

1 APPARATUS AND METHOD FOR MIXING DRILL CUTTINGS IN A
2 TANK AND TRANSFERRING THEM THEREFROM
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4

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

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 pits
4 are used to store drilling waste and drill cuttings.

5
6 Another problem with handling waste materials and drill
7 cuttings is that after the materials are contained in
8 holding tanks the materials will separate into layers
9 with the upper layer containing fluids, a lower layer
10 containing solids, and an intermediate layer containing
11 solids suspended in fluids. This separation also
12 occurs in the containers or tanks that are used to
13 transport the materials to a remote location and
14 storage container where the materials await processing.
15 The separation of the fluids and solids makes it
16 difficult to remove the materials from the containers
17 or tanks.

18
19 The invention herein disclosed solves these problems by
20 providing in certain embodiments an environmentally
21 safe apparatus and method for slurring waste materials
22 and drill cuttings in a tank and transferring the waste
23 materials and drill cuttings from the tank.

24
25 By "slurring" we mean mixing a particulate suspension
26 to produce a slurry.

27
28 The invention provides a pump apparatus as claimed in
29 claim 1.

30

31 The invention also provides a method as claimed in
32 claim 16.

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 may be rotated by a swivel
18 connection and moved and manipulated in the tank from
19 end to end and top to bottom by a crane arm, or it may
20 be 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 cable or other means to
13 lower it into a tank or pit, and the discharge piping
14 can be resilient so as to allow free movement of the
15 pump.

16

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

25

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

30

31 The impeller can have cutters extending below the
32 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 pump
2 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 of
8 example and with reference to the accompanying drawings
9 in which:

10

11 Figs. 1a, 1b, 1c are left side, front, and rear
12 elevation views, respectively, of pump apparatus;
13 Fig 1d is an exploded side view of the pump
14 apparatus;

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

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

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

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

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

28 Figs. 6a and 6b are left side and front elevations
29 of an embodiment of the pump apparatus having a
30 lifting eye;

31 Fig. 7 is a left side elevation showing the pump
32 embodiment of Figs. 6a and 6b suspended in a tank

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

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

1 the drive shaft of the motor 13 is rotatably disposed
2 in the cylindrical chamber 12, and a lower portion of
3 the blades of the impeller extend downwardly through
4 the inlet opening 15 and terminate a distance below the
5 inlet. Legs 17 are secured to the sides of the pump
6 housing 11 and extend downwardly beyond the lower
7 portion of the blades of the impeller 16.

8
9 A pair of circulation ports 18,19 formed in the side
10 wall of the cylindrical chamber 12 extend laterally
11 outwardly from opposite sides of the pump housing 11.
12 The circulation ports 18,19 are circumferentially
13 spaced apart at approximately 180°. A pair of sluice
14 gates 20,21 are slidably mounted on the pump housing to
15 open and close fluid communication through the
16 circulation ports 18,19. The gates 20,21 are each
17 independently raised or lowered to different extents by
18 sluice levers 20A, 21A to expose a desired area of the
19 circulation ports 18,19. It should be understood that
20 the 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 impeller
27 16 and is connected in fluid communication with an
28 outlet conduit 23 by means of mating flanges 22f and
29 23f. The discharge outlet 22 and outlet conduit 23
30 extend outwardly and upwardly from the cylindrical
31 chamber 12 and a flange 24 is secured on the upward
32 facing end of the outlet conduit 23 which connects to a

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

6

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

29

30 The discharge conduit 26 can be connected by
31 conventional means to a discharge hose (not shown)
32 whose outlet(s) terminates in a holding tank on a boat

1 or other vehicle which conveys the waste materials and
2 drill cuttings recovered from the wellbore to a
3 decontamination facility, storage facility, re-
4 injection well, or other type of disposal or processing
5 facility. One or more hydraulic, electric, gas or
6 diesel powered booster pumps may also be installed in
7 the discharge line to facilitate moving the material
8 long distances.

9

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

24

25 Figs. 6a, 6b, and 7 show a modified embodiment of the
26 pump 10A having like features as the pump 10. The
27 common features are assigned the same numerals of
28 reference but will not be described again in detail.
29 The pump 10A has a pair of mounting brackets 31 secured
30 to the housing 11, with a pair of stabiliser bars 32
31 each pivotally connected at one end to a respective
32 mounting bracket, and connected at their other ends to

1 a lifting eye 33 to which a cable 34 for suspending the
2 pump can be attached so as to raise and lower the pump
3 in a tank, and to allow it to be moved around within
4 the tank. As shown in Fig. 7, the pump 10A can be
5 lowered into a tank T on a cable 34 supported by a
6 winch 35 mounted on a frame 36. The frame 36 may be
7 mounted on a structural component of the rig adjacent
8 to a holding tank or other suitable structure. A
9 flexible discharge conduit 26A may be connected at one
10 end to the flange 24 of the outlet conduit 23 and its
11 other end connected in fluid communication with a
12 holding tank on a boat or other carrier.

13

14 Fig. 8 shows a side view of another modification of the
15 pump 10B having like parts as the pump 10 which will
16 not be described further here, but which are designated
17 by the same numerals of reference. In this
18 modification, the discharge conduit 26B leading from
19 the flange 24 of the outlet conduit 23 has a tee or Y-
20 fitting 37 installed in the discharge line to allow
21 flow through the discharge conduit 26A and/or flow
22 through the leg 37A of the fitting 37. Valves 38 and
23 39 (represented schematically) are provided on the leg
24 37A and above the fitting 37, respectively, so as to
25 allow or restrict flow through the respective portions
26 of the discharge conduit 26B or leg 37A. A curved
27 section of discharge conduit 26C is connected to the
28 valve 38. The conduit 26C is open-ended and discharges
29 material out of the pump and back into the tank or
30 other container from which the material is being
31 pumped, so as to enhance the flow of the material being

1 pumped and to exchange the upper layer of the material
2 with the lower layers.
3
4 By closing the valve 39 above the fitting 37, and
5 opening the valve 38 on the leg 37A, the pump displaces
6 fluid through the discharge conduit 26B only as far as
7 the closed valve 39, and thereafter discharges it back
8 into the container from which it was pumped via the leg
9 37A and open-ended conduit 26C. It should be noted
10 that the open end of the conduit 26C is spaced above
11 the inlet 15 at the bottom of the pump 10B, and thus
12 this configuration allows the material being pumped to
13 be re-circulated through the pump chamber 12 and
14 through the outlet 22 and outlet conduit 23 out through
15 the leg 37A and back into the container or tank in
16 order to homogenize the material further if desired.
17 The discharge conduit 26C may alternatively be
18 connected to the valve 38 on the leg 37A of the fitting
19 37 by a swivel connection 40 (represented in dashed
20 line) to allow the direction in which the open end of
21 the conduit 26C faces to be adjusted so that the
22 material discharged from the pump when the valve 38 is
23 open can be distributed over a wide area in the
24 container or tank from which the material is being
25 pumped.
26
27 If desired, the valve 38 on the leg 37A can be closed,
28 and the valve 39 at the top of the fitting 37 can be
29 opened to allow pumping as normal, and in certain
30 cases, both valves can be fully or partially open to
31 various extents as desired, in order to control the
32 extent of material removed via the discharge conduit

1 26B and the amount of material re-circulated via the
2 leg 37A. It should be understood that the valves may
3 be operated by hydraulic or pneumatic means as desired,
4 and may be remotely controlled.

5

6 Circulation ports are rendered unnecessary by the
7 discharge from the leg 37A, but providing the modified
8 pump 10B shown in Fig. 8 both with circulation ports
9 18,19 and with the auxiliary discharge leg 37A produces
10 an additional advantage in that it allows the sluice
11 gates 20,21 to be opened when the pump is deep in the
12 solids layer of a tank of material to slurry the thick
13 viscous lower layers, and the conduit 26C on the leg
14 37A can be used to expel material with some force in
15 order to increase the turbulence at the surface of the
16 material being pumped, thereby exchanging the material
17 in the upper and lower layers more effectively,
18 increasing the homogeneity of the material at two
19 locations and making it easier to pump through the
20 discharge conduit 26B. The advantage of the elevated
21 position of the conduit 26C on the leg 37A and its
22 ability to swivel is that the material discharged
23 through the leg 37A can be expelled over a wide area
24 some distance away from the pump enabling larger pits
25 and tanks to be treated without excessive movement of
26 the pump within the tank. The angle of the discharge
27 leg 37A can be adjustable to accommodate extra
28 variation in the desired trajectory of the material
29 expelled from the discharge leg 37A.

30

31 As shown in dashed line, the pump 10B may be provided
32 with a tee or Y-fitting 41 and valves 43 at any

1 location in the discharge line, with the fitting 41
2 connected with a conduit 44 having an outlet that can
3 be positioned to discharge materials back into the
4 tank. It should be understood that the embodiment of
5 Fig. 8 having an auxiliary discharge conduit for
6 returning materials to the tank may also be provided
7 with a swivel joint (as shown in Fig. 5) above or below
8 the fitting 41 and may be manipulated a crane arm or by
9 a winch and cable (as shown in Fig. 7). It should be
10 noted that the T- or Y- piece can be disposed at any
11 location in the discharge line, and does not require
12 valves or a leg, but simply an aperture, preferably in
13 the ascending limb of the discharge line.

14
15 It should also be understood that one or more booster
16 pumps may also be disposed in the discharge line or
17 elsewhere, so that the apparatus can be used to move
18 material long distances. The same pump and impeller as
19 described in the examples above can be used as a
20 booster pump in the discharge line, by modifying it to
21 remove the sluice gates, and using a hydraulic,
22 electric, gas or diesel motor, as can be used for the
23 pump as shown in the embodiments described. In certain
24 embodiments the booster pump used can be further
25 modified to include one or more fluid injector lines,
26 e.g. a gas injector line and a liquid injector line in
27 the booster pump, which can inject fluid such as
28 compressed air or water into the stream of material
29 passing through the booster pump in the same direction
30 as the stream of material. The gas injection (e.g.
31 compressed air) can help to increase the velocity of
32 the material through the booster pump. The liquid

1 injection (e.g. pressurised water) can decrease the
2 viscosity of the material being pumped through the
3 booster pump, as well as increasing the velocity of the
4 material through the pump. The booster pump can be
5 powered by a hydraulic power source which can usefully
6 also power the lifting arm and the main pump if
7 desired.

8

9 In operation, the pump 10, 10A, 10B is used for mixing
10 and conveying drill cuttings in a tank and transferring
11 them from the tank. During the mixing operation, the
12 circulation ports 18,19 may be opened independently
13 from one another, or together, and to different
14 extents, by moving the respective sluice gates 20,21 in
15 order to provide an exit from the pump chamber 12.
16 This allows the rotating impeller 16 to stir up a
17 slurry in the chamber 12. With the circulation ports
18 18,19 at least partially open, the material entering
19 the inlet 15 to the chamber 12 and being agitated by
20 the impeller 16 is forced out of the circulation ports
21 so that the material in the tank is stirred for easier
22 pumping. The pump can operate in the stirring mode for
23 sufficient time until the material to be removed is
24 generally homogenous, whereupon the circulation ports
25 can be closed, allowing the impeller to direct the
26 slurry through the outlet 22 of the chamber into the
27 discharge conduit 26, 26A, 26B.

28

29 The provision of two circulation ports, and
30 particularly when they are approximately 180° apart
31 from one another equalises the forces exerted on the
32 pump while it is in a slurring mode. The slurring

1 mode can be combined with a discharge mode by simply
2 opening the circulation ports to the degree required to
3 mix to a slurry the material to be pumped while the
4 material is being pumped out through the discharge
5 line.

6
7 In addition to using the present apparatus to mix
8 and/or transfer waste material and drill cuttings from
9 holding tanks located at the well site such as on an
10 offshore drilling rig to holding tanks on a vehicle
11 such as a ship or boat, the apparatus may also be used
12 on the transporting vehicle or on land to mix and/or
13 transfer the materials from the transported tanks on
14 the vehicle to land based tanks at the processing or
15 storage facility, or to tanks on land based vehicles
16 such as portable tanks located on trucks at the
17 quayside etc. The land based facility and/or the
18 vehicles may have lifting arms with pumps as described
19 above to transfer the drill cuttings between the
20 holding tanks etc and the land based facility.

21
22 Figs. 9 to 17 show details of a cuttings storage and
23 mixing tank 70 intended for a ship or other carrier and
24 into which the end of the discharge tube 26 or
25 discharge hose (not shown) can terminate. The tank 70
26 comprises a top 77, base 76, side 75 and end frame, the
27 top frame having a manifold 72 for connection of a
28 discharge tube 26A if desired, and a lid. The side
29 frames 75 (Fig. 17), base 76 and top frame 77 have
30 struts 78 for retaining a series of baffles 79, which
31 are typically disposed at intervals along the base 76
32 and top 77 frames so as to prevent displacement of the

1 contents of the tank while the baffles are in place.
2 The baffles 79 can be removed from the struts 78 if
3 desired to enable the tank 70 to be emptied by a
4 suction pump 10 attached to a crane arm 30 or to a
5 winch and cable 35, 34 as shown in Figs.5 and 7
6 respectively once the tank 70 has reached its
7 destination at the decontamination plant and the
8 cuttings are to be removed therefrom.

9
10 While this invention has been described fully and
11 completely with special emphasis upon preferred
12 embodiments, it should be understood that within the
13 scope of the appended claims the invention may be
14 practiced otherwise than as specifically described
15 herein.
16



1 Claims:

2

3 1 Apparatus for handling drill cuttings in a tank
4 and transferring them therefrom, the apparatus
5 comprising; pump means having a chamber, an inlet
6 opening into said chamber, a rotatable impeller
7 disposed in the chamber and being driven by a motor to
8 draw drill cuttings contained in the tank into the
9 chamber, and a discharge outlet on one side of said
10 chamber.

11

12 2 Apparatus as claimed in claim 1, having discharge
13 conduit means connected with the discharge outlet for
14 conveying drill cuttings from the chamber to a location
15 outside of the tank.

16

17 3 Apparatus as claimed in claim 1 or claim 2, having
18 manipulating means operatively associated with the pump
19 means for moving at least the inlet of the pump means
20 vertically, horizontally, and/or laterally within the
21 tank.

22

23 4 Apparatus according to claim 3, wherein the
24 manipulating means includes swivel means for orienting
25 the pump means in different directions within the tank.

26

27 5 Apparatus according to claim 3 or claim 4, wherein
28 the manipulating means is capable of moving the pump
29 means into the tank and removing it therefrom.

30

31 6 Apparatus according to any preceding claim, having
32 at least one port on a side of the pump chamber to



1 permit movement of drill cuttings from the chamber back
2 into the tank.

3

4 7 Apparatus as claimed in claim 6 having two or more
5 ports circumferentially spaced from one another on the
6 wall of the chamber.

7

8 8 Apparatus as claimed in claim 6 or claim 7, having
9 gate means cooperating with at least one port to
10 control movement of drill cuttings through the or each
11 port.

12

13 9 Apparatus as claimed in claim 8, wherein two or
14 more ports are provided, each with respective gate
15 means, and wherein the gate means can be controlled
16 independently of one another.

17

18 10 Apparatus as claimed in any one of claims 6-9,
19 wherein two or more ports are provided and are disposed
20 on respectively opposite sides of the chamber.

21

22 11 Apparatus according to any preceding claim,
23 wherein the impeller extends below the chamber inlet to
24 break up clumps of drill cuttings in the vicinity of
25 the inlet.

26

27 12 Apparatus according to any preceding claim, having
28 auxiliary discharge means connected to the discharge
29 outlet and having an outlet for returning at least some
30 of the drill cuttings pumped out of the chamber outlet
31 back into the tank.

32



1 13 Apparatus according to claim 12, wherein the
2 orientation of the outlet of the auxiliary discharge
3 means can be adjusted to orient it in different
4 directions.

5
6 14 Apparatus according to claim 12 or 13, having
7 valve means operatively associated with the auxiliary
8 discharge means to control movement of drill cuttings
9 through the auxiliary discharge means.

10
11 15 Apparatus as claimed in any preceding claim,
12 wherein at least the pump inlet is mounted on a movable
13 arm.

14
15 16 A method for moving drill cuttings from a holding
16 tank to a vehicle, comprising pumping the drill
17 cuttings from an inlet in the holding tank to a tank
18 disposed on the vehicle.

19
20 17 A method according to claim 16, wherein the drill
21 cuttings are pumped using apparatus as claimed in any
22 preceding claim.

23
24 18 A method according to claim 16 or claim 17,
25 wherein the material is agitated by the pump, and
26 ejected therefrom back onto the tank.

27
28 19 A method according to any one of claims 16-18,
29 wherein the pump has at least one port which is at
30 least partially opened during a stirring phase of the
31 method, and at least partially closed during a second



1 pumping phase of the method to direct the material
2 through a side outlet of the chamber.

3

4 20 A method according to any one of claims 16-19,
5 wherein at least some material pumped out of the outlet
6 of the chamber is returned to the tank through a
7 discharge opening.

8

9 21 A method according to any one of claims 16-20,
10 wherein the pump inlet is moved in the tank during the
11 method.

12

13 22 A method according to any one of claims 16-21,
14 wherein the pump is mounted on a movable arm and is
15 moved by the arm in the tank during the method.

16

17 23 A method as claimed in any one of claims 16-22,
18 including the step of manipulating the pump during the
19 method by raising and lowering it vertically and/or
20 moving it horizontally and laterally within the tank to
21 position the inlet of the pump in different levels of
22 liquid and solid phases of drill cuttings.

23

24 24 A method according to claim 23, wherein the step
25 of manipulating the pump includes rotating and
26 swivelling the pump within the tank.

27

28 25 A method according to any one of claims 16-24,
29 including the further step of removing the pump from
30 the tank.

31



1 26 A method according to claim 25, including the
2 further step of placing the pump into a second tank
3 containing drill cuttings after removing it from the
4 said tank, and thereafter repeating the claimed steps.

5
6 27 A method according to any one of claims 16-26,
7 wherein the pump apparatus has at least one circulation
8 port, and wherein a portion of the drill cuttings are
9 re-circulated through the port back into the tank.

10
11 28 A method according to claim 27, wherein another
12 portion of drill cuttings is discharged from the
13 chamber through the discharge outlet of the pump while
14 the said portion of drill cuttings is being re-
15 circulated back into the tank.

16
17 29 A method according to claim 27 or 28, wherein the
18 pump has gate means associated with the or each port,
19 and wherein the gate means on at least one port is
20 controlled to adjust the amount of drill cuttings that
21 are re-circulated back into the tank.

22
23 30 A method according to any one of claims 16-29,
24 wherein the pump has auxiliary discharge means
25 connected in fluid communication with said discharge
26 conduit means with an outlet positioned to direct fluid
27 flow onto the top surface of the drill cuttings in said
28 tank; and wherein the method includes the step of
29 directing a portion of the drill cuttings being
30 discharged through the auxiliary discharge means onto
31 the top surface to agitate the drill cuttings contained
32 in the tank.



1 31 A method according to claim 30, wherein the
2 orientation of the outlet of the auxiliary discharge
3 means is adjusted to distribute said portion of drill
4 cuttings being discharged into the top surface over a
5 wide area within the tank.

6

7 32 A method according to claim 30 or 31, wherein the
8 auxiliary discharge means includes valve means and the
9 method includes the further step of controlling the
10 amount of drill cuttings discharged through the
11 auxiliary discharge means back into the tank.

12

13 33 A method according to any one of claims 16-33,
14 wherein at least a portion of the material being pumped
15 is re-circulated back into the tank during a stirring
16 phase of the method, and at least some of the material
17 being pumped is expelled through a discharge outlet of
18 the pump during a second pumping phase of the method.

19

20 34 A tank for containing drill cuttings in a ship or
21 other vehicle, the tank having baffles to resist
22 displacement of the drill cuttings during transport,
23 and at least one or more of the baffles being removable
24 from the tank.

25

26

27

28

29

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31