These portable tanks have only atmospheric pressure rating, and needs to be manned during filling operations. The filling occurs through an open manhole at the top of the tank. Consequently, personnel are exposed to fumes from hydrocarbon contaminated waste during filling. Further, the portable tanks are open vented under filling, and explosive fumes are a potential hazard onboard. The mix of both vertical and horizontal portable tanks shipped offshore, in combination with the deck layout (I-beams), makes it difficult to spot tanks next to each other for efficient space exploitation onboard a rig, where normally there is very little space available.

In addition to the above-described issues related to present storage tanks and/or portable slop tanks, some rigs also have limitations regarding the filling of portable slop tanks in that transfer and filling is only allowed after a well is shut in.

Further issues related to the present storage and/or portable slop tanks is that it is time consuming to transfer and fill the portable slop tanks during for instance a production testing, and further that none of the tanks have any integrated protection against fire. In present solutions, water must be rigged up/directed if not present onboard.

The purpose of the present invention is to avoid or alleviate at least some of the disadvantages of the prior art tanks and/or tank systems.

Summary of the invention

The present invention provides a modular tank system, as well as a tank and a mounting frame for use in such a system. The invention is defined in the appended claims and in the following:

In a first aspect, the present invention provides a modular tank system comprising at least two pressure tanks and a mounting frame, wherein

- each of the pressure tanks comprises a pressure vessel, a tank process line and a protection frame within which the pressure vessel and the tank process line is arranged, the protection frame is adapted, or arranged, such that multiple pressure tanks may be mounted on top of each other and the pressure vessel comprises a vent outlet and a first inlet, wherein
    - the vent outlet is arranged in an upper half of the pressure vessel, the first inlet is arranged in a lower half of the pressure vessel and is fluidly connected to the tank process line, the tank process line comprises a first fluid connector and a second fluid connector on opposite ends of the tank process line, and the tank process line is arranged such that the first fluid connector of the tank process line is arranged at a bottom section of the pressure tank and the second fluid connector of the tank process line is arranged at a top section

of the pressure tank, such that the second fluid connector of a first pressure tank (i.e. one of the at least two pressure tanks) will connect (or connects) to the first fluid connector of a second pressure tank (i.e. another one of the at least two pressure tanks), when the second pressure tank is mounted on top of the first pressure tank; and

- the mounting frame comprises a base frame upon which the at least two pressure tanks may be mounted, the base frame comprises a frame process line; and
    - the frame process line comprises at least two fluid connectors, each fluid connector connectable to the first fluid connector of a tank process line (i.e. connectable to the first fluid connector of one of the at least two pressure tanks) and arranged such that the frame process line may be, or becomes, fluidly connected to the tank process lines of the at least two pressure tanks when the pressure tanks are mounted upon the base frame side by side.

The first inlet of the pressure vessel is preferably arranged in a lower half of the pressure vessel, even more preferred arranged in a bottom part of the pressure vessel, such that the pressure vessel may be emptied through the inlet if required.

In an embodiment of the first aspect, the invention provides a modular tank system, wherein:

- the pressure vessel comprises a first outlet arranged in a lower half of the pressure vessel and fluidly connected to a tank suction line, the tank suction line comprising a first fluid connector; and
- the base frame comprises a frame suction line comprising at least two fluid connectors, each fluid connector connectable to the first fluid connector of the tank suction line (i.e. connectable to at least one of the first fluid connectors of the tank suction lines of the at least two pressure tanks) and arranged such that the frame suction line may be fluidly connected to the tank suction lines of the at least two pressure tanks when the pressure tanks are mounted upon the base frame side by side or on top of each other.

In yet an embodiment of the first aspect, the invention provides a modular tank system, wherein:

- the vent outlet of the pressure vessel is a second outlet arranged in an upper half of the pressure vessel (such that gas may escape the pressure vessel when required) and fluidly connected to at least one of a tank vent line and a tank relief line, the tank vent line and/or the tank relief line comprises a first fluid connector; and
- the base frame comprises at least one of a frame vent line and a frame relief line, the frame vent line and/or the frame relief line comprises at least two fluid connectors, each fluid connector connectable to at least one of the first fluid connector of the tank vent line and the tank relief line (i.e. connectable to at least one of the first fluid connectors of the tank vent lines or tank relief lines of one of the at least two pressure tanks), and arranged such that at least one of the frame vent line and the frame relief line may be fluidly connected to the tank vent line and tank relief line of the at least two pressure tanks (or of one of the at least two pressure tanks), respectively, when the pressure tanks are mounted upon the base frame side by side or on top of each other.

In yet an embodiment of the first aspect, the invention provides a modular tank system, wherein the at least two fluid connectors of the frame process line, and the first fluid connector of the tank process line of the at least two pressure tanks, are arranged such that the frame process line is fluidly connected to the tank process line of one of the at least two pressure tanks when the pressure tank is mounted upon the base frame.

In yet an embodiment of the first aspect, the invention provides a modular tank system, wherein the frame process line, and optionally the frame suction line, the frame vent line and the frame relief line, comprises a process line port, a suction line port, a vent line port and a relief line port, respectively. Each of the respective line ports providing a common fluid connection to the at least two fluid connectors of the frame process line, the frame suction line, the frame vent line and the frame relief line, respectively.

In a second aspect, the present invention provides a pressure tank for use in a modular tank system according to the first aspect, the pressure tank comprises a pressure vessel and a protection frame within which the pressure vessel and a tank process line is arranged, the pressure vessel comprises a vent outlet and a first inlet, wherein

- the vent outlet is arranged in an upper half of the pressure vessel, preferably the top of the pressure vessel, and the first inlet is arranged in a lower half of the pressure vessel and fluidly connected to the tank process line, the tank process line comprising a first fluid connector and a second fluid connector arranged on opposite ends of the tank process line, and the tank process line is arranged such that the first fluid connector of the tank process line is arranged at a bottom section of the pressure tank and the second fluid connector of the tank process line is arranged at a top section of the pressure tank.

In an embodiment of the second aspect, the invention provides a pressure tank wherein the pressure vessel comprises

- a first outlet arranged in a lower half of the pressure vessel, preferably in the bottom of the pressure vessel, and fluidly connected to a tank suction line, the tank suction line comprising a first fluid connector. The first outlet is preferably arranged at a level below the level of the first inlet.

In yet an embodiment of the second aspect, the invention provides a pressure tank wherein the vent outlet of the pressure vessel is a second outlet arranged in an upper half of the pressure vessel and fluidly connected to at least one of a tank vent line and a tank relief line, the tank vent line and the tank relief line comprises a first fluid connector.

In yet an embodiment of the second aspect, the invention provides a pressure tank wherein the pressure vessel has a substantially circular circumference in a horizontal plane during use, and the inlet is arranged such that a process stream will enter the pressure vessel in a direction being substantially tangential to the circular circumference at the inlet.

In yet an embodiment of the second aspect, the invention provides a pressure tank comprising at least one of a tank suction line, a tank vent line or a tank relief line. Preferably, each of the tank process line, the tank suction line, the tank vent line and the tank relief line is arranged between the pressure vessel and the protection frame, such that the lines are not easily damaged. Further, each of the tank process line, the tank suction line, the tank vent line and the tank relief line comprises a pipe or conduit arranged in a substantially vertical direction when the pressure tank is in use. The pipe (or the tank process line, the tank suction line, the tank vent line

or the tank relief line) comprises a first fluid connector and a second fluid connector, arranged at opposite ends of the pipe, wherein the first fluid connector is arranged at the bottom of the pressure tank and the second fluid connector is arranged at the top of the pressure tank.

In a third aspect, the present invention provides a mounting frame for use in a modular tank system according to the first aspect, comprising a base frame upon which at least two pressure tanks may be mounted, the base frame comprises a frame process line having at least two fluid connectors and at least one process line port, wherein each fluid connector is connectable to a first fluid connector of a tank process line of one of the at least two pressure tanks, and arranged such that the frame process line is fluidly connected to the tank process line when said pressure tank is mounted upon the base frame.

In an embodiment of the third aspect, the invention provides a mounting frame wherein the base frame comprises a frame suction line comprising at least two fluid connectors and a suction line port, each fluid connector connectable to a first fluid connector of a tank suction line of one of the at least two pressure tanks and arranged such that the frame suction line is fluidly connected to the tank suction line when the pressure tank is mounted upon the base frame.

In yet an embodiment of the third aspect, the invention provides a mounting frame wherein the base frame comprises at least one of a frame vent line and a frame relief line, the frame vent line and frame relief line comprising at least two fluid connectors and a relief line port and a vent line port, respectively, each fluid connector connectable to at least one of a first fluid connector of a tank vent line and a tank relief line of one of the at least two pressure tanks, and arranged such that at least one of the frame vent line and the frame relief line is fluidly connected to the cooperating tank vent line and tank relief line when the pressure tank is mounted upon the base frame.

In yet an embodiment of the third aspect, the invention provides a mounting frame wherein the base frame comprises a first and second pair of parallel sidewalls, and a bottom plate.

Claims

1. A modular tank system comprising at least two pressure tanks (1,1') and a mounting frame (2), wherein

   - each of the pressure tanks (1,1') comprises a pressure vessel (3), a tank process line (6) and a protection frame (4) within which the pressure vessel and the tank process line (6) is arranged, the protection frame (4) is adapted such that multiple pressure tanks (1,1') may be mounted on top of each other and the pressure vessel comprises a vent outlet and a first inlet (5), wherein

     - the vent outlet is arranged in an upper half of the pressure vessel, the first inlet (5) is arranged in a lower half of the pressure vessel and is fluidly connected to the tank process line (6), the tank process line comprises a first fluid connector (12) and a second fluid connector (23) on opposite ends of the tank process line, and the tank process line (6) is arranged such that the first fluid connector (12) of the tank process line (6) is arranged at a bottom section of the pressure tank and the second fluid connector (23) of the tank process line (6) is arranged at a top section of the pressure tank, such that the second fluid connector (23) of a first pressure tank (1) will connect to the first fluid connector (12) of a second pressure tank (1'), when the second pressure tank (1') is mounted on top of the first pressure tank (1);

   - the mounting frame (2) comprises a base frame (15) upon which the at least two pressure tanks (1) may be mounted, the base frame comprises a frame process line (16);

     - the frame process line (16) comprises at least two fluid connectors (20), each fluid connector (20) connectable to the first fluid connector (12) of a tank process line (6) and arranged such that the frame process line (16) may be fluidly connected to the tank process lines (6) of the at least two pressure tanks when the pressure tanks (1) are mounted upon the base frame (15) side by side.

2. A modular tank system according to claim 1, wherein:

   - the pressure vessel comprises a first outlet (7) arranged in a lower half of the pressure vessel and fluidly connected to a tank suction line (8), the tank suction line comprising a first fluid connector (13); and

- the base frame comprises a frame suction line (17) comprising at least two fluid connectors (21), each fluid connector (21) connectable to the first fluid connector (13) of a tank suction line (8) and arranged such that the frame suction line (17) may be fluidly connected to the tank suction lines (8) of the at least two

pressure tanks when the pressure tanks (1) are mounted upon the base frame (15) side by side.

3. A modular tank system according to claim 1 or 2, wherein:

   - the vent outlet of the pressure vessel is a second outlet (9) arranged in an upper half of the pressure vessel and fluidly connected to at least one of a tank vent line (10) and a tank relief line (11), the tank vent line and the tank relief line comprises a first fluid connector (14, 14'); and
   - the base frame comprises at least one of a frame vent line (18) and a frame relief line (19), the frame vent line (18) and the frame relief line (19) comprises at least two fluid connectors (22,22'), each fluid connector (22,22') connectable to at least one of the first fluid connector (14,14') of a tank vent line (10) and a tank relief line (11), and arranged such that at least one of the frame vent line (18) and the frame relief line (19) may be fluidly connected to the tank vent lines (10) and tank relief lines (11) of the at least two pressure tanks, respectively, when the pressure tanks (1) are mounted upon the base frame (15) side by side.

4. A modular tank system according to any of the preceding claims, wherein the at least two fluid connectors (20) of the frame process line (16), and the first fluid connector (12) of the tank process line (6), are arranged such that the frame process line (16) is fluidly connected to the tank process line (16) when one of the at least two pressure tanks (1) is mounted upon the base frame (15).

5. A modular tank system according to claim 2 or 3, wherein the frame process line (16), and optionally the frame suction line (17), the frame vent line (18) and the frame relief line (19), comprises a process line port (24), a suction line port (25), a vent line port (26) and a relief line port (27), respectively.

6. A pressure tank for use in a modular tank system according to any of claims 1-5, the pressure tank (1) comprises a pressure vessel (3) and a protection frame (4) within which the pressure vessel and a tank process line (6) is arranged, the pressure vessel comprises a vent outlet and a first inlet (5), wherein

- the vent outlet is arranged in an upper half of the pressure vessel, the first inlet (5) is arranged in a lower half of the pressure vessel and fluidly connected to the tank process line (6), the tank process line comprises a first fluid connector (12) and a second fluid connector (23) on opposite ends of the tank process line (6), and the tank process line (6) is arranged such that the first fluid connector (12) of the tank process line (6) is arranged at a bottom section of the pressure tank and the second fluid connector (23) of the tank process line (6) is arranged at a top section of the pressure tank.

7. A pressure tank according to claim 6, wherein the pressure vessel comprises
   - a first outlet (7) arranged in a lower half of the pressure vessel and fluidly connected to a tank suction line (8), the tank suction line comprising a first fluid connector (13).

8. A pressure tank according to claim 6 or 7, wherein the vent outlet of the pressure vessel is a second outlet (9) arranged in an upper half of the pressure vessel and fluidly connected to at least one of a tank vent line (10) and a tank relief line (11), the tank vent line and the tank relief line comprises a first fluid connector (14, 14').

9. A pressure tank according to any of claims 6-8, wherein the first fluid connector (12) and the second fluid connector (23) of the tank process line (6) are arranged such that said second fluid connector (23) is connectable to a first fluid connector of the tank process line (6) of another pressure tank according to claim 8, when said another pressure tank is mounted on top of the pressure tank.

10. A pressure tank according to any of claims 6-9, wherein the pressure vessel have a substantially circular circumference in a horizontal plane during use, and the first inlet (5) is arranged such that a process stream will enter the pressure vessel in a direction being substantially tangential to the circular circumference at the first inlet.

11. A mounting frame (2) for use in a modular tank system according to any of claims 1-5, comprising a base frame (15) upon which at least two pressure tanks (1,1') may be mounted, the base frame comprises a frame process line (16) having at least two fluid connectors (20) and at least one process line port (24), wherein each fluid connector (20) is connectable to a first fluid connector (12) of a tank process line (6) of one of the pressure tanks, and arranged such that the frame process line (16) is fluidly connected to the tank process line (16) when said pressure tank (1) is mounted upon the base frame (15).

12. A mounting frame according to claim 11, wherein the base frame (15) comprises a frame suction line (17) comprising at least two fluid connectors (21) and a suction line port (25), each fluid connector (21) connectable to a first fluid connector (13) of a tank suction line (8) of one of the pressure tanks (1) and arranged such that the frame suction line (17) is fluidly connected to the tank suction line (8) when the pressure tank (1) is mounted upon the base frame (15).

13. A mounting frame according to claim 11 or 12, wherein the base frame (15) comprises at least one of a frame vent line (18) and a frame relief line (19), the frame vent line (18) and frame relief line (19) comprising at least two first fluid connectors (22,22') and a relief line port (26) and a vent line port (27), respectively, each first fluid connector (22,22') connectable to at least one of a first fluid connector of a tank vent line (10) and a tank relief line (11) of one of the pressure tanks (1), and arranged such that the frame vent line (18) and the frame relief line (19) is fluidly connected to the cooperating tank vent line (10) and tank relief line (11) when the pressure tank (1) is mounted upon the base frame (15).

14. A mounting frame according to any of claims 11-13, wherein the base frame (15) comprises a first and second pair of parallel sidewalls (54,55), and a bottom plate (59), and, wherein the sidewalls and bottom plate provides a drip tray into which spillage from a mounted pressure tank may be collected during use.

15. A mounting frame according to any of claims 11-14, comprising two base frames pivotally connected, such that the base frames may be folded together.