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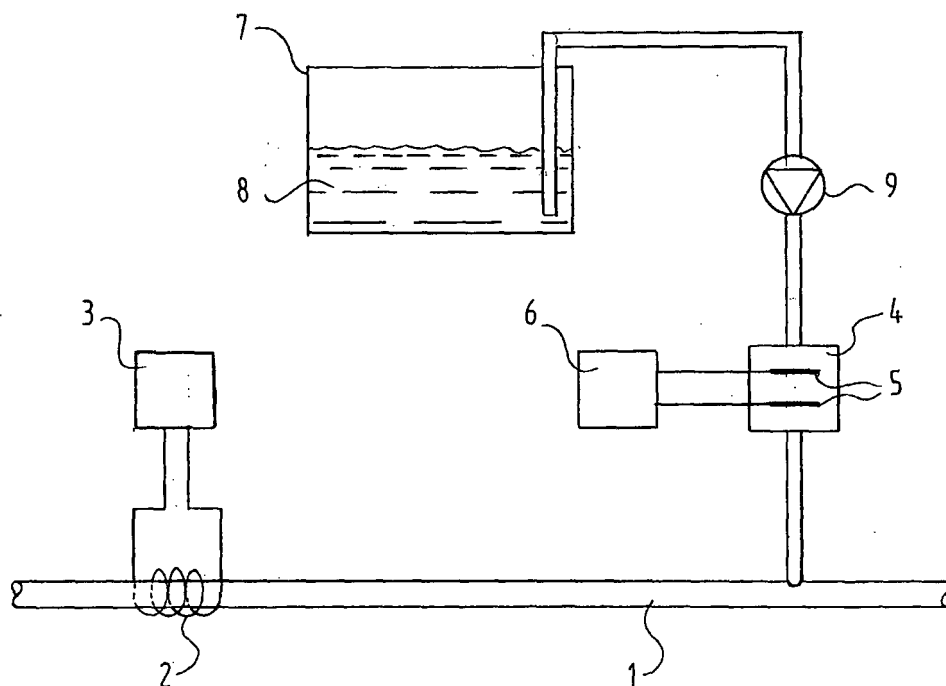
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(54) **System and method for cleaning a beer line, for instance in a beer tap installation**

(57) The invention relates to a system for cleaning a beer conduit, for instance in a beer tap installation, comprising a coil which is mounted round the conduit, a first electronic circuit which is connected to the coil, which circuit is adapted to generate an alternating electromagnetic field in a liquid such as beer or a cleaning liquid flowing through the conduit in order to degrade and discharge crystalline calcium oxalate deposit

($\text{CaC}_2\text{O}_4 \cdot n\text{H}_2\text{O}$) present on the conduit wall, an electrolysis cell which can be connected to the conduit and through which cleaning liquid can flow, and a second electronic circuit which is connected to the electrolysis cell, which electronic circuit is adapted to switch the electrolysis cell on and off in order to generate sodium hypochlorite (NaClOH) in the cleaning liquid in order to kill and discharge micro-organisms present on the conduit wall.



Description

[0001] The invention relates to a system for cleaning a beer conduit, for instance in a beer tap installation. Such a cleaning must take place very regularly since diverse micro-organisms establish themselves in the beer conduit, and this can cause flavour deterioration.

[0002] The formation of a bio-film is a natural process which follows a set pattern. The bio-film consists of a wide variety of micro-organisms which develop over the course of several days or weeks. The micro-organisms form complex relations with each other in a matrix of polysaccharide. A bio-film is a three-dimensionally organized structure of one or more organisms which adhere to the conduit surface. Due to a precise relative placing each organism has its own position in the bio-film. This relative placing is determined particularly by mutual metabolic dependency between the different organisms. The bio-film can be regarded as a small ecosystem which adapts to its environment. The bio-film is substantially distinguished from the individual micro-organisms by its ability to adapt to its environment. The adhesion process starts with the deposition of polysaccharides and glycoproteins. These first layers increase the chance of adhesion of micro-organisms. Some of the micro-organisms then adhere to the surface. If micro-organisms remain in contact with the surface long enough, they develop different structures which eventually result in a permanent connection to the surface. The final phase of the formation of a bio-film is the formation of polysaccharide compounds (the matrix) in which micro-organisms are incorporated. This matrix also comprises other constituents, such as minerals, bacteria, nutrients and so on. The growing bio-film forms a basis for the adhesion and growth of new micro-organisms. All micro-organisms can in principle form a bio-film. Important for the organism about to adhere are the temperature, the presence of nutrients and oxygen, and the pH. The type of surface to which the micro-organism can adhere is also important for the development of the bio-film. Micro-organisms adhere and grow much more rapidly on a rough surface than on a smooth surface.

[0003] The object of the invention is an efficient method of cleaning beer conduits which is inexpensive, which requires little interruption of the operation of the beer tap installation and/or which enhances a long lifespan of the beer tap installation.

[0004] The system according to the invention comprises for this purpose means for degrading crystalline calcium oxalate deposit in the beer conduit and/or preventing the formation thereof, in addition to means for killing micro-organisms which can result in the deterioration of beer, such as *S.cerevisiae*, *E.coli*, *Klebsiella pneumonia*, *Lactobacillus brevis* and *Lactobacillus buchneri*.

[0005] In the preferred embodiment the system comprises a coil which is mounted round the conduit, a first electronic circuit which is connected to the coil, which circuit is adapted to generate an alternating electromagnetic field in a liquid such as beer or a cleaning liquid flowing through the conduit in order to degrade and discharge crystalline calcium oxalate deposit ($\text{CaC}_2\text{O}_4 \cdot n\text{H}_2\text{O}$) present on the conduit wall in the beer conduit and/or prevent the formation thereof, and preferably an electrolysis cell with electrodes which can be connected to the conduit and through which cleaning liquid can flow, or which is situated in a storage tank for cleaning liquid, which storage tank is connected to the beer conduit by means of a pump, and a second electronic circuit which is connected to the electrolysis cell, which electronic circuit is adapted to switch the electrolysis cell on and off in order to generate sodium hypochlorite (NaClO) in the cleaning liquid in order to kill and discharge micro-organisms present on the conduit wall.

[0006] The invention results in a saving for the user of the beer tap, since less beer is lost and there are no external cleaning costs, and in the advantage for both the beer producer and beer tap user that the quality of the beer remains constant and good. In addition, the invention contributes to a longer lifespan of the beer tap installation. The quantity of chemicals is also reduced compared to conventional cleaning methods, which is better for the environment and whereby possible environmental legislation can be complied with more readily.

[0007] The invention makes use of the insight that crystalline calcium oxalate is deposited on the inner wall of the beer conduits during use of beer tap installations, thereby creating a rough surface and further facilitating the formation of bio-film. Removing this crystalline calcium oxalate deposit and preventing its creation achieves that only little bio-film is formed. This small quantity of bio-organisms can then be killed easily by means of a cleaning agent with a very low concentration of sodium hypochlorite. This concentration is so low that the cleaning agent can be made from a simple salt solution by means of electrolysis. It is hereby no longer necessary to feed a highly concentrated bactericidal agent to the conduit system.

[0008] If the electrolysis cell is connected to the conduit through which cleaning liquid can flow, the system preferably comprises a storage tank for cleaning liquid which is connected by means of a pump to the electrolysis cell and the beer conduit. Before being treated by the electrolysis cell, the cleaning liquid preferably comprises at least 10 g/l NaCl, more preferably at least 18 g/l NaCl, still more preferably at least 24 g/l NaCl and, after it has been treated by the electrolysis cell, preferably at least 1 ppm, more preferably between 2 and 10 ppm, still more preferably between 4 and 8 ppm NaClO.

[0009] The electrolysis cell is preferably connected close to the start of the conduit. In the preferred embodiment the electrolysis cell consumes a power between 24 and 240 W during the cleaning. Cleaning preferably takes place each time for at least 10 minutes, more preferably at least 20 minutes. In this respect cleaning can take place not only by allowing cleaning liquid to flow through the conduit but also by filling the conduits with (stationary) cleaning liquid.

Alternatively, a small quantity of cleaning liquid is driven through the beer conduit at substantially regular intervals or the conduit is filled with cleaning liquid for a shorter period of time, wherein the intervals last between 15 and 90 minutes, preferably between 20 and 40 minutes.

[0010] The coil is preferably also arranged close to the start of the conduit, preferably within 2 m to 3 m of the control box. During the cleaning the coil consumes a power of preferably at least 1 W, more preferably at least 5 W, still more preferably at least 10 W. The coil preferably comprises at least 1 m, more preferably at least 2 m of electrically conductive wire. The coil preferably comprises 11 to 22 windings round the beer conduit. In the preferred embodiment the coil operates continuously, i.e. the first electronic circuit with the coil generates an alternating electromagnetic field substantially permanently during use of the beer tap installation.

[0011] The invention further relates to a method for cleaning a beer conduit, for instance in a beer tap installation, wherein a coil is mounted round the conduit, wherein a first electronic circuit is connected to the coil, by means of which circuit an alternating electromagnetic field is generated in a liquid flowing through the conduit, such as beer or a cleaning liquid, in order to degrade and discharge crystalline calcium oxalate deposit ($\text{CaC}_2\text{O}_4 \cdot n\text{H}_2\text{O}$) present on the conduit wall and/or prevent the formation thereof, wherein an electrolysis cell is connected to the conduit and cleaning liquid is carried therethrough, or wherein an electrolysis cell is placed in a storage tank for cleaning liquid and wherein a pump pumps the cleaning liquid into the beer conduit, and wherein a second electronic circuit is connected to the electrolysis cell, which electronic circuit switches the electrolysis cell on and off in order to generate sodium hypochlorite (NaClOH) in the cleaning liquid in order to kill and discharge micro-organisms present on the conduit wall.

[0012] The invention will be further elucidated on the basis of an exemplary embodiment shown schematically in the figure and on the basis of test results.

[0013] According to the figure a system for cleaning a beer conduit 1 in a beer tap installation comprises an electromagnet consisting of a coil 2 which is mounted around conduit 1 and a first electronic circuit 3 connected to coil 2. Circuit 3 is adapted to generate an alternating electromagnetic field in the beer flowing through conduit 1. The system further comprises an electrolysis cell 4,5, which is connected to the conduit and through which cleaning liquid 8 can flow, and a second electronic circuit 6 connected to the electrolysis cell. Electronic circuit 6 is adapted to switch the electrolysis cell on and off in order to generate sodium hypochlorite (NaClOH) in the cleaning liquid. The system further comprises a storage tank 7 for cleaning liquid 8. Storage tank 7 is connected to electrolysis cell 4 and beer conduit 1 by means of a pump 9.

[0014] In an alternative embodiment (not shown) electrolysis cell 4,5 is situated in storage tank 7 and sufficient sodium hypochlorite is formed in storage tank 7 before pump 9 is activated.

[0015] An electromagnet is used to remove crystalline calcium oxalate deposit and to prevent deposition thereof in a beer conduit. This electromagnet treats the beer in beer conduit 1 in accordance with a non-chemical method and produces a pulsating current in a wire which forms coil 2 and which is wound round the conduit. This pulsating current creates a magnetic field in the passing beer. The effect hereof is that the crystalline calcium oxalate particles cake together to form larger particles and form a soft substance instead of a hard stone layer adhered to the surface. An optimal operation of the electromagnet is obtained at a flow speed of 2.3 m/s.

[0016] In order to test the effect of the electromagnet on the formation of beer stone, a beer conduit with coil and a beer conduit without coil were tested in a practical situation for three months as specified in the instructions for use. Before the start of the test the two beer conduits had substantial crystalline calcium oxalate deposits on the inner wall. After the test, the two beer conduits were viewed with an endoscope. The beer conduit with coil was practically free of crystalline calcium oxalate deposits, while the beer conduit without coil had a thick layer of crystalline calcium oxalate deposits on the inner wall.

[0017] For the removal of micro-organisms use is made of an electrolysis cell which is arranged in a cleaning conduit which is connected to the beer conduit or which is disposed in a storage tank for cleaning liquid. A pump drives through the electrolysis cell a 24 g/l NaCl water solution present in a storage tank. Sodium hypochlorite is herein produced by means of electrolysis at a low direct voltage of 12 V and a current strength of a maximum of 20 A between the electrodes of the electrolysis cell. Sodium hypochlorite, also referred to as active chlorine, kills a large number of different micro-organisms. After it has done its disinfecting work it disintegrates into the original constituents NaCl and water.

[0018] The method has been tested on five different micro-organisms which could cause beer deterioration, i.e.

[0019] *S.cerevisiae*, *E.coli*, *Klebsiella pneumonia*, *Lactobacillus brevis* and *Lactobacillus buchneri*. This was done with three different types of beer, i.e. Grolsch (TM) pilsner, Guinness (TM) stout and Strongbow (TM) cider, wherein a bio-film comprising said micro-organisms was cultured on an adhesion buffer in a beer conduit for three days at 30°C.

[0020] In respect of corrosion of stainless steel parts of the beer conduit it is important that the hypochlorite concentration is no higher than 10 ppm. The required contact time with hypochlorite in concentrations below 10 ppm was therefore investigated.

[0021] Test tube tests showed that the micro-organism which is most difficult to kill by means of hypochlorite is the *S.cerevisiae*, also known as beer yeast or baking yeast. The test results herefor are shown in the following table, in which the disinfecting capacity is shown at different concentrations of NaClOH and various contact times (in minutes):

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Time	10ppm	8ppm	6ppm	4ppm	2ppm
0	4	4	4	4	4
15	3	3	4	4	4
30	2	1	4	4	4
60	0	0	2	4	4
120	0	0	2	4	4
180	0	0	2	4	4
240	0	0	1	4	4
300	0	0	0/1	4	4

Key:

4	=	high growth
3	=	growth
2	=	moderate growth
1	=	little growth
0	=	no growth

[0022] This shows that a concentration of at least 8 ppm must be applied to kill all five stated micro-organisms within 1 hour, and that a concentration of at least 6 ppm must be applied to kill all five stated micro-organisms within 6 hours.

[0023] Longer contact times may however be necessary in a beer conduit without the use of said electromagnet, wherein the micro-organisms are incorporated in a bio-film, which may act to protect the micro-organisms. At a hypochlorite concentration of 8 ppm a contact time of for instance 2.5 hours may be necessary to kill the micro-organisms. The above mentioned electromagnet can be applied in order to prevent or at least decrease such bio-films, whereby the adhesion of bio-film to the wall of the beer conduit is greatly reduced and whereby shorter cleaning times with hypochlorite can be achieved.

Claims

- System for cleaning a beer conduit, for instance in a beer tap installation, comprising means for degrading crystalline calcium oxalate deposits in the beer conduit and/or preventing the formation thereof, in addition to means for killing micro-organisms which can result in the deterioration of beer, such as *S.cerevisiae*, *E.coli*, *Klebsiella pneumonia*, *Lactobacillus brevis* and *Lactobacillus buchneri*.
- System as claimed in claim 1, wherein the means for degrading crystalline calcium oxalate deposits in the beer conduit and/or preventing the formation thereof comprise:
 - a coil which is mounted round the conduit;
 - a first electronic circuit which is connected to the coil, which circuit is adapted to generate an alternating electromagnetic field in a liquid such as beer or a cleaning liquid flowing through the conduit.
- System as claimed in claim 1 or 2, wherein during the cleaning the coil consumes a power of at least 1 W, preferably at least 5 W, more preferably at least 10 W.
- System as claimed in claim 1, 2 or 3, wherein the coil comprises between 11 and 22 windings.
- System as claimed in any of the foregoing claims 1-3, wherein the first electronic circuit generates an alternating field with a frequency between 1 and 100 kHz, preferably between 1 and 30 kHz, more preferably between 1 and 3 kHz.
- System as claimed in any of the foregoing claims 1-5, wherein the coil is arranged close to the start of the conduit.
- System as claimed in any of the foregoing claims 1-6, wherein the means for killing micro-organisms comprise:

an electrolysis cell which can be connected to the conduit and through which cleaning liquid can flow, or which is situated in a storage tank for cleaning liquid, which storage tank is connected to the beer conduit by means of a pump; and

a second electronic circuit which is connected to the electrolysis cell, which electronic circuit is adapted to switch the electrolysis cell on and off in order to generate sodium hypochlorite (NaClOH) in the cleaning liquid.

8. System as claimed in claim 7, wherein the system comprises a storage tank for cleaning liquid which is connected by means of a pump to the electrolysis cell and the beer conduit.

9. System as claimed in claim 7 or 8, wherein the electrolysis cell consumes a power between 24 and 240 W.

10. System as claimed in claim 7, 8 or 9, wherein the electrolysis cell is connected close to the start of the conduit.

11. Method for cleaning a beer conduit, for instance in a beer tap installation, wherein:

a coil is mounted round the conduit;

a first electronic circuit is connected to the coil, by means of which circuit an alternating electromagnetic field is generated in a liquid flowing through the conduit, such as beer or a cleaning liquid;

an electrolysis cell is connected to the conduit and cleaning liquid is carried therethrough, or an electrolysis cell is placed in a storage tank for cleaning liquid and wherein a pump pumps the cleaning liquid into the beer conduit; and

a second electronic circuit is connected to the electrolysis cell, which electronic circuit switches the electrolysis cell on and off in order to generate sodium hypochlorite (NaClOH) in the cleaning liquid.

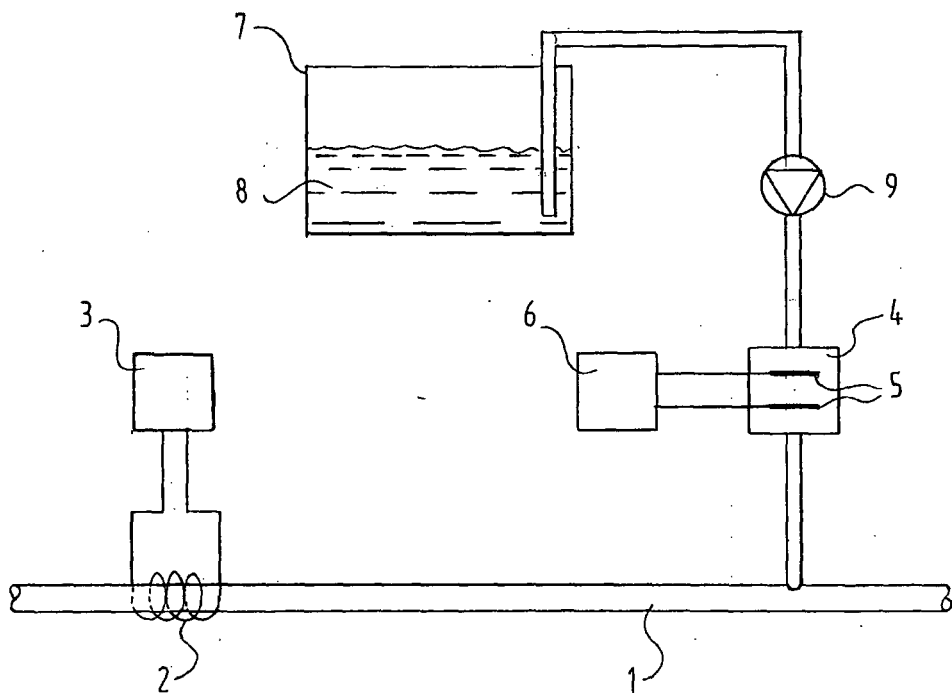
12. Method as claimed in claim 11 for cleaning a beer conduit, for instance in a beer tap installation, wherein a system according to any of the foregoing claims 1-10 is used.

13. Method as claimed in either of the foregoing claims 11 or 12, wherein before being treated by the electrolysis cell, the cleaning liquid comprises at least 10 g/l NaCl, preferably at least 18 g/l NaCl, more preferably at least 24 g/l NaCl.

14. Method as claimed in any of the foregoing claims 11-13, wherein after it has been treated by the operative electrolysis cell, the cleaning liquid comprises at least 1 ppm, preferably between 2 and 10 ppm, more preferably between 4 and 8 ppm NaClOH.

15. Method as claimed in any of the foregoing claims 11-14, wherein a small quantity of cleaning liquid is driven through the beer conduit at substantially regular intervals or the beer conduit is filled with cleaning liquid for a short period of time.

16. Method as claimed in any of the foregoing claims 11-15, wherein the first electronic circuit with the coil generates an alternating electromagnetic field substantially permanently during use of the beer tap installation.





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Application Number
EP 07 07 5915

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Place of search Munich		Date of completion of the search 18 March 2008	Examiner Muller, Gérard
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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