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DEWULF A ET AL: "A GLOBAL CONCEPT OF WORT PRODUCTION WITH REDUCED CONSUMPTION OF ENERGY AND PROCESS WATER", EUROPEAN BREWERY CONVENTION: PROCEEDINGS OF THE CONGRESS, INTERNATIONAL CONGRESS PROCEEDINGS, XX, XX, no. 34Th, 26 May 2013 (2013-05-26), page 1, XP003036003,

The invention relates to a method and a brewhouse plant for a continuous wort production according to the preambles of the independent main claims.

In classical brewhouse plants wort is produced in a batch operation. This means
5 in other words that the wort successively passes different containers for mashing including mash boiling, for lautering, for wort boiling and for trub separation. The capacity of such installations is determined by the capacity of the vessel having the lowest flow rate. Furthermore, operating brewhouse plants in the batch operation has disadvantages with regard to the energy consumption since the batch
10 operation leads to peaks in demand. The entire plant for energy supply and water supply then has to be adjusted in terms of its capacity to these peaks in demand, which leads to high costs.

In order to avoid these disadvantages of classical brewhouse plants with batch
15 operation, brewhouse plants are known in which the wort production can be carried out in a continuous flow-through process. This means in other words that the wort no longer successively passes individual vessels step-by-step. Rather, the mash flow and the wort flow continuously flow through the different apparatus and devices of the brewhouse. In this process, the raw materials have to be continuously refilled. The finished product, namely the wort, is produced continuously
20 or quasi continuously.

A method and a brewhouse plant for a continuous wort production are known from DE 3614431 A1, for example. In this device, the residual heat generated in
25 two expansion vessels is regained and used for preheating the wort which is to be boiled continuously.

From WO 2011/076410 A1, a brewhouse plant is known in which two plate heat exchangers disposed one behind the other are provided in order to cool the wort.
30 In the first stage of the wort cooling process in the first plate heat exchanger, water from an energy storage tank is used which is heated by the heat transfer in the first plate heat exchanger and afterwards is pumped back into the energy storage tank. The wort, which, due to the transfer of heat to the water from the

energy storage tank, has already been cooled by approximately 15 to 20 degrees Celsius in the first plate heat exchanger, subsequently is cooled in the second plate heat exchanger to the desired pitching temperature for the fermenting cellar, said pitching temperature being approximately 8 to 12 degrees Celsius. The cooling in the second plate heat exchanger is carried out by means of heat transfer to cold water. The cold water is heated from a cold water temperature of approximately 3 to 12 degrees Celsius to a storage temperature of 80 degrees Celsius and is stored temporarily in a second energy storage tank.

- 10 In the essay by A. DEWULF, "MEURASTERAM: A GLOBAL CONCEPT OF WORT PRODUCTION WITH REDUCED CONSUMPTION OF ENERGY AND PROCESS WATER", a brewhouse plant for a continuous wort production, in which two aggregates are provided between the wort cooler on the one hand and the wort preheating device on the other hand, is shown on page 1. These two
15 aggregates are a heat exchanger, in which the process water heated in the wort cooler is further heated to 99°C, and a hot water storage tank.

Said brewhouse plant has the disadvantage that it does not allow a really continuous wort boiling process since the process water heated in the wort cooler has to be temporarily stored in a temporary storage tank which is to be additionally provided. In addition to the disadvantage of additional device-related expenditure for the construction of the temporary storage tank, this temporary storage in a temporary storage tank also has technological disadvantages with regard to energy use since a mixed temperature occurs in the temporary storage tank during
20 the temporary storage of the hot water heated in the wort cooler, in such a manner that the peak temperatures of the hot water cannot be optimally used. In order to compensate for this disadvantage, the plant according to document D8 provides for an additional heat exchanger by means of which the process water is uniformly raised to a temperature level of 99°C after being heated in the wort cooler.
25
30 Only by the fact that the process water is raised to a uniform temperature of 99°C by using fresh energy, namely steam, the disadvantages of a mixed temperature occurring in the downstream hot water storage tank can be avoided. However, thereby it is necessary to additionally install a heat exchanger between the wort

cooler on the one hand and the hot water storage tank on the other hand. Furthermore, the energy efficiency is worsened by this solution as fresh energy has to be used for uniformly raising the temperature level to 99°C. Moreover, due to the hot water storage tank according to document D8 significant energy losses
5 due to the heat emission of the hot water storage tank are caused. Compared to other storage vessels, these energy losses are particularly high as the hot water in the hot water storage tank has a very high temperature close to the boiling point.

10 The object of the invention at hand is to propose a method and a brewhouse plant for a continuous wort production which is further improved with regard to the energy consumption, compared to the previously known state of the art.

This object is attained by a method and a brewhouse plant according to the teach-
15 ing of the independent main claims.

Advantageous embodiments of the invention are the subject matter of the dependent claims.

20 Generically speaking, the method according to the invention is first of all characterised in that, after the wort is boiled and before yeast is added, the wort is cooled in a continuously operating wort cooler from the hot water temperature to the desired pitching temperature. In order to cool the continuously operating wort cooler, water is used which flows through the wort cooler in a counter current.
25 The wort cooler is realised in the manner of a heat transfer means, in such a manner that the heat contained in the wort can be transferred to the water. Thus, the water is heated from the cold water temperature to an intermediate temperature.

30 In order to be able to use the heat gained in this way, which has been transferred from the continuously boiled wort to the water, a wort preheating device is disposed upstream of the actual wort boiling device. The water from the wort cooler is fed into the wort preheating device and there serves to raise the temperature

of the wort before it is fed into the wort boiling device. Due to the preheating of the wort before the wort is actually boiled, a certain part of the heat energy required for the wort boiling can be saved.

- 5 After the water in the wort preheating device has been cooled by means of heat transfer, it usually still has quite a high temperature of, for example, 80°C. If said water is drained after having passed through the wort preheating device, for example by being discharged into the sewer system, a high proportion of energy is wasted. In order to still be able to use the heat contained in the water after the
- 10 water has passed through the wort preheating device, it is particularly advantageous if the brewhouse plant has at least one hot water tank, from which different heat consumers can be supplied with hot water for the heat supply. The water from the wort preheating device can then be cooled in the wort preheating device from the intermediate temperature to the hot water storage temperature of the
- 15 hot water tank and can easily be fed into the hot water tank. As a result, in this way, the heat energy still contained in the water can be stored in the hot water tank after the water has passed through the wort preheating device and can be distributed to other heat consumers from there.
- 20 According to the invention, the water in the wort cooler is heated from a cold water temperature in the range between 2°C and 6°C to an intermediate temperature in the range between 90°C and 96°C.

- In order to ensure that the continuous wort preparation is carried out particularly
- 25 effectively, it is furthermore provided according to the invention that the water in the continuously operating wort preheating device is cooled down from an intermediate temperature in the range between 90°C and 96°C to a hot water storage temperature in the range between 75°C and 85°C. Said water having a temperature in the range between 75°C and 85°C can then easily be fed into the hot water
- 30 storage in order to provide the heat contained therein to other heat consumers.

It is generally optional with which temperature spread the continuously operating wort cooler operates, i.e. with which temperature difference the water in the wort

cooler is heated or the wort in the wort cooler is cooled. According to a preferred variant, it is provided that the water in the wort cooler is heated with a temperature spread in the range of 88 K to 95 K. The temperature spread is advantageously in the range of 99 K to 95 K, also when the temperature of the wort in the wort cooler is reduced.

A temperature spread in the range of 80 K to 95 K is also particularly advantageous when the wort in the wort cooler is cooled. In particular, it is provided according to a preferred variant that the wort in the wort cooler is cooled from a hot wort temperature in the range between 95 °C and 99°C to a pitching temperature in the range between 5°C and 20°C, in particular to a pitching temperature in the range between 10°C and 15°C.

With regard to avoiding unnecessary hot water excesses, the mass ratio between the wort flowing through the wort cooler and the water flowing through the wort cooler should be in the range between 0.9 and 1.1, in particular approximately at 1.0.

The degree to which the wort in the continuously operating wort preheating device is preheated in turn depends on the individual boundary conditions of the continuous wort preparation. A particularly high effectiveness is achieved when the wort in the continuously operating wort preheating device is heated by a temperature difference in the range of 10 K to 25 K.

According to a preferred embodiment, it is provided that the wort is heated in the continuously operating wort preheating device to a temperature over 85°C, in particular to a temperature over 91°C. The brewhouse plant according to the invention is characterised by the continuous wort cooler in which the wort can be cooled down to the pitching temperature, the water being heated to an intermediate temperature in this process. Said continuously operating wort cooler is connected to the wort preheating device in such a manner that the water heated in the wort cooler can serve to heat the wort before the actual wort boiling by means of heat transfer takes place.

It is particularly advantageous if, in addition to the continuously operating wort cooler and the continuously operating wort preheating device, there is a hot water tank into which the water can be fed after the transfer of heat to the wort while flowing through said wort preheating device. In this case, it is then necessary that
5 the water in the wort preheating device is cooled down from the intermediate temperature, i.e. the temperature that the water has after flowing through the wort cooler, to the hot water storage temperature of the hot water tank.

Continuously operating plate heat transfer means, in particular plate heat transfer
10 means operating in a single-stage manner, can particularly advantageously be used as wort cooler or as wort preheating device. The heat transfer can be carried out redundantly so that the continuous process can also be continuously kept up during the required cleaning intervals.

15 With regard to an efficient wort preparation, a continuously operating device for separating undesirable aroma substances, such as a stripping device operating in the counter current, should be disposed downstream of the continuously operating wort boiling device.

20 Furthermore, a continuously operating device for separating hot trub should be disposed downstream of the wort boiling device.

An embodiment of the invention is schematically sketched in the drawing and will be explained in more detail below.

25

Fig. 1 shows a schematic diagram of a brewhouse plant for a continuous wort production in accordance with the method according to the invention.

Fig. 1 shows a brewhouse plant 01 for a continuous wort production, wherein Fig.
30 1 only illustrates the plant components which are necessary to understand the invention.

At a temperature of, for example, 73°C, the lautered wort 02 enters a wort preheating device 03 in which the wort is heated from 73°C to 91°C while continuously flowing through. Subsequently, the wort 02 enters a wort boiling device 04, where it is heated from 91°C to 105°C while continuously flowing through, for example by adding steam 05. The wort 02 having a temperature of 105°C is then fed into a device 06 for separating undesirable aroma substances. After flowing through the device 06, the wort 02 has a temperature of 101°C and is passed into a continuously operating device 07 for separating hot trub. After flowing through the device 07, the wort having a temperature of approximately 99°C enters a continuously operating wort cooler 08. In the wort cooler 08, the wort 02 is continuously cooled from 99°C to a pitching temperature of, for example, 6°C.

Water 09, which has a temperature of, for example, 3°C when it flows into the wort cooler 08, serves to cool the wort cooler 08. The water 09 is heated in the wort cooler 08 to 95°C by absorbing heat from the wort 02. The water 09 is then fed from the wort cooler 08 into the wort preheating device 03, where the wort 02 is preheated by means of the heat transferred from the water 09. Due to the heat transfer, the water 09 in the wort preheating device 03 is cooled from 95°C to 80°C and is then stored with this temperature in a hot water tank 10. The water 09 from the hot water tank 10 can then be used for supplying heat to other heat consumers of the brewhouse plant 01.

Due to the heating of the water 09 to the intermediate temperature of 95°C, which is above the hot water storage temperature of 80°C in the hot water tank 10, the hot water accumulating in the wort cooler 08 during the wort cooling process is reduced in quantity in such a manner that undesired hot water excesses, as they arise in particular in warm countries, are avoided. Furthermore, due to the heating of the water 09 in the wort cooler 08 to an intermediate temperature of 95°C, the transfer of heat to the lautering wort is possible, in such a manner that the wort can be preheated to 91°C before it enters the actual wort boiling device 04.

Patentkrav

1. Fremgangsmåde til kontinuerlig urtfremstilling i et bryghusanlæg (01), hvorved urtkogningens urt (02) i en kontinuerligt arbejdende kogeindretning (04) og
5 før tilførslen af gær afkøles med en kontinuerligt arbejdende urtkøler (08) fra en varmurttemperatur til den ønskede starttemperatur, hvorved urtkøleren (08) er tildannet som en varmeoverføringsindretning, med hvilken urten (02) afkøles i modstrøm med vand (09), hvorved vandet (09) i urtkøleren (08) opvarmes fra en koldvandtemperatur,
- 10 **kendetegnet ved,**
at vandet (09) i urtkøleren (08) opvarmes kontinuerligt fra en koldvandtemperatur i området imellem 2°C og 6°C til en mellemtemperatur i området imellem 90°C og 96°C, hvorved vandet (09), som har en mellemtemperatur i området imellem 90°C og 96°C efterfølgende ledes direkte som varmecarere ind i en kontinuerligt
15 arbejdende urtforopvarmningsindretning (03), som er anbragt foran urtkogeindretningen (04), og hvorved urtens (02) temperatur i urtforopvarmningsindretningen (03) hæves ved hjælp af varmeoverføring, og hvorved vandet i den kontinuerligt arbejdende urtforopvarmningsindretning (03) afkøles fra den i urtkøleren (08) opnåede mellemtemperatur i området imellem 90°C og 96°C til en varmtvandlagertemperatur i området imellem 75°C og 85°C.
20
2. Fremgangsmåde ifølge krav 1,
kendetegnet ved,
at der i bryghusanlægget (01) er i det mindste en varmtvandstank (10), hvori vandet (09) til varmemforsyningen af forskellige varmemforbrugere kan lagres ved en
25 varmtvandslagertemperatur, hvorved vandet (09) i urtforopvarmningsindretningen (03) afkøles fra mellemtemperaturen til varmtvandslagertemperaturen, og ledes ind i varmtvandstanken (10).
- 30 3. Fremgangsmåde ifølge krav 1 eller 2,
kendetegnet ved,
at vandet (09) i urtkøleren (08) opvarmes med en temperaturspredning i området fra 88 K til 95 K.

4. Fremgangsmåde ifølge et af kravene 1 til 3,

kendetegnet ved,

at urten (02) i urtkøleren (08) afkøles med en temperaturspredning i området fra 80 K til 95 K.

5

5. Fremgangsmåde ifølge krav 4,

kendetegnet ved,

at urten (02) i varmekøleren (08) afkøles fra en varmurttemperatur i området imellem 95°C og 99°C til en starttemperatur i området imellem 5°C og 20°C, især til en starttemperatur imellem 10°C og 15°C.

10

6. Fremgangsmåde ifølge et af kravene 1 til 5,

kendetegnet ved,

at masseforholdet imellem den urt (02), som strømmer igennem urtkøleren (08), og det vand (09), som strømmer igennem urtkøleren (08), ligger i området imellem 0,9 og 1,1.

15

7. Fremgangsmåde ifølge et af kravene 1 til 6,

kendetegnet ved,

at urten (02) i den kontinuerligt arbejdende urtforopvarmningsindretning (03) opvarmes med en temperatur i området fra 10 K til 25 K.

20

8. Fremgangsmåde ifølge krav 7,

kendetegnet ved,

at urten (02) i den kontinuerligt arbejdende urtforopvarmningsindretning (03) opvarmes til en temperatur over 85°C, især til en temperatur over 91°C.

25

9. Bryghusanlæg (01) til kontinuerlig urtfremstilling med en kontinuerligt arbejdende urtkogeindretning (04) og med en kontinuerligt arbejdende urtkøler (08), med hvilken urten (02) efter urtkogningen og før tilførslen af gær kan afkøles fra en varmurttemperatur til den ønskede starttemperatur, hvorved urtkøleren (08) er tildannet som en varmeoverføringsindretning, med hvilken urten kan afkøles i modstrøm med vand (09),

30

kendetegnet ved,

at vandet (09) opvarmes ved hjælp af varmeoverføring kontinuerligt fra en koldvandtemperatur i området imellem 2°C og 6°C til en mellemtemperatur i området imellem 90°C og 96°C,

- 5 hvorved varmekøleren (08) er forbundet med en kontinuerligt arbejdende urtforopvarmningsindretning (03) for at lede det i urtkøleren (08) opvarmede vand (09) direkte som varmemæder ind i urtforopvarmningsindretningen (03), og hvorved urtens (02) temperatur i den kontinuerligt arbejdende urtforopvarmningsindretning (03) hæves ved hjælp af varmeoverføring, og hvorved vandet (09) i den
- 10 kontinuerligt arbejdende urtforopvarmningsindretning (03) afkøles fra den i urtkøleren (08) opnåedes mellemtemperatur i området imellem 90°C og 96°C til en varmvandlagertemperatur i området imellem 75°C og 85°C.

10. Bryghusanlæg ifølge krav 9,

15 **kendetegnet ved,**

- at der i bryghusanlægget (01) er i det mindste en varmtvandstank (10), i hvilken vand (09) til varmforsyningen af forskellige varmemæder kan lagres ved en varmvandlagertemperatur, hvorved urtforopvarmningsindretningen (03) er forbundet med varmtvandstanken (10) med henblik på at kunne lede det i urtforopvarmningsindretningen (03) afkølede vand (09) ind i varmtvandstanken (10).
- 20

11. Bryghusanlæg ifølge krav 9 eller 10,

kendetegnet ved,

- at urtkøleren (08) er tildannet som en kontinuerligt arbejdende pladevarmeoverføringsindretning, især som en enkelttrins pladevarmeoverføringsindretning.
- 25

12. Bryghusanlæg ifølge et af kravene 9 til 11,

kendetegnet ved,

- at urtforopvarmningsindretningen (03) er tildannet som en kontinuerligt arbejdende pladevarmeoverføringsindretning, især som en enkelttrins pladevarmeoverføringsindretning.
- 30

13. Bryghusanlæg ifølge et af kravene 9 til 12,

kendetegnet ved,

at der imellem urtkogeindretningen (04) på den ene side og varmekøleren (08) på den anden side er tilvejebragt en kontinuerligt arbejdende indretning (06) til udskillelsen af uønskede aromastoffer, især en i modstrøm arbejdende strippe-
5 indretning.

14. Bryghusanlæg ifølge et af kravene 9 til 13,

kendetegnet ved,

at der imellem urtkogeindretningen (04) på den ene side og urtkøleren (08) på
10 den anden side er tilvejebragt en kontinuerligt arbejdende indretning (07) til udskillelsen af varmbundfald.

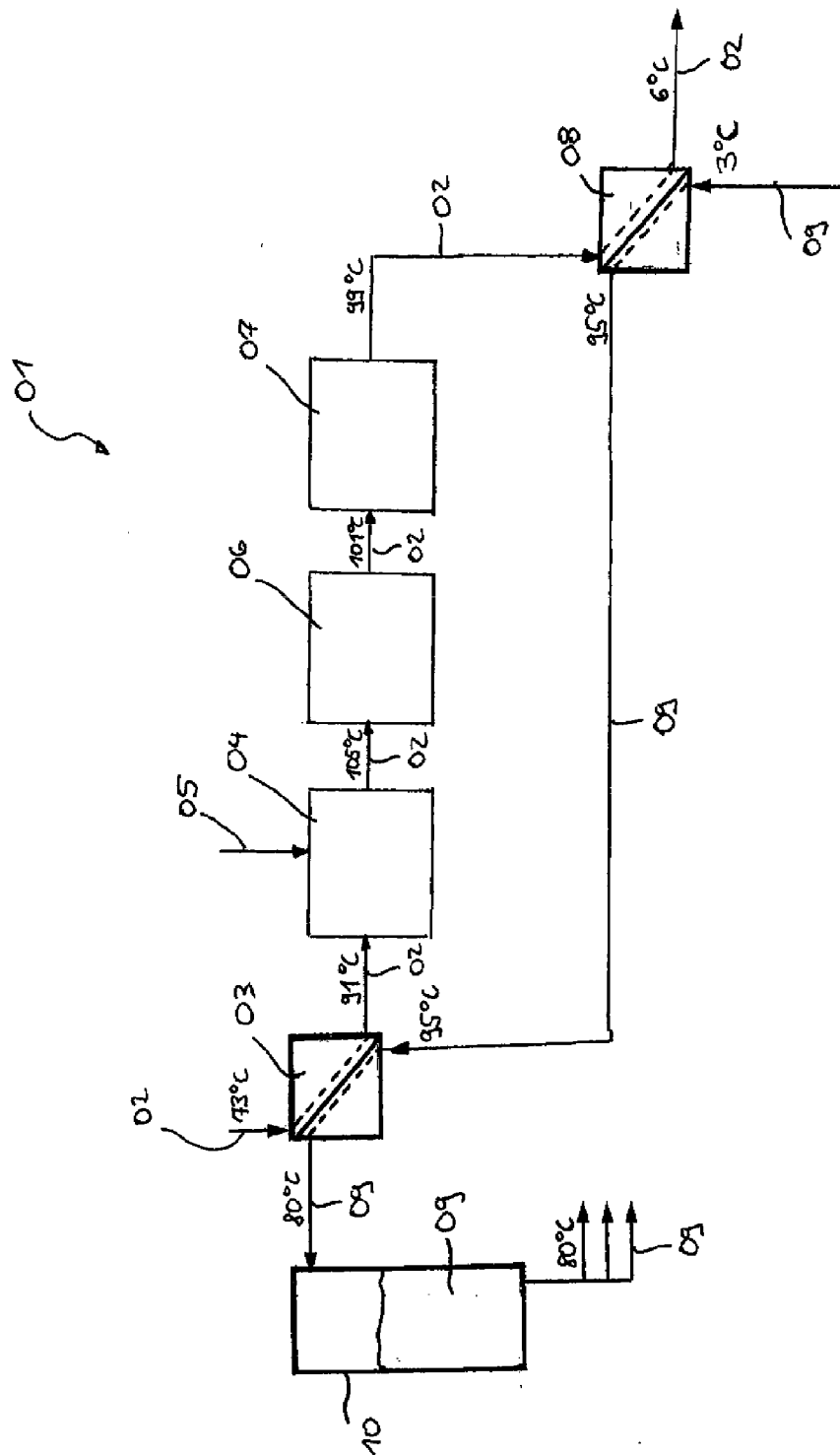


Fig. 1