

A Vessel For Storing Fluids And A Method For Containment Of Fluids Onboard A Vessel

5 FIELD OF INVENTION

The present invention relates broadly to a vessel for storing fluids and to a method for containing fluids onboard a vessel. The vessel can also be configured for mixing fluids and treating fluids and treating drilling waste.

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BACKGROUND

For drilling rigs such as oil rigs, different chemically formulated materials are typically used on the rigs for different drilling operations. In addition, drill cuttings contaminated with drilling fluids are typically generated during drilling operations.

With regard to preparation of the chemically formulated materials, although the materials can be prepared on the rigs themselves, it is typically not practical to keep the fluids on the rigs during certain operational periods. Further, since solids typically settle and form from the fluids during non active periods and tank cleaning would have to be carried out on the rigs, rig time delays and environmental discharge issues typically arise.

25 Furthermore, it is practically difficult to ensure that environmental policies, such as zero-spillage and zero discharge of drill cuttings rules, are adhered to if the materials are prepared and treated on the rigs, if tank cleaning is performed on the rigs and if drill cuttings are treated on the rigs. Further, it is not economical nor viable, e.g. due to limited space on the rigs, to reserve space on the rigs to store e.g. different chemicals for mixing to obtain the different materials and to treat drill cuttings on the rigs to meet required environment regulations and standards.

30 In addition, even if different chemicals are stored on the rigs, and even if drilling waste is treated on the rigs, it is practically difficult and not economical to

construct spillage prevention systems for the rigs to adhere to environmental policies.

Thus, the drilling fluids materials are typically prepared on land by mixing
5 different chemicals according to different recipes. After obtaining the different materials on land, the materials are typically transported to the rigs using boats or ships. Due to typical substantial transporting distances, the materials can be easily contaminated typically with water leaking into the fluids from pumping operations. Also, drilling waste cuttings generated on the rigs through drilling operations are
10 typically partially treated on the rigs, e.g. by solids control equipment, and then either discharged overboard into the environment or discharged into small transport tanks known as "bins". These "bins" are then lifted by rig cranes onto supply boats and transported to land for further treatment operations.

15 Further, due to the distances that are traveled by the boats or ships, a substantial lead time is typically required for ordering of the "bins" and mixing of the different chemicals. In addition, for transporting the "bins" to land for treatment operations, several issues typically arise e.g. safety issues for handling the "bins" in adverse offshore weather and the risk of the contents of the "bins" spilling on the
20 supply boats and contaminating the environment.

It is with a view of addressing one or more of the above problems that the present invention has been made.

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SUMMARY

In accordance with an aspect of the present invention, there is provided a vessel for storing fluids, the vessel comprising one or more storage tanks for storing
30 fluids; an enclosure formed around the storage tanks; one or more spillage tanks in fluid communication with the enclosure; and wherein when the fluids are released into the enclosure, the fluids are drained into the spillage tanks under gravitational force.

The enclosure may comprise containment wall sections, wherein one or more of the containment wall sections function as a side railing of the vessel.

One of the containment wall sections may separate a living quarters of the vessel from the enclosure for containing the fluid within the enclosure and away from the living quarters.

One of the containment wall sections may function as a bow spread wall.

The vessel may further comprise one or more drainage inlets disposed in the enclosure for providing the fluid communication between the spillage tanks and the enclosure.

The vessel may further comprise a first pipe system for providing active fluid communication between the spillage tanks and the storage tanks; and a pump for returning the drained fluids from the spillage tanks against gravitational force to the storage tanks via the first pipe system.

The vessel may further comprise a pump room external to the spillage tanks wherein the pump is disposed in the pump room; a water chest disposed in the pump room, the water chest for providing fluid communication with the pump for pumping water onto the vessel.

The vessel may further comprise a second pipe system for connecting the pump to an airconditioning system such that water pumped onto the vessel is circulated to the airconditioning system via the second pipe system.

The vessel may further comprise a third pipe system for providing fluid communication between the spillage tanks; and a submersible pump provided in one of the spillage tanks for pumping the drained fluids between the spillage tanks via the third pipe system.

The spillage tanks may be incorporated in a hull section of the vessel.

The storage tanks may be disposed on a deck level of the vessel.

5 The vessel may further comprise a fluid discharge pipe system interconnecting the storage tanks; and a fluid suction pipe system interconnecting the storage tanks; wherein the vessel is configured for treating fluids and drilling waste and for mixing fluids using the interconnected storage tanks.

10 In accordance with another aspect of the present invention, there is provided a method for containing fluids onboard a vessel for storing fluids, the method comprising providing one or more storage tanks onboard the vessel for storing fluids; forming an enclosure around the storage tanks; providing one or more spillage tanks in fluid communication with the enclosure; and wherein when the fluids are released into the enclosure, containing of the fluids into the spillage tanks occurs under gravitational force.

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The enclosure may comprise containment wall sections, wherein one or more of the containment wall sections function as a side railing of the vessel.

20 The method may further comprise providing the fluid communication between the spillage tanks and the enclosure using one or more drainage inlets disposed in the enclosure.

25 The method may further comprise providing active fluid communication between the spillage tanks and the storage tanks using a first pipe system; and returning the drained fluids from the spillage tanks against gravitational force to the storage tanks via the first pipe system using a pump.

30 The method may further comprise providing a pump room external to the spillage tanks wherein the pump is disposed in the pump room; providing fluid communication with the pump using providing a water chest disposed in the pump room for pumping water onto the vessel.

The method may further comprise connecting the pump to an airconditioning system using a second pipe system such that water pumped onto the vessel is circulated to the airconditioning system via the second pipe system.

5 The method may further comprise providing fluid communication between the spillage tanks using a third pipe system; and pumping the drained fluids between the spillage tanks via the third pipe system using a submersible pump disposed in one of the spillage tanks.

10 The spillage tanks may be incorporated in a hull section of the vessel.

The storage tanks may be disposed on a deck level of the vessel.

15 The method may further comprise interconnecting the storage tanks using a fluid discharge pipe system; and interconnecting the storage tanks using a fluid suction pipe system; for treating fluids and drilling waste and for mixing fluids using the interconnected storage tanks.

20 **BRIEF DESCRIPTION OF THE DRAWINGS**

Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

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Figure 1 is a schematic side view diagram of a vessel in an example embodiment.

Figure 2(a) is a schematic top view diagram of the vessel.

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Figure 2(b) is a schematic enlarged view of section A of Figure 2(a).

Figure 2(c) is a schematic enlarged view of section B of Figure 2(a).

Figure 3(a) is a schematic top-down view of a hull section of the vessel.

Figure 3(b) is a schematic enlarged view of section C of Figure 3(a).

5 Figure 3(c) is a schematic isolated view of section D of Figure 3(a).

Figure 4 is a schematic isolated top view of a section of a deck section of the vessel.

10 Figure 5 is schematic view along an A-A line with reference to Figure 4.

Figure 6 is schematic view along a B-B line with reference to Figure 4.

15 Figure 7(a) is a schematic top view showing a fluids discharge pipe system of deck tanks.

Figure 7(b) is a schematic isometric view of the fluids discharge pipe system.

20 Figure 8(a) is a schematic top view showing a fluids suction pipe system of the deck tanks.

Figure 8(b) is a schematic isometric view of the fluids suction pipe system.

25 Figure 9 is a schematic flowchart illustrating a method for draining fluids onboard a vessel in an example embodiment.

DETAILED DESCRIPTION

30 Figure 1 is a schematic side view diagram of a vessel 102 in an example embodiment. The vessel can be a towed vessel such as a barge or a self-powered vessel. The vessel 102 comprises a deck section 104 and a hull section 106. The deck section 104 is disposed on the hull section 106. The deck section 104 comprises a plurality of mixing compartments e.g. 108, 110, living quarters 112 and containment wall

sections, herein referred to as walls e.g. 114, 116, 118, 120, 122. The walls may be made of, but not limited to, steel etc. In the example embodiment, one or more of the walls e.g. 114, 116, 118, 120, 122 can function as a side railing of the vessel. In the example embodiment, there are about 14 gates formed and incorporated at the base of the walls 114, 116, 118, 120, 122. The gates can be mechanically operated to open to discharge e.g. rain water on the deck section 104 and to close to prevent sea water from entering the deck section 104 e.g. if the weather is rough. If a spill of stored/mixing fluids is detected from the mixing compartments e.g. 108, 110, these gates can be sealed closed further by e.g. fastening of wing nuts provided on each of these gates to prevent spilled material from leaking outside the walls 114, 116, 118, 120, 122.

Figure 2(a) is a schematic top view diagram of the vessel 102. Figure 2(b) is a schematic enlarged view of section A of Figure 2(a). Figure 2(c) is a schematic enlarged view of section B of Figure 2(a). Each mixing compartment e.g. 108, 110 comprises a plurality of storage or deck tanks e.g. 202, 204. Thus, in the example embodiment, the deck tanks e.g. 202, 204 are disposed on a deck level of the vessel 102. The deck tanks e.g. 202, 204 are connected using a plurality of mixing line pipes and mixing valves e.g. 206. Chemicals stored in the deck tanks e.g. 202, 204 can be mixed by operating the mixing valves e.g. 206. Each deck tank e.g. 202, 204 further comprises one or more agitators e.g. 208 for facilitating the mixing. One or more diesel pumps e.g. 210, 212 may be used to pump chemicals into or out of the deck tanks e.g. 202, 204 for e.g. mixing operations. A crane 214 is provided on the deck section 104 for moving or loading/unloading material, equipment etc. on the vessel 102.

In the example embodiment, the vessel 102 can be anchored about 2 to 4 kilometers from a drilling rig to provide e.g. different drilling fluids for different drilling operations. The drilling fluids are mixed onboard the vessel 102 and transported to the drilling rig by supply vessels.

In the example embodiment, the walls 114, 116, 118 and 122 enclose the mixing compartments e.g. 108, 110 in a first enclosure 216. The walls 114, 116, 118 and 120 enclose the living quarters 112 in a second enclosure 218. The wall 118 separates the living quarters 112 of the vessel 102 from the first enclosure 216 such that fluids

released into the first enclosure 216 is contained within the first enclosure 216 and away from the living quarters 112.

5 The vessel 102 further comprises drainage inlets 220, 222 in the first enclosure 216. In the example embodiment, the walls 114, 116, 118 and 120 are each at least about 1.2 meters or about 4 feet in height. The wall 122 is bow spread to at least about 2.4 meters or about 8 feet in height. Thus, the first enclosure 216 can contain fluid spillage from the deck tanks e.g. 202, 204, ie. preventing fluid spillage from leaking outside the walls 114, 116, 118 and 122 forming the first enclosure 216. In the example
10 embodiment, the wall 122 is bow spread such that it can be used for towing operations and for e.g. coping with rough weather.

Figure 3(a) is a schematic top-down view of the hull section 106. Figure 3(b) is a schematic enlarged view of section C of Figure 3(a). Figure 3(c) is a schematic isolated
15 view of section D of Figure 3(a). The hull section 106 comprises a plurality of void tanks e.g. 302, 304, a pump room 306, a main spillage containment tank 308 and a starboard spillage containment tank 310. The void tanks e.g. 302, 304 can provide buoyancy to the vessel 102. The main spillage containment tank 308 is located at aft port quarter and the starboard spillage containment tank 310 is located amidships starboard to provide
20 stability to the vessel 102. The main spillage containment tank 308 and the starboard spillage containment tank 310 are connected (not shown) to each other via a pipe system. The pipe system comprises flexible high pressure rubber hoses. Fluids in the starboard spillage containment tank 310 can be pumped into the main spillage containment tank 308 via the pipe system using a submersible internal pump 316. The
25 pump room 306 comprises a pump 312 and is connected to the main spillage containment tank 308. The pump room 306 further comprises a water or sea chest 314 connectable to the pump 312. The sea chest 314 is secured and is used for pumping sea water onto the vessel 102.

30 In the example embodiment, the main spillage containment tank 308 and the starboard spillage containment tank 310 can each contain about 350 m³ or about 5000 barrels (bbls) of fluid. It will be appreciated that the capacities of the main spillage containment tank 308 and the starboard spillage containment tank 310 can be configured such that the main spillage containment tank 308 and the starboard spillage

containment tank 310 are capable of containing the total storage capacity of the deck tanks e.g. 202, 204 (Figure 2).

Figure 4 is a schematic isolated top view of a section 228 (Figure 2) of the deck
5 section 104. The drainage inlets 220, 222 are located such that materials released in the first enclosure 216 from e.g. the deck tanks e.g. 202, 204 (Figure 2) can be easily drained or channeled to the main spillage containment tank 308 (Figure 3) and the starboard spillage containment tank 310 (Figure 3) respectively. Fluid communication is provided between the first enclosure 216 and the main spillage containment tank 308
10 (Figure 3) and the starboard spillage containment tank 310 (Figure 3). A view along an A-A line (see numerals 402, 404) is provided in Figure 5. A view along a B-B line (see numerals 406, 408) is provided in Figure 6.

Figure 5 is schematic view along the A-A line with reference to Figure 4. The
15 drainage inlet 220 is connected in fluid communication with the main spillage containment tank 308 using a pipe 502. The drainage inlet 220 is covered using a grizzly screen. The grizzly screen is constructed from stainless steel and can have apertures of about 5 to 10 mm in diameter to ensure that clogging does not occur at the grizzly screen. The pipe 502 can be e.g. made of a 12" piping. A stainless steel grating may be
20 provided to cover an inlet opening of the pipe 502.

In addition, active fluid communication between the main spillage containment tank 308 and the deck tanks e.g. 202, 204 (Figure 2) is provided using another pipe system and via the pump 312 (Figure 3). The pipe system can comprise e.g. a 6" pipe
25 and/or high pressure rubber hoses. The pump 312 (Figure 3) can be used to transfer spillage material contained in the main spillage containment tank 308 to the deck tanks e.g. 202, 204 (Figure 2) via the pipe system against gravitational force.

Figure 6 is schematic view along the B-B line with reference to Figure 4. The
30 drainage inlet 222 is connected in fluid communication with the starboard spillage containment tank 310 using a pipe 602 and a valve 604. The drainage inlet 222 is covered using a grizzly screen. The inlet opening of the pipe 602 is covered with a stainless steel grating. The grizzly screen is constructed from stainless steel and can have apertures of about 5 to 10 mm in diameter to ensure that clogging does not occur

at the grizzly screen. The pipe 602 is inverted after the valve 604 such that spillage materials can be discharged directly from the pipe 602 into the starboard spillage containment tank 310.

5 In the example embodiment, spillage containment and management can be provided onboard the vessel 102. For example, referring to Figure 2, a spillage can occur when a mixing valve e.g. 206 breaks and the pressure in one or more deck tanks e.g. 202, 204 (Figure 2) equalize, thus releasing stored chemicals into the first enclosure 216. Since the first enclosure 216 is enclosed within the walls 114, 116, 118 and 122,
10 the chemicals are funneled or channeled to flow into the main spillage containment tank 308 (Figure 3) and the starboard spillage containment tank 310 (Figure 3) via the drainage inlets 220, 222 respectively. The drainage of the spilled chemicals into the main spillage containment tank 308 (Figure 3) and the starboard spillage containment tank 310 (Figure 3) is under gravitational force. Thus, advantageously, the example
15 embodiment does not require a separate drainage pump for spillage containment and management.

Further, as described, the main spillage containment tank 308 (Figure 3) and the starboard spillage containment tank 310 (Figure 3) are capable of containing the total
20 storage capacity of the deck tanks e.g. 202, 204. Thus, advantageously, any spillage of materials or chemicals is contained and prevented from leaking from the vessel 102.

Referring to Figure 3, after containing any spillage in the main spillage containment tank 308 and the starboard spillage containment tank 310, repairs may be
25 carried out on faulty components. As active fluid communication between the main spillage containment tank 308 and the deck tanks e.g. 202, 204 (Figure 2) is provided via the pump 312, the pump 312 can be used to pump spillage materials against gravitational force from the main spillage containment tank 308 (and from the starboard spillage containment tank 310 via the submersible internal pump 316) to any of the deck
30 tanks e.g. 202, 204 (Figure 2).

Thus, advantageously, the main spillage containment tank 308 and the starboard spillage containment tank 310 can function as temporary storage for spillage materials

until there are available deck tanks e.g. 202, 204 (Figure 2) to contain or remove the spillage materials from the vessel 102.

5 In the example embodiment, the pump room 306 further comprises an access stairs 318 and water tight doors (not shown). The access stairs 318 can allow access to the pump room 306 from the second enclosure 218 (Figure 2) via e.g. an access stairs 224 (Figure 2). The pump room 306 can also provide a number of other functions.

10 The pump room 306 can provide a continuous supply of cooling water for air-conditioning systems in e.g. the living quarters 112 (Figure 2) by using the pump 312 to draw sea water via the sea chest 314 and via another pipe system. The pump room 306 can also circulate cooling water to electric generators or electric generating engines used e.g. in the living quarters 112 (Figure 2) by using the pump 312 to draw sea water via the sea chest 314. An oily-water separator (not shown) can be installed in the pump
15 room 306 to provide environmentally acceptable or "clean" cooling water for the circulating cooling water.

In the example embodiment, with reference to Figure 2, the vessel 102 further comprises a High "G" force solids removal centrifuge apparatus 226. The centrifuge
20 apparatus 226 can be used for treatment/conditioning and/or removal from the drilling fluids e.g. of solid materials formed in the drilling fluids during drilling operations to obtain suitable drilling fluids. The centrifuge apparatus 226 is connected by suitable pipes (not shown) into the deck tanks e.g. 202, 204 such that mixing of materials to obtain a particular drilling fluid can be carried out using a to and return flow of materials via the
25 centrifuge apparatus 226. Advantageously, the high "G" force centrifuge apparatus 226 can maintain the properties and weight of the drilling fluids without having to perform such operations on the oil rigs themselves.

Figure 7(a) is a schematic top view showing a fluids discharge pipe system of the
30 deck tanks. Figure 7(b) is a schematic isometric view of the fluids discharge pipe system. Each deck tank e.g. 202, 204 comprises a discharge valve V1 e.g. 702, 704. The discharge valve V1 e.g. 702, 704 is connected and opened for fluids to be discharged into the respective deck tank e.g. 202, 204 using the diesel pumps e.g. 210, 212.

Figure 8(a) is a schematic top view showing a fluids suction pipe system of the deck tanks. Figure 8(b) is a schematic isometric view of the fluids suction pipe system. Each deck tank e.g. 202, 204 further comprises a suction valve V2 e.g. 802, 804. The suction valve V2 e.g. 802, 804 is connected and opened for fluids to be "sucked" from the respective deck tank e.g. 202, 204 using the diesel pumps e.g. 210, 212.

Therefore, using the fluids discharge pipe system and fluids suction pipe system illustrated in Figures 7(a),(b) and Figures 8(a), (b) respectively, mixing operations can be carried out. For example, a deck tank A can be used for mixing of a particular volume of a fluid with specified properties. After mixing is achieved, the fluid can be stored in another deck tank B for transfer to an oil rig that requires the fluid.

Further, the deck tanks e.g. 202, 204 each comprises a solid steel chequer plate roof so that water proofing may be provided for drilling fluids. It will be appreciated by a person skilled in the art that rain water can have adverse effects on drilling fluids. Further, the crane 214 can be of about 165 feet with a rotational radius of about 150 feet so that the crane can lift loads from e.g. ends of the vessel 102 and supply boats. A forklift of about 13 feet may also be provided on the deck section 104 for facilitating lifting of loads.

In the example embodiment, installation of a contaminated drilling waste treatment process, such as a Total Waste Management Alliance (TWMA) Hammer mill or a Thermal Desorption Unit (TDU) unit, can be carried out on the vessel. Contaminated drilling waste can be received from oil rigs or feeder barges and stored in one or more of the deck tanks. The waste can be transmitted to a process unit from the deck tanks using e.g. a slurry pump. Oily water skimmers can be provided in these deck tanks for separation of any water contaminants.

After processing the contaminated waste, a base oil portion can be stored in one or more of the deck tanks of the vessel. The deck tanks for storing such base oil portions can be modified to accommodate such materials. Water from the processed waste can be channelled to a sewage treatment tank (not shown) for further treatment for controlled discharge or transferred to a contaminated water storage tank (not shown) for chemical

treatment. The remainder of the processed decontaminated drilling waste can be released into the environment (subject to regulations) or returned to shore e.g. for use for other purposes.

5 Figure 9 is schematic flowchart 900 illustrating a method for containing fluids onboard a vessel in an example embodiment. At step 902, one or more storage tanks onboard the vessel for storing fluids are provided. At step 904, an enclosure around the storage tanks is formed. At step 906, one or more spillage tanks in fluid communication with the enclosure are provided. At step 908, when the fluids are
10 released into the enclosure, containing of the fluids into the spillage tanks occurs under gravitational force.

 In the above described example embodiment, the vessel 102 can be used for mixing, storing, centrifuging, conditioning and treating drilling fluids etc. Since treatment
15 and mixing of drilling fluids on the vessel 102 is carried out "off-line" from actual drilling rig operations, rig time delays in waiting on tank cleaning on drilling units can be eliminated. Contamination of drilling fluids such as water can also be prevented when transferring the drilling fluids to transporting vessels and marine bases. Since handling of drilling fluids by drilling rigs can be reduced (ie. by up to 90% for handling carried out on
20 the vessel 102), only day to day maintenance would be required on drilling units. In addition, storage of drilling fluids on the vessel 102 after utilization on wells, during rig moves and prior to being utilized again (ie. after treatment) can eliminate the requirement for storage facilities at supply bases or supply vessels. Furthermore, the vessel 102 can significantly eliminate the travelling distance from drilling rigs to a supply
25 base since it can be located at a closer distance to the oil rig. This can reduce supply vessel costs and travel frequency. In the above described example embodiment, by storing drilling fluids on the vessel 102, other marine supply vessels can be freed to utilize their deck load capacity for other supplies and thus, can improve provide logistical support for drilling rigs (e.g. even providing temporary storage of drilling items).

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The above described example embodiment can also provide, beside drilling fluids, mixing, treating, reconditioning and storage of Water Base Mud (WBM) and Synthetic Base Mud (SBM), Drill in Fluids WBM and SBM, and completion brines.

Below is a listing of fluid systems that can be provided by the above described example embodiment. They reflect general industry practice and terminology consistent with descriptions adopted by the American Petroleum Institute (API) and the International Association of Drilling Contractors (IADC). The fluid systems are typically stored in the deck tanks after mixing operations.

Nine distinct fluid systems are listed, of which the first six are water-based, followed by oil- and synthetic-based systems, along with the last system which uses air, mist, foam or gas as the circulating medium. The chemicals and fluid systems listed are designed for use in drilling, completion and workover operations.

Non-dispersed systems are provided which include spud muds, natural muds and other lightly treated systems that are generally used for shallow wells or top-hole drilling. Thinners and dispersants are not added to disperse drill solids and clay particles.

Dispersed systems are provided where at greater depths, where higher densities are required, or where hole conditions may be problematic, muds are often dispersed, typically with lignosulfonates, lignites or tannins. These and similar products are effective deflocculants and filtrate reducers. Potassium-containing chemicals are frequently used to provide greater shale inhibition. Specialized chemicals are also added to adjust or maintain specific mud properties.

Calcium treated systems are provided where divalent cations, such as calcium and magnesium, when added to a freshwater drilling mud, inhibit formation clay and shale swelling. High levels of soluble calcium are used to control sloughing shale and hole enlargement, and to prevent formation damage. Hydrated lime (calcium hydroxide), gypsum (calcium sulfate) and calcium chloride are principal ingredients of calcium systems. Gyp systems usually have a pH of 9.5 to 10.5 and an excess gyp concentration of 2 to 4 lb/bbl (600 to 1,200 mg/l calcium). Lime systems typically have either excess lime concentration of 1 to 2 lb/bbl and a pH of 11.0 to 12.0 for a low lime system, or excess lime concentration of 5 to 15 lb/bbl for a high lime system. Specialized products are added to control individual mud properties. Calcium-treated muds resist salt and anhydrite contamination but are susceptible to gelation and solidification at high temperatures.

Polymer systems are provided where muds incorporating generally long-chain, high-molecular-weight polymers are utilized to either encapsulate drill solids to prevent dispersion and coat shales for inhibition, or for increasing viscosity and reducing fluid loss. Various polymers are available for these purposes, including acrylamide, cellulose and natural gum-based products. Frequently, inhibiting salts, such as KCl or NaCl, are used to provide greater shale stability. These systems normally contain a minimum amount of bentonite and may be sensitive to divalent cations, such as calcium and magnesium. Most polymers have temperature limits below 300°F, but under certain conditions, may be used in wells with appreciably higher BHTs.

Low solids systems are provided where listings include systems in which the amount (volume) and type of solids are controlled. Total solids should not range higher than about 6% to 10% by volume. Clay solids should be some 3% or less and exhibit a ratio of drilled solids to bentonite of less than 2:1. Low-solids systems typically use polymer additive as a viscosifier or bentonite extender and are non-dispersed. One primary advantage of low-solids systems is that they significantly improve drilling penetration rate.

Saltwater systems are provided. Saturated salt systems have a chloride concentration near 190,000 mg/l (saturated) and are used to drill salt formations. Saltwater systems have a chloride content of 10,000 to 190,000 mg/l. The lower levels are usually referred to as brackish or seawater systems. Saltwater muds are usually prepared from brackish, seawater or produced-water sources. Mud is prepared from fresh or brine water and dry sodium chloride (or other salts, such as potassium chloride used for shale inhibition), which are added to achieve desired salinity. Various specialty products, such as attapulgite, CMC, starch and others, are used to increase viscosity for hole-cleaning properties and to reduce fluid loss.

Oil-based muds are provided where oil-based systems are used for a variety of applications, where fluid stability and inhibition are necessary, such as high-temperature wells, deep holes, and where sticking and hole stabilization are problems. They comprise two types of systems. Invert emulsion muds are water-in-oil emulsions, typically with calcium chloride brine as the emulsified phase and oil as the continuous

phase. They may contain as much as 50% brine in the liquid phase. Relaxed, invert emulsion muds are a "relaxed" emulsion, and have lower electrical stabilities and higher fluid-loss values. Concentration of additives and brine content/salinity are varied to control rheological, filtration and emulsion stability. Oil-based muds are formulated with only oil as the liquid phase and are often used as coring fluids. Although these systems pick up water from the formation, no additional water or brine is added. All oil systems require higher additional gelling agents for viscosity. Specialized oil-based mud additives include: emulsifiers and wetting agents (commonly fatty acids and amine derivatives) for viscosity; high-molecular-weight soaps; surfactants; amine treated organic materials; organo clays and lime for alkalinity.

Synthetic muds systems are provided. Synthetic fluids are designed to mirror oil-based mud performance, with less environmental hazards. Primary synthetic fluids include paraffins, iso-paraffins, esters, ethers, poly alpha olefins and isomerized alpha olefins. Synthetic based drilling fluids use a variety of different "Base Oils".

Air, mist, foam and/or gas systems are provided. Four basic operations are included in this category. These include dry air drilling, which involves injecting dry air or gas into the wellbore at rates capable of achieving annular velocities that will remove cuttings; mist drilling, which involves injecting a foaming agent into the air stream that mixes with produced water and coats the cuttings to prevent mud-cavings, allowing drill solids to be removed; foam uses surfactants and possibly clays or polymers to form a high carrying-capacity foam; and aerated fluids rely on mud with injected air (which reduces hydrostatic head) to remove drilled solids from the wellbore.

After briefly listing the fluid systems above, additives are listed below. These are generally accepted by the IADC Subcommittee on Drilling Fluids. Additives are typically transported dry, e.g. in sacks, and prepalletized to oil rigs or vessels for further/additional treatment of already formulated or mixed drilling fluid systems. Some additives have multiple uses, and for those a primary and two secondary function categories are listed.

Alkalinity, pH control additives are provided which include products used to control the degree of acidity or alkalinity of a fluid include lime, caustic soda, soda ash and bicarbonate of soda, as well as other common acids and bases.

Bactericides are provided which include products used to prevent bacterial degradation of natural organic additives, such as starch and xanthan gum.

5 Calcium reducers are provided which include soda ash, bicarbonate of soda, caustic soda and certain polyphosphates used to reduce calcium in seawater, treat cement contamination, and overcome contaminating effects of anhydrite and gypsum, both forms of calcium sulfates.

10 Corrosion inhibitors are provided where pH control, along with an appropriate corrosion inhibitor, is used to control corrosion, neutralize hazardous acid gases and prevent scale in drilling fluids. Common corrosion inhibitors are amine- or phosphate-based products, as well as other specially formulated chemicals.

15 Defoamers are provided which include products designed to reduce foaming action, particularly in brackish and saturated saltwater muds.

 Emulsifiers are provided which include products that create a heterogeneous mixture (emulsion) of two insoluble liquids. They include fatty acids and amine-based
20 chemicals for oil-based muds and detergents; soaps; organic acids; and water-based surfactants for water-based muds. Products may be anionic (negatively charged), non-ionic (neutral) or cationic (positively charged) chemicals, depending on the application.

 Filtrate reducers are provided which include filtrate, or fluid loss reducers – such
25 as bentonite clays, lignite, CMC (sodium carboxymethylcellulose), polyacrylate and pregelatinized starch – that serve to decrease fluid loss, a measure of the tendency of the drilling fluid's liquid phase to pass through the filter cake into the formation.

 Flocculants are provided to increase viscosity for improved hole cleaning, to
30 increase bentonite yield and to clarify or de-water low-solids fluids. Salt (or brine), hydrated lime, gypsum, soda ash, bicarbonate of soda, sodium tetrphosphate and acrylamide-based polymers may be used. They cause colloidal particles in suspension to group into bunches or "flocs," causing solids to settle out.

Foaming agents are provided which include chemicals that also act as surfactants (surface active agents) to foam in the presence of water. These foamers permit air or gas drilling through water-bearing formations.

- 5 Lost circulation materials are provided to plug the zone of loss back in the formation, away from the borehole face, so that subsequent operations will not result in additional drilling fluids losses.

- 10 Lubricants are provided which include products designed to reduce a drilling fluid's coefficient of friction, which decreases torque and drag. Various oils, synthetic liquids, graphite, surfactants, glycols and glycerin, as well as other chemicals, are used for this purpose.

- 15 Pipe-freeing agents are provided which include products consisting of detergents, soaps, oils, surfactants and other chemicals. These agents are spotted in an area of suspected pipe stickage to reduce friction and increase lubricity, thereby freeing stuck pipes.

- 20 Shale control inhibitors are provided which include sources of soluble calcium and potassium, as well as inorganic salts and organic compounds, that provide shale control by reducing shale hydration. These products are used to prevent excessive wellbore enlargement and heaving or caving while drilling water-sensitive shales.

- 25 Surface active agents are provided which include surfactants, as they are called, that reduce interfacial tension between contacting surfaces (water/oil, water/solid, water/air, etc.). These may be emulsifiers, de-emulsifiers, wetting agents, flocculants or deflocculants, depending on the surfaces involved.

- 30 Temperature stability agents are provided which include products that increase rheological and filtration stability of drilling fluids exposed to high temperatures and those that continue to perform their intended purpose under these conditions. Various chemicals are used, including acrylic polymers, sulfonated polymers and copolymers, as well as lignite, lignosulfonate and tannin-based additives.

Thinners, dispersants are provided which include chemicals that modify the relationship between viscosity and percentage of solids in a drilling mud. They may be used, further, to reduce gel strength, increase a fluid's "pumpability," etc. Tannins (quebracho), various polyphosphates, lignite and lignosulfonate materials function as thinners, or as dispersants. Principal purpose of a thinner is to function as a deflocculant to reduce attraction (flocculation) of clay particles, which produces high viscosity and gel strengths.

Viscosifiers are provided which include Bentonite, CMC, attapulgite clays and polymers that are used to increase viscosity for better hole cleaning and suspension of solids.

Weighting materials are provided which include Barite, iron oxides, calcium carbonates and similar products possessing high specific gravity that are used to control formation pressures, check formation caving and facilitate pulling dry pipe.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

CLAIMS

1. A vessel for storing fluids, the vessel comprising,
one or more storage tanks for storing fluids;
5 an enclosure formed around the storage tanks;
one or more spillage tanks in fluid communication with the enclosure; and
wherein when the fluids are released into the enclosure, the fluids are
drained into the spillage tanks under gravitational force.
- 10 2. The vessel as claimed in claim 1, wherein the enclosure comprises
containment wall sections, wherein one or more of the containment wall sections
function as a side railing of the vessel.
3. The vessel as claimed in claim 2, wherein one of the containment wall
15 sections separates a living quarters of the vessel from the enclosure for containing
the fluid within the enclosure and away from the living quarters.
4. The vessel as claimed in claims 2 or 3, wherein one of the
containment wall sections functions as a bow spread wall.
- 20 5. The vessel as claimed in any one of the preceding claims, further
comprising one or more drainage inlets disposed in the enclosure for providing the
fluid communication between the spillage tanks and the enclosure.
- 25 6. The vessel as claimed in any one of the preceding claims, further
comprising
a first pipe system for providing active fluid communication between the
spillage tanks and the storage tanks; and
a pump for returning the drained fluids from the spillage tanks against
30 gravitational force to the storage tanks via the first pipe system.
7. The vessel as claimed in claim 6, further comprising
a pump room external to the spillage tanks wherein the pump is disposed in
the pump room;

a water chest disposed in the pump room, the water chest for providing fluid communication with the pump for pumping water onto the vessel.

8. The vessel as claimed in claim 7, further comprising a second pipe
5 system for connecting the pump to an airconditioning system such that water pumped onto the vessel is circulated to the airconditioning system via the second pipe system.

9. The vessel as claimed in any one of the preceding claims, further
10 comprising

a third pipe system for providing fluid communication between the spillage tanks; and

a submersible pump provided in one of the spillage tanks for pumping the drained fluids between the spillage tanks via the third pipe system.

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10. The vessel as claimed in any one of the preceding claims, wherein the spillage tanks are incorporated in a hull section of the vessel.

11. The vessel as claimed in any one of the preceding claims, wherein the
20 storage tanks are disposed on a deck level of the vessel.

12. The vessel as claimed in any one of the preceding claims, further comprising:

a fluid discharge pipe system interconnecting the storage tanks; and

25 a fluid suction pipe system interconnecting the storage tanks;

wherein the vessel is configured for treating fluids and drilling waste and for mixing fluids using the interconnected storage tanks.

13. A method for containing fluids onboard a vessel, the method
30 comprising,

providing one or more storage tanks onboard the vessel for storing fluids;

forming an enclosure around the storage tanks;

providing one or more spillage tanks in fluid communication with the enclosure; and

wherein when the fluids are released into the enclosure, containing of the fluids into the spillage tanks occurs under gravitational force.

14. The method as claimed in claim 13, wherein the enclosure comprises
5 containment wall sections, wherein one or more of the containment wall sections function as a side railing of the vessel.

15. The method as claimed in claims 13 or 14, further comprising
10 providing the fluid communication between the spillage tanks and the enclosure using one or more drainage inlets disposed in the enclosure.

16. The method as claimed in any one of claims 13 to 15, further comprising
providing active fluid communication between the spillage tanks and the
15 storage tanks using a first pipe system; and
returning the drained fluids from the spillage tanks against gravitational force to the storage tanks via the first pipe system using a pump.

17. The method as claimed in claim 16, further comprising
20 providing a pump room external to the spillage tanks wherein the pump is disposed in the pump room;
providing fluid communication with the pump using providing a water chest disposed in the pump room for pumping water onto the vessel.

25 18. The method as claimed in claim 17, further comprising connecting the pump to an airconditioning system using a second pipe system such that water pumped onto the vessel is circulated to the airconditioning system via the second pipe system.

30 19. The method as claimed in any one of claims 13 to 18, further comprising
providing fluid communication between the spillage tanks using a third pipe system; and

pumping the drained fluids between the spillage tanks via the third pipe system using a submersible pump disposed in one of the spillage tanks.

20. The method as claimed in any one of claims 13 to 19, wherein the
5 spillage tanks are incorporated in a hull section of the vessel.

21. The method as claimed in any one of claims 13 to 20, wherein the storage tanks are disposed on a deck level of the vessel.

10 22. The method as claimed in any one of claims 13 to 21, further comprising:

interconnecting the storage tanks using a fluid discharge pipe system; and

interconnecting the storage tanks using a fluid suction pipe system;

for treating fluids and drilling waste and for mixing fluids using the
15 interconnected storage tanks.

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