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Rotating vacuum tank and method

Abstract

A vacuum tank with a rear door, and air and material hoses connectable to the tank door. The tank is rotatable, while the door remains stationary. Liquid, particulate, or slurry material can be vacuumed into the rotating tank, without twisting the hoses. Additional water and/or drying agent can be added to the tank to create a slurry mixture, which can then be discharged from the tank at a convenient dump or work site. The tank may be mounted on a truck, trailer, or frame for transport to a job site and the dump or work site. In an alternative embodiment, the tank may be tilted end-to-end between fill and discharge positions.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application is a Continuation-in-Part Application of U.S. Ser. No. 18/581,854, filed Feb. 20, 2024, which is herein incorporated by reference in its entirety.

TECHNICAL FIELD

(1) The invention relates to a rotatable vacuum tank into which liquid or particulate material is vacuumed and mixed with additional particulate or liquid material, respectively, to create a slurry mixture which can be disposed in an environmentally safe manner.

BACKGROUND

(2) Vacuum equipment is used for hydro-excavation, hazardous waste cleanup, and the like. In the industry of underground pipe repair and replacement, contractors often utilize portable vacuum machines to locate existing utilities and prevent damage thereto. Vacuums are also used to remove slurry material in underground horizontal directional drilling projects.

(3) A vacuum hose suctions liquid or particular material into a stationary tank. The material in the tank may be combined with additional solid or liquid materials to create a slurry, and so as to minimize environmental risks upon disposal of the slurry mixture. The tank may be mounted on a truck or trailer for portability. Mixing paddles or augurs may be provided inside the tank to stir and mix the vacuumed materials with the added materials. The truck or trailer with the tank of slurry mixture is then hauled to a dumpsite for discharge. Depending on the location of the project and the type of material being removed, dump sites may be located long distances from the job site and can have expensive dumping fees, both of which add to the cost of the project. Asbestos-containing

matter, such as old underground pipe, also must be handled according to governmental regulations to reduce risk to the operators and to the environment.
(4) Therefore, the primary objective of the present invention is the provision of a rotating vacuum tank into which vacuumed liquids and solids are mixed with additional solids or liquids, respectively, to create a neutralized slurry mixture which can then be safely discharged in a convenient location without environmental risks.
(5) Another objective of the present invention is the provision of an improved vacuum tank and vacuum process which minimizes costs.
(6) A further object of the present invention is the provision of a rotating vacuum tank and vacuum process which is safe, efficient, and environmentally responsible for removing and disposing of various materials from project jobsites.
(7) Still another objective of the invention is the provision of a tank for mixing particulate and liquid materials wherein the tank is rotatable about a longitudinal axis and pivot about a lateral axis.
(8) Yet another objective for the invention is the provision of a vacuum tank having material inlet and a material outlet, both on the same end of the tank.
(9) A further objective of the present invention is the provision of a vacuum tank having a vacuum source for introducing materials into the tank and for discharging materials from the tank.
(10) Another objective of the present invention is the provisional of a rotatable vacuum tank having a scale system to weigh materials in the tank.
(11) These and/or other objects, features, advantages, aspects, and/or embodiments will become apparent to those skilled in the art after reviewing the following brief and detailed descriptions of the drawings. The present disclosure encompasses (a) combinations of disclosed aspects and/or embodiments and/or (b) reasonable modifications not shown or described.
SUMMARY
(12) A rotatable vacuum tank is used for removal of waste materials and for mixing raw materials for the production of concrete or similar slurry based products. The tank has front and rear ends. A drive assembly is operably connected to the front end of the tank to rotate the tank. The rear end of the tank includes a door with one or more ports to which hoses are connected to vacuum materials into the tank and to discharge materials from the tank. The door is mounted on a bearing sleeve, such that the door is stationary as the tank rotates, to prevent twisting of the hoses. The swivel connection of the door sleeve is hinged to the tank, such that the door can be moved between opened and closed positions. A vacuum source and a pressure source apply vacuum or pressure, respectively, inside the tank. The vacuumed material may be a liquid or particulate. Water or other liquids may be added to the tank to mix with the vacuumed particulate material to form a slurry mixture. Alternatively, a drying agent or other solids may be added to liquid in the tank to form a slurry mixture. The slurry mixture can then be discharged, without the release or risk of airborne particles, and the discharge material is allowed to harden. The dump or work site for the slurry material may be a field, an empty lot, or back filling excavations at a project site. The tank may be mounted on a truck or trailer for portability. In an alternative embodiment, the tank is mounted on a frame which can be moved by a fork truck or other lift vehicle. The tank may also be pivotal end-to-end about a lateral axis, while the tank is rotated, between a fill position wherein the inlet/outlet end of the tank is raised and a discharge position wherein the inlet/outlet end of the tank is lowered. A scale may be provided to weigh materials inside the tank.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1** is a side elevation view of the vacuum tank according to the present invention.

(2) FIG. **2** is a side elevation enlarged view of the rotatable tank shown in FIG. **1**.
(3) FIG. **3** is a rear end view of the tank door and bearing sleeve.
(4) FIG. **4** is a schematic flow chart illustrating the method of the present invention.
(5) FIG. **5** is a side elevation view of an alternative embodiment of the vacuum tank, with the tank pivoted or tilted to a fill position.
(6) FIG. **6** is a side elevation view of the alternative embodiment tank in a neutral or level position.
(7) FIG. **7** is a side elevation view of the alternative embodiment tank pivoted or tilted to a discharge position.
(8) FIG. **8** is a view showing one embodiment of a screw mixer for the inside of the tank.
(9) FIG. **9** is an exploded view showing a weigh scale base for weighing the contents of the vacuum tank.
(10) FIG. **10** is an exploded perspective view of one embodiment of inlet/outlet swivel structure for the tank.

DETAILED DESCRIPTION

(11) A truck for transporting the rotatable vacuum tank of the present invention is generally designated by the reference numeral **10** in the drawings. The truck **10** includes a chassis **12** and a cab **14**, which are conventional. A rotatable tank **16** is mounted on the chassis **12**. The truck **10** includes a powered drive assembly **18** to rotate the tank **16**. One example of the drive assembly **18** is shown in FIG. **1**, wherein a motor **20** has an output shaft operably connected to a sprocket and chain **24** on the front end **26** of the tank **16**. Alternatively, the drive assembly **18** may be a hydraulic drive system, an electric motor, a gasoline engine, or a manual drive. As an alternative to the truck **10**, the tank **16** may be rotatably mounted on a trailer to be pulled by a truck.
(12) The tank **16** is supported on rollers similar to the tank of a ready-mix cement truck. Unlike a ready-mix tank, the tank **16** includes a door **28** mounted in a sleeve assembly **30** on the rear end **27** of the tank. The sleeve assembly **30** includes an outer sleeve **32** attached to the tank **16** by a hinge **34**, such that the door **28** is pivotal about the hinge axis so as to be movable between opened and closed positions. The sleeve assembly **30** also includes an inner sleeve **36** fit within the outer sleeve, with bearings **38** between the outer and inner sleeves **32**, **36**. The door **28** is fixed to the inner sleeve **36**. The bearings **38** allow the outer sleeve **32** to rotate with the tank **16**, while the inner sleeve **36** and the door **28** remain stationary.
(13) The door **28** includes a first tube **40** extending through the door having an inner end **42** and an outer end **44**. The door **28** includes a second tube **46** extending therethrough, with inner and outer ends **48**, **50**. A third tube **52** extends to the door **28**, and has an inner end **54** and an outer end **56**. The tubes **40**, **46** and **52** define first, second, and third ports in or through the door **28**. An air hose **58** has opposite ends removably connected to the outer end **44** of the first tube **40** and an air source **60**, such as a reversible pump, so as to provide positive or negative air pressure inside the tank **16**. A material vacuum hose **62** is removably connected to the outer end **50** of the second tube, or to the outer end **56** of the third tube **52**. The hoses **58**, **62** can be secured to the tubes with any conventional coupler. While the drawings show the tubes **40**, **46**, **52** to have the same diameters, it is understood that their diameters may vary from one another, with the hoses having diameters to fit the respective tubes.
(14) The tank **16** also has a discharge tube **64** adjacent the rear end **27** of the tank, and apart from the door **28**.
(15) The truck **10** or trailer (not shown) includes a supply tank **68** for water or other liquid, and a supply tank **70** for particulate material, such as a drying agent. The liquid supply **68** and the particulate supply **70** have appropriate delivery systems or plumbing for connection to the tank **16**, with pumps and shut off valves (not shown) such that the water, liquid, drying agent, or other particulate material may be added to the to the rotating tank **16**.
(16) In use, the truck **10** or trailer with the tank **16** is driven to a jobsite wherein material needs to be removed. The material may be a liquid, particulate, or slurry. For example, the tank **16** can be

used at a hydro-excavation site, an underground pipe repair or replacement site, a horizontal directional drilling site, or a hazardous material spill site. The air hose **58** is connected to the air source **60** and to the first tube **40**. The vacuum hose **62** is connected to the second tube **46**. The air source **60** is actuated to provide a vacuum through the hoses **58**, **62** such that material at the site can be suctioned into the tank **16**, as the tank rotates via the drive assembly **18**. If the vacuumed material is liquid, a drying agent or other material from the supply **70** may be added to the tank **16** to create a slurry mixture. If the vacuumed site material is a particulate, water, or other liquid from the supply **68** can be added to the tank **16** to create a slurry mixture. If the vacuumed material at the jobsite is a slurry material, additional liquid, or particulates from the supplies **68**, **70** may or may not need to be added to the tank **16**. Rotation of the tank **16** mixes the contents to form a slurry material, which can then be discharged at any convenient location.

(17) One option for discharge of the slurry mixture is by connecting the second hose **62** to the third tube **52**, closing or shutting the tube **46** via a valve, gate, door, or other closure mechanism on the outer end of the respective tube or on the coupler for the tube and hose, and reversing the air source **60** so as to provide a positive pressure inside the tank **16**, thereby forcing the slurry material out the hose **62**, as the tank **16** rotates. Alternatively, rotation of the tank **16** can be stopped, the tube **46** is shut or closed, and the hose **62** connected to the fixed discharge tube **64** on the tank to discharge slurry material therethrough. Another option is to disconnect or disable the drive assembly **18**, and raise the front end **26** of the tank **16** so as to drain slurry material out of the fixed tube **64**, with or without the hose **62** connected thereto. As a further option for cleaning out the tank **16**, with the tank rotation stopped, the door **28** can be opened via the hinge **34** for removal of material from the tank. A vibrator, shaker or oscillation motor **72** may be provided on the for the tank **16** to facilitate clean out of slurry material from the tank **16**.

(18) It is understood that the size or volume of the tank **16** may vary, depending on the jobsite need. A smaller tank may be hand rotated with a crank or handle. A larger tank will be rotated with a powered drive assembly **18**. Also, the door **28** may have additional tubes or ports for coupling additional hoses, beyond that shown in the drawings. For example, preferably the water source **68** and the particulate or drying agent source **70** are connected to the tank **16** through the door **28** so that the additives may be delivered, as needed, through the stationary door as the tank **16** rotates.

(19) FIGS. **5-7** show a second embodiment of the invention, including a tank **100** rotatably mounted on a frame **102**. The tank **100** includes a forward end **104** and a rearward end **106**. The forward end **104** of the tank **100** has a drive assembly, similar to the drive assembly **18** of the embodiment shown in FIGS. **1** and **2**, such that the tank **100** is rotatable about its longitudinal axis. The tank **100** is rotatably supported on rollers (not shown) mounted on the rocker **110** in a roller housing **114** adjacent the rearward end **106** of the tank **100**.

(20) The frame **102** includes a base **108** and a rocker **110** pivotally mounted on the base for pivotal movement about a lateral or transverse axis. In a preferred embodiment, the rocker **110** has a V-configuration, including an apex **112** which defines the pivot axis of the rocker **110**. The tank **100** is rotatably supported on the rocker **110** and pivots therewith. The pivotal movement of the rocker **110** and the tank **100** is controlled in any convenient manner, such as a linear actuator (not shown) extending between the base **108** and the rocker **110**. Thus, the tank **110** can be pivoted or tilted to and from the rearwardly inclined orientation shown in FIG. **5**, a horizontal or neutral position shown in FIG. **6**, and in a forwardly inclined position shown in FIG. **7**. Normally, the position shown in FIG. **5** is used for filling the tank and mixing materials therein, while the position shown in FIG. **7** is used for discharging materials from the tank.

(21) The base **108** of the frame **102** includes fork channels **116** adapted to receive the forks of a fork truck or lift vehicle which can raise and lower the tank and frame assembly **100**, **102** and transport the assembly to a desired location.

(22) As a further option, the frame **102** may include a weigh scale **118** to weigh the material or contents of the tank **100**. In one embodiment shown in FIG. **9**, the scale **118** is sandwiched between

an upper base member **120** and a lower base member **122**. The upper base member **120** is connected and aligned with the lower base member **122** by a series of posts or pins **124** extending upwardly from the lower base member **122** and through aligned holes **126** on the upper base member **120**. Load springs **128** extend around each support pin **124**, such that the upper frame member **120** floats upwardly and downwardly with respect to the lower base member **122**, whereby the weigh scale **118** determines the weight of the material inside the tank **100**. Thus, with the scale **118**, the weight of materials or ingredients can be precisely measured as the materials or ingredients are added to the tank, so as to prepare various mixtures, according to specific formulations or recipes, such as for concrete, flowable fill, and other products to be used at a work site.

(23) In a preferred embodiment, a mixing screw **130** is attached to the inside wall of the tank **100**. One example of a mixing screw is shown in FIG. **8**. The screw **130** is configured to match the interior contour of the tank **100**. The screw **130** includes cutouts or openings **132**. When the contents of the tank **100** are to be discharged, the tank is rotated to position such that the cutouts **132** reside along the bottom lower most portion of the tank, such that material in the tank can flow through the cutouts for discharge. As an alternative to the cutouts **132**, the screw segments can be discontinuous so as to have spaced apart ends defining an opening similar to the cut-out openings **132**.

(24) It is contemplated that other mixing means may be used with the screw **130**, or in place of the screw **130**. For example, mixing paddles can be operatively installed inside the tank to mix the materials therein as the tank **100** rotates.

(25) The rearward end **106** of the tank **100** includes a door and sleeve assembly, similar to that used for the tank **16**, as well as the tubes and hoses on the door **28** of the tank **16**. Alternatively, the tank **100** may utilize the door and sleeve assembly shown in FIG. **10**. More particularly, a door **134** may be removably mounted to the rear of the tank **100** via spaced apart tabs **136** through which fasteners (not shown), such as nut and bolt connectors extend. An inner sleeve **138** is fixed to the door **134**, by welding or any other convenient means. The inner sleeve **138** includes one or more circumferential bearings **140**. An outer sleeve **142** extends over the inner sleeve **138** and rides upon the bearings **140**. An outer plate **146** is fixed to the rearward end of the outer sleeve **142**. The plate **146** includes a first hole **148** and a second hole **150** to which tubes similar to the tubes **40**, **46** of the first embodiment extend. Vacuum hoses and a vacuum source are connected to the tubes, similar to the hoses **58**, **62** and air source **60** of the first embodiment described above. The door and sleeve assembly **134**, **138**, **142** allows the tank to function identically as the tank **16**, as described above.

(26) Thus, the tank **100** can be used to collect waste material, mix the waste material with environmentally friendly additives, and discharge the mixed slurry at an appropriate site. Also, the tank **100** can be used to mix building materials, such as concrete, in substantially the same manner as waste material is treated in the tank, for use at a work or project site. The concrete components or ingredients can be vacuumed into the tank **100**, mixed with water as the tank rotates to create a concrete slurry, and discharge the slurry at the job site.

(27) Thus, the tanks **16** and **100** are portable container assemblies for which can be used to remove waste and/or hazardous materials from a site, treat these materials, transport these materials, and discharge the treated materials at a safe location. The tanks **16**, **100** can also be used as container assemblies to mix fresh materials, for example to create concrete and other useful mixtures, transport the mixture, and dispense the mixture at a job site.

(28) The “scope” of the present disclosure is defined by the appended claims, along with the full scope of equivalents to which such claims are entitled. The scope of the disclosure is further qualified as including any possible modification to any of the aspects and/or embodiments disclosed herein which would result in other embodiments, combinations, subcombinations, or the like that would be obvious to those skilled in the art.

Claims

1. A vacuum tank for liquid and particulate materials, comprising: a rotatable tank having front and rear ends; a drive assembly operably connected to the front end to rotate the tank; a door on the rear end; ports on the door; hoses connected to the ports to vacuum materials into the tank and to discharge materials from the tank; and a vibrator connected to the tank to facilitate emptying of material from the tank.
2. The vacuum tank of claim 1 further comprising a frame to support the tank for end-to-end tipping between inclining and declining positions.
3. The vacuum tank of claim 2 wherein the frame includes a base and a rocker assembly to support the tank.
4. The vacuum tank of claim 3, wherein the base includes opposite side rails, and the rocker assembly resides between the side rails.
5. The vacuum assembly of claim 3 wherein the base includes transverse openings adapted to receive forks for raising and lowering the vacuum tank.
6. The vacuum tank of claim 1 further comprising a screw inside the tank to mix the materials as the tank rotates, and the screw having discontinuous inner edge to facilitate discharge of material from the tank.
7. A vacuum tank for liquid and particulate materials, comprising: a rotatable tank having front and rear ends; a drive assembly operably connected to the front end to rotate the tank; a door on the rear end; ports on the door; hoses connected to the ports to vacuum materials into the tank and to discharge materials from the tank; and a frame to support the tank for end-to-end tipping between inclining and declining positions.
8. The vacuum tank of claim 7 further comprising a swivel connection between the door and the tank to allow the tank to rotate without the door rotating.
9. The vacuum tank of claim 7 further comprising a vibrator connected to the tank to facilitate emptying of material from the tank.
10. The vacuum tank of claim 7 further comprising an air source outside the tank to selectively provide positive and negative pressure to the tank.
11. The vacuum assembly of claim 7 further comprising a motor vehicle with a flat bed to support the tank.
12. The vacuum tank of claim 7 further comprising a screw inside the tank to mix the materials as the tank rotates, and the screw having discontinuous inner edge to facilitate discharge of material from the tank.
13. A container assembly for liquid and particular materials, comprising: a rotatable and pivotal tank; a material inlet and a material outlet on one end of the tank; wherein the tank is pivoted in one direction to receive the materials via the inlet and pivoted in an opposite direction to discharge the materials, a frame to support the tank for rotation about a longitudinal axis and pivoting about a lateral axis; and a weigh scale on the frame to weigh the tank.
14. The container assembly of claim 13 further comprising a vacuum source to vacuum materials into the tank.
15. The container assembly of claim 13 wherein the vacuum source is reversed to remove materials from the tank.
16. The container assembly of claim 13 further comprising the scale weighs materials added to the tank to produce precise mixtures.
17. The container assembly of claim 13 wherein the tank is mounted on a truck.
18. The container assembly of claim 13 further comprising a screw inside the tank to mix the materials as the tank rotates, and the screw having a discontinuous inner edge to facilitate discharge of material from the tank.

19. A vacuum tank for liquid and particulate materials, comprising: a rotatable tank having front and rear ends; a drive assembly operably connected to the front end to rotate the tank; a door on the rear end; ports on the door; hoses connected to the ports to vacuum materials into the tank and to discharge materials from the tank; and a swivel connection between the door and the tank to allow the tank to rotate without the door rotating.

20. The vacuum tank of claim 19 further comprising a screw inside the tank to mix the materials as the tank rotates, and the screw having discontinuous inner edge to facilitate discharge of material from the tank.

21. The vacuum tank of claim 19 further comprising a frame to support the tank for end-to-end tipping between inclining and declining positions.