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(54) **Equipment and method for the rapid decontamination of underground tanks used for the storage of liquid fuels**

(57) Equipment for the rapid decontamination of underground tanks (11) used for the storage of liquid fuels, typically for storing hydrocarbons, where the equipment comprises a vehicle (10) comprising at least one storage tank (12), at least one transfer pump (13), at least one vacuum pump (14), and at least one dosing pump (15) for delivering, where required, a biocidal product (16) and which is connected by piping (17) to the tank (11) to enable the transfer of the liquid from the tank (11) to the storage tank (12) by using the pump (13), that is, via the piping (17) and connected to the tank (11) by piping (18) which carries on its end a sludge removal device (19), where the sludge removal device (19) also comprises a special tool (20) which has a truncated cone-shaped head with two suitably shaped slits which spray a jet at 360° covering the entire circumference of the tank surface.

able the transfer of the liquid from the tank (11) to the storage tank (12) by using the pump (13), that is, via the piping (17) and connected to the tank (11) by piping (18) which carries on its end a sludge removal device (19), where the sludge removal device (19) also comprises a special tool (20) which has a truncated cone-shaped head with two suitably shaped slits which spray a jet at 360° covering the entire circumference of the tank surface.

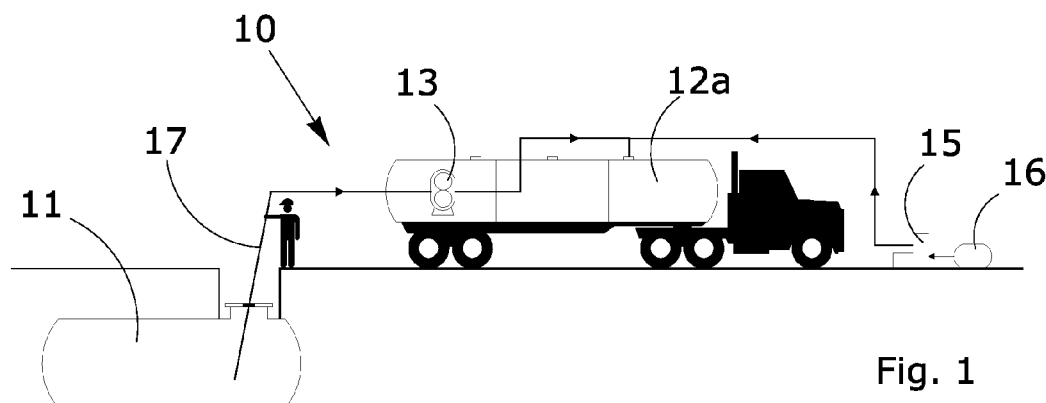


Fig. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to complete equipment with specifically designed devices and a method for the rapid decontamination of non-horizontal axis, underground tanks used for the storage of liquid fuels.

[0002] In particular the equipment and the method for the rapid decontamination of underground tanks used for the storage of liquid fuels according to the present invention is designed for the cleaning of underground tanks used for the storage of liquid fuels without the need to disassemble the equipment on the manhole with the exception of the two accesses enabling the introduction of devices necessary for the operation.

[0003] The equipment and the method according to the present invention offer several major advantages over known solutions, principally in that they enable rapid execution of the operation because it is only necessary to disassemble a minimum part of the manhole equipment. A further advantage is that under the same operating conditions as the traditional method of washing with water, the method ensures improved cleaning results thanks to a special device for washing the walls.

[0004] Furthermore, by using an original product rather than water, the equipment and method limit the amount of waste to be disposed of and at the same time optimise safety for the operator who does not need to enter the tank.

[0005] The principal field of application for the invention is in the ordinary activities related to the operation of tanks containing hydrocarbons or flammable liquids and the ordinary maintenance of these tanks.

BACKGROUND ART

[0006] It is known that tanks for storing fuel need to undergo decontamination at regular intervals because with the passage of time organic residues (of bacterial origin) and inorganic (inert) residues tend to deposit on the walls and bottoms inside the tanks. These residues can contaminate the liquid fuels stored in the tanks also creating risks for the delivery equipment and the fuel supply systems of motor vehicles.

[0007] Decontamination of a tank is understood as the set of activities needed to return the tank to its original state by eliminating the product residues inside the tank which might contaminate the liquid fuel fed into the tank.

[0008] At the present time the decontamination of underground fuel tanks is performed in three different ways as follows:

1. Manual removal of sludge by an operator working inside the tank. In this case it is necessary to completely remove the equipment and the manhole from the tank and then empty the tank using a suction

pump. After this, an operator climbs down into the tank and performs the following operations: the operator manually removes the sludge from the inside surfaces of the tank using special tools designed to prevent any type of spark (which could trigger an explosion); the operator then washes the tank walls with a high-pressure water jet and then finally removes the results of the previous operation with the suction equipment.

[0009] In practice this method is extremely hazardous because the fumes inside the tank are flammable and potentially explosive and could ignite causing fatal injuries to operators.

[0010] A further drawback is that this cleaning method requires a large amount of water which has to be removed in order to prevent contamination of the fuel and then has to be disposed of as special waste.

2. Sludge removal using mechanised devices inserted inside the tank.

[0011] This method does not require the presence of an operator inside the tank and therefore avoids a situation which is potentially hazardous for operators.

[0012] However, a considerable amount of time is still needed to remove all the equipment and the manhole from the tank in order to enable insertion of the equipment into the tank.

3. Washing the tank with a lance and suction of washing waste.

[0013] In this case there is no need to remove all the equipment but the cleaning method is not particularly effective for the upper part of the tank or the part opposite the manhole.

[0014] A further disadvantage of this method is that it produces contaminated waste water which has to be disposed of in accordance with special waste disposal regulations.

DESCRIPTION OF THE INVENTION

[0015] The present invention overcomes the shortcomings described above by providing equipment and a method for the rapid decontamination of underground tanks used for the storage of liquid fuels, typically hydrocarbons.

[0016] This purpose is achieved by the equipment and method for the rapid decontamination of underground tanks for the storage of liquid fuels whose characteristics are described in the main claim.

[0017] The equipment according to the present invention substantially comprises a transfer pump, a vacuum pump, a dosing pump, a device for washing the inside surfaces of the tank, a device for the suction removal of sludge and a filtration unit. The equipment can be mount-

ed on an easy to manoeuvre mobile base or directly onto a special vehicle fitted with a storage tank.

[0018] The purpose of the present invention is to enable the cleaning of liquid fuel storage tanks without having to disassemble the equipment present on the manhole except for the two access points needed to insert the cleaning equipment and the suction and delivery hoses of the system.

[0019] The filtration unit ensures the removal of large solid particles and also has the possibility of performing fine and very fine filtration down to 0.8 μm thereby removing the sludge and separating the water.

[0020] In comparison with current equipment and methods, the device system has the following advantages:

- a) Rapid execution because only a minimum part of the equipment mounted on the manhole flange needs to be dismantled;
- b) Under the same operating conditions and without having to disassemble the manhole closing flange, the invention provides improved cleaning results thanks to a special device for washing the walls;
- c) Reduction in the amount of waste produced and to be disposed of thanks to the use of an original product instead of water for washing the tank;
- d) Improved operator safety because the operator no longer has to enter the tank.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Further features and advantages of the invention will become apparent from the description of an example embodiment which follows with reference to the annexed drawings, given purely by way of a non-limiting example, in which:

- Figure 1 is a diagram showing the transfer step according to the present invention and the injection of a biocidal product into the tank to reduce the organic contaminant load;
- Figure 2 is a diagram showing the step of removing the sludge;
- Figures 3 to 8 are detailed views of the set of devices used to remove sludge;
- Figure 9 is a diagram showing washing of the tank;
- Figure 10 is a detailed view of the washing device head;
- Figure 11 is a diagram showing the first filtration step;
- Figure 12 is a diagram showing the second filtration step, and
- Figure 13 is a diagram showing the final transfer step.

DESCRIPTION OF AN EXAMPLE EMBODIMENT

[0022] With reference to the annexed drawings, the numeral 10 indicates in its entirety a vehicle equipped for the decontamination of tanks according to the present

invention, while the numeral 11 indicates the tank to be decontaminated.

[0023] As shown in Figure 1, the vehicle equipped for decontamination comprises a storage tank 12a and a transfer pump 13 which in Figure 2 is substituted by a vacuum pump 14.

[0024] The decontamination vehicle 10 is equipped with a dosing pump 15 used to feed biocidal product 16 into the tank.

[0025] In Figure 1 the numeral 17 indicates the piping used to transfer the liquid from the tank 11 to the storage tank via the transfer pump 13. In Figure 2 the numeral 18 indicates the piping which carries on its end the sludge suction device 19.

Figures 3 to 8 show that the device 19 substantially comprises a slotted brush with a profile shaped to ensure improved action on the bottom of the tank.

Figure 8 shows that in order to facilitate insertion through the tank flange, the device can be rotated through 90° from its work position and then rotated back to the work position once inside the tank.

Figure 9 shows how the sludge removal device 19 can be substituted with another special tool 20 which has a truncated cone-shaped head with two suitably shaped slits which spray a jet at 360° covering the entire circumference of the tank surface.

Figure 11 shows the decontamination unit connected to filtration unit which comprises a disc filter 21, which acts together with a counter-washing ring 22, and a bag filter 23. The filtration system is connected to the transfer pump 13 mentioned previously.

Figure 12 shows a further item of equipment comprising a coalescing filter 24, a disc filter 25 and a progressive cavity pump 26, in this case all connected to the storage tank 12c.

[0026] Finally, Figure 13 shows the final transfer step where the liquid fuel in the tank 11 is restored to its original level by the transfer pump 13 which draws the fuel from the storage tank 12a.

[0027] The next section is a brief description of the work procedure according to the present invention.

[0028] The first step in the procedure is to dismantle the equipment on the manhole of the tank 11 and switch off any piping and other equipment.

[0029] Two openings are required. A first opening to be used for the main items of equipment and a second opening for the video inspection equipment which is used to monitor the progress of operations.

[0030] The video inspection equipment can be mounted on the opening prepared previously.

[0031] The next step is to store the clean product (Fig. 1). In order to optimise operation times, initially the clean product is transferred to the supplementary storage tank 12a mounted on the vehicle 10, or, in the case of large volumes, to an external supplementary tank.

[0032] Usually the lower part of the product is left inside

the tank because this is typically contaminated with water, inert material and sludge.

[0033] In this step the biocidal product can be dosed in order to counteract the presence of any bacteria contained in the product.

[0034] The fourth step involves removing the sediment, that is, vacuuming up the sludge remaining inside the tank 11 using the special sludge suction device 19 fixed to the semi-rigid piping and then transferring the results to the tank 12b.

[0035] This step is fundamental to reducing the times of the operation. Increasing the amount of sludge removed in this step reduces the amount of time needed for filtration.

[0036] The next step is washing of the tank walls with a specified quantity of fresh product (previously stored in tank 12a or in a supplementary tank) which is returned to the tank 11 being decontaminated in sufficient amounts to guarantee that the system will function. Fresh product is applied under pressure using the special head 20 mounted on semi-rigid piping which in turn is connected to the delivery hose of the transfer pump 13.

[0037] The next step consists of washing of the tank with the device for washing the tank walls 20 which, as already mentioned, comprises a special cone-shaped head with two suitably shaped slits which spray a jet at 360° covering the entire circumference of the tank surface.

[0038] The filtration of the washing liquid is performed by two pre-filters upstream from the transfer pump which filter the larger size inert particles and two filters downstream for filtering the smaller inert particles.

[0039] Filtration involves complete recirculation, that is, the product is drawn from the tank 11, filtered and then returned directly to the inside of the tank 11.

[0040] In this case the pump is suitably regulated to optimise filtration as a function of the contaminant load present in the mixture to be treated so that this work is performed at a variable capacity.

[0041] It is possible to perform a further filtering step on the product (fig. 12). The purpose of this second and final filtration step is to hold back the dirty part of the mixture being treated by using a very fine filter and separating out the water with a special filter.

[0042] Fine filtration is performed in a single step. The product, after storage in the special supplementary tank or the tank 12c, is returned to the inside of the client's tank 11.

[0043] The last step is product transfer, that is, the delivery of clean product back into the inside of the original tank 11 (fig. 13).

[0044] It will be noted that the system according to the present invention achieves the stated original purpose of the invention, that is, it enables the cleaning of tanks used for the storage of liquid fuels without the need to dismantle the equipment on the manhole except for the two access points used to insert the suction and delivery pipes of the system.

[0045] This confirms that the filtration unit ensures the removal of large solid particles and also has the possibility of performing a further fine filtration down to 0.8 µm thereby removing the sludge and separating the water.

[0046] The invention as described above refers to a preferred embodiment. Naturally, while the principle of the invention remains the same, the details of construction and the embodiments may widely vary with respect to what has been described and illustrated purely by way of the example, without departing from the scope of the present invention.

Claims

1. Equipment for the rapid decontamination of underground tanks (11) used for the storage of liquid fuels, typically for storing hydrocarbons, where the equipment comprises a vehicle (10), **characterised in that** the vehicle (10) comprises at least one storage tank (12), at least one transfer pump (13), at least one vacuum pump (14) and at least one dosing pump (15) for delivering, where required, a biocidal product (16) and which is connected by piping (17) to the tank (11) to enable the transfer of the liquid from the tank (11) to the storage tank (12) by using the pump (13), that is, via the piping (17) and connected to the tank (11) by piping (18) which carries on its end a sludge removal device (19) where the sludge removal device (19) also comprises a special tool (20) which has a truncated cone-shaped head with two suitably shaped slits which spray a jet at 360° covering the entire circumference of the tank surface.
2. The equipment for the rapid decontamination of underground tanks (11) according to the foregoing claim, **characterised in that** the sludge removal device (19) substantially comprises a slotted brush with a profile shaped to ensure improved action on the bottom of the tank.
3. The equipment for the rapid decontamination of underground tanks (11) according to one of the foregoing claims, **characterised in that** access through the tank flange is made possible by the ability to rotate the sludge removal device (19) through 90° from its work position and then rotate it back again to the work position once it is inside the tank.
4. The equipment for the rapid decontamination of underground tanks (11) according to one of the foregoing claims, **characterised in that** the vehicle (10) comprises a filtration unit which comprises a disc filter (21) which acts together with a counter-washing ring (22), and also comprises a bag filter (23); this filtration system is connected to the transfer pump (13).

5. The equipment for the rapid decontamination of underground tanks (11) according to one of the foregoing claims, **characterised in that** it comprises a further item of equipment which includes a coalescing filter (24), a disc filter (25) and a progressive cavity pump (26), in this case all connected to the storage tank (12), and **in that** for the final transfer step, the tank (11) is filled with liquid fuel by the transfer pump (13) which draws the fuel from the storage tank (12).

6. A method for the rapid decontamination of underground tanks (11) comprising equipment according to one of the foregoing claims, **characterised in that** the method has the following work steps:

a) dismantling of the equipment on the manhole of the tank (11) and switching off of any piping or other equipment in order to create two openings: the first opening to be used for the main items of equipment and the second opening to be used for the video inspection equipment used to monitor the progress of operations.

b) storing of clean product (fig. 1) by initially transferring the clean product to the supplementary storage tank (12) mounted on the vehicle (10), or, in the case of large volumes, to an external supplementary tank, leaving inside the tank only the lower part of the contents because this is typically contaminated with water, inert material and sludge.

c) dosing of a biocidal product in this step is possible in order to counteract the presence of any bacteria contained in the product.

d) removal of sediment which comprises the vacuuming up of sludge remaining inside the tank using the special device (19) fixed to the semi-rigid piping.

e) washing of the tank walls with a specified quantity of fresh product which is then returned to the work tank in sufficient amounts to guarantee that the system will function; fresh product is applied under pressure using the special head (20) mounted on semi-rigid piping which in turn is connected to the delivery hose of the transfer pump (13).

f) washing of the tank using the device for washing the tank walls (20) which comprises a special cone-shaped head with two suitably shaped slits which spray a jet at 360° covering the entire circumference of the tank surface; filtration of the washing liquid is performed by two basket filters upstream from the transfer pump which filter the large-size inert particles and by two disc filters downstream for filtering the small-size inert particles.

g) The last step is product transfer, that is, the delivery of clean product back into the inside of

the original tank (fig. 13).

7. The method for the rapid decontamination of underground tanks (11) comprising equipment according to one of the foregoing claims, **characterised in that** filtration involves complete recirculation: product is drawn from, and returned to the inside of the tank, and the disc filters need counter-washing to clean the filtering surfaces while the product is discharged separately.

8. The method for the rapid decontamination of underground tanks (11) comprising equipment according to one of the foregoing claims, **characterised in that** the pump is suitably regulated to optimise filtration as a function of the contaminant load present in the mixture to be treated so that this work is performed at variable capacities approximately at 60 to 120 l/min., while the counter-washing action is performed at approximately 230 l/min.

9. The method for the rapid decontamination of underground tanks (11) comprising equipment according to one of the foregoing claims, **characterised in that** it performs a further filtering step on the product where the purpose of this second and final filtration step is to hold back the sludge part of the mixture being treated by means of a cellulose disc filter and to separate out the water with a coalescing filter, and where fine filtration is performed in a single step: the product, after storage in a special supplementary tank, is returned to the inside of the tank (11).

