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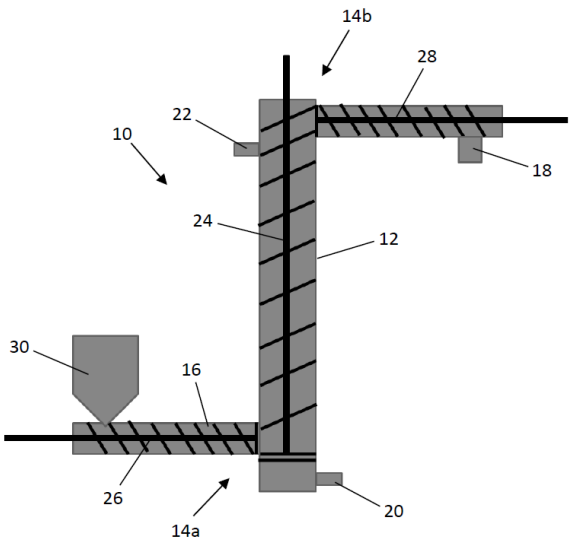
(54)	Title	**Apparatus and method for mashing of malt and water to produce wort in a tank**
(56)	References Cited:	GB 810146 A, DE 102008039373 A1, GB 1000221 A, GB 962572 A
(57)	Abstract	

Method for mashing of malt and water to produce wort in a tank (12), comprising the steps: feeding of fresh malt via a fresh malt inlet (16) to the tank (12); feeding of mash water via a mash water inlet (22) to the tank (12); mixing of the fresh malt and the mash water in the tank (12) to produce the wort by conveying malt from a lower part of the tank (12) to an upper part of the tank (12); discharge of used malt through an upper used malt outlet (18); and discharge of wort from the tank (12) through a lower wort outlet (20). The invention also disclose a mash apparatus (10) for production of wort, comprising a tank (12) for holding malt and water, said tank (12) having a lower part (14a) with a lower fresh malt inlet (16) and a lower wort outlet (20), an upper part (14b) with an upper used malt outlet (18) and an upper mash water inlet (22), wherein said tank (12) further comprises an internal conveyer (24) for feeding of malt from the lower part (14a) to the upper part (14b).



Field of the invention

The present invention relates to an apparatus and method for mashing of malt and water to produce wort in a single upright tank.

Disclosure of the state of art

Today's methods for mashing wort for producing beer can be divided in 3:

- Infusion method
- RIMS method - Recirculating Infusion Mash System
- HERMS method - Heat Exchange Recirculating Mash System

All methods are based on infusion which by temperature breaks down complex sugar to sugar that can be fermented by yeast.

The infusion method is a batch method where you fill in warm water and malt in a container which ends up at the desired mashing temperature. The mash temperature should ideally be kept stable for approximately 60 minutes. The mash temperature will determine the characteristics of the beer and the resulting alcohol level.

The RIMS mashing method is also a batch method where the wort is circulated normally out from the bottom of the mashing vessel through a circulation pump and back to the top of the mashing vessel. The wort is directly heated normally inside the mashing vessel.

The HERMS mashing method is also a batch method where the wort is circulated normally out from the bottom of the mashing vessel through a circulation pump and back to the top of the mashing vessel. This method transfer heat to the wort through a heat exchanger, normally heated by hot water in a separate vessel.

All known mashing methods are targeting to extract sugar from the grain/malt in such a way that the quality of the beer is as good as possible. In addition, it is important to extract as much sugar as possible out from the available grain/malt. The efficiency of extracting the sugar from grain/malt is defined as Mash efficiency and finally Brewhouse efficiency.

The closest known techniques to the invention are presented in documents GB 810146 A, DE 102008039373 A1, GB 1000221 A and GB 962572 A.

GB 810146 A relates to improvements in or relating to the preparation of worts, in where malt grist and hot water are fed continuously into the head of a tube or tower for passage downwardly at a temperature adequate for enzymatic conversion and the solid residue is separated from the wort produced at the bottom of the tube or tower. Ground malt mixed with hot water by a stirrer is fed down a conversion tower heated through coils; spent grains are conveyed away up a branch tube for passage up a washing tube against a counter-current stream of hot water for removal of further soluble extractives. The wort and wash liquor are separated through rotating disc filters, respectively. The wash liquor may be mixed for use with the wort, or the wash liquor or wort may be returned to the head of the tower.

DE 102008039373 A1 discloses a mash refining device comprises a refining unit with a conveyor to which a sieve-tube is arranged, an inlet for mash, a device for collecting and supplying of flavour, and/or an outlet for spent grains

GB 1000221 A discloses that brewers' wort is continuously hopped and boiled by flowing a stream of wort along a substantially horizontal path, adding hops at a first position in said path, positively carrying the hops in the wort, at a desired speed, to a second position in said path, and heating the wort between the said positions. The hops may be carried in a direction opposite to the direction of flow of wort and may be removed from the wort adjacent the second position.

GB 962572 A relates to production of hopped wort, in where hops are conveyed, on the perforated platforms of an end-less travelling conveyer, through and against a stream of boiling wort flowing through the U-shaped lower portion of a casing, which may be heated by steam, at a temperature between 215 and 230 DEG F, in a jacket. Fresh hops are fed on to the platforms through an opening in the inverted-U-shaped upper portion of the casing and spent hops together with precipitated trub are removed through an opening, as by steam from an injector.

Objects of the present invention

The new method and mash apparatus of in-line brewing differ itself from the known methods by being a continuous mashing method opposite to the known methods which are batch methods. The in-line brewing invention may result in a mashing process:

- Requiring less labour per litre wort.
- No washing of equipment as for batch equipment.

- Enabling unmanned 24/7 operation.
- Closed waste disposal logistics
- Possible higher thermal efficiency
- High Mash Efficiency

It is thus an object of the present invention to provide an apparatus and method for continuous mashing process, in where there is no need for cleaning of the mashing tank. The invention will also give the flexibility to change to a new beer type in short time, and can be more energy efficient.

Summary of the invention

According a first aspect of the invention, a method for mashing of malt and water to produce wort in a single upright tank is provided, comprising the steps: feeding of fresh malt via a fresh malt inlet to a lower part of the tank; feeding of mash water via a mash water inlet to an upper part of the tank; mixing of the fresh malt and the mash water in the tank to produce the wort by conveying malt from the lower part of the tank to the upper part of the tank; discharge of used malt through an upper used malt outlet; and discharge of wort from the tank through a lower wort outlet.

Malt can be continuously conveyed from the lower part of the tank to the upper part of the tank by a screw conveyer. Alternatively, malt can be semi-continuously conveyed from the lower part of the tank to the upper part of the tank, in that malt for a complete mash batch is fed into the tank, and conveyed up in the tank by a screw conveyer.

The mash water can be preheated prior to being fed to the mash water inlet.

The mash water is pumped in through the mash water inlet in an upper part of the tank, and the mash water can be regulated to a temperature that together with the malt ends up at desired mashing temperature in the tank.
The time to convey the malt from the lower part of the tank to the upper part of the tank can be set to normal mashing time. Mashing time can be set to approximately 60 minutes.

Mash water can be circulated from a lower part of the tank to an upper part of the tank in a sparging loop comprising a circulation pump.

Further, mash water can be heated or heat is maintained in the sparging loop by a heat exchanger.

According to a second aspect of the invention, a mash apparatus for production of wort is provided, comprising a single upright tank for holding malt and water, said tank having a lower part with a lower fresh malt inlet and a lower wort outlet, an upper part with an upper used malt outlet and an upper mash water inlet, wherein said tank further comprises an internal conveyer for feeding of fresh malt from the lower part to the upper part.

Said conveyer can be a screw conveyer. Further, the tank can be an upright circular-cylindrical cylinder, and the conveyer a vertical screw conveyer located inside the tank.

The lower part of the tank may comprise a screw conveyer for feeding of fresh malt from the fresh malt inlet to the interior of the tank. A malt hopper can be located above the screw conveyer in the fresh malt inlet.

The upper part of the tank can also comprise a screw conveyer for feeding of used malt from the interior of the tank to the used malt outlet.

The tank may further comprise a circulation pump for creation of a sparging loop, to circulate mash water that has run down, from the lower part of the tank to the upper part of the tank.
A heat exchanger to heat or maintain heat in the mash water during the mashing process can be included in the sparging loop.

Description of the diagrams

Embodiments of the present invention will now be described, by way of example only, with reference to the following diagrams wherein:

Figure 1 shows a first embodiment of a mash apparatus according to the invention.

Figure 2 shows a second embodiment of a mash apparatus according to the invention.

Description of preferred embodiments of the invention

Figure 1 shows a mash apparatus 10 with a tank 12 in the form of a cylinder with a lower part 14a and an upper part 14b. The lower part 14a comprises a lower fresh malt inlet 16 and a lower wort outlet 20. The lower fresh malt inlet 16 may further comprise a horizontal screw conveyer 26 for conveying fresh malt from a malt hopper 30 to the lower part 14a of the tank 12. The upper part 14b of the tank 12 may comprise an upper mash water inlet 22 and an upper used malt outlet 18. The upper part 14b of the tank 12 may further comprise a horizontal screw conveyer 28 for conveying used malt to the upper used malt outlet 18.

The upright tank 12 further comprises an internally and vertically placed conveyer, preferable a screw conveyer 24, for transport of malt, and water, vertically in the tank 12.

Figure 2 shows a second embodiment of the mash apparatus 10 according to the invention. The mash apparatus 10 is similar to the first embodiment shown in figure 1, but may include a sparging loop 36. The sparging loop can include a pump 32 for pumping mash water from the lower part 14a of the tank 12 to the upper part 14b of the tank 12. The sparging loop 36 may further include a heat exchanger 34 heating or maintaining heat in the mash water in the loop.

Each screw conveyer 24, 26, 28 are preferable driven by an adjoining drive motor (not shown), and connected to a control system. The mash water inlet 22 can also be connected to the same control system. The same applies to the wort outlet 20 and used malt outlet 18. All parts of the apparatus 10 may be connected to said control system, thus providing an automatic mashing process.
The method according to the invention may include two mashing processes.

A first idea of the present invention is to have a continuous mashing process instead of batch process. This is done by feeding the malt into the lower part 14a of the cylindrical tank 12 where the transport screw 24 is located inside. The time to move the malt, by the screw conveyer 24, from the bottom 14a of the tank to the top outlet 18 in the upper part 14b of the tank 12, is equal to the mashing time (normally 60 minutes). In the upper part 14b of the tank 12 the mash water will be pumped in through the malt water inlet 22 at a temperature that together with the malt ends up at the mashing temperature in the tank 12. The mash water can be preheated or not, and the temperature can be regulated in the tank 12. The outside of the tank 12 can

be heat traced if required. When the fresh malt, injected in the bottom 14a of the tank 12, meets the mashing water it will lose its sugar content to the water. In the bottom the malt will have the maximum sugar content and in the top, near the exit, it will have the minimum sugar content. The water will have its minimum sugar content in the top of the tank 12 and its maximum sugar content in the bottom of the tank 12, near the exit. The volumetric flow and the malt vs the volumetric flow of the mash water will give the efficiency of the brewery. If required the apparatus 10 can be equipped with the sparging loop 36 where mash water that has run down can be circulated from the bottom of the tank 12 to the top of the tank. If required this loop can pass the heat exchanger 34 to heat or maintain heat during the mashing process. The finished wort will be taken out in the bottom of the tank 12 through the wort outlet 20 and the used malt discharged in the top of the tank 12 through the used malt outlet 18.

A second idea of the present invention is to have a semi-continuous mashing process instead of a batch process. This is done by feeding the malt into the bottom part 14a of the tank 12 where the transport screw 24 is located inside. The malt for a complete mash batch will then be screwed up to a level in the tank 12. In the top of the tank 12 the mash water will be pumped in through the mash water inlet 22 at a temperature that together with the malt ends up at the mashing temperature in the tank 12. The mash water can be preheated or not, and the temperature can be regulated in the tank 12. The outside of the tank 12 can be heat traced if required. If required the apparatus 10 can be equipped with the sparging loop 36 where mash water that has run down can be circulated from the bottom 14a of the tank 12 to the top 14b of the tank 12. If required this loop 36 can pass the heat exchanger 34 to heat or maintain heat during the mashing process. When the mash batch is completed the wort is drained out in the bottom 14a of the apparatus 10, through the wort outlet 20, and the used malt discharged at the top 14b through the used malt outlet 18.

Other means than screw conveyers may be used for conveying the malt in the tank, for instance rotary valves, or other feeding methods.

Claims

1. Method for mashing of malt and water to produce wort in a single upright tank (12), comprising the steps:

- feeding of fresh malt via a fresh malt inlet (16) to a lower part of the tank (12),
- feeding of mash water via a mash water inlet (22) to an upper part of the tank (12),
- mixing of the fresh malt and the mash water in the tank (12) to produce the wort by conveying malt from the lower part of the tank (12) to the upper part of the tank (12),
- discharge of used malt through an upper used malt outlet (18), and
- discharge of wort from the tank (12) through a lower wort outlet (20).

2. Method according to claim 1, wherein malt is continuously conveyed from the lower part of the tank (12) to the upper part of the tank (12) by a screw conveyer (24).

3. Method according to claim 1, wherein malt is semi-continuously conveyed from the lower part of the tank (12) to the upper part of the tank (12), in that malt for a complete mash batch is fed into the tank, and conveyed up in the tank (12) by a screw conveyer (24).

4. Method according to claim 1, wherein the mash water is preheated prior to being fed to the mash water inlet (22).

5. Method according to claim 1, wherein the mash water is pumped in through the mash water inlet (22) in an upper part of the tank (12), and the mash water is regulated to a temperature that together with the malt ends up at desired mashing temperature in the tank (12).

6. Method according to claim 1, wherein the time to convey the malt from the lower part of the tank (12) to the upper part of the tank (12) is set to normal mashing time, such as approximately 60 minutes.

7. Method according to claim 1, wherein mash water is circulated from a lower part (14a) of the tank (12) to an upper part (14b) of the tank (12) in a sparging loop (36) comprising a circulation pump (32).

8. Method according to claim 7, wherein mash water is heated or heat is maintained in the sparging loop (36) by a heat exchanger (34).

9. Mash apparatus (10) for production of wort, comprising a single upright tank (12) for holding malt and water, said tank (12) having a lower part (14a) with a lower fresh malt inlet (16) and a lower wort outlet (20), an upper part (14b) with an upper used malt outlet (18) and an upper mash water inlet (22), wherein said tank (12) further comprises an internal conveyer (24) for feeding of fresh malt from the lower part (14a) to the upper part (14b).

10. Mash apparatus according to claim 9, wherein said conveyer (24) is a screw conveyer.

11. Mash apparatus according to claim 10, wherein said tank (12) is an upright circular-cylindrical cylinder, and the conveyer (24) is a vertical screw conveyer located inside the tank (12).

12. Mash apparatus according to claim 9, wherein the lower part (14a) of the tank (12) comprises a screw conveyer (26) for feeding of fresh malt from the fresh malt inlet (16) to the interior of the tank (12).

13. Mash apparatus according to claim 12, wherein a malt hopper (30) is located above the screw conveyer (26) in the fresh malt inlet (16).

14. Mash apparatus according to claim 9, wherein the upper part (14b) of the tank (12) comprises a screw conveyer (28) for feeding of used malt from the interior of the tank (12) to the used malt outlet (18).

15. Mash apparatus according to claim 9, wherein the tank (12) comprises a circulation pump (32) for creation of a sparging loop (36), to circulated mash water that has run down, from the lower part (14a) of the tank (12) to the upper part (14b) of the tank (12).

16. Mash apparatus according to claim 15, wherein a heat exchanger (34) to heat or maintain heat in the mash water during the mashing process is included in the sparging loop (36).

Patentkrav

1. Fremgangsmåte for mesking av malt og vann for produksjon av vørter i en enkeltstående tank (12), omfattende trinnene:

- mating av fersk malt via et ferskmaltinnløp (16) til en nedre del av tanken (12),
- mating av meskevann via et meskevanninnløp (22) til en øvre del av tanken (12),
- blanding av den ferske malten og meskevannet i tanken (12) for å produsere vørteren ved å transportere malt fra den nedre delen av tanken (12) til den øvre delen av tanken (12),
- utslipp av brukt malt gjennom et øvre bruktmaltutløp (18), og
- utslipp av vørter fra tanken (12) gjennom et nedre vørterutløp (20).

2. Fremgangsmåte i samsvar med krav 1, hvori malt kontinuerlig transporteres fra tankens nedre del (12) til den øvre delen av tanken (12) av en skruetransportør (24).

3. Fremgangsmåte i samsvar med krav 1, hvori malt delvis kontinuerlig transporteres fra den nedre delen av tanken (12) til den øvre delen av tanken (12), idet malt for et komplett meskparti mates inni tanken, og transporteres opp i tanken (12) av en skruetransportør (24).

4. Fremgangsmåte i samsvar med krav 1, hvori meskevannet forvarmes i forkant av mating til meskevanninnløpet (22).

5. Fremgangsmåte i samsvar med krav 1, hvori meskevannet pumpes inn gjennom meskevanninnløpet (22) i en øvre del av tanken (12), og at meskevannet reguleres til en temperatur som sammen med malten gir ønsket mesketemperatur i tanken (12).

6. Fremgangsmåte i samsvar med krav 1, hvori tiden for å transportere malten fra den nede delen av tanken (12) til den øvre delen av tanken (12) er satt til normal mesketid, som for eksempel ca. seksti minutter.

7. Fremgangsmåte i samsvar med krav 1, hvori meskevann sirkuleres fra en nedre del (14a) av tanken (12) til en øvre del (14b) av tanken (12) i en overslagssløyfe (36) som omfatter en sirkulasjonspumpe (32).

8. Fremgangsmåte i samsvar med krav 7, hvori meskevannet oppvarmes eller varme opprettholdes i overslagssløyfen (36) av en varmeveksler (34).

9. Meskeapparat (10) for fremstilling av vørter, omfattende en enkeltstående tank (12) for å romme malt og vann, nevnte tank (12) har en nedre del (14a) med et nedre ferskmaltinnløp (16) og et nedre vørterutløp(20), en øvre del (14b) med et øvre bruktmaltutløp (18) og et øvre meskevanninnløp (22), hvori nevnte tank (12) videre omfatter en innvendig transportør (24) for mating av fersk malt fra den nedre delen (14a) til den øvre delen (14b).

10. Meskeapparat i samsvar med krav 9, hvori nevnte transportør (24) er en skruetransportør.

11. Meskeapparat i samsvar med krav 10, hvori nevnte tank (12) er en stående sirkulærsylindrisk sylinder, og at transportøren (24) er en vertikal skruetransportør plassert innvendig tanken (12).

12. Meskeapparat i samsvar med krav 9, hvori nedre del (14a) av tanken (12) omfatter en skruetransportør (26) for mating av fersk malt fra ferskmaltinnløpet (16) til innsiden av tanken (12).

13. Meskeapparat i samsvar med krav 12, hvori en maltbeholder (30) er plassert over skruetransportøren (26) i ferskmaltinnløpet (16).

14. Meskeapparat ifølge krav 9, hvori den øvre delen (14b) av tanken (12) omfatter en skruetransportør (28) for mating av brukt malt fra innsiden av tanken (12) til bruktmaltutløpet (18).

15. Meskeapparat ifølge krav 9, hvori tanken (12) omfatter en sirkulasjonspumpe (32) for frembringelse av en overslagssløyfe (36), for sirkulert meskevann som har rent ned, fra tankens (12) nedre del (14a) til tankens øvre del (14b).

16. Meskeapparat ifølge krav 15, hvori en varmeveksler (34) for oppvarming eller opprettholdelse av varme i meskevannet under meskeprosessen er inkludert i overslagssløyfen (36).

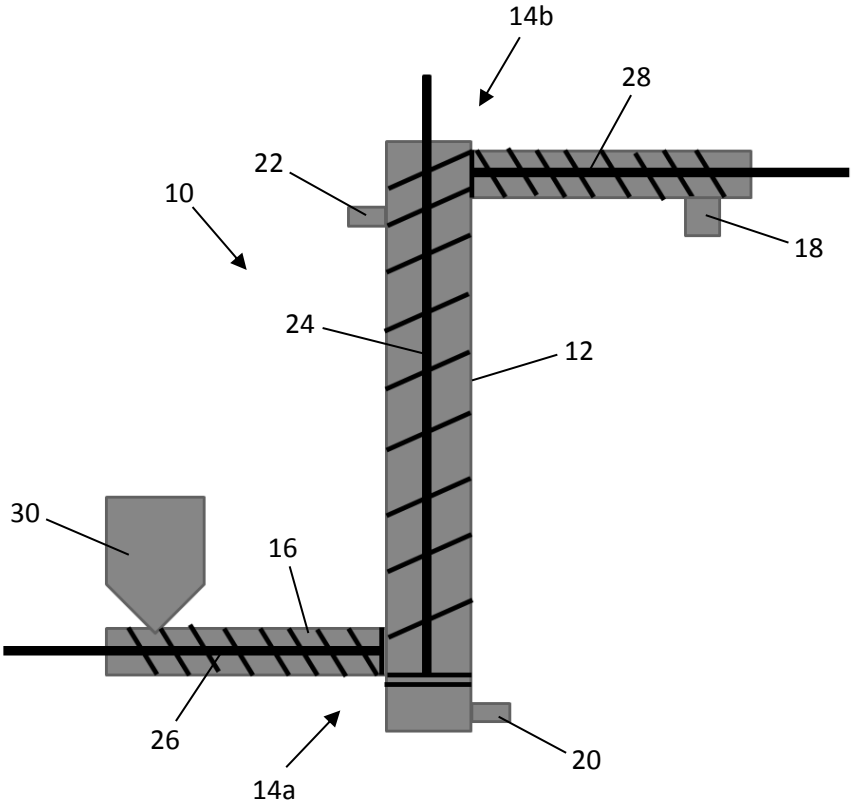

14b
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Fig. 1

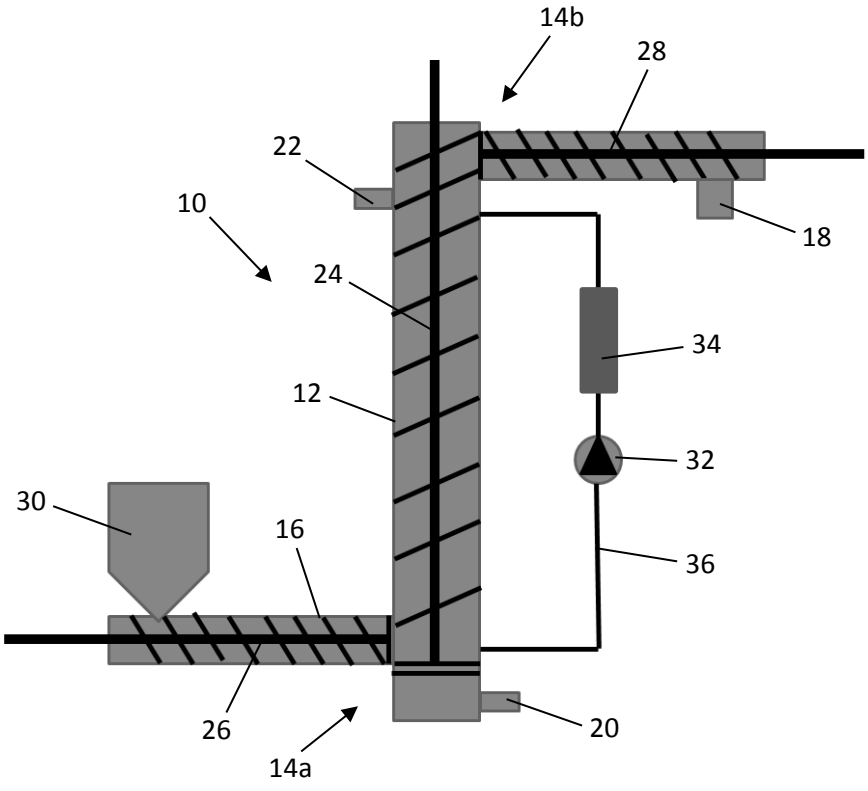
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Fig. 2