METHOD OF RECONDITIONING USED STEEL DRUMS

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Filed: Mar. 10, 1972

Appl. No.: 236,529


Int. Cl.................. B08b 3/02, B08b 5/10

Field of Search........... 134/2, 30, 29, 28, 27, 134/22 R, 24, 3, 105, 107, 166 R

References Cited

UNITED STATES PATENTS

1,642,419 9/1927 Loew......................... 134/22
3,099,276 7/1963 Bergendahl................ 134/107
2,677,630 5/1954 Scales...................... 134/23
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3,163,134 12/1964 Stratford............... 110/18
3,067,070 12/1962 Loucks................... 134/27

ABSTRACT

The method and apparatus for reconditioning used steel drums containing organic matter, rust, interior linings, and the like, preheating the drums up to 700°F, chemical and/or water washing the drums' interior with high pressure spray and draining, a sulfuric acid solution bath spray impinging on said surface while heated, a hydrochloric acid solution bath spray impinging on said surface after the sulfuric acid is drained off, a water bath and drain stage for reducing the acidity in the drum, and a neutralizing bath to clean the final remnants of any presence of an acid from the inner surfaces of the drum.

12 Claims, 4 Drawing Figures
METHOD OF RECONDITIONING USED STEEL DRUMS

CROSS REFERENCES TO PRIOR ART

References exemplary of some of the prior art of the present invention and considered distinctive therefrom are at least the following:

Rosenbloom 2,839,438
Mergulies 2,923,608
Ardon 3,000,829
Everson 3,015,589
Loucks 3,067,070
Smull 3,352,723
Rothkegel 3,355,330
Knox 3,360,399
Steinbrecher 3,401,065
Kennedy 3,513,226
Vazrani 3,595,708

FIELD OF THE INVENTION

The present invention relates to an improved method and apparatus of reconditioning used steel drums having layers of rust, organic matter and/or liners embedded on the interior surface of the drum, and more particularly the invention relates and is directed toward a process of cleaning interior surfaces of drums for removing embedded linings by a series of heated stages of an alkaline wash, a water wash, an acid wash, a water rinse, and an alkaline final rinse.

Acid is currently and primarily being used in the trade to remove rust. Generally the equipment consists of an open tank which contains cold or warm hydrochloric acid which is pumped into drums placed over the tank and through a manifold and nozzles that project into the drums. After it is determined that sufficient acid treatment has occurred, the drums are manually removed from the device and placed on a similar device containing water where the process is repeated. Following this, the drums are removed from this device, placed on a third device which also is similar where an alkaline and neutralizing solution is pumped into the drums. The neutralizing solution in many systems consists of sodium nitrate.

In conventional systems, an effect occurs, namely, that a hot solution strikes the surface of a drum that is somewhat cooler than the solution creating a thin, slightly cooler film of solution at the surface of the drum where consumption occurs. The present invention overcomes this effect.

The inherent disadvantages of many prior art systems are:

1. They require an excess of labor.
2. That they will not remove the residual previous contents of the drum or the interior linings that are sprayed on drums, but merely remove rust.
3. The temperature and the concentration of the acid are greatly reduced because the fuming of the acid, and due also to the fact that a harsher acid would be more difficult to neutralize.

The characteristics of acid treatment are such that as soon as the flow of acid is stopped, the drum within seconds begins to re-rust creating a problem in a system requiring removing the drums from the acid cleaning device to the neutralization device.

BRIEF SUMMARY AND OBJECT OF THE INVENTION

It is a primary object of the present invention to provide apparatus and a method for reducing the time between positional stages of acid treatment and a subsequent positional stage of neutralization to avoid the rusting that is created on the drum surface by the time delay in transfer of drums from the first stage to the second stage.

A further object of the invention is to materially reduce the time between acid treatment and neutralization by maintaining the drums in the first positional stage over a nozzle, and applying through the nozzle successive acid treatment, that is, chemical and/or water wash, a rinse or water treatment, and neutralization stages in situ, for the several successive stages.

Another object of the invention is that the heating of the surface of the drum above the temperature of the solution being pumped into the drum creates a thin superheated film of cleaning solution along the entire surface of the interior of the drum at precisely the location of the rust and contaminates coating the interior surface of the drum.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The above and other objects and advantages of the invention will become apparent upon full consideration of the following detailed description and accompanying drawings in which:

FIG. 1 is an elevation view of an acid washer showing a method of reconditioning used steel drums according to a preferred embodiment of the invention;
FIG. 2 is a plan view of FIG. 1;
FIG. 3 is an enlarged view in elevation with parts removed therefrom and showing the manner that a nozzle for each drum is used to selectively spray solutions during each of the several stages of wash and reconditioning; and
FIG. 4 similarly is an enlarged view of the discharge manifold for draining selected solutions into selected tanks.

Referring now to the drawings, there is shown an elongated and enclosed housing 10 for receiving ten drums 12,12,12. The ends of the housing are provided with a front end removable panel 14 and an end or rear panel 16. Through the housing 10, there is a passage space or plenum 18 that communicates with an entrance area 20 shown as an arrow that shows the direction the drums pass through the housing. An exit area 22 is near the panel 14.

The entire length from the entrance area 20 to the exit area 22 is provided with a conveyor track 24 at the entrance area 20, a conveyor track 26 passing throughout the length within the housing 10, and a conveyor track 28 extending out the exit area. A lift device 30 raises the conveyor track for the drums 12,12,12 to clear nozzles 32,32,32 that only extend into the interior of the drums when lowered to a wash-reconditioning position for treatment of the drums, as shown in FIGS. 1 and 2.

For moving the drums through the plenum 18 and along the tracks 24,26,28, there is provided a drum conveyor cable 34 that draws the drums down along the inclined tracks, as shown, by cable drive means (not shown) of conventional construction and manufacture.

On each side of the housing 10, there are vertical operating doors 36,38 having mounted or attached thereto gas burners or like types of drum heaters 40 to heat respectively adjacent drums in the housing 10. FIG. 2 shows twenty heaters 40.
The floor or bottom wall 42 contains a centrally disposed discharge channel or pipe 44 extending through the length of the housing 10 but which at the lower area 22 terminates in an elbow 46 feeding into a reducer 48 for directing drainage solutions into a discharge manifold 50 containing valve means 52 directing a given solution into an identified tank or containers 54, 56, 58, 60.

The containers 54, 56, 58, 60 are respectively identified to collect drain solutions of (1) alkaline solutions, (2) rinse water, (3) sulfuric acid, and (4) hydrochloric acid.

The discharge manifold valve means 52 shown in FIG. 4 may be a valve rod as shown connected to a valve plug 62 and being raised or lowered by a solenoid type or like lifting device 64. The rod passes through a packing gland 66. A valve seat 68 receives the plug 62 and from the valve seat the drain solutions may pass through a flexible or rigid discharge line 70 into the given containers 56–60.

The wash solutions are introduced into the plenum 18 within the housing 10 by a solution intake manifold 80 that feeds into a solution manifold 82 that passes or extends above the discharge pipe 44, as shown in FIG. 1.

The solution intake manifold 80 receives several selected solutions or washes from pumps and source tanks (not shown) of an alkaline solution, a rinse water solution, a sulfuric acid and hydrochloric or muriatic acid, by respective valves 84, 86, 88, 90.

While not a preferred embodiment it is within the purview of the invention to recycle these solutions through said pumps from the containers 54–60, thence into the solution intake manifold 82.

After the drums 12, 12, 12, usually 10 in number, are in place as shown within the housing 10, a drum clamping means or device 92 for each drum position is actuated, whether manually or electrically, so that the drums are tightly maintained and held or clamped in place. In place, the drums are now positioned to have nozzles 32 extend within the interior of the drums. Across the open end of the drum, there may be provided a sealing collar 96 for the small opening usually found in such drums, while a larger sealing collar 98 may be provided for the larger opening of the drum and through which the nozzle 32 extends.

The lower end of the solution manifold 80 is provided with a solution manifold drain discharge 102 so that at times between stages the intake manifold 80 and the manifold 82 may be drained into the respective containers. The line 102 includes a discharge valve 104.

In FIG. 3, there is illustrated the details of a nozzle assembly as it is interposed within a drum for selectively spraying the interior of the drum with a series of acids or washes and which then drain off through discharge pipe 44.

Solution under pressure is passed through a selected one of the solution valves 84–90 to the solution manifold 82 via the solution intake manifold 80. The pressure causes the nozzle 32 which is inserted about four inches, or at least between 2–8 inches, within the drum 12 to spray successively an alkaline solution, a water rinse, a sulfuric acid solution, a further water rinse if needed, an acid wash as hydrochloric or muriatic, a water rinse and finally an alkaline rinse or wash, before the cycling is recommenced with another set of drums.

The sealing collar 98 is shown in FIG. 3 mounted in supporting relation onto the discharge pipe 44, while seal supports 108, 110 secure the collar 98 from being broken. The collar, as well as other seals, may be constructed of VITON or similar material.

The drum 12 having a drum head 115 is shown with a large threaded bung opening 114 and a thread portion 116. The drum head 115 is usually provided with a ridge or bevel shown as a drum chime 118 resting on the track 26. Beneath the track 26 is a bottom plate 120 spatially disposed lower than the track 26, so that cooling air is driven from the manifold or space 122 into surface contact with the VITON seal or collar 98 and the seal support 108.

In reconditioning used steel drums 12, which may contain embedded material or layers of organic matter and rust which adhere to the inner surfaces of the drum, the drums in the plenum 18 within the housing 10 are heated by the gas burners or heaters 40, 40 on each side of the drum. The drum may then be pre-washed or pre-rinsed by an alkaline solution passing from the valve 84 to the solution manifold 82, thence into the drum through the nozzle 32. The rinse then collects in a discharge pipe 44 and is selected to pass through the discharge manifold 50 into the alkaline container 54 by the proper discharge manifold valve being actuated to lift the plug 62 from the seat 68. Valve 84 is then closed.

Then water may be rinsed through the drum by opening valve 86 to spray water on the interior of the drum 12. The preheating of the drums warms or heats the water rinsed in the drum, and the water drains through the discharge pipe 44 and, upon operation of the proper lifting device 64, the rinsed water passes to container 56. The water washes out any remnants of the alkaline solution remaining within the drum.

After approximately 45 seconds of water wash, the water valve 86 is closed and a period of approximately 10–15 seconds elapses during which time the drums in the housing 10 continue to drain the water through the discharge manifold 50 into the container 56. Meanwhile, the gas burners or heaters 40, 40 remain on for heating the drums to a range of up to 500°–700°F. After the completion of the draining cycle and after the drums are properly heated, the acid valve 88 is turned on for feeding sulfuric acid under pressure from a pump (not shown) into the heated drum interiors through nozzle 32. The impact creates a strong reaction which produces an essentially short period of boiling the acid.

As the acid continues to impinge on the inner wall of the drum, the wall temperature tends to drop to about 250°F. From 45 seconds to about 1½ minutes later, the acid valve 88 is shut off. While the acid plug, i.e., the plug leading to the container 58 containing the acid, is opened while the acid valve is open, it continues to remain open for a period of continued draining of approximately 10–15 seconds to enable the drum and discharge manifold 50 to drain.

During that period the acid valve is turned off, the gas flame of heaters 40, 40 may be turned off, or left on depending upon whether or not it is desired to superheat the drum being wet with acid on its interior. The next cycle could be a water down and flush cycle during which time the first or water rinse cycle operation is then repeated by opening and closing valve 86 as described above. Alternatively, and preferably, the next cycle
could be a wash of hydrochloric acid by turning the acid valve 90 on and opening the container 60 to the discharge manifold 50. During the hydrochloric acid cycle, it is generally found to be unlikely that the gas flame of the heaters would be turned on. The hydrochloric acid cycle will always follow either the sulfuric acid cycle or follow the water cycle that in turn follows the sulfuric acid cycle.

After the hydrochloric acid cycle (third stage), the water cycle (fourth like the first stage) is repeated to thereby reduce the acidity in the drum interior. The fourth stage is then followed by an alkaline neutralizing cycle (fifth stage) which would usually be performed while the heaters were again on. At the end of the fifth stage and drain phase thereof, the drums 12 in the housing 10 are conveyed out along the track 28 and 10 or so drums for reconditioning are passed into the housing 10 along the entrance track 24 and the several cycles are recommenced.

In the meanwhile, waste heat from the apparatus comprising the heaters in the housing 10 has been passing over the 10 drums awaiting the reconditioning process causing them to become preheated. It is possible to provide automatic or semi-automatic controls so that one operator can simply work two or more of the reconditioning apparatus and methods of the invention.

Since the ten drums in the machine rest on the flat conveyor 26 which is slightly wider than the width of the drums and inclined downwardly and made part of an air plenum and since this plate is inclined, drums that have been cleaned slide out of the machine very easily after the air plenum rises so that the nozzles that have been inserted within the drums are free and clear of the drums. A slight push by the operator will start these drums sliding while at the same time, the 10 drums in the enclosed entrance tunnel move by gravity or by conveyor so that the incoming drums follow directly behind the outgoing drums.

After the clean drums are clear of the machine, a stop (not shown) rises so that the incoming drums are stopped in a position approximately over the nozzles. At that point, the air plenum 18 is lowered so that the nozzles 32 protrude above the top of the plenum and attempt to enter the drums. Most of them do not, however, the operator can quickly position the 2-inch opening in the drum over the nozzle.

Some of the advantages of the method are as follows:

1. During operation, the system is sealed so that no vapors escape while acid is being pumped into the drum and evacuated from the drum.

2. Unlike conventional systems, the drums are not removed from the nozzle and transferred from one machine to another, each of which contains its own solution. This drastically reduces the manpower required, eliminates the fuming that would occur when drums were being transferred from the tanks containing the acid, but perhaps more important of all, reduces the time required between the acid cycle and neutralization. The nature of acid cleaning is such that as soon as the flow of acids discontinues, immediate reaction results which causes the interior of the drum to stain or re-rust. This happens in seconds, and reducing the elapsed time between the treatment of acid and the neutralization cycle is most important in affecting good neutralization.

3. An acid such as sulfuric acid when heated creates a very harsh reactive condition which is more effective in removing rust and interior linings or contaminants in the drum. Its cost is less and it is a very effective cleaning medium. Its disadvantage is that when heated, it creates a substantial amount of fumes which are difficult to control and which are destructive to the mechanism of the machine and to other machinery in the area of the material. Additionally, the neutralization of such drums is much more difficult. By following the heated sulfuric acid cycle by a water and/or cooler milder inhibited muriatic acid, two things that are very important to the operation of the machine are accomplished:

a. Any staining that may occur after the sulfuric acid cycle is removed.

b. A film of sulfuric acid that forms on the interior of the drums is removed and replaced with a milder inhibited muriatic acid which subsequently can be neutralized easier. The economy of the entire operation is substantially increased for the reason that the sulfuric acid does most of the work and receives most of the contamination. It can therefore be disposed of more economically than the hydrochloric acid for the reason that it is much cheaper. By the same token, the life of the hydrochloric acid is extended greatly due to the fact that it does little work.

4. Completely eliminated is a tremendously expensive and complex fume-gathering and neutralizing equipment so necessary when drums are treated in the conventional fashion. The original cost and maintenance of a sulfuric acid heat is eliminated by heating the drum which, in turn, heats the sulfuric acid and/or other solutions. Heating the surface of the drum above the temperature of the solution being pumped into the drum creates a thin superheated film of cleaning solution along the entire surface of the interior of the drum at precisely the location of the rust and contaminates coating the interior surface of the drum. The cost of acid-receiving tanks and acid pumps is greatly reduced for the reason that the high temperature sulfuric acid which is released from the drum during only a small part of the sulfuric acid cycle is immediately mixed with cooler acid released during the greater part of the cycle thereby lowering the temperature of the acid that must be contained in the tank and pumped to more tolerable levels.

While the acid stages in a preferred embodiment of the invention may be sulfuric acid and hydrochloric acid, respectively, or sulfuric and muriatic acid, respectively, other acids may be used for the purposes and ends desired. Also, added numbers of control valves, such as valves 84 to 90, may be provided and used to control added cycles.

Additional embodiments of the invention in this specification will occur to others and therefore it is intended that the scope of the invention be limited only by the appended claims and not by the embodiments described hereinabove. Accordingly, reference should be made to the following claims in determining the full scope of the invention.

The claim:

1. The method of reconditioning used steel drums and the like containing layers of organic matter, rust and interior lining adhering to the surfaces thereof comprising:
preheating the drums by means of gas burner means; subjecting such heated steel drums and the adhering layers of organic matter, rust and interior lining to a first stage of pumping water and a drain cycle; then

a second stage of pumping an aqueous solution of sulfuric acid under pressure onto inner surfaces of said heated drums, said surfaces having an elevated temperature of up to about 700°F, and draining during which stage there is a short period of boiling the acid due to the heat contained in the heated drums; then

a third stage of pumping an aqueous solution of hydrochloric acid under pressure onto the inner surfaces of the drums; then

a fourth stage of pumping water to reduce the acidity in the drum, and a drain cycle; and

a fifth stage of pumping an alkaline neutralizing solution under pressure onto the inner surfaces of the drums.

2. The invention of claim 1, wherein the first stage is preceded by a stage of pumping an alkaline solution for washing the inner surfaces of the drums, said surfaces being preheated to about 500°–700°F, and draining.

3. The invention of claim 1, wherein the third stage includes applying heat during the stage.

4. The invention of claim 1, wherein the fourth stage includes applying heat for drying and accelerating any action between the water and the remaining aqueous solution of hydrochloric acid remaining from the third stage for reducing the acidity in the drum and in the manifold.

5. The invention of claim 1, wherein the fifth stage includes applying heat in the form of heated air from said gas burner means having a temperature range from 500°–700°F to assist the alkaline neutralizing cycle.

6. The invention of claim 1, wherein the air heated by said gas burner means is passed or exhausted from the work area onto a series of drums awaiting the process of claim 1 for pre-heating such series of drums.

7. The invention according to claim 1, wherein the hydrochloric acid bath includes sulfuric acid.

8. The invention of claim 1, wherein the third stage is preceded by a stage of pumping water to rinse the inner surfaces of the drums to reduce the acidity in the drum, and is followed by a drain cycle.

9. The invention of claim 8, wherein heat is applied during the stage of pumping water and the drain cycle.

10. The invention of claim 1, wherein the draining during each stage includes collecting selectively the several liquids in a plurality of containers fed by a discharge manifold, namely, one each for (1) an alkaline solution, (2) rinse water, (3) sulfuric acid, and (4) hydrochloric acid.

11. The invention of claim 10, wherein the draining during said stages includes passing the draining solutions through a solution discharge manifold and through a discharge manifold valve means directing a given solution into its identified container.

12. The invention according to claim 10, wherein solenoid valve lifting devices are selectively energized to lift a valve plug from a valve seat for opening access to a container during a given drain cycle.