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1 APPARATUS AND METHOD FOR MIXING DRILL CUTTINGS IN A
2 TANK AND TRANSFERRING THEM THEREFROM

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5 This invention relates generally to apparatus and
6 methods for handling drilling waste generated in
7 offshore drilling operations. More particularly, but
8 not by way of limitation, this invention relates to an
9 environmentally safe apparatus and method for slurring
10 waste materials and drill cuttings in a tank and
11 transferring the waste materials and drill cuttings
12 from the tank to other tanks or containers. The
13 invention is suited for offshore drilling operations as
14 well as land based operations. In the process of
15 drilling oil and gas wells, a wellbore is drilled into
16 the earth many thousands of feet which generates large
17 amounts of waste material known as drill cuttings
18 composed of rock, dirt, shale and other debris. To
19 prevent damage to the drill bit and to clear the
20 wellbore of the drilled material, these drill cuttings
21 are conveyed to the surface of the well bore by the
22 drilling fluid. The waste material and drill cuttings

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1 are typically separated from the drilling fluid at the
2 surface and the drilling fluid is returned to the
3 system and is reused while the waste material and drill
4 cuttings are disposed of.

5
6 Because the waste material and drill cuttings contain
7 chemicals, hydrocarbons such as oil, and other
8 components hazardous to the environment, environmental
9 regulations require that the waste material and drill
10 cuttings be disposed of in an environmentally
11 acceptable manner and prohibit disposal by dumping the
12 materials into the sea.

13
14 Typical environmentally acceptable disposal methods
15 include; re-injecting the waste material and drill
16 cuttings into the earth down an injection well located
17 at the drilling platform or at a remote location,
18 treating the material in an accepted treatment facility
19 usually located away from the drilling rig, or
20 disposing of the material in a land fill location. The
21 volume of drill cuttings generated while drilling a
22 well bore is quite large and consists of several tons
23 of waste material. Thus, the disposal of waste
24 material and drill cuttings represent a major operation
25 and expense.

26
27 In some disposal regimes, contaminated waste materials
28 and drill cuttings recovered from an offshore drilling
29 rig require removal from the rig or wellbore for
30 treatment on land to decontaminate them before they can
31 be disposed of safely. Because the volume of the waste
32 material and drill cuttings can be very large, the

1 transport of waste materials and drill cuttings from an
2 offshore rig to a suitable decontamination facility is
3 also a major operation.

4
5 In one conventional offshore operation, the waste
6 material and drill cuttings are caught on the rig in
7 small containers known as skips, which are then lifted
8 by a crane and loaded on a boat, transported to a shore
9 base facility, offloaded from the boat by a crane,
10 dumped into a larger storage container to await
11 processing, and then transported to a process facility.
12 Many skips are necessary on a typical drilling rig to
13 handle the large amount of drill cuttings generated.
14 Dedicated crews are necessary to handle the skips on
15 the drilling rig and at the shore base facility,
16 cleaning crews are necessary to clean the skips after
17 each use, and safety and environmental concerns have to
18 be addressed in each operation handling the skips. The
19 use of skips interferes with and slows down the
20 drilling process and creates a major environmental
21 concern due to the possibility of spillage. During
22 inclement weather conditions the skips cannot be loaded
23 on and offloaded from the boats and this, at times,
24 stops the drilling process and increases the dangers
25 associated with skip handling.

26
27 On offshore drilling rigs, the shale shakers and solids
28 control equipment are permanently mounted inside
29 enclosed structures, thus the rig has severe space
30 limitations for the installation of additional
31 equipment, and access to the areas around the existing
32 shale shakers and solids control equipment is limited.

1 An offshore drilling rig typically also has holding
2 tanks known as "mud pits", that are permanently
3 installed and part of the rig sub-structure. Mud
4 pits are used to store drilling waste and drill
5 cuttings.

6
7 WO-A-9410448 describes an apparatus suitable for
8 pumping a slurry, which includes a vessel into which
9 fluids and solids are added. These fluids and
10 solids are then mixed by an impeller to form a
11 slurry, which is then pumped away. The pump means
12 comprising a chamber, inlet, motor-driven impeller
13 and discharge outlet. The pump means are fixed at
14 the bottom of the vessel.

15
16 Another problem with handling waste materials and
17 drill cuttings is that after the materials are
18 contained in holding tanks the materials will
19 separate into layers with the upper layer containing
20 fluids, a lower layer containing solids, and an
21 intermediate layer containing solids suspended in
22 fluids. This separation also occurs in the
23 containers or tanks that are used to transport the
24 materials to a remote location and storage container
25 where the materials await processing. The
26 separation of the fluids and solids makes it
27 difficult to remove the materials from the
28 containers or tanks.

29
30 The invention herein disclosed solves these problems
31 by providing in certain embodiments an
32 environmentally safe apparatus and method for

4a

1 slurring waste materials and drill cuttings in a
2 tank and transferring the waste materials and drill
3 cuttings from the tank.

4 By "slurring" we mean mixing a particulate
5 suspension to produce a slurry.

6

7 The invention provides a pump apparatus as claimed
8 in claim 1.

9

10 The invention also provides a method as claimed in
11 claim 15.

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1 Preferable features of the invention are set out in the
2 dependent claims. Any combination of features shown in
3 the dependent claims can be used except where such
4 features are mutually exclusive.

5
6 Certain embodiments of the invention are particularly
7 suited for offshore drilling operations as well as land
8 based operations. The inlet typically opens into the
9 bottom of the chamber. The apparatus typically has
10 circumferentially spaced circulation ports in the
11 chamber side typically facing in opposed directions.
12 The impeller typically extends below the chamber and
13 breaks up debris in addition to drawing material into
14 the pump chamber. The circulation ports may be opened
15 or closed independently of one other, or together, and
16 to different extents to provide an exit from the
17 chamber. The pump is rotatable by a swivel connection
18 and may be moved and manipulated in the tank from end
19 to end and top to bottom by a crane arm, or it may be
20 suspended by cable, chain or other means. The pump
21 typically stirs up a slurry by rotating the impeller
22 when the circulation ports are at least partially open
23 so that the material entering the bottom inlet to the
24 chamber and being agitated by the impeller is forced
25 out of the circulation ports and the material in the
26 tank is stirred for easier pumping. The pump can
27 operate in the stirring mode with the ports closed
28 until the material to be removed is generally
29 homogenous, whereupon the circulation ports can be
30 closed, allowing the impeller to direct the slurry
31 through the side outlet of the chamber into the
32 discharge line. The stirring or slurring mode can be

1 combined with a discharge mode by opening the
2 circulation ports to the degree required to slurry the
3 material to be pumped while the material is being
4 pumped out through the discharge line. An auxiliary
5 discharge conduit may also be connected with the outlet
6 to discharge material back into the tank to exchange
7 upper fluid layers of the material with lower layers of
8 solids and fluids and enhance the flow of the material
9 being pumped.

10

11 The provision of even pairs of circulation ports (e.g.
12 two), and particularly when they are 180° apart from
13 one another balances the forces exerted on the pump
14 particularly while it is in a mixing mode. The mixing
15 mode can be combined with a suction mode by simply
16 opening the one or both of the ports to the degree
17 required to mix the material to be pumped.

18

19 Ports are not necessary, and the apparatus can simply
20 be run with an outlet communicating with the chamber so
21 that material leaving the chamber is discharged through
22 the outlet.

23

24 The outlet can be simply an aperture in the chamber and
25 can have a conduit leading from the aperture to convey
26 material from the pump. The outlet or discharge
27 conduit itself can have an opening for discharge of
28 material from the conduit back into the tank, so as to
29 enhance the turbulent flow of the material being
30 pumped. Preferably the opening in the discharge
31 conduit is spaced above the pump inlet so that material

1 discharged from the outlet in the conduit can be
2 distributed some distance away from the pump.

3

4 The outlet may optionally be directed in different
5 directions, e.g. by means of a swivel at some point in
6 the conduit, or elsewhere in the apparatus.

7

8 The outlet of the chamber is typically connected to a
9 discharge pipe which can preferably form a support
10 structure of the pump.

11

12 The pump can be suspended by means to lower it into a
13 tank or pit, and the discharge piping can be resilient
14 so as to allow free movement of the pump.

15

16 The pump has a swivel associated with it (e.g. not
17 necessarily on the body of the pump) to allow rotation
18 of the pump in a holding tank. The swivel can be
19 powered. This can preferably allow 360° rotation of
20 the chamber. The swivel can be hydraulically operated
21 from a remote panel by secondary motor or cylinder.
22 The swivel can have a full opening for reduced pressure
23 loss.

24

25 The pump can be mounted on a hydraulically operated arm
26 such as a crane arm for operation in a pit or open top
27 tank. This allows sludge to be mixed from top to
28 bottom uniformly.

29

30 The impeller can have cutters extending below the
31 chamber in order to break up large pieces of debris in

1 the material being pumped as well as to draw the
2 material into the pump chamber.

3

4 The invention also provides a tank for containing drill
5 cuttings in a ship or other vehicle for conveyance from
6 a wellbore, the tank having baffles to resist
7 displacement of the drill cuttings during transport,
8 and at least one or more of the baffles being removable
9 from the tank.

10

11 This allows efficient removal of the material from the
12 tank after transport.

13

14 Certain embodiments of the invention provide apparatus
15 and a method for mixing waste materials and drill
16 cuttings in a tank and transfer the materials and drill
17 cuttings from the tank by pumping it through a
18 discharge line into a holding tank on a boat or other
19 vehicle which conveys the waste materials and drill
20 cuttings to a remote decontamination facility, storage
21 facility, re-injection well, or other type of disposal
22 facility. The material can then be transferred from
23 the holding tank to the facility or well etc by pumping
24 using similar apparatus. Booster pumps similar to the
25 above-mentioned pump can usefully be employed in the
26 conduit from the tank to the vehicle and/or from there
27 to the holding tank or storage/decontamination
28 facility. The materials can simply be conveyed to a
29 remote location and a similar or adapted pump or method
30 can also be used at the remote location to slurry and
31 transfer the materials from holding tank.

32

1 Certain embodiments of this invention provide apparatus
2 and a method for mixing waste materials and drill
3 cuttings in large quantities (bulk form) and eliminate
4 the need for a large number of small containers.

5

6 Another embodiment of this invention provides a pump
7 apparatus for mixing and/or transferring waste
8 materials and drill cuttings that has a swivel
9 associated with it to allow rotation of the pump in a
10 tank.

11

12 Another embodiment of this invention provides a pump
13 apparatus for mixing and/or transferring waste
14 materials and drill cuttings that can be mounted on a
15 hydraulically or mechanically operated arm such as a
16 crane arm for manipulation the pump in a tank to allow
17 the material to be slurried from top to bottom
18 uniformly by movement of the pump through the material
19 to be mixed and pumped.

20

21 Another embodiment of this invention provides a pump
22 apparatus for mixing and transferring waste materials
23 and drill cuttings that can be suspended by cable or
24 other means to lower it into a tank and has resilient
25 discharge piping to allow free movement of the pump.

26

27 A further embodiment of this invention provides a pump
28 apparatus that does not require a specially constructed
29 tank and may be used with various existing conventional
30 tanks for mixing and/or transferring waste materials
31 and drill cuttings contained in the tanks.

32

1 A further embodiment of this invention provides a
2 pump apparatus for mixing and/or transferring waste
3 materials and drill cuttings from a tank which is
4 simple in construction, and rugged and reliable in
5 operation.

6

7 The present invention will now be described by way
8 of example and with reference to the accompanying
9 drawings in which:

10

11 Figs. 1a, 1b, 1c are left side, front, and rear
12 elevation views, respectively, of pump
13 apparatus;

14 Fig 1d is an exploded side view of the pump
15 apparatus;

16 Fig. 2 is a top plan view of the pump apparatus
17 taken along line 2-2 of Fig. 1a;

18 Fig. 3 is a top plan view of the pump apparatus
19 taken along line 3-3 of Fig. 1a showing the
20 apparatus with the pump motor and discharge
21 conduit removed;

22 Fig. 4a is an exploded perspective view of the
23 pump housing, bottom plate, and impeller in an
24 unassembled condition;

25 Fig 4b is an exploded side view of a bearing
26 housing of an impeller assembly of the Fig 1
27 pump;

28 Fig. 5 is a side elevation view showing the
29 pump supported on a crane arm;

30 Fig. 6 is a left side elevation of an
31 embodiment of the pump apparatus having an

1 auxiliary discharge conduit for directing
2 materials back into a tank;
3 Fig. 7 is a plan view of a base of a holding
4 tank;
5 Fig. 8 is an end elevation of the Fig. 7 tank;
6 Fig. 9 is a sectional view through the Fig. 7
7 tank;
8 Fig. 10 is a plan view of a lid for the Fig. 7
9 tank;
10 Fig. 11 is an end view of the Fig. 10 lid;
11 Fig. 12 is a plan view of a top frame of the
12 Fig. 7 tank;
13 Fig. 13 is a series of views of side and end
14 plates of the Fig. 7 tank;
15 Fig. 14 is a front elevation of the Fig. 7
16 tank;
17 Fig. 15 is a section view through the head
18 point of the Fig. 7 tank; and
19 Fig. 16 is a series of section views of the
20 Fig. 7 tank.

21
22 Referring now to Figs. 1-4 of the drawings, there is
23 shown a pump 10 having a housing 11 with cylindrical
24 chamber 12 (seen in Fig. 4a). A drive motor 13 and
25 bearing assembly 13A is secured to the top end of
26 the pump housing 11 and encloses the open top end of
27 the cylindrical chamber 12. A bottom plate 14 is
28 secured to the bottom end of the pump housing 11 and
29 has a central opening that defines the inlet 15 into
30 the cylindrical chamber 12. An impeller 16
31 connected to the drive shaft of the motor 13 is
32 rotatably disposed in the cylindrical chamber 12,

1 and a lower portion of the blades of the impeller
2 extend downwardly through the inlet opening 15 and
3 terminate a distance below the inlet. Legs 17 are
4 secured to the sides of the pump housing 11 and
5 extend downwardly beyond the lower portion of the
6 blades of the impeller 16.

7
8 A pair of circulation ports 18,19 formed in the side
9 wall of the cylindrical chamber 12 extend laterally
10 outwardly from opposite sides of the pump housing
11 11. The circulation ports 18,19 are
12 circumferentially spaced apart at approximately
13 180°. A pair of sluice gates 20,21 are slidably
14 mounted on the pump housing to open and close fluid
15 communication through the circulation ports 18,19.
16 The gates 20,21 are each independently raised or
17 lowered to different extents by sluice levers 20A,
18 21A to expose a desired area of the circulation
19 ports 18,19. It should be understood that the
20 sluice gates 20,21 may be powered by hydraulic or
21 pneumatic means as desired, and may be remotely
22 controlled.

23
24 A discharge outlet opening 22 is formed in the side
25 wall of the cylindrical chamber 12 to facilitate
26 centrifugal expulsion of the material by the
27 impeller 16 and is connected in fluid communication
28 with an outlet conduit 23 by means of mating flanges
29 22f and 23f. The discharge outlet 22 and outlet
30 conduit 23 extend outwardly and upwardly from the
31 cylindrical chamber 12 and a flange 24 is secured on
32 the upward facing end of the outlet conduit 23 which

1 connects to a mating flange 25 of a generally S-
2 shaped discharge conduit 26. It should be
3 understood that the flange 24 of the discharge
4 outlet conduit 23 may be eliminated and the
5 discharge outlet conduit 23 and discharge conduit 26
6 may be constructed as one piece.

7
8 As described hereinafter, the pump 10 is placed into
9 and manipulated in a tank containing the waste
10 materials and drill cuttings. In operation, the
11 motor 13 rotates the impeller 16 in the pump chamber
12 12. The portion of the blades of the impeller 16
13 extending outside the inlet 15 of the chamber 12
14 serve to break up large lumps of debris. The legs 17
15 keep the lower portion of the impeller blades 16 off
16 the bottom of the tank preventing damage to them,
17 and keep the pump inlet 15 free from large lumps of
18 debris which may occlude it. The circulation ports
19 18,19 can be opened by the gates 20,21 so that the
20 impeller 16 discharges the material centrifugally
21 through the circulation ports and back into the tank
22 in opposite directions. This can be useful in
23 mixing a non-homogenous material before it is ready
24 to be pumped. Once the material to be pumped is
25 generally homogenous, the circulation ports 18,19
26 can be closed by the gates 20,21 so that the
27 impeller 16 drives the fluid centrifugally outward
28 from the side wall of the chamber 12 into the outlet
29 22 and through the outlet conduit 23 to the
30 discharge conduit 26.

31

1 The discharge conduit 26 can be connected by
2 conventional means to a discharge hose (not shown)
3 whose outlet(s) terminates in a holding tank on a
4 boat or other vehicle which conveys the waste
5 materials and drill cuttings recovered from the
6 wellbore to a decontamination facility, storage
7 facility, re-injection well, or other type of
8 disposal or processing facility. One or more
9 hydraulic, electric, gas or diesel powered booster
10 pumps may also be installed in the discharge line to
11 facilitate moving the material long distances.

12
13 Fig. 5 shows an embodiment of the pump 10 wherein
14 the discharge conduit 26 is connected to a motorised
15 swivel joint 27 by which the pump 10 can be rotated
16 in a tank to access all areas of the tank floor.
17 Another section of discharge conduit 28 is secured
18 above the swivel joint 27 and attached to a mounting
19 frame 29 which is connected to a crane arm 30. The
20 crane arm 30 may be mounted on a structural
21 component of the rig adjacent to a holding tank or
22 other suitable structure. The crane arm 30 is used
23 to place the pump 10 into a tank, to move it from
24 one end of the tank to the other, to raise and lower
25 it within the tank to access various levels in the
26 tank, and to remove it from one tank and place it in
27 another tank.

28
29 Fig. 6 shows a side view of another modification of
30 the pump 10A having like parts as the pump 10 which
31 will not be described further here, but which are
32 designated by the same numerals of reference. In

1 this modification, the discharge conduit 26B leading
2 from the flange 24 of the outlet conduit 23 has a
3 tee or Y-fitting 37 installed in the discharge line
4 to allow flow through the discharge conduit 26A
5 and/or flow through the leg 37A of the fitting 37.
6 Valves 38 and 39 (represented schematically) are
7 provided on the leg 37A and above the fitting 37,
8 respectively, so as to allow or restrict flow
9 through the respective portions of the discharge
10 conduit 26B or leg 37A. A curved section of
11 discharge conduit 26C is connected to the valve 38.
12 The conduit 26C is open-ended and discharges
13 material out of the pump and back into the tank or
14 other container from which the material is being
15 pumped, so as to enhance the flow of the material
16 being pumped and to exchange the upper layer of the
17 material with the lower layers.

18
19 By closing the valve 39 above the fitting 37, and
20 opening the valve 38 on the leg 37A, the pump
21 displaces fluid through the discharge conduit 26B
22 only as far as the closed valve 39, and thereafter
23 discharges it back into the container from which it
24 was pumped via the leg 37A and open-ended conduit
25 26C. It should be noted that the open end of the
26 conduit 26C is spaced above the inlet 15 at the
27 bottom of the pump 10A, and thus this configuration
28 allows the material being pumped to be re-circulated
29 through the pump chamber 12 and through the outlet
30 22 and outlet conduit 23 out through the leg 37A and
31 back into the container or tank in order to
32 homogenize the material further if desired. The

1 discharge conduit 26C may alternatively be connected
2 to the valve 38 on the leg 37A of the fitting 37 by
3 a swivel connection 40 (represented in dashed line)
4 to allow the direction in which the open end of the
5 conduit 26C faces to be adjusted so that the
6 material discharged from the pump when the valve 38
7 is open can be distributed over a wide area in the
8 container or tank from which the material is being
9 pumped.

10

11 If desired, the valve 38 on the leg 37A can be
12 closed, and the valve 39 at the top of the fitting
13 37 can be opened to allow pumping as normal, and in
14 certain cases, both valves can be fully or partially
15 open to various extents as desired, in order to
16 control the extent of material removed via the
17 discharge conduit 26B and the amount of material re-
18 circulated via the leg 37A. It should be understood
19 that the valves may be operated by hydraulic or
20 pneumatic means as desired, and may be remotely
21 controlled.

22

23 Circulation ports are rendered unnecessary by the
24 discharge from the leg 37A, but providing the
25 modified pump 10A shown in Fig. 6 both with
26 circulation ports 18,19 and with the auxiliary
27 discharge leg 37A produces an additional advantage
28 in that it allows the sluice gates 20,21 to be
29 opened when the pump is deep in the solids layer of
30 a tank of material to slurry the thick viscous lower
31 layers, and the conduit 26C on the leg 37A can be
32 used to expel material with some force in order to

1 increase the turbulence at the surface of the
2 material being pumped, thereby exchanging the
3 material in the upper and lower layers more
4 effectively, increasing the homogeneity of the
5 material at two locations and making it easier to
6 pump through the discharge conduit 26B. The
7 advantage of the elevated position of the conduit
8 26C on the leg 37A and its ability to swivel is that
9 the material discharged through the leg 37A can be
10 expelled over a wide area some distance away from
11 the pump enabling larger pits and tanks to be
12 treated without excessive movement of the pump
13 within the tank. The angle of the discharge leg 37A
14 can be adjustable to accommodate extra variation in
15 the desired trajectory of the material expelled from
16 the discharge leg 37A.

17
18 As shown in dashed line, the pump 10A may be
19 provided with a tee or Y-fitting 41 and valves 43 at
20 any location in the discharge line, with the fitting
21 41 connected with a conduit 44 having an outlet that
22 can be positioned to discharge materials back into
23 the tank. It should be understood that the
24 embodiment of Fig. 6 having an auxiliary discharge
25 conduit for returning materials to the tank may also
26 be provided with a swivel joint (as shown in Fig. 5)
27 above or below the fitting 41 and may be manipulated
28 a crane arm or by a winch and cable. It should be
29 noted that the T- or Y- piece can be disposed at any
30 location in the discharge line, and does not require
31 valves or a leg, but simply an aperture, preferably
32 in the ascending limb of the discharge line.

1
2 It should also be understood that one or more
3 booster pumps may also be disposed in the discharge
4 line or elsewhere, so that the apparatus can be used
5 to move material long distances. The same pump and
6 impeller as described in the examples above can be
7 used as a booster pump in the discharge line, by
8 modifying it to remove the sluice gates, and using a
9 hydraulic, electric, gas or diesel motor, as can be
10 used for the pump as shown in the embodiments
11 described. In certain embodiments the booster pump
12 used can be further modified to include one or more
13 fluid injector lines, e.g. a gas injector line and a
14 liquid injector line in the booster pump, which can
15 inject fluid such as compressed air or water into
16 the stream of material passing through the booster
17 pump in the same direction as the stream of
18 material. The gas injection (e.g. compressed air)
19 can help to increase the velocity of the material
20 through the booster pump. The liquid injection
21 (e.g. pressurised water) can decrease the viscosity
22 of the material being pumped through the booster
23 pump, as well as increasing the velocity of the
24 material through the pump. The booster pump can be
25 powered by a hydraulic power source which can
26 usefully also power the lifting arm and the main
27 pump if desired.

28
29 In operation, the pump 10, 10A, is used for mixing
30 and conveying drill cuttings in a tank and
31 transferring them from the tank. During the mixing
32 operation, the circulation ports 18,19 may be opened

1 independently from one another, or together, and to
2 different extents, by moving the respective sluice
3 gates 20,21 in order to provide an exit from the
4 pump chamber 12. This allows the rotating impeller
5 16 to stir up a slurry in the chamber 12. With the
6 circulation ports 18,19 at least partially open, the
7 material entering the inlet 15 to the chamber 12 and
8 being agitated by the impeller 16 is forced out of
9 the circulation ports so that the material in the
10 tank is stirred for easier pumping. The pump can
11 operate in the stirring mode for sufficient time
12 until the material to be removed is generally
13 homogenous, whereupon the circulation ports can be
14 closed, allowing the impeller to direct the slurry
15 through the outlet 22 of the chamber into the
16 discharge conduit 26, 26B.

17
18 The provision of two circulation ports, and
19 particularly when they are approximately 180° apart
20 from one another equalises the forces exerted on the
21 pump while it is in a slurring mode. The slurring
22 mode can be combined with a discharge mode by simply
23 opening the circulation ports to the degree required
24 to mix to a slurry the material to be pumped while
25 the material is being pumped out through the
26 discharge line.

27
28 In addition to using the present apparatus to mix
29 and/or transfer waste material and drill cuttings
30 from holding tanks located at the well site such as
31 on an offshore drilling rig to holding tanks on a
32 vehicle such as a ship or boat, the apparatus may

1 also be used on the transporting vehicle or on land
2 to mix and/or transfer the materials from the
3 transported tanks on the vehicle to land based tanks
4 at the processing or storage facility, or to tanks
5 on land based vehicles such as portable tanks
6 located on trucks at the quayside etc. The land
7 based facility and/or the vehicles may have lifting
8 arms with pumps as described above to transfer the
9 drill cuttings between the holding tanks etc and the
10 land based facility.

11
12 Figs. 7 to 15 show details of a cuttings storage and
13 mixing tank 70 intended for a ship or other carrier
14 and into which the end of the discharge tube 26 or
15 discharge hose (not shown) can terminate. The tank
16 70 comprises a top 77, base 76, side 75 and end
17 frame, the top frame having a manifold 72 for
18 connection of a discharge tube if desired, and a
19 lid. The side frames 75 (Fig. 15), base 76 and top
20 frame 77 have struts 78 for retaining a series of
21 baffles 79, which are typically disposed at
22 intervals along the base 76 and top 77 frames so as
23 to prevent displacement of the contents of the tank
24 while the baffles are in place. The baffles 79 can
25 be removed from the struts 78 if desired to enable
26 the tank 70 to be emptied by a suction pump 10
27 attached to a crane arm 30 (as shown in Fig. 5) or
28 to a winch and cable once the tank 70 has reached
29 its destination at the decontamination plant and the
30 cuttings are to be removed therefrom.

31

1 While this invention has been described fully and
2 completely with special emphasis upon preferred
3 embodiments, it should be understood that within the
4 scope of the appended claims the invention may be
5 practised otherwise than as specifically described
6 herein.
7

1 Claims

2
3 1 Apparatus for handling drill cuttings in a tank
4 and transferring them therefrom, the apparatus
5 comprising; pump means (10, 10A, 10B) having a
6 chamber (12), an inlet (15) opening into said
7 chamber (12), a rotatable impeller (16)
8 disposed in the chamber (12) and being driven
9 by a motor (13) to draw drill cuttings
10 contained in the tank into the chamber (12), a
11 discharge outlet (22) on one side of said
12 chamber (12) and manipulating means operatively
13 associated with the pump means for moving at
14 least the inlet (15) of the pump means (10,
15 10A, 10B) vertically, horizontally, and/or
16 laterally within the tank;
17 wherein the manipulating means includes swivel means
18 for orienting the pump means within the tank.

19
20 2 Apparatus as claimed in claim 1, having
21 discharge conduit means (26, 26A, 26B) connected
22 with the discharge outlet (22) for conveying drill
23 cuttings from the chamber (12) to a location outside
24 of the tank.

25
26 3 Apparatus according to claim 1 or claim 2,
27 wherein the swivel means rotates the pump means (10,
28 10A, 10B) on a vertical axis thereof within the
29 tank.

30
31 4 Apparatus according to any preceding claim,
32 wherein the manipulating means is capable of moving

1 the pump means (10, 10A, 10B) into the tank and
2 removing it therefrom.

3

4 5 Apparatus according to any preceding claim,
5 having at least one port (18,19) on a side of the
6 pump chamber (12) to permit movement of drill
7 cuttings from the chamber (12) back into the tank.

8

9 6 Apparatus as claimed in claim 5 having two or
10 more ports (18,19) circumferentially spaced from one
11 another on the wall of the chamber (12).

12

13 7 Apparatus as claimed in claim 5 or claim 6,
14 having gate means (20,21) cooperating with at least
15 one port (18,19) to control movement of drill
16 cuttings through the or each port (18,19).

17

18 8 Apparatus as claimed in claim 7, wherein two or
19 more ports (18,19) are provided, each with
20 respective gate means (20,21), and wherein the gate
21 means (20,21) can be controlled independently of one
22 another.

23

24 9 Apparatus as claimed in any one of claims 5-8,
25 wherein two or more ports (18,19) are provided and
26 are disposed on respectively opposite sides of the
27 chamber (12).

28

29 10 Apparatus according to any preceding claim,
30 wherein the impeller (16) extends below the chamber
31 inlet (15) to break up clumps of drill cuttings in
32 the vicinity of the inlet (15).

1

2 11 Apparatus according to any preceding claim,
3 having auxiliary discharge means (26C) connected to
4 the discharge outlet (22) and having an outlet for
5 returning at least some of the drill cuttings pumped
6 out of the chamber outlet back into the tank.

7

8 12 Apparatus according to claim 11, wherein the
9 orientation of the outlet of the auxiliary discharge
10 means can be adjusted to orient it in different
11 directions.

12

13 13 Apparatus according to claim 11 or 12, having
14 valve means (38, 39) operatively associated with the
15 auxiliary discharge means (26C) to control movement
16 of drill cuttings through the auxiliary discharge
17 means (26C).

18

19 14 Apparatus as claimed in any preceding claim,
20 wherein at least the pump inlet (15) is mounted on a
21 movable arm (30).

22

23 15 A method for moving drill cuttings from a
24 holding tank to a vehicle, the method comprising the
25 steps of locating a pump means (10, 10A, 10B) in the
26 tank, swivelling the pump means (10, 10A, 10B) in
27 the tank, and pumping the drill cuttings from an
28 inlet (15) in the pump means (10, 10A, 10B) to a
29 tank disposed on the vehicle.

30

1 16 A method according to claim 15, wherein the
2 drill cuttings are pumped using apparatus as claimed
3 in any preceding claim.

4
5 17 A method according to claim 15 or claim 16,
6 wherein the material is agitated by the pump (10,
7 10A, 10B), and ejected therefrom back onto the tank.

8
9 18 A method according to any one of claims 15-17,
10 wherein the pump (10, 10A, 10B) has at least one
11 port (18, 19) which is at least partially opened
12 during a stirring phase of the method, and at least
13 partially closed during a second pumping phase of
14 the method to direct the material through a side
15 outlet (22) of the chamber (12).

16
17 19 A method according to any one of claims 15-18,
18 wherein at least some material pumped out of the
19 outlet (22) of the chamber (12) is returned to the
20 tank through a discharge opening.

21
22 20 A method according to any one of claims 15-19,
23 wherein the pump (10, 10A, 10B) is mounted on a
24 movable arm (30) and is moved by the arm (30) in the
25 tank during the method.

26
27 21 A method as claimed in any one of claims 15-20,
28 including the step of manipulating the pump (10,
29 10A, 10B) during the method by raising and lowering
30 it vertically and/or moving it horizontally and
31 laterally within the tank to position the inlet (15)

1 of the pump (10, 10A, 10B) in different levels of
2 liquid and solid phases of drill cuttings.

3

4 22 A method according to any one of claims 15-23,
5 including the further step of removing the pump (10,
6 10A, 10B) from the tank.

7

8 23 A method according to claim 22, including the
9 further step of placing the pump (10, 10A, 10B) into
10 a second tank containing drill cuttings after
11 removing it from the said tank, and thereafter
12 repeating the claimed steps.

13

14 24 A method according to any one of claims 15-23,
15 wherein the pump apparatus has at least one
16 circulation port (18, 19), and wherein a portion of
17 the drill cuttings are re-circulated through the
18 port (18, 19) back into the tank.

19

20 25 A method according to claim 24, wherein another
21 portion of drill cuttings is discharged from the
22 chamber (12) through the discharge outlet (22) of
23 the pump (10, 10A, 10B) while the said portion of
24 drill cuttings is being re-circulated back into the
25 tank.

26

27 26 A method according to claim 24 or 25, wherein
28 the pump (10, 10A, 10B) has gate means (20, 21)
29 associated with the or each port (18, 19), and
30 wherein the gate means (20, 21) on at least one port
31 (18, 19) is controlled to adjust the amount of drill
32 cuttings that are re-circulated back into the tank.

1
2 27 A method according to any one of claims 15-26,
3 wherein the pump (10, 10A, 10B) has auxiliary
4 discharge means (26C) connected in fluid
5 communication with said discharge conduit means (26,
6 26A, 26B) with an outlet positioned to direct fluid
7 flow onto the top surface of the drill cuttings in
8 said tank; and wherein the method includes the step
9 of directing a portion of the drill cuttings being
10 discharged through the auxiliary discharge means
11 (26C) onto the top surface to agitate the drill
12 cuttings contained in the tank.

13
14 28 A method according to claim 27, wherein the
15 orientation of the outlet of the auxiliary discharge
16 means (26C) is adjusted to distribute said portion
17 of drill cuttings being discharged into the top
18 surface over a wide area within the tank.

19
20 29 A method according to claim 27 or 28, wherein
21 the auxiliary discharge means (26C) includes valve
22 means (38, 39) and the method includes the further
23 step of controlling the amount of drill cuttings
24 discharged through the auxiliary discharge means
25 (26C) back into the tank.

26
27 30 A method according to any one of claims 15-29,
28 wherein at least a portion of the material being
29 pumped is re-circulated back into the tank during a
30 stirring phase of the method, and at least some of
31 the material being pumped is expelled through a

1 discharge outlet (22) of the pump (10, 10A, 10B)
2 during a second pumping phase of the method.

3

4 31 Apparatus as according to any one of claims 1-
5 15, which further comprises a tank (70) for
6 containing drill cuttings in a ship or other
7 vehicle, the tank (70) having baffles (79) to resist
8 displacement of the drill cuttings during transport,
9 and at least one or more of the baffles (79) being
10 removable from the tank (70).

11

12

13