipes 15.

The embodiment for carrying out the present invention adopts a configuration that the aerator by diffused air 5 is positioned in the base structure 13. The aerator by diffused air 5 may be lifted directly by the hoist without using the base structure.

Since the base structure 13 (and the aerator by diffused air 5) can be lifted above the water level in the tank body 1 using the hoist 16, inspection and maintenance of the aerator by diffused air 5 is able to be conducted above the water level, so there is no need of draining the tank body 1 for inspection and maintenance. After the inspection and maintenance completed, the hoist 16 is operated to bring-down the base structure 13 (and the aerator by diffused air 5), and the operation of the ditch apparatus is immediately resumed.

According to the embodiment for carrying out the present invention, a single base structure 13 (aerator by diffused air 5) is positioned, (Fig. 2). The base structure (aerator by diffused air) may be located more than one in the tank body to configure the oxidation ditch apparatus. In that case, a single

hoist (debit or gantry crane) may be designed to move lengthwise along the tank body, thus allowing to transferring the base structure to a position of a specific aerator by diffused air that requires lifting, then to bring-up the base structure. With the configuration, only the base structure (aerator by diffused air) necessary of inspection and maintenance can be brought-up, while other aerator by diffused airs continue to operate not to stop the operation of the oxidation ditch apparatus.

(Preferred Embodiments 2)

Fig. 4 shows a schematic plan view of a embodiment for carrying out the present invention. The reference number 110 designates a circulation water channel in a form of rectangle with circular short sides to introduce and treat organic wastewater. The reference number 111 designates a separation wall to form the circulation water channel. The reference number 114 designates a straightening wall to stabilize the corner flow in the circular water channel 110. The reference number 112 is a circulation flow generator that creates circulation flow of introduced wastewater along the route of the circulation water channel 110. A propeller propulsion unit is adopted as the circulation flow generator 112. The reference number 113 designates a fine bubble aerator by diffused air mounted to the bottom section of the circulation water channel 110. The fine bubble aerator by diffused air 113 is equipped with a porous diffusion plate or a porous diffusion pipe that generates fine bubbles. The fine bubble aerator by diffused air 113 is positioned at 1.5 m or longer distance from the

circulation flow generator 112. The value of 1.5 m was decided on the basis of the experiments described later.

Both the fine bubble aerator by diffused air 113 and the circulation flow generator 112 are located in a flow area of circulation water channel, without having corner, or located in the same area of circulation flow (in the same water channel) where the circulation flow flows in straight direction with the aid of the separation wall 111. By arranging the fine bubble aerator by diffused air 113 and the circulation flow generator 112 in a embodiment described above, the distribution density of ascending bubbles becomes less, and the bubble growth is suppressed, thus providing higher oxygen dissolving efficiency.

Fig. 5 shows a schematic plan view of another embodiment for carrying out the present invention. For a part relating to the same configuration of Fig. 4, the same reference number as in Fig. 5 is given, and no description therefor is given here. According to the embodiment for carrying out the present invention, a hairpin circulation water channel 120 is added to a tank in a shape of horseshoe formed by connecting two tanks in a shape of rectangle with circular short sides. The reference numbers 121a and 121b designate separation walls that divide the width direction of the tank to four segments.

Also in this case, the fine bubble aerator by diffused air 113 is positioned at downstream side of the circulation flow generator 112 at distances of 1.5 m or more, and both the fine bubble aerator by diffused air 113 and the circulation flow generator 112 are located in the same circulation flow area where the circulation flow flows in the straight direction. As

a result, similar with the case of Fig. 4, the distribution density of ascending bubbles becomes less and the growth of bubbles is suppressed, thus attaining higher oxygen dissolving efficiency.

Next, the description is given on the results of experiments to determine adequate positioning of the fine bubble aerator by diffused air 113. An oxidation ditch apparatus having the same configuration with that of Fig. 4 was adopted to conduct the experiments for determining the relation between the relative positioning of the circulation flow generator 112 and the fine bubble aerator by diffused air 113 and the oxygen dissolving efficiency. The adopted oxidation ditch apparatus had a circulation water channel having 1.5 m in width, about 45 m in total length, and 1.8 m in water depth. The circulation flow generator 112 located in the circulation water channel was a propulsion unit equipped with a large diameter propeller. The fine bubble aerator by diffused air 113 had a structure of a base plate overlaid on upper face with a specially prepared polyurethane membrane having fine throughholes, thus allowing generating fine bubbles therefrom.

The rotational speed of the circulation flow generator 112 was adjusted to establish the average flow speed of about 0.3 m in the circulation flow that was formed in the circulation water channel. The circulation flow generator 112 was fixed in a flow area where the circulation flows near the corner outlet flows in the straight direction. The fine bubble aerator by diffused air 113 was moved to vary the distance between the circulation flow generator 112 and the fine bubble aerator by diffused air 113 during aeration. A dissolved oxygen meter was

applied to determine the dissolved oxygen concentration. Based on thus acquired values of dissolved oxygen concentration, the overall oxygen transfer coefficient (KLa) was determined.

Fig. 6 shows the experimental results. According to the figure, the value of the overall oxygen transfer coefficient (KLa) shows sudden increase when the position of the fine bubble aerator by diffused air becomes distant from the circulation flow generator. Then, the values of KLa reach almost constant level when the distance between the circulation flow generator and the fine bubble aerator by diffused air exceeds 1.5 m, thus forming a flow area where high KLa values are stable attained. The area to give that high KLa value continues to a zone very close to corner section. Even if the fine bubble aerator by diffused air is positioned in a straight flow area opposite to the straight flow area where the circulation flow generator is located, both areas are connected by a corner section, (or an area that gives 25 m or longer distance between the circulation flow generator and the fine bubble aerator by diffused air), the values of KLa hold a high level, though the absolute values become somewhat lower than those in the above-described case. The shaded zone in Fig. 6 indicates the corner section.

The above-described experimental results show that the positioning of the fine bubble aerator by diffused air very close to the circulation flow generator is not preferable, and that the fine bubble aerator by diffused air is necessarily positioned at 1.5 m or longer distance from the circulation flow generator. By positioning the fine bubble aerator by diffused air at 1.5 m or longer distance from the circulation flow generator, high KLa values are stable attained.

As described above, the present invention provides useful effects summarized below.

(1) With the configuration that a aerator by diffused air is brought-up and -down by a hoist, the aerator by diffused air can be brought-up above the water level even in a state of presence of water (treating liquid) in the water tank. Thus there is no need of draining the water tank during inspection and maintenance. As a result, the time for draining from and refilling water to the tank is eliminated, and the operation can be resumed immediately after completed the inspection and maintenance, which shortens the period of stop-operation of the oxidation ditch apparatus.

(2) In the case of adoption of more than one base structure (aerator by diffused air), only the aerator by diffused air that needs inspection and maintenance is brought-up, while other aerator by diffused airs continue operation, thus the inspection and maintenance can be given without stopping operation of the oxidation ditch apparatus.

(3) Fixation of the aerator by diffused air to the base structure assures the strength thereof, thus assuring the endurance of the aerator by diffused air against the shock of bring-up and -down thereof by the hoist.

Furthermore, according to the present invention, the circulation flow generator and the fine bubble aerator by diffused air are located at adequate positions, thus allowing attaining high oxygen dissolving efficiency. As a result, the power consumption of the aerator decreases to reduce the

wastewater treatment cost.

What is claimed is:

1. An oxidation ditch apparatus comprising a tank body, a circulation water channel formed horizontally in the tank body, a circulation water flow generator, an aerator by diffused air mounted to a bottom section of the circulation water channel, and a detaching device to detach the aerator by the diffused air, wherein at least one piece of diffusing unit is fixed to a base structure, and wherein each diffusing unit has a membrane having fine throughholes and a flat base plate.
2. The oxidation ditch apparatus according to claim 1, wherein the aerator by the diffused air has a guide pipe and a hoist to lift the aerator by the diffused air.
3. An oxidation ditch apparatus comprising a circulation water channel, a circulation flow generator, and a fine bubble aerator by diffused air mounted to a bottom section of the circulation water channel, wherein the fine bubble aerator by diffused air is positioned at distances of 1.5 m or more apart from the circulation flow generator.

4. The oxidation ditch apparatus according to claim 3, wherein both the circulation flow generator and the fine bubble aerator by the diffused air are located in the same circulation water channel.

5. An oxidation ditch apparatus comprising a circulation water channel, a circulation flow generator, and a fine bubble aerator by diffused air mounted to a bottom section of the circulation water channel, wherein the oxidation ditch apparatus has a detaching device to detach the aerator by the diffused air and wherein the fine bubble aerator by the diffused air is positioned at distances of 1.5 m or more apart from the circulation flow generator.