Claims

[Claim 1]

A water treatment device, comprising:

a biological treatment tank configured to store a stored liquid containing organisms that decompose contaminants;

a pump configured to generate a circulating liquid flow formed of a circulating liquid extracted from the stored liquid;

a gas-liquid two-phase flow generation device configured to use the circulating liquid flow to suction a gas containing oxygen and thus generate a gas-liquid two-phase flow of the circulating liquid having the gas dispersed therein; and

a nozzle for injecting the gas-liquid two-phase flow into a region that stores the stored liquid.

[Claim 2]

The water treatment device according to claim 1, further comprising a circulating liquid pipe configured to supply the circulating liquid to the pump by extracting the stored liquid from a bottom portion of the biological treatment tank.

[Claim 3]

The water treatment device according to claim 2, further comprising a separation membrane immersed in the stored liquid;

the separation membrane generating treated water by filtering the stored liquid; and

the nozzle injecting the gas-liquid two-phase flow toward the separation membrane.

[Claim 4]

The water treatment device according to claim 3, wherein the region includes:

an upflow portion having the separation membrane disposed therein; and

a downflow portion disposed side-by-side with the upflow portion in a horizontal direction;

the circulating liquid pipe extracting the stored liquid from the downflow portion.

[Claim 5]

The water treatment device according to claim 4, wherein the nozzle is formed by a plurality of nozzles that inject the gas-liquid two-phase flow into a plurality of different regions of the separation membrane.

[Claim 6]

The water treatment device according to claim 5, wherein each of the nozzles injects the gas-liquid two-phase flow upward.

[Claim 7]

The water treatment device according to claim 6, wherein the gas-liquid two-phase flow generation device is disposed above the biological treatment tank.

[Claim 8]

The water treatment device according to claim 7, further comprising:

a pipe that supplies the gas-liquid two-phase flow from the gas-liquid two-phase flow generation device to the nozzle; and

a gas-liquid agitation device that agitates a fluid and a gas that flow through the pipe.

[Claim 9]

The water treatment device according to claim 8, wherein the pipe is disposed so as to extend through a liquid surface of the stored liquid.

[Claim 10]

The water treatment device according to claim 9, wherein the biological treatment tank includes:

a membrane separation tank that forms a region having the separation membrane disposed therein; and

a biological oxidation tank configured to supply the stored liquid to the membrane separation tank;

the biological oxidation tank including a biological oxidation tank nozzle configured to inject the gas-liquid two-phase flow into a region that stores the stored liquid.

[Claim 11]

The water treatment device according to claim 1, wherein the biological treatment tank includes:

a dispersed bacteria treatment tank configured to store a dispersed bacteria mixture having non-agglomerative bacteria that decompose dispersed contaminants; and

an activated sludge treatment tank configured to store an activated sludge mixture having suspended activated sludge that decomposes the dispersed bacteria;

the dispersed bacteria mixture being supplied to the activated sludge mixture;

the circulating liquid being extracted from the dispersed bacteria mixture; and

the nozzle injecting the gas-liquid two-phase flow into a region that stores the dispersed bacteria mixture.

[Claim 12]

The water treatment device according to claim 11, further comprising an activated sludge treatment tank nozzle configured to inject the gas-liquid two-phase flow into a region that stores the activated sludge mixture.

Claims

[Claim 1]

A water treatment device, comprising:

a biological treatment tank configured to store a stored liquid containing organisms that decompose contaminants;

a pump configured to generate a circulating liquid flow formed of a circulating liquid extracted from the stored liquid;

a gas-liquid two-phase flow generation device configured to use the circulating liquid flow to suction a gas containing oxygen and thus generate a gas-liquid two-phase flow of the circulating liquid having the gas dispersed therein;

a nozzle for injecting the gas-liquid two-phase flow into a region that stores the stored liquid;

a circulating liquid pipe configured to supply the circulating liquid to the pump by extracting the stored liquid from a bottom portion of the biological treatment tank;

a separation membrane immersed in the stored liquid; the separation membrane generating treated water by filtering the stored liquid;

the nozzle injecting the gas-liquid two-phase flow toward the separation membrane;

the region includes an upflow portion having the separation membrane disposed therein; and a downflow portion disposed side-by-side with the upflow portion in a horizontal direction; the circulating liquid pipe extracting the stored liquid from the downflow portion;

the nozzle is formed by a plurality of nozzles that inject the gas-liquid two-phase flow into a plurality of different regions of the separation membrane;

each of the nozzles injects the gas-liquid two-phase flow upward; and

the gas-liquid two-phase flow generation device is disposed above the biological treatment tank.

[Claim 2]

The water treatment device according to claim 1, further comprising:

a pipe to supply the gas-liquid two-phase flow from the gas-liquid two-phase flow generation device to the nozzle; and

a gas-liquid agitation device to agitate a fluid and a gas that flow through the pipe.

[Claim 3]

The water treatment device according to claim 2, wherein the pipe is disposed so as to extend through a liquid surface of the stored liquid.

[Claim 4]

The water treatment device according to claim 3, wherein the biological treatment tank includes:

a membrane separation tank that forms a region having the separation membrane disposed therein; and

a biological oxidation tank to supply the stored liquid to the membrane separation tank;

the biological oxidation tank including a biological oxidation tank nozzle to inject the gas-liquid two-phase flow into a region that stores the stored liquid.

[Claim 5]

The water treatment device according to claim 1, wherein the biological treatment tank includes:

a dispersed bacteria treatment tank to store a dispersed bacteria mixture having non-agglomerative bacteria that decompose dispersed contaminants; and

an activated sludge treatment tank to store an activated sludge mixture having suspended activated sludge that decomposes the dispersed bacteria;

the dispersed bacteria mixture to supply to the activated sludge mixture;

the circulating liquid being extracted from the dispersed bacteria mixture; and

the nozzle to inject the gas-liquid two-phase flow into a region that stores the dispersed bacteria mixture.

[Claim 6]

The water treatment device according to claim 5, further comprising an activated sludge treatment tank nozzle to inject the gas-liquid two-phase flow into a region that stores the activated sludge mixture.