Oil palm fruit is sterilized by feeding bunches of fruit into a vertical sterilizer that sterilizes the fruit with steam and water. The fruit is charged via inlet 50. A blow down valve 58 and a bleed-off valve 60 are closed. A water valve 62 is opened to pass water into the sterilizer and to displace air/steam. The water also washes the fruit and dampens the impact of the bunches of fresh fruit when loading the sterilizer. The water valve is closed when water reaches the air vent valve 66. Steam inlet valve 68 is opened and increases the pressure in the vessel. Water is discharged via blow down valve 58 to about mid-level and then second steam inlet valve 70 is opened to inject more steam. Once water and condensate have been drained the blow down valve 58 is closed and the bleed-off valve 60 is opened to continuously remove any condensate generated throughout the cycle. The fruit is then discharged from the vertical sterilizer and onto a bunch conveyor for further processing, for example stripping pressing and kernel recovery.
GB 2421169 A continuation

(74) Agent and/or Address for Service:
W P Thompson & Co
Eastcheap House, Central Approach,
LETCWHORTH, Herts, SG6 3DS,
United Kingdom
METHOD FOR EXTRACTING OIL FROM OIL PALM FRUIT AND APPARATUS FOR STERILIZING OIL PALM FRUIT

Field of Invention

This invention relates to a method for extracting oil from oil palm fruit and relates particularly, though not exclusively, to improvements in the method where the fruit is sterilized in a sterilizer with a mechanical discharging device which operates in the absence of air by means of water or liquid displacement. An apparatus for sterilizing oil palm fruit is also disclosed.

Background to the Invention

The extraction of palm oil from bunches of fresh fruit in conventional oil palm mills includes the process of sterilization of fresh fruit bunches in horizontal multiple-cage sterilizer systems with the subsequent stripping of fruit from the bunch. The fruit is then digested, and thereafter oil is extracted from the fruit in a screw press.

The production process from the stage bunches of fresh fruit are received from the field until the sterilized fruit are introduced to the stripper (or thresher) involves the use of a substantial quantity of heavy equipment, labour and a series of repeated operations.

In earlier techniques of extraction, bunches of fresh fruit are first loaded onto cages, which are then introduced into horizontal sterilizer containers. The bunches of fresh fruit are then subjected to pressurized steam to arrest the production of free fatty acids and loosen fruit from bunches. The sterilization process is based on a multiple-peaks cycle and repeated blow off to remove the air trapped inside the sterilizer. This process involves the use of substantial quantities of steam, and thus a lot of heat is lost and energy consumed.

After sterilization, the cages containing the steamed bunches of fresh fruit are removed using a capstan or hydraulic winch with wire rope. The cages containing the steamed FFB are then lifted using an overhead crane and emptied onto a stripper (thresher)
where the fruit are separated from the bunches. The fruit are then introduced into a digester for subsequent processing.

In another process where overhead cranes are not used, bunches of fresh fruit and sterilized fruit cages are transferred by means of transfer carriages and a cantilever trolley assisted by an indexer or hydraulic winch/capstan. Here, a tipper is used to tip the sterilized fruit from the cage onto a hopper which is then conveyed to the stripper. Where a hydraulic winch/capstan is not used, a wheel loader or a skid loader is used to push the cages around the length and breadth of the sterilizer marshalling yard.

As sterilization and the transfer of sterilized fruit to the stripper is done in individual cages, there is a substantial outlay in capital for a plurality of cages, overhead cranes/tippers, rail tracks, transfer carriages, cantilever trolleys and winches/capstans or indexers. Operation and maintenance costs are relatively high as the cages are subjected to heavy wear and tear. Also, there is significant damage to the bunches of fresh fruit from the first stage of the cycle of receiving the bunches of fresh fruit, transferring to the sterilizer containers, sterilizing, transferring to stripper, returning from stripper to rail tracks and final return of empty cages to the loading bays. The presence of air trapped in pockets in the sterilizer during sterilization accelerates corrosion on the sterilizer and cages.

There are also substantial labour requirements at the various stages, in particular at the loading of bunches of fresh fruit onto the cages, transferring the cages onto the sterilizer, operating the sterilizer on a multiple-peaks cycle, removal of the cages from the sterilizer, transferring the cages onto the stripper and returning the cages to the loading bay. The nature of these various process stages and the existing methods of operation do not allow for the automation of such processes.

At the loading of bunches of fresh fruit to each cage and transferring of bunches of fresh fruit and sterilized fruit cages to stripper, there is loss of oil from the fruit that is spilt during transport, and oil dripping from cages. The sterilizer condensate oil is unrecoverable due to its low quality. Moreover, the process requires the utilization of large quantities of pressurized and high temperature steam. The utilization and
condensation of large quantities of steam in the enclosed sterilization vessels also contributes to the substantial oil loss, and high unit cost of palm oil extraction.

Summary of Invention

There is provided a method for extracting oil from oil palm fruit that may comprise: directly feeding bunches of fruit into a vertical sterilizer that sterilizes the fruit bearing bunches with steam and water; and directly discharging bunches of fruit from the vertical sterilizer onto a bunch conveyor for further processing. The introduction of water in the sterilizer may be for displacing air, washing the fruit, and damping the impact on the fruit during movement in the sterilizer. A systematic displacement of air, water and condensate using mechanical means and ingress of pressurized steam in the sterilizer sterilizes the fruit. Preferably, the mechanical means may be selected from either a vacuum pump or at least two steam inlet valves operating in sequence. It may be advantageous to use a fruit pusher mechanism to evacuate the sterilized fruit from the vertical sterilizer. Further processing after discharge from the sterilizer comprises the processes stripping, pressing, or kernel recovery.

There is also provided an apparatus for sterilizing bunches of fruit from oil palm, the apparatus may comprise a container with its height greater than its diameter. The container may comprise: at least one entry opening for loading bunches of fruit; at least one exit opening for discharging bunches of fruit; at least one blowdown valve for exit of steam and water from the container; at least two steam inlet valves for entry of steam into the container; at least one bleed-off valve for the egress of condensate from the container; at least one water valve for the control of water entry into the container; and at least one air vent valve for allowing venting of air from the container. Preferably, a systematic displacement of air, water and condensate using mechanical means and ingress of pressurized steam in the apparatus sterilizes the fruit. The mechanical means may be either a vacuum pump or at least two steam inlet valves operating in sequence. It is preferable that the container is either cylindrical or inverted conical in shape. Advantageously, the inverted conical shaped container allows the fruit to drop into the container and pulp will tend not to form bridges because of the shape. Advantageously, the apparatus may further include a perforated inclined plate that acts as a screen. It
may be advantageous for the apparatus to further include an arch breaker. The apparatus may preferably further include a fruit pusher mechanism.

Description of Drawings

In order that the invention may be better understood and readily put into practical effect, there shall now be described by way of non-limitative example a preferred embodiment of the present invention, the description being in reference to the accompanying illustrative drawings in which:

Figure 1 is a schematic flow diagram of a preferred embodiment; and
Figure 2 is a side view of a vertical sterilizer of the preferred embodiment.

Description of the Preferred Embodiments

According to the preferred embodiment there is provided a method where bunches of fresh fruit of oil palms are directly fed into a vertical sterilizer by a fruit bunch conveyor. Referring to Figure 1, there is shown a schematic flow diagram of a method 20 of extracting oil from bunches of fresh fruit of oil palm. The bunches of fresh fruit from the field are unloaded from a mode of transportation 22 such as, for example, lorries (as shown), vans, pick-ups, ships and other vehicles. The bunches of fresh fruit are fed onto a storage cum unloading ramp 24. The ramp 24 may consist of a series of loading ramps with a capacity of for example, approximately ten tonnes per door. However, the capacity will depend on the extraction capacity of a particular palm oil mill. The bunches of fresh fruit may subsequently be discharged into a fruit bunch conveyor 26 through hydraulically/mechanically operated doors (not shown). The fruit bunch conveyor 26 may be operated by a chain drive system, a friction drive, or a system of gears. The fruit bunch conveyor 26 may be used to transfer the bunches of fresh fruit to various heights.

Referring also to Figure 2, a first quick actuating door 50 at the top 52 of a vertical sterilizer 28 may be opened to allow bunches of fresh fruit from the fruit bunch conveyor 26 to be directly loaded into the vertical sterilizer 28. The vertical sterilizer 28 is may be cylindrical or inverted conical, with its height greater than its diameter. The inverted conical shape may facilitate the fruit to drop due to a bigger diameter at its base. The
conical shape may also minimize the incidence of pulp/fruit forming a "bridge" in the sterilizer 28. At the same time, a second quick actuating door 54 at a lower portion 56 of the vertical sterilizer 28 will be at a closed position, and a blowdown valve 58 and a bleed-off valve 60 at the lower portion 56 of the vertical sterilizer 28 will also be closed. The bunches of fresh fruit on the fruit bunch conveyor 26 may be discharged into the sterilizer 28 by gravitational action guided by connecting chute 30. A water valve 62 is opened to pass water into the sterilizer 28 for displacement of air/steam, for washing the fruit, and also to damp the impact of the bunches of fresh fruit when loading the sterilizer 28 as water provides a cushioning effect for the bunches dropping into the sterilizer 28. Water or liquid may be introduced into the vertical sterilizer 28 at an optimal rate and volume to displace air pockets trapped in and between the fruit when filling. The displacement of air prior to sterilization is important as air is a bad conductor of heat. This process makes de-aeration unnecessary. Hence the process has a higher heat penetration efficiency. Moreover, immersing the fruit in hot water of temperature of, for example, above fifty-five degrees Celsius, for a short time will inactivate the oil-splitting enzymes and check further enzymatic hydrolysis and degradation of the oil. This controls the free fatty acid formation in the oil. As heat penetration is more efficient in the absence of air, a shorter sterilization period of sixty minutes or less, and based on a single peak cycle, is possible. This may enhance oil and kernel quality as over-sterilization is avoided.

As water is introduced to the vertical sterilizer 28 before the start of sterilization, the cleaning of bunches of fruit is facilitated whereby dirt and sand particles trapped within the bunches will be screened off at the bottom through a perforated inclined plate 78 installed inside the sterilizer. Water, together with sterilizer condensate oil, dirt and sand particles, is contained in a separate tank for a further settling process that recovers virgin oil of a predetermined quality (together with some water) and is pumped back as dilution water in the press station 33.

Upon filling the bunches of fresh fruit into the sterilizer 28 to optimal level, the fruit bunch conveyor 26 is stopped and a control door 64 at the top 52 of the sterilizer 28 is shut. The water valve 62 is closed when water reaches an air vent valve 66. This may be before or just after water flows into valve 66. At this juncture, the first quick actuating door 50 is closed and safely locked.
In the vertical sterilizer 28, a first stage of the sterilizing cycle commences with a first steam inlet valve 68 opening to allow steam from an operating engine room LP (Low Pressure) receiver to inject steam of pressure of, approximately forty-five psi into a sterilizer container 29. The pressure used may vary according to the sterilizer container 29 and/or the amount of fruit in the sterilizer 28. Subsequently (approximately five seconds), the blowdown valve 58 may be opened to drain off the water in the sterilizer container 29. When water in the sterilizer container 29 has drained to about mid-level, a second steam inlet valve 70 may be opened to inject more steam, particularly in the mid-section of the sterilizer container 29. Once the water and condensate have been drained, either completely or almost completely, the blowdown valve 58 is closed and the bleed-off valve 60 is opened to continuously remove any condensate generated throughout the cycle.

At the end of a predetermined period depending on the composition of the fruit set (for example, sixty minutes), both the first steam inlet valve 68 and the second steam inlet valve 70 are closed and the blowdown valve 58 is opened to depressurize the sterilizer container 29. Subsequently, the air vent valve 66 is opened to release any residual steam inside the sterilizer container 29.

Once the pressure gauge 72 is at ‘0’ and no steam is passing through the air vent valve 66, the second quick actuating door 54 at a lower portion 56 of the vertical sterilizer 28 is opened.

A fruit pusher mechanism 74 is activated for evacuating fruit from the sterilizer container 29. The fruit pusher mechanism 74 may be regulated by variable speed control on a drive that may be either electrically or hydraulically controlled. The fruit pusher mechanism 74 may also be a helical blade that rotates about an axis to push bunches of fruit out of the sterilizer 28.

When the fruit pusher mechanism 74 activates a sprocket-on-link chain that will drive a top sprocket mounted approximately at the mid-section of the sterilizer 28. The top sprocket rotates and may serve as an arch breaking device 76 for arch breaking of a mash of sterilized fruit during evacuation of sterilized fruit from the sterilizer container 29.
As the pusher mechanism rotates when emptying the sterilized fruit, the arch breaking sprocket installed at about central position of the container will rotate at the same time. Thus the central mash of sterilized fruit may be broken and arch formation may be prevented. It is important to prevent arch formation due to the enmeshment of the bunch fibre. Once the sterilizer container 29 is completely emptied, the sterilizing cycle repeats for the next batch of sterilization.

The discharged sterilized fruit is then conveyed through a bunch conveyor 32 to a stripper 34 for subsequent processing.

During the sterilizing or cooking time in the sterilizer 28, virgin oil from the fruit and the condensate is drained to a blowdown tower. This oil and condensate are separated from dirt and sand particles in an oil settling tank 35. The recovered oil and sludge from the settling tank is pumped to the press station dilution tank 36 for subsequent processing. The sterilization cycle may be carried out in the absence of air which minimizes oxidation. As such, the quality of sterilizer condensate oil may be of better quality and may be almost the same as pressed oil quality. The process may allow waste oil to be recovered.

Referring to Figure 2, there is provided a vertical sterilizer 28 that operates such that after the opening of the first steam inlet valve 68, a few seconds later the blowdown valve 58 opens. A while later (for example, approximately five minutes, depending on requirements), the second steam inlet valve 70 may open to inject steam at the mid-section of the sterilizer container 29. Consequently, water inside the sterilizer container 29 would have also dropped to the mid-section level. When the water inside the sterilizer container 29 is about to be emptied, the blowdown valve 58 closes and another smaller bleed-off valve 60 opens. The sequential operation of the steam inlet valves 68, 70 systematically displaces air, water and condensate through the blow down valve 58 and the bleed off valve 60. Besides steam inlet valves 68, 70, at least one vacuum pump may also be used in their place.

The cooking period of bunches of fresh fruit actually begins with the opening of the two steam inlet valves 68, 70 and the bleed off valve 60. Upon completion of a single-peak sterilization cycle lasting, for example, approximately sixty minutes, the two steam inlet
valves 68, 70 close and the blow down valve 58 and air vent valve 66 open to depressurize the sterilizer container 29. As such, there may be minimum utilization of steam, effective heat penetration, and a faster and simpler sterilizing cycle. The use of the sterilizer 28 may give rise to the production of palm oil and kernel of consistent and good quality.

The utilization of space inside the sterilizer container 29 may be optimized by filling bunches of fresh fruit to the shell of the container 29, unlike horizontal sterilizers where there are empty spaces between incorporated cages and the sterilizer shell, as well as voids in each cage. The typical vertical sterilizer 28 also utilizes steam that is used in a conventional horizontal sterilizer when operating on a triple or multiple peaks cycle. A typical vertical sterilizer 28 may utilize approximately one hundred and fifty kg of dry saturated steam per tonne FFB compared to horizontal sterilizers which may utilize more than three hundred kg of dry saturated steam per tonne FFB.

Directly feeding FFB into the vertical sterilizer 28 and emptying the sterilizer 28 of the sterilized fruit directly to bunch conveyor 32 may minimize the spillage of fruit. This may minimize unnecessary loss of oil and kernel such that overall yield of the extracted oil and kernel per unit weight of FFB may be higher. Consequently, the higher heat penetration efficiency in the sterilizer 28 may result in better control in the subsequent stages which include stripping, pressing and kernel recovery.

The preferred embodiment of the present invention eliminates the use of cages, rail tracks, transfer carriages, winch/capstan, overhead crane/tipper and cantilever trolley. This is aided because of the use of a cageless sterilization vessel 28 that avoids the need for auxiliary equipment, which is standard in the conventional process. This may lower the cost of extracting palm oil as the elimination of traditional sterilizing and crane/tipper stations in the oil mill reduces capital outlay. The overall footprint in these stations is also substantially reduced because the sterilizer marshalling yard is no longer needed. In addition the number of human operatives required at the two stations is significantly reduced to two, or even one, per shift. It may be automatatable.

Whilst there has been described in the foregoing description preferred embodiments of the present invention, it will be understood by those skilled in the technology concerned
that many variations or modifications may be made to details of design or construction without departing from the present invention.

The present invention extends to all features disclosed either individually, or in all possible permutations and combinations.
Claims

1. A method for extracting oil from oil palm fruit comprising:
   directly feeding bunches of fruit into a vertical sterilizer that sterilizes the fruit bearing bunches with steam and water; and
directly discharging bunches of fruit from the vertical sterilizer onto a bunch conveyor for further processing,
   wherein introduction of water in the sterilizer:
   (a) displaces air;
   (b) washes the fruit; and
   (c) damps the impact on the fruit during movement in the sterilizer, and wherein a systematic displacement of air, water and condensate using mechanical means and ingress of pressurized steam in the sterilizer sterilizes the fruit.

2. A method as claimed in claim 1, wherein the mechanical means is selected from the group consisting of: a vacuum pump and at least two steam inlet valves operating in sequence.

3. A method as claimed in either claim 1 or 2, further comprising the use of a fruit pusher mechanism to evacuate the fruit from the vertical sterilizer.

4. A method as claimed in any one of claims 1 to 3, wherein further processing after discharging comprises the processes selected from the group consisting of: stripping, pressing, and kernel recovery.

5. An apparatus for sterilizing bunches of fruit from oil palm, the apparatus comprising a container with its height greater than its diameter, the container comprising:
   at least one entry opening for loading bunches of fruit;
   at least one exit opening for discharging bunches of fruit;
   at least one blowdown valve for exit of water, condensate, and steam from the container;
   at least two steam inlet valves for entry of steam into the container;
   at least one bleed-off valve for the egress of condensate from the container;
at least one water valve for the control of water entry into the container; and
at least one air vent valve for allowing venting of air from the container
wherein a systematic displacement of air, water and condensate using
mechanical means and ingress of pressurized steam in the apparatus sterilizes the fruit.

6. An apparatus as claimed in claim 5, wherein the mechanical means is selected
from the group consisting of: a vacuum pump and at least two steam inlet valves
operating in sequence.

7. An apparatus as claimed in either claim 5 or 6, wherein the container is selected
from the shapes consisting of: cylindrical and inverted conical.

8. An apparatus as claimed in claim 7, wherein the inverted conical shaped
container allows the fruit to drop into the container and pulp will tend not to form bridges
because of the inverted conical shape.

9. An apparatus as claimed in any one of claims 5 to 8, wherein the apparatus
further includes a perforated inclined plate that acts as a screen.

10. An apparatus as claimed in any one of claims 5 to 9, wherein the apparatus
further includes an arch breaker.

11. An apparatus as claimed in any one of claims 5 to 10, wherein the apparatus
further includes a fruit pusher mechanism.

12. A method for extracting oil from oil palm fruit, the method being
substantially as hereinbefore described with reference to the drawings.

13. An apparatus for sterilizing bunches of fruit from oil palm, the
apparatus being substantially as hereinbefore described with reference to
the drawings.
Application No: GB0601499.7  Examiner: Kathryn Orme
Claims searched: 1-13  Date of search: 2 May 2006

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

- A2D; C5C

Worldwide search of patent documents classified in the following areas of the IPC:

- A23B; A23L; C11B

The following online and other databases have been used in the preparation of this search report:

- WPI, EPDOC and TXTE