HELICAL SHELF FOR ROTARY INCLINED PROCESSING TANK

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ABSTRACT
A pair of helically shaped flat shelves each having a first rearward curving lip along a portion of its inner edge located in a generally cylindrical rotatable processing tank, such as a hide processing tank, with an axis of rotation inclined to the horizontal. Rotation of the tank about the axis of rotation causes the shelves to move thereby producing improved circulation of the hides in suspension in processing fluid in the tank. The circulating motion of the hides is down the walls of the tank along the shelves towards the rear and up the central portion of the tank towards the front. In addition to this improved circulation, the hides are also lifted up the walls by the motion of the shelves and dropped back into the processing fluid, thereby subjecting the hides to improved "scudding" action. This lifting and dropping action is dependent upon lips which curve from the inner edge of the shelves towards the rear of the tank. The degree of lifting action is also determined by the pitch of the shelves as well as the angle of inclination of the axis of rotation, and therefore the pitch of the shelves is varied in three different zones along the length of the tank to produce different lifting action in each zone. The junctions of the shelves with the rear end of the tank are filled to form smooth sloping surfaces and a deflection barrier provided across the rear end of the tank between the junctions to provide improved circulation of the hides in the tank. The shelves may also each have a second forward curving lip extending a second portion of its inner edge through a truncated cone shaped body portion leading to a front opening. Processed hides may be removed from the tank by reversing the direction of rotation of the tank. The hides are retained on the shelves by the second curved lips as they are carried forwardly along the shelves to the front opening.

19 Claims, 8 Drawing Figures
HELVICAL SHELF FOR ROTARY INCLINED PROCESSING TANK

BACKGROUND OF THE INVENTION

This invention relates generally to processing tanks, and more particularly to helical shelves located in such processing tanks.

The applicant's copending Canadian Application No. 094,622 entitled "Fiberglass Processing Tank" filed Oct. 2, 1970 discloses an inclined processing tank used in the hide processing industry, with which the helical shelves may of the present invention be used. The processing tank disclosed in Application No. 094,622 and in the present disclosure is a rotating, generally cylindrically shaped tank, similar in appearance to the truck mounted concrete mixers in common use. However, it is to be understood that the helical shelves of the present invention are not to be restricted to use in this particular tank, nor to use in the hide processing industry.

In the past in the hide processing industry, a variety of shelves, baffles and fins have been used in hide processing tanks in attempts to provide improved processing of the hides by the processing fluid as the tank is rotated. However, none of these arrangements have provided optimum processing of the hides, and all have had the disadvantage that the hides are not satisfactorily circulated through the processing fluid.

More recently, spiral fins have been used on inclined rotating tanks in an attempt to produce an improved mixing action on the hides in the tank. This arrangement while being an improvement over the previous arrangements, still has the disadvantage that the hides are not satisfactorily circulated through the processing fluid in the tank to result in the desired quality of processing of the hides. Processed hides may be conveniently removed from tanks of this type by reversing the direction of rotation of the tank to carry the hides forwardly along the fins or shelves to a front opening. However, during this process, it has been found that some of the hides carry over the shelves towards the rear of the tank. In addition, it has been found that in some cases involving larger hides, the shelves interfere with the loading of the dry hides into the tank.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to at least partially overcome these disadvantages by providing an improved helical shelf for an inclined rotating processing tank.

To this end, in one of its aspects, the invention provides in a rotatable processing tank of molded fiberglass resin laminate located with its axis of rotation inclined to the horizontal and having a closed lower rear end, a main body portion with a cylindrically shaped wall, and an open upper front end, a helically shaped shelf extending along at least a portion of the inside surface of the wall of the main body portion, said shelf having an outer and inner edge, the outer edge being rigidly secured to the said cylindrically shaped wall, and a first curved lip extending along at least a first portion of its inner edge said first lip curving toward the rear end of the tank.

In another of its aspects, the invention further provides in a rotatable processing tank of molded fiberglass resin laminate located with its axis of rotation inclined to the horizontal and having a closed lower rear end, a main body portion with a cylindrically shaped wall extending from the rear end, a truncated cone body portion having a cone shaped wall extending from the main body portion, and an open upper front end defined by the cone shaped body portion to be smaller in diameter than the main body portion, a pair of equally spaced helically shaped shelves, each shelf having an outer and inner edge, each shelf extending from the closed rear end to the open front end of the tank, each shelf being rigidly secured along its outer edge to the cylindrically shaped wall of the main body portion and to the cone shaped wall of the cone shaped body portion, each shelf having a first rearwardly curved lip extending along a first portion of its inner edge and a second forwardly curved lip extending along a second front portion of its inner edge.

Further objects and advantages of the invention will appear from the following description taken together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially cut-away elevation view of a processing tank, showing a pair of helical shelves according to a preferred embodiment of the invention;

FIG. 2 is a sectional view taken along line II—II in FIG. 1;

FIG. 3 is a sectional view taken along line III—III in FIG. 2;

FIG. 4 shows one of the shelves seen in FIG. 1, in transverse section;

FIG. 5 is a sectional view taken along line V—V in FIG. 1;

FIG. 6 is a cut-away perspective view of a junction between one of the shelves and the lower end of the tank seen in FIG. 1;

FIG. 7 is a sectional view similar to FIG. 3, of an alternate embodiment of the invention, and

FIG. 8 is a sectional view similar to FIG. 2, of the embodiment shown in FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference is first made to FIG. 1 which shows a processing tank 10 having a main body portion 12 with a generally cylindrically shaped wall 14, a truncated cone body portion 16 with a generally cone shaped wall 18, an open upper front end 20, a closed lower rear end 22, and a pair of helically shaped shelves 24, 26. The truncated cone body portion 16 is attached to extend the main body portion 12 along flanges 27 and extends to define the circular open upper front end 20 which is smaller in diameter than the main body portion 12.

As are more extensively described in copending application No. 094,622, the processing tank 10 also has a belt track 28, a supporting ring 30, a plurality of outlets 32 communicating with perforated wash ring 34, and a hub 36. The rear end 22, main body portion 12 and the cone body portion 18 are formed of molded fiberglass resin laminate in a manner described in copending application No. 094,622. The wash ring 34 is substantially rectangular in cross-section and extends around the inside of the tank adjacent the junction between the wall 14 and the rear end 22.
The cone body portion 16 has a continuous drip-lip 38 extending around its periphery so that any processing fluid which spills out of the open upper front end 20 of the tank will not run downward past the drip-lip 38 towards the rear end 22 of the tank, and by thereby spread over the outer surface of the tank by the rotary motion of the tank.

The processing tank 10 has a longitudinal axis of rotation 40 which is inclined to the horizontal, and about which the tank is rotated at a desired angular velocity by motor 42 or other suitably attached power source. The tank may of course be constructed to be rotated in either direction about the axis of rotation 40 during processing, but in the embodiment shown in the drawings the helically shaped shelves 24, 26 are located for counter clockwise rotation (as seen from the open upper front end 20) of the tank 10 about the axis 40.

In the embodiment of the invention shown, each of the pair of helically shaped shelves 24, 26 extends from the rear end 22 of the tank along the inside surface 44 of the cylindrically shaped wall 14 of the main body portion and the inside surface 46 of the cone shaped wall 18 of the truncated cone body portion 16 to the front end 20. Each shelf has an outer edge 48, 50 and an inner edge 52, 54. As best seen in FIG. 4, each shelf is attached along its outer edge to the inside surface 44 of the cylindrical shaped wall of the main body portion 12 by a resin-bonded fiberglass laminate 56. The shelves 24, 26 are similarly attached by a resin-bonded fiberglass laminate along their outer edges 48, 50 to the inside surface 46 of the cone shaped wall 18 of the truncated cone portion 16 of the tank. The shelves 24, 26 are located in a position in which, in transverse section, they project inward substantially perpendicular from the cylindrically shaped wall 14. The shelves 24, 26 each have a first curved lip 58, 60 extending rearward from its inner edge 52, 54. The first lips extend along a first lip section 59 of the inner edge of each shelf from the rear end 22 through the main body portion 12 and part way through the truncated cone body portion 16. As best seen in FIGS. 2 and 3, the first lip on each shelf terminates part way through the cone body portion 16, and through the remaining portion of the cone body portion 16 to the front end of the tank, the width of each shelf is extended so that this remaining lipless portion 61 of each shelf projects inwardly from the cone shaped wall 18 the same distance as the combined shelf and first lip of the first mentioned lip section of each shelf projects inwardly from the cylindrically shaped wall 14 or the cone shaped wall 18. Each shelf 24, 26 is perforated with a number of holes 62 along its length except for a non-perforated portion 63, 65 extending from part way through the cone body portion 16 to the front end 20 of the tank.

The shelves 24, 26 and the lips 58, 60 are formed of molded fiberglass resin laminate, and are preferably formed so that the first lips are integral with the shelves along the lip portion of each shelf.

In the preferred embodiment shown in the drawings, each first lip 58, 60 terminates a distance of approximately 36 inches from the front end 20 of the tank, measured along the respective shelf. The distance, d that the lipless portion of the shelf and the combination of the first lip and the lipless portion of the shelf respectively project inwardly from the inside surface 46 of the cone shaped wall and the inside surface 44 of the cylindrically shaped wall is approximately 16 inches. The radius of curvature r of the lips 58, 60 is approximately 6 inches. There are three rows of approximately 1 1/2 inch diameter perforated holes 62 in each shelf, the rows are 3 inches apart and the holes are 6 inches apart. The perforated holes 62 in each shelf terminate a distance of approximately 18 inches from the front end 20 of the tank measured along the respective shelf. It is, of course, to be understood that these dimensions are given by way of example of the invention, and are not be taken as a limitation thereof.

In the preferred embodiment shown, the helix angle α between each shelf and the axis of rotation 40 decreases from the front end 20 toward the rear end 22 of the tank. This increase in pitch from the front end to the rear end occurs in three steps or stages corresponding to zone 1, zone 2 and zone 3 shown in FIG. 1. In zone 1, adjacent the rear end 22 of the tank, the pitch of each shelf is such that the shelf would extend through an arc of 180° in approximately three-fifths the length of the tank; in zone 2 each shelf would extend through an arc of approximately two-thirds the length of the tank; and in zone 3, adjacent the front end 20 of the tank, each shelf extends through an arc of approximately 180° in the length of the cone body portion. Although in this embodiment, the pitch of the shelves is substantially constant through each zone, it must of course vary slightly towards each side of each zone in order to result in a smooth transition to the next zone. It is similarly to be understood that these pitch dimensions are given by way of example and are not to be taken as a limitation of the invention.

FIG. 6 shows one of the junctions 64, 66 between the shelves 24, 26 and the rear end 22 of the tank. As may be seen the wash ring 34 extends through the shelf at this point to form recesses 68, 70 between the inside surface 44 of the cylindrically shaped wall, the wash ring 34, the rear end 22, and the shelf. In practice, it has been found advantageous to fill these recesses 68, 70 with resin bonded fiberglass to provide sloping surfaces 72, 74 of the respective junction.

As shown in FIGS. 1 and 5, a V-shaped deflection barrier 76 extends across the rear end 22. The barrier 76 is formed of a fiberglass resin laminate and is resin-bonded to the rear end 22 and the inside surface 44 of the cylindrical shaped wall. In the embodiment shown, the barrier 76 extends in a direction approximately perpendicular to an imaginary line joining the junctions 64, 68 of the shelves 24, 26 with the rear end 22. Although the tank shown has a pair of helically shaped shelves 24, 26 it is possible that a tank having only a single similar shelf could be used.

In use in the hide processing industry, the processing tank 10 is partially filled with hides in suspension in a hide processing fluid, and the tank is rotated counter clockwise (as viewed from the front end 20). In order to obtain optimum results, it is desirable to exert an improved "scudding" action on the hides. This desired "scudding" action involves producing numerous two directional bends over the entire area of each hide to pop out the bulbs which hold the hairs in place. In order to obtain improved "scudding" action it is necessary that the hides continuously circulate in the tank without stopping in dead spots and that the circular motion of the hides is such as to result in improved two directional bending of the hides. It has been found that the helically shaped shelves according to the invention
produce this desired action by slowly moving the hides towards the rear of the tank to maintain circulation, while at the same time lifting the hides up the inside surface of the cylindrically shaped wall 44 and dropping them to produce the bending action. As the tank 4 rotates, the shelves 24, 26 move through the processing fluid and the leading faces 78, 80 of the shelves come in contact with some of the hides in suspension in the fluid. The motion of the shelves causes some of the hides contacted by the leading faces 78, 80 to be lifted up the inside surface of the wall and moved towards the rear end 22 of the tank. When the hides which are moved towards the rear end 22 of the tank reach the sloping surfaces 72, 74 of the respective junctions 64, 68, they are discharged back into free suspension in the processing fluid in the central portion of the tank and are carried towards the front end 20 of the tank by circulation of the processing fluid through the central portion of the tank. Filling of the recesses 68, 70 with resin bonded fiberglass to provide sloping surfaces 72, 74 has been found to improve circulation of the hides in the tank as it quickens discharge of the hides from the shelves and avoids the hides being retained in the recesses. The sloping surfaces 72, 74 also reduces the backwash of the processing fluid from each junction 64, 66 across the tank which hinders discharge of the hides from the opposite junction. Similarly, it has been found that use of the deflection barrier 76 divides the flow of the processing fluid from the junctions to reduce the effect of this backwash on the discharge of hides from the opposing junctions and, therefore, improves circulation of the hides towards the front of the tank through the central portion of the tank. As a result, it has been found that "dead spots" or pockets of hides which are not circulating have been eliminated. The hides which are lifted by the shelves 24, 26, mount the inside surface of the walls 44 to varying positions before dropping back into the processing fluid in the central portion of the tank. This improved lifting action, which results in some of the hides being carried up the wall 44 by the shelves 24, 26 to positions near the top of the tank, is permitted by the existence and shape of the lips 58, 60 on the shelves. The degree of lifting or mounting action is also dependent of the inclination of the axis of rotation 40 and the pitch or helix angle of the shelves.

Therefore, the combination of longitudinal circulatory motion and lifting action of the hides varies somewhat in the different zones. In rear zone 1, in which the helix angle \( \alpha \) of the shelves is the least, the dominant action is that of lifting and dropping of the hides although, as mentioned above, a gentle action due to the pitch of the shelves forces the hides along the shelves toward the rear end of the tank. In zone 2, a slightly less vigorous lifting action is found, with a greater force producing a longitudinal movement towards the rear of the vessel. This longitudinal movement aids in the shifting of the suspended hides through zone 1. In zone 3, the volume of hides being processed is considerably less due to the smaller capacity in this area. The helix angle \( \alpha \) is a maximum so that the dominant action becomes the rearward longitudinal force with just a slight lifting action. The increases helix angle \( \alpha \) in zone 3 also helps to prevent hides being force out the open front end 20 of the tank by the circulation of processing fluid through the central portion of the tank towards the front end. The movement of the shelves with the greater helix angle through the processing fluid as the tank rotates combined with the smaller capacity of zone 3, reverses the direction of the processing fluid and starts it moving along the shelves towards the rear end of the tank.

In summary, the combined lateral and lifting circulation pattern of the hides in the processing fluid depends upon a variety of factors, such as the number, size, shape and pitch of the shelves, the shape of the junctions between the shelves and the rear end of the tank, the shape and position of the deflection barrier, the angle of inclination and the speed of rotation of the tank, the type of hides, and the density and viscosity of the processing fluid. The holes 62 in the shelves have also been found to improve mixing of the processing fluid by releasing the hydraulic pressure built up against the shelves as they move through the fluid.

At the end of the processing cycle, the processing fluid may be removed from the tank through the outlets 32, and the hides may be removed by reversing the direction of rotation of the tank. This results in the hides being carried to the front end 20 of the tank by the shelves. An advantage of the shelves having the greatest helix angle \( \alpha \) through zone 3 is that the maximum lift of the hides toward the open front end 20 is provided where it is necessary through the cone body portion 16 of the tank. The holes 62 in the shelves are again of use, in that they allow the residual processing fluid to flow toward the rear end of the tank while the hides are carried to the front end.

Reference is now made to a second embodiment of the invention, as shown in FIGS. 7 and 8, which provides a second curved lip which extends along a front portion of the inner edge of each shelf and curves towards the front of the tank rather than towards the rear. This allows the shelves to be formed of a lesser width near the front of the tank for those applications where this is a problem in loading dry hides into the tank.

The pair of helically shaped shelves 24, 26 are shown extending along the inside surface 44 of the cylindrically shaped wall 14 of the main body portion 12 and the inside surface 46 of the cone shaped wall 18 of the truncated cone body portion 16. As may be seen, each of the shelves has a second curved lip 90, 92 extending along a second portion 94 of the inner edge 52, 54 of each shelf. Each of the second curved lips 90, 92 extends towards the front end 20 of the tank, and each of the shelves also has a gradually curved transition lip portion 96, 98 which connects the first and second curved lips. As seen in this embodiment, the transition lip portions are located adjacent the junction between the main body portion 12 and the truncated cone body portion 16. Therefore, the rearwardly extending first curved lips 58, 60 are substantially located within the main body portion 12, while the forwardly extending second curved lips 90, 92 are substantially located in the truncated cone body portion 16. The structure of the second curved lips 90, 92 is otherwise substantially the same as that of the first curved lips 58, 60, except that the combined width of the shelf and second lip is somewhat less. By way of example, the combined width of the shelf and first lip shown is 16 inches, while the combined width of the shelf and second lip is 14 inches. The front corners 100, 102 of the second curved lips are tapered to avoid extension beyond the front end 20.
and to provide a greater effective opening distance between them.

In use, the processed hides are removed from this second embodiment of the tank through the open front end 20 by reversing the direction of rotation of the tank. The hides are retained on the shelves 24, 26 by the second curved lips 90, 92 as they are carried forward along the shelves through the truncated cone body portion 16 of the tank.

Although the disclosure describes and illustrates preferred embodiments of the invention, it is to be understood that the invention is not restricted to these particular embodiments.

What I claim is:

1. In a rotatable processing tank of molded fiberglass resin laminate located with its axis of rotation inclined to the horizontal and having a closed lower rear end, a main body portion with a cylindrically shaped wall, and an open upper front end,
a helically shaped shelf extending along at least a portion of the inside surface of the wall of the main body portion, said shelf having an outer and inner edge, the outer edge being rigidly secured to the said cylindrically shaped wall, and a first curved lip extending along at least a first portion of its inner edge, said first lip curving towards the rear end of the tank.

2. In a processing tank according to claim 1, a further identical shelf rigidly secured to the said wall to provide a pair of helically shaped shelves equally spaced around the inside surface of the wall of the main body portion, each shelf extending from the closed rear end to the open front end of the tank, each shelf being rigidly secured along its outer edge to the cylindrically shaped wall of the main body portion.

3. In a processing tank according to claim 1, a second curved lip extending along a second front portion of the inner edge of the helically shaped shelf, said second lip curving towards the front end of the tank, said shelf having a gradually curved transition lip portion connecting the first curved lip to the second curved lip.

4. In a processing tank according to claim 3, a further identical shelf rigidly secured to said wall to provide a pair of helically shaped shelves equally spaced around the inside surface of the wall of the main body portion, each shelf extending from the closed rear end to the open front end of the tank, each shelf being rigidly secured along its outer edge to the cylindrically shaped wall of the main body portion.

5. In a rotatable processing tank of molded fiberglass resin laminate located with its axis of rotation inclined to the horizontal and having a closed lower rear end, a main body portion with a cylindrically shaped wall extending from the rear end, a truncated cone body portion having a cone shaped wall extending from the main body portion, and an open upper front end defined by the cone shaped body portion to be smaller in diameter than the main body portion,
a pair of helically shaped shelves equally spaced around and extending along at least a portion of the inside surface of the wall of the main body portion, each shelf having an outer and inner edge, the outer edge being rigidly secured to the said cylindrically shaped wall, and a first curved lip extending along at least a first portion of its inner edge, each said first lip curving towards the rear end of the tank.

6. A pair of helically shaped shelves as claimed in claim 5, each shelf extending from the closed rear end to the open front end of the tank, each shelf being rigidly secured along its outer edge to the cylindrically shaped wall of the main body portion and to the cone shaped wall of the cone shaped body portion.

7. A pair of helically shaped shelves as claimed in claim 5, each shelf extending from the closed rear end to the open front end of the tank, each shelf being formed of molded fiberglass resin laminate and bonded along its outer edge to the cylindrically shaped wall of the main body portion and to the cone shaped wall of the cone shaped body portion by a resin-bonded fiberglass laminate, each shelf projecting inward, in transverse section, substantially perpendicular to the cylindrically shaped wall of the main body portion of the tank, each shelf forming a junction with the closed rear end of the tank, each junction being filled to provide relatively smooth sloping surfaces between the respective shelf, the lower end of the tank and the wall of the main body portion.

8. A pair of helically shaped shelves as claimed in claim 6, each shelf extending to form a junction with the closed rear end of the tank, the tank also having a deflection barrier projecting inward from the rear end of the tank to bisect the rear end substantially perpendicular to an imaginary straight line extending between the said two junctions, the deflection barrier having a cross-section in the shape of an inverted V.

9. A pair of helically shaped shelves as claimed in claim 6 each shelf having a helix angle with respect to the longitudinal axis of the tank which increases in steps towards the front end of the drum.

10. A pair of helically shaped shelves as claimed in claim 6 the tank also having a continuous perforated wash ring located adjacent the wall and the rear end of the tank, the wash ring being substantially rectangular in cross-section.

11. A pair of helically shaped shelves as claimed in claim 6 each shelf having a second curved lip extending along a second front portion of its inner edge, each said second curved lip curving towards the front end of the tank, each shelf having a gradually curved transition lip portion connecting the first curved lip to the second curved lip.

12. A pair of helically shaped shelves as claimed in claim 11 wherein each transition lip portion is located substantially adjacent the junction between the main body portion and the truncated cone body portion.

13. A pair of helically shaped shelves as claimed in claim 11 wherein the first lip projects inwardly from the outer edge of the shelf a greater distance than the second lip.

14. A pair of helically shaped shelves as claimed in claim 11 each shelf extending to form a junction with the closed rear end of the tank, the tank also having a deflection barrier projecting inwardly from the rear end of the tank.

15. A pair of helically shaped shelves as claimed in claim 11 each shelf extending to form a junction with the closed rear end of the tank, the tank also having a deflection barrier projecting inward from the rear end of the tank to bisect the rear end substantially perpendicular to an imaginary straight line extending between the said two junctions, the deflection barrier having a cross-section in the shape of an inverted V.
16. A pair of helically shaped shelves as claimed in claim 11 each shelf being formed of molded fiberglass resin laminate and bonded to the cylindrically shaped wall of the main body portion by a resin-bonded fiberglass laminate, each shelf forming a junction with the closed rear end of the tank, each junction being filled to provide relatively smooth sloping surfaces between the respective shelf, the lower end of the tank and the wall of the main body portion.

17. A pair of helically shaped shelves as claimed in claim 11, each shelf having a helix angle with respect to the longitudinal axis of the tank which increases in steps towards the front end of the drum.

18. A pair of helically shaped shelves as claimed in claim 11 each shelf having a helix angle with respect to the longitudinal axis of the tank which increases in first, second and third steps towards the front end of the drum, first, second and third steps corresponding to first, second and third zones of the tank, the first zone being adjacent the rear end of the tank and the third zone corresponding to the cone body portion of the tank.

19. A pair of helically shaped shelves as claimed in claim 11, the tank also having a continuous perforated wash ring located adjacent the wall and the rear end of the tank, the wash ring being substantially rectangular in cross-section.