

[DESCRIPTION]

[Title of Invention]

CLOSED CIRCULATION TYPE LAND-BASED AQUACULTURE SYSTEM

[Technical Field]

[0001]

The present disclosure relates to a closed circulation type land-based aquaculture system.

[Background Art]

[0002]

Along with the global population growth, demands for food are increasing, and from the viewpoint of realizing a sustainable society, stable supply of aquatic resources having superior productivity is required. Regarding productivity, a feed conversion rate defined by the amount of feed required to obtain a 1-kg gain is 10 to 15 for cow, 3 to 4 for pig, and 1.4 to 2.2 for chicken, whereas in crustaceans such as shrimp, the rate is 1.3 to 1.7, and in fish, the rate is approximately 1.1. Further, the amount of water required to obtain a 1-kg gain is 20,000 L or more for cow, approximately 6,000 L for pig, and 4,500 L for chicken, whereas if a closed circulation type land-based aquaculture is used for growth, the amount of water required for crustaceans such as shrimp is only 315 L.

[0003]

As described, aquatic resources have higher productivity compared to edible resources of land animals, but if natural water sources such as the sea, river, or pond are used for cultivation, the installation location of the cultivation facility will be limited. Therefore, recently, closed circulation type land-based aquaculture is regarded as a promising technique. Closed circulation type land-based aquaculture enables installation of the cultivation facility even at a location distant from natural water sources, and it is especially advantageous in inland areas.

[0004]

Prior art techniques related to such closed circulation type land-based aquaculture are disclosed in Patent Literature 1 and Patent Literature 2, for example.

[0005]

A temperature adjustment fishery greenhouse for artificial culture disclosed in Patent Literature 1 discloses installing a water tank within a greenhouse, wherein temperature adjustment is performed by ventilation when the temperature within the greenhouse becomes high, and wherein

changing of water is performed automatically. Changing of water of the water tank according to Patent Literature 1 is performed by operating a pump disposed within the water tank to discharge the water within the water tank and supplying the amount of water corresponding to the discharged water from the exterior.

[0006]

A land cultivation system disclosed in Patent Literature 2 is equipped with a plurality of water tanks arranged on land, a top panel that covers at least a part of a space between the plurality of water tanks and connected to at least one water tank constituting the space, and partitioning walls disposed in the space covered by the top panel and connected to at least one water tank constituting the space. According to the water tank of Patent Literature 2, the temperature of the water tank is adjusted through a window disposed on the top panel or by detaching the partitioning walls.

[Citation List]

[Patent Literature]

[0007]

[Patent Literature 1] Publication of Japanese Patent No. 6784879

[Patent Literature 2] Publication of Japanese Patent No. 5274884

[Summary of Invention]

[Problems to be Solved by the Invention]

[0008]

According to the cultivation system disclosed in Patent Literature 1 and Patent Literature 2, the water tanks are disposed within a greenhouse or in a closed space, and ventilation etc. is performed as needed to perform temperature adjustment. In such a conventional cultivation system, there are attempts to perform temperature adjustment using as little power as possible.

[0009]

Meanwhile, according to the system disclosed in Patent Literature 1, the changing of water is performed by discharging water from the water tank and feeding water thereto from the exterior, such that a large amount of water is required. Further, according to the system of Patent Literature 2, there is no description regarding management of water, such that according to the system, purification of water is recognized to be performed similarly by changing water.

[0010]

When installing the cultivation system on land, breeding water is required to be circulated in order to reduce the amount of use of water. Meanwhile, if

the breeding water is circulated, electric energy is required to drive a circulating pump for circulating water continuously and for driving an aeration pump for adjustment of dissolved oxygen, and electric power, heavy oil, or kerosene is used for adjusting water temperature, such that energy consumption is high, and from the viewpoint of CO₂ emission, the environmental load is not considered low.

[0011]

The present invention aims at providing a closed circulation type land-based aquaculture system having a lower environmental load compared to the breeding system of the prior art.

[Means of Solving the Problems]

[0012]

A closed circulation type land-based aquaculture system according to the present invention provided to solve the problems mentioned above includes a breeding water tank configured to retain breeding water and grow a marine product, a heat insulating member configured to cover at least a part of the breeding water tank, a filtration tank configured to purify a water quality of the breeding water tank, a circulation pump configured to supply the breeding water from the filtration tank to the breeding water tank, a distributor configured to connect an electric power by renewable energy or an electric power from a power system to a cultivation system load including the circulation pump, and a control unit configured to control at least the circulation pump, wherein the breeding water tank and the filtration tank are arranged adjacent one another, and wherein the circulation pump is located below a water level of either the breeding water tank or the filtration tank, whichever is lower, and water within the filtration tank is sent into the breeding water tank.

[0013]

According to the closed circulation type land-based aquaculture system of the present invention, the circulation pump is disposed below the water level of either the breeding water tank or the filtration tank, whichever is lower, and the water within the filtration tank is caused to be supplied into the breeding water tank, such that circulation within the breeding water tank is enabled with a small electric power. Thereby, a closed circulation type land-based aquaculture system having a lower environmental load compared to a conventional breeding system may be provided.

[0014]

According to the closed circulation type land-based aquaculture system of the present invention, the renewable energy may be a solar power generation panel, wherein the closed circulation type land-based aquaculture system may further include a converter configured to convert voltage of electric power generated by the solar power generation panel, and a storage battery connected via the converter to the solar power generation panel and configured to store the electric power generated by the solar power generation panel, and wherein the circulation pump may be a DC pump.

[0015]

By disposing the solar power generation panel, the closed circulation type land-based aquaculture system may be installed even in a location where there is no electric power supplied from power systems. Furthermore, by adopting a DC pump as the circulation pump, the electric power consumption may be suppressed compared to the AC pump, and water within the filtration tank may be supplied into the breeding water tank by low electric power consumption.

[0016]

The closed circulation type land-based aquaculture system of the present invention further includes a temperature sensor for measuring a temperature of the breeding water, and a solar water heater configured to store solar heat in a heat medium and to enable heat of the heat medium to be transmitted to the breeding water, wherein the control unit may generate a first control signal for starting transmission of heat of the heat medium in the solar water heater to the breeding water in a case where information indicating that the breeding water is equal to or below a predetermined first temperature is entered from the temperature sensor, and may generate a second control signal for stopping transmission of heat of the heat medium in the solar water heater to the breeding water in a case where information indicating that the breeding water has reached a predetermined second temperature is entered from the temperature sensor. According to this configuration, the temperature within the breeding water tank may be controlled to a fixed temperature by the solar water heater.

[0017]

The closed circulation type land-based aquaculture system according to the present invention further includes a boiler configured to heat the breeding water, and wherein, if the control unit does not generate the second control signal after a predetermined first time has elapsed from the generation of the first control signal, the control unit may generate a third control signal for

operating the boiler and heating the breeding water. According to this configuration, even if temperature control by the solar water heater may not be performed due to weather, the temperature within the breeding water tank may be controlled to a fixed temperature using the boiler.

[0018]

The closed circulation type land-based aquaculture system according to the present invention further includes a wind power generating facility connected to the distributor. According to this configuration, electric power may be obtained further by installing the system at a location where the wind is strong.

[0019]

The closed circulation type land-based aquaculture system according to the present invention further includes a water quality sensor for measuring a water quantity of the breeding water, and wherein the control unit may generate a fifth control signal for realizing at least either starting of operation of the circulation pump or increasing of a discharge rate per unit time of the circulation pup when information indicating that the breeding water has reached a first water quality level is entered from the water quality sensor, and may generate a sixth control signal for realizing at least either stopping of operation of the circulation pump or reducing of a discharge rate per unit time of the circulation pump when information indicating that the breeding water has reached a second water quality level is entered from the water quality sensor. According to this configuration, the water quality within the breeding water tank may be maintained constant.

[0020]

The closed circulation type land-based aquaculture system according to the present invention further includes an aeration device for performing aeration of the breeding water, wherein the fifth control signal may include a signal for starting operation of the aeration device, and wherein the sixth control signal may include a signal for stopping operation of the aeration device. According to this configuration, the water quality within the breeding water tank may further be maintained constant.

[Effects of Invention]

[0021]

According to the present invention, a closed circulation type land-based aquaculture system having a lower environmental load compared to the conventional breeding system is provided.

[Brief Description of Drawings]

[0022]

FIG. 1 is an explanatory view illustrating a closed circulation type land-based aquaculture system according to one embodiment of a present invention, wherein (A) is a view illustrated from an oblique frontward direction, and (B) is a view illustrated from an oblique rearward direction.

FIG. 2 is an explanatory view of a closed circulation type land-based aquaculture system according to the present embodiment.

FIG. 3 is a block diagram illustrating a function of a control unit.

[Mode for Carrying out the Invention]

[0023]

Now, the present disclosure will be described with reference to the drawings. FIGs. 1(A) and 1(B) are explanatory views illustrating a closed circulation type land-based aquaculture system according to one embodiment of the present invention, wherein (A) is a view illustrating an exterior of the present system from an oblique frontward direction, and (B) is a view illustrating the same from an oblique rearward direction.

[0024]

A closed circulation type land-based aquaculture system 100 according to one embodiment of the present invention is equipped with a container 110 that adopts a known unit house, or a transportation container, and an inner side of the container 110 constitutes a breeding space 100U. Since the container 110 has a length of 4899 mm $\times$ a width of 2230 mm $\times$ a height of 2694 mm, a footprint (occupation range) of the closed circulation type land-based aquaculture system 100 according to the present embodiment is 9.99 m² (3.02 tsubo), which is smaller than 10 m².

[0025]

Therefore, the closed circulation type land-based aquaculture system 100 according to the present embodiment can be sufficiently installed if there is a parking space corresponding to a parking area of one car. Therefore, the closed circulation type land-based aquaculture system 100 according to the present embodiment may be installed in a densely populated area, such as an outdoor parking area of a commercial zone or a vacant lot in a residential area, where the closed circulation type land-based aquaculture system has not been installed up to this point. By installing the closed circulation type land-based aquaculture system 100 in such areas where people live, it becomes possible to provide fresh aquatic resources safely and at a low cost.

[0026]

The closed circulation type land-based aquaculture system 100 according to the present embodiment is equipped with a solar power generation panel 200, a solar water heater 210 capable of storing solar heat in a heat medium (examples of which are water and antifreezing solution) and capable of transmitting heat of the heat medium to a breeding water inside the breeding space 100U, and a wind power generating facility 230, which are disposed on a ceiling 111 of the container 110. The solar power generation panel 200, the solar water heater 210, and the wind power generating facility 230 are not essential configurations of the closed circulation type land-based aquaculture system 100.

[0027]

Further, the closed circulation type land-based aquaculture system 100 is equipped with a storage battery 240 for storing electric power that has been generated by the solar power generation panel 200 and the wind power generating facility 230 as needed, so as to utilize renewable energy. Thereby, electric power that is required to operate the closed circulation type land-based aquaculture system 100 may be acquired without receiving electric power from external power systems. That is, CO₂ emission related to energy may be reduced to zero.

[0028]

Further, as an unlimiting example, the cultivation system load may be operated stably if the solar power generation panel 200 and the wind power generating facility 230 may generate electric power of 7.5 kWh/day. According to one example, the footprint of the storage battery 240 disposed outside the container 110 is 0.25 m² or smaller.

[0029]

As described, since the closed circulation type land-based aquaculture system 100 according to the present embodiment is operable without supply of electric power from the exterior, such that it may be installed in a temporary housing area in a disaster-stricken district or in a residential area of refugees (refugee camp). In a nonstationary environment such as a temporary housing area, it is extremely difficult to obtain new aquatic resources, but by installing the closed circulation type land-based aquaculture system 100, it becomes possible to provide fresh aquatic resources continuously.

[0030]

FIG. 2 is an explanatory view of a closed circulation type land-based aquaculture system according to the present embodiment. As illustrated in FIG. 2, the closed circulation type land-based aquaculture system 100

according to the present embodiment is equipped with a breeding water tank 300 for retaining breeding water and growing marine products within the breeding space 100U. As a non-limiting example, the breeding water tank 300 illustrated in FIG. 2 is approximately 12.5 m^3 (W $3.6 \text{ m} \times$ D $1.9 \text{ m} \times$ H 1.2 m), and is capable of stably retaining approximately 7 m^3 , such as approximately 7 t of breeding water.

[0031]

In the breeding space 100U, a filtration tank 310 for purifying water quality of the breeding water tank 300 is disposed adjacent to the breeding water tank 300. A water guiding portion 350 for supplying breeding water from the breeding water tank 300 to the filtration tank 310 is disposed between the breeding water tank 300 and the filtration tank 310. A circulation pump 340 is arranged at a bottom portion of the filtration tank 310, and a water introducing pipe 330 for supplying breeding water discharged from the circulation pump 340 to the breeding water tank 300 communicates the bottom portion of the filtration tank 310 and the bottom portion of the breeding water tank 300. As described, the circulation pump 340 is disposed below a water level WL1 of the breeding water tank 300 and a water level WL2 of the filtration tank 310.

[0032]

In the present embodiment, a DC pump is adopted as the circulation pump 340, and as an example, it has a total pump head is 8 m or smaller and a discharge rate per unit time of 15000 L/h or smaller. Compared to an AC pump, the DC pump may suppress electric power consumption. As a non-limiting example, according to the closed circulation type land-based aquaculture system 100 of the present embodiment, the electric power consumption when a breeding water of approximately 10 t is circulated for 50 times/day may be approximately 0.2 kW. If the circulation pump 340 is a DC pump, the voltage of electric power that has been generated by the solar power generation panel 200 may be converted by a converter 510 to drive the DC pump directly.

[0033]

By adopting a configuration of arranging the circulation pump 340 at a bottom portion of the filtration tank 310 and discharging the breeding water through the water introducing pipe 330 to the bottom portion of the breeding water tank 300, the total pump head required for the circulation pump 340 may be made low. Therefore, according to the closed circulation type land-based aquaculture system 100 of the present embodiment, the circulation

pump 340 may be downsized. The total pump head of the circulation pump 340 may be 10 m or less, 8 m or less, or even 5 m or less.

[0034]

The discharge rate per unit time of the circulation pump 340 is set, for example, by a total sum of amount of breeding water in the breeding water tank 300 and the filtration tank 310, and a flow velocity of breeding water moving within the filtration tank 310. For example, if the discharge rate per unit time of the circulation pump 340 is 15000 L/hour, breeding water within the breeding water tank 300 may be circulated once every 40 minutes. The discharge rate per unit time of the circulation pump 340 may be 20000 L/hour or less, 15000 L/hour or less, or even 10000 L/hour or less.

[0035]

An agitation pump 301 for generating waves, a temperature sensor 302 for measuring breeding water temperature, a water quality sensor 303 for measuring water quality of breeding water, a heat exchanger 304 for transmitting heat from a heat medium heated by the solar water heater 210 to the breeding water, and an aeration device 305 are disposed inside the breeding water tank 300.

[0036]

By having the circulation pump 340 discharge breeding water from the water introducing pipe 330, water current is generated at a bottom surface of the breeding water tank 300. The aeration device 305 disposed on the bottom surface of the breeding water tank 300 creates a water current toward the upper direction, and the water current created by the agitation pump 301 causes the breeding water to overflow from the water guiding portion 350 and flow into the filtration tank 310. Therefore, the water level WL1 of the breeding water tank 300 becomes higher than the water level WL2 of the filtration tank 310.

[0037]

As described, according to the closed circulation type land-based aquaculture system 100 of the present embodiment, a circulating water flow of a vertical rotation that flows from the lower direction upward in the breeding water tank 300 and flowing downward from the upper direction in the filtration tank 310 is configured, and by this circulating water flow, solid refuse such as remaining feed, feces, exuvium and the like normally accumulated on the bottom surface of breeding water tank 300 are flown up and easily delivered to the filtration tank 310. It is also possible to provide an additional aeration device 305 disposed on the bottom surface of the breeding water tank 300 close to the wall

on the side of the filtration tank 310 of the breeding water tank 300. It becomes possible to more stably prevent solid refuse included in the breeding water that overflows from the breeding water tank 300 to the filtration tank 310 from settling by its own weight and returning into the breeding water tank 300, by the water current toward the upper direction created by the aeration device 305 and moving the solid refuse toward the filtration tank 310.
[0038]

A heat insulating member 320 is disposed to cover at least a part of the breeding water tank 300. According to the closed circulation type land-based aquaculture system 100 of the present embodiment, the heat insulating member 320 having a grid shape is disposed, and a water tank portion composed of the breeding water tank 300 and the filtration tank 310 are disposed on the inner side of the heat insulating member 320. Thereby, lowering of temperature of breeding water in the water tank portion may be suppressed.
[0039]

Further, as described above, the heat exchanger 304 is disposed in the breeding water tank 300, and heat from the heat medium heated by the solar water heater 210 may be transmitted through the heat exchanger 304 to the breeding water within the breeding water tank 300. As described, the closed circulation type land-based aquaculture system 100 according to the present embodiment is provided with the solar water heater 210, such that there is no need to supply an energy source (electricity and fuel) for heating the breeding water within the breeding water tank 300, and the running costs of the closed circulation type land-based aquaculture system 100 may be suppressed.
[0040]

The closed circulation type land-based aquaculture system 100 may provide a boiler 410 in a circulation path of the heat medium connecting the solar water heater 210 and the heat exchanger 304, as needed. The boiler 410 may further increase the temperature of the heat medium heated in the solar water heater 210, and supply the same to the heat exchanger 304. A non-limiting example of output of the boiler 410 is 50 kW.
[0041]

Actual configuration of the temperature sensor 302 and the water quality sensor 303 is arbitrary, but it is necessary to be able to output predetermined information (information related to the temperature of breeding water in the temperature sensor 302, and information related to the water quality of breeding water in the water quality sensor 303) to a control unit 500.

[0042]

A water quality purification device is provided in the filtration tank 310. Among the following functions, the water quality purification device may have a part of or all the functions listed below, and may have functions other than those listed below.

- Physical filtration (specific example: settling tank, foam separation device, screen filter, drum filter, etc.)
- Nitrification (specific example: biological filtration, etc.)
- Denitrification

[0043]

Further, the closed circulation type land-based aquaculture system 100 according to the present embodiment may be equipped with the following functions.

- Sterilization (specific example: ultraviolet sterilization device, ozone sterilization device, etc.)
- Dissolved oxygen adjustment (specific example: blower / aeration, oxygen dissolution device, etc.)
- Feeding device

[0044]

The closed circulation type land-based aquaculture system 100 according to the present embodiment is equipped with a power supply control board 400 including the converter 510 that converts the voltage of electric power that has been generated by the solar power generation panel 200. According to the closed circulation type land-based aquaculture system 100 of the present embodiment, the power supply control board 400 is also equipped with a distributor 520 that connects the electric power generated by the solar power generation panel 200 or the wind power generating facility 230 or the electric power from a power supply 600 of a power system to the storage battery 240 and the cultivation system load such as the circulation pump 340.

[0045]

Further, in FIG. 2, a feeder line connected to the distributor 520 of the power supply control board 400 is illustrated to be connected to only the circulation pump 340 as a specific example of the cultivation system load, but the cultivation system load further includes the agitation pump 301, the aeration device 305, the boiler 410, and the control unit 500, and feeder lines connecting the distributor 520 of the power supply control board 400 and these components are not shown in FIG. 2.

[0046]

By providing the distributor 520 as described above, it becomes possible to store excessive electric power that has occurred in the solar power generation panel 200 or the wind power generating facility 230 in the storage battery 240 so as to enable the system to operate in an autonomous state without having to supply electric power from the power supply 600 of a power system, or the electric power from the power supply 600 of a power system may be stored in the storage battery 240 to prepare for a state such as bad weather where it is difficult to generate electric power in a stable manner by the closed circulation type land-based aquaculture system 100. Of course, it is possible to provide all the necessary electric power required by the cultivation system load from the power supply 600 of a power system. That is, freedom of system operation may be enhanced by providing the distributor 520.

[0047]

Next, an operation of the control unit 500 equipped in the closed circulation type land-based aquaculture system 100 according to the present embodiment will be described. In FIG. 2, the control unit 500 is illustrated as being disposed outside the power supply control board 400, but the control unit 500 may be disposed on an inner side of the power supply control board 400. FIG. 3 is a block diagram illustrating the functions of the control unit 500. As illustrated in FIG. 3, the control unit 500 includes four control units (a water heater starting unit 501, a water heater stopping unit 502, a boiler starting unit 503, and a boiler stopping unit 504) related to controlling temperature of the breeding water, and based on information entered from the temperature sensor 302, any one of these control units is operated to generate a control signal and to control the operations of the solar water heater 210 and the boiler 410.

[0048]

In the water heater starting unit 501, when information indicating that the temperature of breeding water is equal to or lower than a predetermined first temperature T1 is entered from the temperature sensor 302, a first control signal for starting transmission of heat of the heat medium of the solar water heater 210 to breeding water is generated. As a specific example, circulation of heat medium from the solar water heater 210 to the heat exchanger 304 is started by the first control signal, and breeding water in the breeding water tank 300 is heated via the heat exchanger 304.

[0049]

In the water heater stopping unit 502, when information indicating that the temperature of breeding water has reached a predetermined second

temperature T2 is entered from the temperature sensor 302, a second control signal for stopping transmission of heat of the heat medium in the solar water heater 210 to breeding water is generated. As a specific example, circulation of heat medium from the solar water heater 210 to the heat exchanger 304 is stopped by the second control signal, and heating of breeding water within the breeding water tank 300 via the heat exchanger 304 is stopped.

[0050]

In the boiler starting unit 503, in a state where the second control signal is not generated even after elapse of a predetermined first time t1 after the generation of the first control signal by the water heater starting unit 501, a third control signal for heating breeding water by operating the boiler 410 is generated. As a specific example, additional heating of the heat medium circulated in the heat exchanger 304 by the boiler 410 is started based on the third control signal.

[0051]

In the boiler stopping unit 504, when information indicating that the temperature of breeding water has reached a third temperature T3 is entered from the temperature sensor 302, a fourth control signal for stopping heating of breeding water by the boiler 410 is generated. As a specific example, heating of the heat medium by the boiler 410 is stopped based on the fourth control signal. From the viewpoint of preventing excessive increase (overshooting) of breeding water temperature and the viewpoint of minimizing use of external energy, it may be preferable to set the third temperature T3 lower than the second temperature T2.

[0052]

Since the closed circulation type land-based aquaculture system 100 according to the present embodiment includes the heat insulating member 320, heat of breeding water within the breeding water tank 300 does not easily escape to the exterior. Therefore, normally when the water heater starting unit 501 generates the first control signal, the water temperature of breeding water rises speedily. By setting the temperature difference between the first temperature T1 and the second temperature T2 to be small (such as 4°C), in an example where the difference between outside air temperature and the water temperature of breeding water is 10°C, the change of temperature of breeding water may be suppressed to 0.5°C/day to 1°C/day, such that additional energy (that is, operation of the boiler 410) for temperature adjustment may be suppressed. Specifically, if the actual temperature is to be maintained between 20°C and 28°C, regarding the temperature difference

between the first temperature T1 and the second temperature T2, it may be possible to set the first temperature to 22°C and the second temperature to 26°C.

[0053]

As illustrated in FIG. 3, the control unit 500 includes two control units (a circulation starting unit 505 and a circulation stopping unit 506) for controlling the circulation pump 340, and based on information entered from the water quality sensor 303, one of these control units is operated to generate a control signal and control the operation of the circulation pump 340.

[0054]

In the circulation starting unit 505, when information indicating that breeding water has reached a first water quality level Q1 is entered from the water quality sensor 303, a fifth control signal for realizing at least either starting of operation of the circulation pump 340 or increasing of the discharge rate per unit time of the circulation pump 340 is generated. Increasing the discharge rate per unit time of the circulation pump 340 may be realized by either raising the operation frequency of the circulation pump 340 or by performing intermittent operation.

[0055]

The circulation starting unit 505 may generate a control signal to increase the discharge rate per unit time of the circulation pump 340 in a stepwise manner. Further, similar to the circulation pump 340, the circulation starting unit 505 may generate control signals for other devices that form circulation of breeding water, such as the agitation pump 301 and the aeration device 305.

[0056]

In the circulation stopping unit 506, when information indicating that breeding water has reached a second water quality level Q2 is entered from the water quality sensor 303, a sixth control signal for realizing at least either stopping of operation of the circulation pump 340 or reducing of the discharge rate per unit time of the circulation pump 340 is generated. Similar to the circulation pump 340, the circulation stopping unit 506 may generate control signals for other devices that form circulation of breeding water, such as the agitation pump 301 and the aeration device 305.

[0057]

The embodiment described here is illustrated to facilitate understanding of the present disclosure, and it is not intended to limit the scope of the present disclosure. Therefore, respective elements disclosed in the above-described

embodiment are recognized to include all design changes and equivalents that belong to the technical scope of the present disclosure.

[0058]

For example, a heat insulating cover member that covers an upper portion of the water tank portion composed of the breeding water tank 300 and the filtration tank 310 may be disposed. Further, according to the present embodiment, a DC pump is used as the circulation pump 340, but an AC pump may also be used, if it has a low electric power consumption.

[Description of the Reference Numeral]

[0059]

100: closed circulation type land-based aquaculture system

100U: breeding space

110: container

111: ceiling

200: solar power generation panel

210: solar water heater

230: wind power generating facility

240: storage battery

300: breeding water tank

301: agitation pump

302: temperature sensor

303: water quality sensor

304: heat exchanger

305: aeration device

310: filtration tank

320: heat insulating member

330: water introducing pipe

340: circulation pump

350: water guiding portion

400: power supply control board

410: boiler

500: control unit

501: water heater starting unit

502: water heater stopping unit

503: boiler starting unit

504: boiler stopping unit

505: circulation starting unit

506: circulation stopping unit

510: converter

520: distributor

600: power supply of power system

WL1: water level

WL2: water level

[TITLE OF THE DOCUMENT] CLAIMS

1. A closed circulation type land-based aquaculture system comprising:
 - a breeding water tank configured to retain breeding water and grow a marine product;
 - a heat insulating member configured to cover at least a part of the breeding water tank;
 - a filtration tank configured to purify a water quality of the breeding water tank;
 - a circulation pump configured to supply the breeding water from the filtration tank to the breeding water tank;
 - a distributor configured to connect an electric power by renewable energy or an electric power from a power system to a cultivation system load including the circulation pump; and
 - a control unit configured to control at least the circulation pump, wherein the breeding water tank and the filtration tank are arranged adjacent one another, and wherein the circulation pump is located below a water level of either the breeding water tank or the filtration tank, whichever is lower, and water within the filtration tank is sent into the breeding water tank.
2. The closed circulation type land-based aquaculture system according to claim 1,
 - wherein the renewable energy is a solar power generation panel,
 - wherein the closed circulation type land-based aquaculture system further includes:
 - a converter configured to convert voltage of electric power generated by the solar power generation panel; and
 - a storage battery connected via the converter to the solar power generation panel and configured to store electric power generated by the solar power generation panel, and
 - wherein the circulation pump is a DC pump.
3. The closed circulation type land-based aquaculture system according to claims 1 or 2, further comprising:
 - a temperature sensor configured to measure a temperature of the breeding water; and

a solar water heater configured to store solar heat in a heat medium and to transmit heat of the heat medium to the breeding water,

wherein the control unit is configured to

generate a first control signal for starting transmission of heat of the heat medium in the solar water heater to the breeding water in a case where information indicating that the breeding water is equal to or below a predetermined first temperature is entered from the temperature sensor, and

generate a second control signal for stopping transmission of heat of the heat medium in the solar water heater to the breeding water in a case where information indicating that the breeding water has reached a predetermined second temperature is entered from the temperature sensor.

4. The closed circulation type land-based aquaculture system according to claim 3, further comprising:

a boiler configured to heat the breeding water, and

wherein, if the control unit does not generate the second control signal after a predetermined first time has elapsed from the generation of the first control signal,

the control unit generates a third control signal for operating the boiler and heating the breeding water.

5. The closed circulation type land-based aquaculture system according to any one of claims 1 to 4, further comprising

a wind power generating facility connected to the distributor.

6. The closed circulation type land-based aquaculture system according to any one of claims 1 to 5, further comprising:

a water quality sensor for measuring a water quantity of the breeding water, and

wherein the control unit is configured to

generate a fifth control signal for realizing at least either starting of operation of the circulation pump or increasing of a discharge rate per unit time of the circulation pump when information indicating that the breeding water has reached a first water quality level is entered from the water quality sensor, and

generate a sixth control signal for realizing at least either stopping of operation of the circulation pump or reducing of a discharge rate per unit time of the circulation pump when information indicating that the breeding water

has reached a second water quality level is entered from the water quality sensor.

7. The closed circulation type land-based aquaculture system according to claim 6, further comprising:

an aeration device for performing aeration of the breeding water,

wherein the fifth control signal includes a signal for starting operation of the aeration device, and

wherein the sixth control signal includes a signal for stopping operation of the aeration device.