

Description

Title of Invention: WASTEWATER TREATMENT SYSTEM FOR FPSO

Technical Field

[0001] The present invention relates to a wastewater treatment system for FPSO.

Background Art

[0002] A Ship having a collecting header to collect a liquid containing rainwater falling on the deck and an outlet formed on the outer plate of a hull to drain the liquid collected in the collecting header to the sea is known (See, for example, Japanese Unexamined Patent Application Publication No. 7-117787).

[0003] In LNG-FPSO (Floating Production, Storage and Off-loading system), chemical substances such as amines and monoethylene glycol are often used for mining and refining natural gas. Therefore, if rainwater is drained to the outside of the ship as it is, the chemical substance may be drained out of the ship together with the rainwater when the chemical substance leaks, and it may pollute the sea. On the other hand, all of the rainwater falling on the FPSO may be stored as contaminated water in the tank, and the stored contaminated water may be periodically off-loaded to other vessels. In this case, a large tank is required to store the contaminated water, and the space on the FPSO becomes narrow. In addition, frequent off-loading the contaminated water to the other vessel is necessary due to rainfall.

[0004] The present invention was made in view of such a background, and has a primary object to provide a wastewater treatment system for FPSO capable of draining rainwater to the sea while preventing discharge of contaminated water.

Summary of Invention

[0005] To achieve such an object, one aspect of the present invention provides a wastewater treatment system (10) for FPSO (1) including a chemical plant (5), the chemical plant including a plurality of first devices (13), comprising: a liquid receiver (26) provided under at least one of the first devices to receive liquid containing rainwater and a chemical substance that may have leaked from the first device; a temporary storage tank (47) connected to the liquid receiver via a conduit to temporarily store the liquid collected in the liquid receiver; a drain conduit (52) connected to the temporary storage tank and provided with a first valve (55) for draining the liquid stored in the temporary storage tank to the sea; and a contaminated water storage tank (58) connected to the temporary storage tank via a conduit provided with a second valve (57).

[0006] According to this aspect of the present invention, the wastewater treatment system can temporarily store the liquid including rainwater and leakage of chemical substance

in the temporary storage tank. The liquid stored in the temporary storage tank can be selected to be drained to the sea or stored in the contaminated water storage tank according to the quality of the liquid. Therefore, when the chemical substance is not contained in the liquid, or when the concentration of the chemical substance is lower than the regulation value, the amount of the liquid stored in the contaminated water storage tank can be reduced by draining the liquid to the sea.

- [0007] The wastewater treatment system may further comprise an oil-water separator (35) provided between the liquid receiver and the temporary storage tank to separate oil from the liquid collected in the liquid receiver; and a waste oil storage tank (85) connected to the oil-water separator via a conduit to store the oil separated by the oil-water separator.
- [0008] According to this aspect of the present invention, the oil can be removed from the liquid by an oil-water separator. Therefore, even when the oil is mixed in the liquid, it is possible to drain the liquid to the sea after removing the oil from the liquid.
- [0009] The wastewater treatment system may further comprise a detector (61) to detect the chemical substance in the liquid stored in the temporary storage tank.
- [0010] According to this aspect of the present invention, the concentration of the chemical substance in the liquid can be detected by the detector. Therefore, it is easy to select whether to drain the liquid to the sea or to storage the liquid in the contaminated water storage tank.
- [0011] The wastewater treatment system may further comprise a control device (63) for controlling the first valve and the second valve based on the concentration of the chemical substances in the liquid detected by the detector.
- [0012] According to this aspect of the present invention, the control device automatically selects whether to drain the liquid to the sea or to storage the liquid in the contaminated water storage tank according to the concentration of the chemical substance in the liquid.
- [0013] The FPSO may include a hull (2), and a plurality of floors (11, 12) arranged vertically on the hull; wherein the plurality of floors including a collecting floor (11) and at least one upper floor (12) provided above the collecting floor; wherein the collecting floor has a gutter (21) that collects the liquid flowing on the surface of the collecting floor and is connected to the temporary storage tank via a conduit, wherein each of the upper floor (12) has some grating floors (28), wherein the liquid receiver is provided on the collecting floor and the upper floor. In another aspect, The FPSO may include a hull (2), and a collecting floor (11) provided on the hull; wherein the collecting floor has a gutter (21) that collects the liquid flowing on the surface of the collecting floor and is connected to the temporary storage tank via a conduit, wherein the liquid receiver is provided on the collecting floor.

- [0014] According to this aspect of the present invention, rainwater falling on the module is collected in the collecting floor and is delivered to the temporary storage tank. Thus, it is possible to select whether to drain the liquid to the sea or to deliver it to the contaminated water storage tank after detecting the presence of the chemical substance.
- [0015] The oil-water separator may be provided on a hull deck.
- [0016] According to this aspect of the present invention, the liquid on the module can flow to the oil-water separator by gravity.
- [0017] The temporary storage tank may be provided in an upper part of the hull, and the contaminated water storage tank may be provided below the temporary storage tank in the hull.
- [0018] According to this aspect of the present invention, the liquid can flow from the oil-water separator to the temporary storage tank by gravity. Also, the liquid may flow from the temporary storage tank to the contaminated water storage tank by gravity. Also, the liquid can flow from the temporary storage tank to the sea by gravity.
- [0019] The first device may include an acid gas removal device using amines for adsorbing acid gas. The first device may include an inhibitor of hydrate formation regenerator for processing monoethylene glycol.
- [0020] According to this aspect of the present invention, it is possible to prevent from discharging specific chemical substances to the sea.
- [0021] The wastewater treatment system for FPSO may further comprise a second liquid receiver (26) provided under at least one of second devices (14) to receive liquid containing rainwater and oil that may have leaked from the second device; a second oil-water separator (94) connected to the second liquid receiver via a conduit to separate oil from the liquid collected in the second liquid receiver, a second drain conduit (104) connected to the second oil-water separator to drain the water separated from oil by the second oil-water separator to the sea, wherein the second oil-water separator is connected to the waste oil storage tank via a conduit to deliver the oil separated by the second oil-water separator to the waste oil storage tank.
- [0022] According to this aspect of the present invention, it is possible to separate the oil leaked from the second devices from the rainwater and to store only the oil in the waste oil storage tank.

Brief Description of Drawings

- [0023] [fig.1]Figure 1 is a schematic diagram of the FPSO;
[fig.2]Figure 2 is a perspective view of the module;
[fig.3]Figure 3 is a block diagram of the wastewater treatment system; and
[fig.4]Figure 4 is a block diagram of the wastewater treatment system.

Description of Embodiments

- [0024] A preferred embodiment of the present invention is described in the following with reference to the appended drawings.
- [0025] As shown in FIG. 1, LNG-FPSO 1, also called FLNG, is a facility on the sea, purifying natural gas, liquefying natural gas, storing LNG, and off-loading LNG. FPSO 1 has a hull 2 floating on the sea. A production facility 4 is provided on the deck 3 of the hull 2 for producing LNG. The production facility 4 includes a plurality of modules 5 and 6. A plurality of LNG tanks 7 for storing LNG produced by the production facility 4 are provided in the hull 2. A residential facility 8 for workers to reside is provided at the rear end of the deck 3. Further, the FPSO 1 has a wastewater treatment system 10 to treat wastewater such as rainwater and leakage liquid generated in the plurality of modules 5, 6.
- [0026] Each module 5, 6 has a plurality of floors 11, 12 arranged vertically. Some of the plurality of modules 5, 6 are chemical modules 5 including at least one first device 13 using chemical substance. Also, some of the plurality of modules 5, 6 are oil modules 6 including at least one second device 14 using oil such as fuel or lubricant.
- [0027] The first devices 13 may include an acid gas removal and an inhibitor of hydrate formation regenerator. The acid gas removal uses an absorption liquid to remove acid gas such as carbon dioxide and hydrogen sulfide from the feed gas. The absorption liquid contains an amine such as monoethanolamine or N-methyl diethanolamine. The acid gas removal has an absorption tower for bringing the feed gas and the absorption liquid into contact with each other and a regeneration tower for regenerating an absorption liquid containing the acid gas. The inhibitor of hydrate formation regenerator regenerates inhibitor of hydrate formation injected into a pipeline connecting the FPSO 1 with a natural gas well. The inhibitor of hydrate formation contains monoethylene glycol for example. The inhibitor of hydrate formation regenerator may also have a centrifugal separator which separates solid impurities from the inhibitor of hydrate formation.
- [0028] The second devices 14 may include a boiler or an internal combustion engine such as a turbine or a reciprocating engine that uses oil as fuel. The second devices 14 also may include a compressor and a generator that uses oil for lubrication.
- [0029] As shown in FIG. 1 and FIG. 2, one of the plurality of floors 11, 12 of each the chemical module 5 is a collecting floor 11 to collect liquid such as rainwater. The collecting floor 11 may be the lowest floor in the chemical module 5. At least one upper floor 12 is provided above the collecting floor 11. All the floors disposed above the collecting floor 11 are the upper floors 12.
- [0030] The collecting floor 11 is formed of plate materials such as an iron plate so as not to allow liquid to pass through. A gutter 21 recessed downward is formed on the collecting floor 11. The gutter 21 may be disposed so as to surround the collecting

floor 11. In another embodiment, the gutter 21 may be disposed so as to traverse the collecting floor 11. The collecting floor 11 may be inclined toward the gutter 21. A drain box 22 recessed downward is formed at an appropriate position on the collecting floor 11. The upper opening of the gutter 21 and the drain box 22 are closed by some gratings 23. A conduit 24 is connected to the bottom of the gutter 21 and the drain box 22. The bottom portion of the gutter 21 is inclined toward the connection portion with the conduit 24.

[0031] Each upper floor 12 has some grating floors 28 through which liquid can pass downwards. A plurality of dish-shaped drip pans 26 (liquid receiver) opened upward is provided at appropriate positions of the collecting floor 11 and the upper floors 12. Each of the first devices 13 is arranged above the drip pans 26.

[0032] Each drip pan 26 on the collecting floor 11 and the upper floors 12 are connected with a conduit 24 via a conduit 31. The conduit 31 is connected so that liquid flows from each drip pan 26 to the conduit 24 by gravity.

[0033] The oil module 6 has the same structure as the chemical module 5. The oil module 6 has one collecting floor 11 and at least one upper floor 12. The collecting floor 11 of the oil module 6 has a gutter 21, a drip pan 26, a drain box 22, and each upper floor 12 has a grating floor 28 and a drip pan 26. A conduit 32 is connected with the gutter 21 and the drain box 22 of the oil module 6. Each drip pan 26 of the oil module 6 is connected with the middle part of the conduit 32 via a conduit 33.

[0034] Fig. 3 and Fig. 4 show a block diagram of the wastewater treatment system 10. In Fig. 3 and Fig. 4, the letters A and B are connected with each other by corresponding letters. One end of the conduit 24 extending from the chemical module 5 is connected with a first collecting pit 35 (oil-water separator). The first collecting pit 35 has a first chamber 37 and a second chamber 38 partitioned by a partition wall 36 extending vertically. A connection passage 39 connecting the first chamber 37 and the second chamber 38 is formed in the lower part of the partition wall 36. The conduit 24 is connected with the first chamber 37. A first outlet 41 is provided at an upper portion of the second chamber 38, and a second outlet 42 is provided at a lower portion of the second chamber 38. A third outlet 43 is provided at an upper portion of the first chamber 37, and a fourth outlet 44 is provided at a lower portion of the first chamber 37. When the liquid stored in the first collecting pit 35 exceeds a certain amount, the liquid overflows from the first outlet 41 and the third outlet 43. Since oil is lighter than water, the oil contained in the liquid supplied from the conduit 24 to the first collecting pit 35 gathers in the vicinity of the liquid surface of the first chamber 37. Therefore, liquid (water) containing almost no oil flows from the first outlet 41 to the outside, and liquid containing much oil flows from the third outlet 43 to the outside. The first collecting pit 35 functions as an oil-water separator.

- [0035] The first outlet 41 is connected with a temporary storage tank 47 via a conduit 46. The second outlet 42 is connected with the conduit 46 via a conduit 49 provided with a manual valve 48.
- [0036] The temporary storage tank 47 is a tank for temporarily storing the liquid. An outlet of the temporary storage tank 47 is connected with a suction port of a pump 51. A first drain conduit 52 and a conduit 53 branched from each other are connected with a discharge port of the pump 51. The first drain conduit 52 is provided with a first control valve 55. The downstream end of the first drain conduit 52 is provided with a first drain outlet 56 to drain the liquid to the sea. The conduit 53 is provided with a second control valve 57 and is connected with a contaminated water storage tank 58. The contaminated water storage tank 58 is a tank to store the liquid containing chemical substance. Chemical substance may include amines and monoethylene glycol.
- [0037] A chemical substance detecting device 61 detecting chemical substances in the liquid is provided in the temporary storage tank 47 or the conduit 46. The chemical substance detecting device 61 may include a pH meter and an electric conductivity meter. A liquid level gauge 62 detecting the liquid level in the temporary storage tank 47 is provided in the temporary storage tank 47. The chemical substance detecting device 61 and the liquid level gauge 62 are connected with a control device 63. The control device 63 is connected with the pump 51, the first control valve 55 and the second control valve 57. The control device 63 makes a determination based on signals from the chemical substance detecting device 61 and the liquid level gauge 62, and controls the pump 51, the first control valve 55, and the second control valve 57 according to the determination result.
- [0038] The contaminated water storage tank 58 is connected with the chemical drain drum 66 via a conduit 65. The chemical drain drum 66 is connected with the plurality of the first devices 13, and chemical inventory is drained from the first devices 13. The conduit 65 is provided with a valve 67. In case that the drained liquid in chemical drain drum 66 is degraded, when the valve 67 is opened, the chemical inventory stored in the chemical drain drum 66 is delivered to the contaminated water storage tank 58 via the conduit 65.
- [0039] A first off-loading pipe 68 is connected with the contaminated water storage tank 58. The first off-loading pipe 68 is provided with a pump 69. The first off-loading pipe 68 can be connected to a receiving port of the waste liquid carrier, and can off-load the contaminated water to the waste liquid carrier. The waste liquid carrier is a vessel which collects the contaminated water and carries it to the shore.
- [0040] As shown in FIG. 3 and FIG. 4, the third outlet 43 of the first collecting pit 35 is connected with an oil-water holding tank 72 via a conduit 71. The oil-water holding

tank 72 is a tank which temporarily stores a liquid mixed with oil and water.

[0041] An outlet of the oil-water holding tank 72 is connected with the oil-water separator 78 via a conduit 77 provided with a pump 76. The pump 76 feeds the liquid from the oil-water holding tank 72 to the oil-water separator 78 via a conduit 77. The oil-water separator 78 may be a hydrocyclone and separate oil and water respectively. The oil-water separator 78 has a water outlet for discharging the separated water and an oil outlet for discharging the oil. A second drain conduit 81 is connected with the water outlet of the oil-water separator 78. The second drain conduit 81 has a second drain outlet 82 at its downstream end to drain water to the sea.

[0042] The oil outlet of the oil-water separator 78 is connected with a waste oil storage tank 85 via a conduit 84. The waste oil storage tank 85 is a tank which stores a liquid containing oil. A second off-loading pipe 86 provided with a pump 87 is connected with the waste oil storage tank 85. The second off-loading pipe 86 can be connected with the receiving port of the waste liquid carrier, and the liquid containing oil in the waste oil storage tank 85 can be off-loaded to the waste liquid carrier.

[0043] The fourth outlet 44 of the first collecting pit 35 is connected with the waste oil storage tank 85 via a conduit 89 provided with a manual valve 88. The fourth outlet 44 is connected with the conduit 71 via a conduit 92 provided with a manual valve 91.

[0044] A conduit 32 extending from the oil module 6 is connected to a second collecting pit 94 (second oil-water separator). The second collecting pit 94 has a configuration similar to that of the first collecting pit 35, and includes a partition wall 95 extending vertically, a third chamber 96 and a fourth chamber 97 partitioned by the partition wall 95, and a connecting passage 98 formed in a lower portion of the partition wall 95 and connecting the chamber 96 and the fourth chamber 97. The conduit 32 is connected to the third chamber 96. A fifth outlet 101 is provided in the upper portion of the fourth chamber 97, a sixth outlet 102 is provided in the upper portion of the third chamber 96, and a seventh outlet 103 is provided in the lower portion of the third chamber 96.

When the amount of liquid stored in the second collecting pit 94 exceeds a certain amount, the liquid overflows from the fifth outlet 101 and the sixth outlet 102. Since oil is lighter than water, the oil contained in the liquid supplied from the conduit 32 to the second collecting pit 94 gathers in the vicinity of the liquid surface of the third chamber 96. Therefore, liquid (water) containing almost no oil flows from the fifth outlet 101 to the outside, and liquid containing much oil flows from the sixth outlet 102 to the outside. The second collecting pit 94 functions as an oil-water separator.

[0045] As shown in FIG. 4, a third drain conduit 104 (second drain conduit) is connected with the fifth outlet 101 of the second collecting pit 94. The third drain conduit 104 has a third outlet 105 at its downstream end to drain the liquid to the sea. The sixth outlet 102 of the second collecting pit 94 is connected with the oil-water holding tank 72 via

a conduit 107. The seventh outlet 103 of the second collecting pit 94 is connected with the waste oil storage tank 85 via a conduit 109 provided with a manual valve 108. The seventh outlet 103 is connected with the conduit 107 via a conduit 112 provided with a manual valve 111.

- [0046] As shown in FIG. 1, the first collecting pit 35 and the second collecting pit 94 are disposed on the deck 3. The first collecting pit 35 is disposed below the collecting floor 11 of the chemical module 5 so that the liquid in the conduit 24 can flow to the first collecting pit 35 by gravity. The second collecting pit 94 is disposed below the collecting floor 11 of the oil module 6 so that the liquid in the conduit 32 can flow to the second collecting pit 94 by gravity.
- [0047] The temporary storage tank 47, the oil-water holding tank 72, and the waste oil storage tank 85 are disposed in the hull 2, that is, below the deck 3. As a result, the liquid in the first collecting pit 35 can flow to the temporary storage tank 47, the oil-water holding tank 72, and the waste oil storage tank 85 by gravity. The liquid in the second collecting pit 94 can flow to the oil-water holding tank 72 and the waste oil storage tank 85 by gravity.
- [0048] The contaminated water storage tank 58 is disposed below the temporary storage tank 47 in the hull 2. As a result, the liquid in the temporary storage tank 47 may flow to the contaminated water storage tank 58 by gravity. The chemical drain drum 66 is disposed on the deck 3. As a result, the liquid in the chemical drain drum 66 can flow to the contaminated water storage tank 58 by gravity.
- [0049] It is preferable that the first drain outlet 56 is disposed lower than the temporary storage tank 47. As a result, the liquid in the temporary storage tank 47 can flow to the first drain outlet 56 by gravity. Also, it is preferable that the second drain outlet 82 is disposed lower than the oil-water separator 78. The oil-water separator 78 is disposed on the floor 11, 12 in the oil module 6. In addition, it is preferable that the third drain outlet 105 is disposed lower than the fifth outlet 101 of the second collecting pit 94.
- [0050] The capacity of the temporary storage tank 47 is preferably set to be equal to or greater than the sum of the maximum leakage amount of the chemical substance from the chemical modules 5 and the maximum rainfall per day falling to all the chemical modules 5.
- [0051] Next, the operation of the wastewater treatment system 10 configured as described above will be described. The rainwater falling to each chemical module 5 falls through the grating floors 28 of each upper layer floor 12 and reaches the collecting floor 11. The rainwater is collected in the gutter 21 and the drain box 22 in the collecting floor 11 and flows to the first collecting pit 35 via the conduit 24. When the chemical substance leaks out from some of the first devices 13, the chemical substance is collected in the drip pans 26 provided under the first devices 13, and is delivered to the

first collecting pit 35 via the conduit 31 and the conduit 24. When the chemical substance leaks from each of the first devices 13, the drip pans 26 can minimize the area in which the chemical substance spreads out in each of the floors 11, 12. In case chemical substance flows out over the drip pan 26 to the respective floors 11, 12, the chemical substance is gathered in the gutter 21 and the drain box 22 of the collecting floor in the same manner as rainwater. As described above, the rainwater and the chemical liquid generated in each chemical module 5 are collected in the first collecting pit 35.

[0052] The liquid collected in the first collecting pit 35 is separated into oil and water, and water is delivered from the first outlet 41 to the temporary storage tank 47 via the conduit 46. When a large amount of the oily water is collected in the first collecting pit 35, the oily water overflows from the third outlet 43 and is delivered to the oil-water holding tank 72 via the conduit 71.

[0053] By opening the manual valve 88, the oil collected in the first chamber 37 of the first collecting pit 35 is delivered from the fourth outlet 44 to the waste oil storage tank 85 via the conduit 89. By opening the manual valve 91, the oil stored in the first chamber 37 of the first collecting pit 35 is delivered from the fourth outlet 44 to the oil-water holding tank 72 via the conduit 92 and the conduit 71. By opening the manual valve 48, the liquid in the first collecting pit 35 is delivered from the second outlet 42 to the temporary storage tank 47 via the conduit 49 and the conduit 46.

[0054] The control device 63 determines whether to release the liquid stored in the temporary storage tank 47 to the sea or to store it in the contaminated water storage tank 58. When the liquid level of the temporary storage tank 47 is equal to or higher than the predetermined judgment value and the concentration of the chemical substance in the liquid is lower than the predetermined judgment value, the control device 63 drives the pump 51, and make the first control valve 55 open and make the second control valve 57 close. When the liquid level of the temporary storage tank 47 is equal to or higher than the predetermined judgment value and the concentration of the chemical substance in the liquid is equal to or higher than the predetermined judgment value, the control device 63 drives the pump 51, make the first control valve 55 close and make the second control valve 57 open. Accordingly, when the concentration of the chemical substance in the liquid is lower than the regulation value, the liquid is drained to the sea, and when the concentration of the chemical substance in the liquid is higher than the regulation value, the liquid is stored in the contaminated water storage tank 58.

[0055] Like the rainwater falling and the chemical substance leaking on the chemical modules 5, the rainwater falling and oil leaking from the outside of drip pans 26 on each oil module 6 falls through the grating floor 28 of each upper floor 12, is collected

in the gutter 21 and the drain box 22 of the collecting floor 11, and flows to the second collecting pit 94 via the conduit 32. When the oil leaks out from some of the second devices 14, the oil is collected in the drip pans 26 provided under the second devices 14 and is delivered to the second collecting pit 94 via the conduit 33 and the conduit 32. When the oil leaks out from each of the second devices 14, the drip pans 26 can minimize the area in which the oil spreads out in each of the floors 11, 12. As described above, rainwater and oil generated in each oil module 6 are collected in the second collecting pit 94.

- [0056] The liquid collected in the second collecting pit 94 is separated into oil and water, and water is discharged from the fifth outlet 101 to the sea via the third drain conduit 104. The oil is delivered from the sixth outlet 102 to the oil-water holding tank 72 via the conduit 107. By opening the manual valve 108, the oil collected in the third chamber 96 of the second collecting pit 94 is delivered from the seventh outlet 103 to the waste oil storage tank 85 via the conduit 109. By opening the manual valve 111, the oil collected in the third chamber 96 of the second collecting pit 94 is delivered from the seventh outlet 103 to the oil-water holding tank 72 via the conduit 112 and the conduit 107.
- [0057] The liquid stored in the oil-water holding tank 72 is delivered to the oil-water separator 78 via a conduit 77 and separated into oil and water. The water is drained from the water outlet of the oil-water separator 78 to the sea via the second drain conduit 81. The oil is delivered from the oil outlet of the oil-water separator 78 to the waste oil storage tank 85 via the conduit 84.
- [0058] The contaminated water stored in the contaminated water storage tank 58 and the oil stored in the waste oil storage tank 85 are off-loaded to the waste liquid carrier.
- [0059] Since the wastewater treatment system 10 releases the liquid whose concentration of the chemical substance is lower than the regulation value to the sea, the amount of liquid stored in the contaminated water storage tank 58 can be reduced. As a result, the capacity of the contaminated water storage tank 58 can be reduced.
- [0060] Although the present invention has been described in terms of preferred embodiments thereof, it is obvious to a person skilled in the art that various alterations and modifications are possible without departing from the scope of the present invention. For example, the first control valve 55 and the second control valve 57 may be changed to manual valves. In this case, the worker operates the manual valves based on the detection results of the chemical substance detecting device 61 and liquid level meter 62 to drain the liquid stored in the temporary storage tank 47 to the sea, or to deliver the contaminated water storage tank 58. In other embodiments, the modules 5, 6 may not have the upper floors 12 and may have only a single collecting floor 11.

List of the Numerals

- [0061]
- 1 : FPSO
 - 2 : hull
 - 3 : deck
 - 5 : chemical module
 - 6 : oil module
 - 10 : wastewater treatment system
 - 11 : collecting floor
 - 12 : upper floor
 - 13 : first device
 - 14 : second device
 - 21 : gutter
 - 22 : drain box
 - 26 : drip pan
 - 28 : grating floor
 - 35 : first collecting pit
 - 47 : temporary storage tank
 - 52 : first drain conduit
 - 55 : first control valve
 - 57 : second control valve
 - 58 : contaminated water storage tank
 - 61 : chemical substance detecting device
 - 62 : liquid level gauge
 - 63 : control device
 - 72 : oil-water holding tank
 - 78 : oil-water separator
 - 81 : second drain conduit
 - 85 : waste oil storage tank
 - 94 : second collecting pit

Claims

[Claim 1] A wastewater treatment system for FPSO including a chemical plant, the chemical plant including a plurality of first devices, comprising:

5 a liquid receiver provided under at least one of the first devices to receive liquid containing rainwater and a chemical substance that may have leaked from the first device;

a temporary storage tank connected to the liquid receiver via a conduit to temporarily store the liquid collected in the liquid receiver;

10 a drain conduit connected to the temporary storage tank and provided with a first valve for draining the liquid stored in the temporary storage tank to the sea; and

a contaminated water storage tank connected to the temporary storage tank via a conduit provided with a second valve,

15 wherein the FPSO includes a hull, and a plurality of floors arranged vertically on the hull,

wherein the plurality of floors including a collecting floor and at least one upper floor provided above the collecting floor,

20 wherein the collecting floor has a gutter that collects the liquid flowing on the surface of the collecting floor and is connected to the temporary storage tank via a conduit,

wherein each of the upper floor has some grating floors, and

wherein the liquid receiver is provided on the collecting floor or the

25 upper floor.

- [Claim 2] The wastewater treatment system for FPSO according to claim 1,
further comprising an oil-water separator provided between the
liquid receiver and the temporary storage tank to separate oil from
the liquid collected in the liquid receiver; and
5 a waste oil storage tank connected to the oil-water separator via a
conduit to store the oil separated by the oil-water separator.
- [Claim 3] The wastewater treatment system for FPSO according to claim 1,
further comprising a detector to detect the chemical substance in
the liquid stored in the temporary storage tank.
- 10 [Claim 4] The wastewater treatment system for FPSO according to claim 3,
further comprising a control device for controlling the first valve
and the second valve based on the concentration of the chemical
substances in the liquid detected by the detector.
- [Claim 5] The wastewater treatment system for FPSO according to claim 1,
15 wherein the oil-water separator is provided on a hull deck.
- [Claim 6] The wastewater treatment system for FPSO according to claim 1,
wherein the temporary storage tank is provided in an upper part of
the hull;
wherein the contaminated water storage tank is provided below the
20 temporary storage tank in the hull.
- [Claim 7] The wastewater treatment system for FPSO according to claim 1,
wherein the first device includes an acid gas removal device using
amines for adsorbing acid gas.
- [Claim 8] The wastewater treatment system for FPSO according to claim 1,
25 wherein the first device includes an inhibitor of hydrate formation

regenerator for processing monoethylene glycol.

[Claim 9] The wastewater treatment system for FPSO according to claim 2,
further comprising:
a second liquid receiver provided under at least one of second
5 devices to receive liquid containing rainwater and oil that may have
leaked from the second device;
a second oil-water separator connected to the second liquid receiver
via a conduit to separate oil from the liquid collected in the second
liquid receiver,
10 a second drain conduit connected to the second oil-water separator
to drain the water separated from oil by the second oil-water
separator to the sea,
wherein the second oil-water separator is connected to the waste oil
storage tank via a conduit to deliver the oil separated by the second
15 oil-water separator to the waste oil storage tank.