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(54) Benævnelse: **FERMENTERINGSINDRETNING**

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Fermenter equipment

Description

The invention relates to a fermenter device with a cross-flow filtration device, a system which has such a fermenter device, and a method for operating such a fermenter device.

In dynamic cross-flow filtration, filtration membranes are moved relative to a suspension held in a container in order to keep the filter membranes free of solid residues during ongoing filtration operation by means of a resulting cross-flow of the suspension along the filter membranes (i.e. a cross-flow is generated in the fermentation broth on the surface of the respective filter membrane). A dynamic cross-flow filtration device is known, for example, from DE 10 2014 101 499 A1. It is also known, for example, from WO 2011 050 825 A1 to use a cross-flow filtration device in conjunction with a fermentation device, for example to obtain target products and/or metabolism products from a fermentation broth.

EP 2 905 067 relates to a dynamic cross-flow filtration device with filtration membranes which are moved relative to a suspension held in the tank in order to keep the filter membranes free of filter residues during ongoing filtration operation by means of a resulting cross-flow of the suspension along the filter membranes, since a cross-flow is generated on the surface of the respective filter membrane.

The invention provides a fermenter device by means of which an improved fermentation operation and thus possibly an improved efficiency (e.g. in the form of an increased yield) in the recovery of target products from a fermentation broth can be achieved. The invention also provides a fermenter system with such a fermenter device and a method for operating such a fermenter device.

For this purpose, the present invention provides a fermenter device according to claim 1, a fermenter system according to claim 12 and a method for operating a fermenter device according to claim 13. Further embodiments of the invention are described in the respective dependent claims.

According to the subject matter of claim 1, it is possible to supply a supply gas, e.g. oxygen, e.g. pure oxygen, and/or oxygen-containing air and/or nitrogen (e.g. pure nitrogen or nitrogen-containing air), into the interior of the fermenter vessel via the at least one of the respective body connection lines connected to the supply gas source via the respective filter membrane associated therewith. As the filter membrane(s) usually have(s) many small pores, the supply gas can thus be introduced very gently and in small bubbles (e.g. in the form of microbubbles or even nanobubbles) into a fermentation broth present in the fermenter vessel, so that the gas can be better absorbed by the fermentation broth (e.g. can be better dissolved in it).This means that the gas can be better absorbed by the fermentation broth (e.g. can be better dissolved in it) and thus the formation of larger supply gas bubbles, which then accumulate on the top of a container, for example, or coalescence of supply gas bubbles can be better suppressed and/or even essentially prevented. This means that organisms/cells normally present in the fermentation broth, such as bacteria, fungi, algae, other biological cell cultures, etc., can be better supplied with a supply gas that is vital for them, so that the fermenter device can be operated more efficiently in accordance with its task. During operation/filtration, the organisms/cells/enzymes present in the fermentation broth produce the desired target products intended for further use/further utilisation, such as metabolic products, whereby the improved supply of supply gas can be expected to result in improved efficiency in the production of the target products and possibly also an improved service life of the working organisms/enzymes.

The movement of the respective filter membrane body can also, for example, improve the distribution of the supply gas bubbles in the fermentation broth. This can also serve, for example, to prevent coalescence of the gas bubbles, whereby the gas bubbles remain in the fermentation broth for longer and, for example, an improved gas transfer rate can be achieved.

The fermenter container is, for example, a closed container with, for example, a container opening closed by a container lid for access to the container interior. The respective filter membrane body can have any shape, such as a block shape or a plate shape, whereby in practice, for example, a disc shape has been shown to be suitable for generating the desired

cross-flow along the membrane surface. The respective filter membrane body is, for example, arranged to be wobble-movable and/or vibration-movable and/or rotatable/rotatable and can be driven to wobble, vibrate and/or rotate accordingly by means of a corresponding drive device, which is, for example, a component of the fermenter device.

For example, several permeate discharge lines can be provided, each of which is individually assigned to the respective body connection line, or two or more body connection lines can be connected to each permeate discharge line. However, only one permeate discharge line can also be provided, to which the respective body connection line is then connected.

In the case of the design of the respective body connecting line as a rotary shaft, such as according to claim 2, for example, two body connecting lines can always be arranged in parallel next to each other with mutually intermeshing filter membrane bodies, e.g. filter membrane discs. There may also be, for example, four or always four body connection lines arranged parallel to one another with mutually intermeshing filter membrane bodies, e.g. filter membrane discs.

According to the embodiment of claim 3, first option, both permeate can be discharged and supply gas can be supplied via the respective body connection line, e.g. disc connection line. For example, permeate can be discharged and supply gas supplied at different times via the same filter membranes. For example, the supply of supply gas via the respective filter membrane connected to the (e.g. respective) permeate discharge line can achieve additional cleaning of the filter membranes from solid particles adhering to them. For example, each body connection line can be fluid-connected (e.g. via one or more valves) or fluid-connectable (e.g. via one or more valves) to both the (e.g. respective) permeate discharge line and the supply gas source. However, only a number of body connection lines can also be fluid-connected and/or fluid-connectable to the supply gas source, and only a number of body connection lines can be connected and/or fluid-connectable to the permeate discharge line. In the case of the embodiment of claim 3, option 2, for example, supply gas can be simultaneously (e.g. simultaneously) fed into the fermenter vessel (via the respective body connection line connected to the supply gas source but not connected or connectable to the (e.g. respective) permeate discharge line) and permeate can be discharged from the

fermenter vessel (via the respective body connection line connected to the (e.g. respective) permeate discharge line).

The embodiment according to claim 4 can, for example, help to keep a fermentation broth to be filtered at a respective optimum reaction temperature in order to counteract the heating of the fermentation broth by, for example, organisms which generate waste heat by means of their metabolism.

In the embodiment of claim 5, the filtration device housing and the fermenter container can be designed and arranged separately from one another, wherein, for example, the housing interior of the dynamic cross-flow filtration device and the container interior of the fermenter container are in fluid connection via lines arranged between them, in which, for example, flow control valves are arranged. Such a decentralised arrangement can make sense, for example, for reasons of space and/or for reasons of a necessary arrangement of drive motors for the rotary shafts that may be provided. The independent filtration device housing is, for example, a closed housing with, for example, a housing opening closed by a housing cover for access to the interior of the housing. In the embodiment of claim 7, for example, a very compact construction unit can be achieved.

In the embodiment according to claim 8, first option, the waste water connection can be, for example, a gully to which and/or into which the (e.g. respective) permeate discharge line is led in the form of, for example, a permeate discharge hose or a permeate discharge pipe. In the event that a target product or target products is/are not discharged via the permeate, but remains in the fermentation broth, it may not be necessary to collect the permeate, for example, and the permeate can be disposed of directly via the (e.g. respective) permeate discharge line and the wastewater outlet.

The provision of a feed supply connection according to claim 8 and claim 9, in each case the second option, can, for example, enable substantially continuous operation of the fermenter device, wherein permeate is continuously discharged/removed from the fermenter vessel (via the respective permeate discharge line) and an amount of fermentation broth corresponding to the amount of permeate discharged is fed into the fermenter vessel via the feed supply

connection. Essentially continuous here also includes, for example, that permeate is fed in continuously (e.g. regularly) occurring, short successive intervals in accordance with a discharge of permeate that takes place at corresponding intervals.

If, for example, the target product (or products) is discharged via the permeate, the permeate can be collected in a permeate discharge container. While a fermentation reaction is still in progress in the fermentation device, the target product can, for example, already be processed and/or isolated in this way.

The movement of the respective filter membrane body can, for example, per se achieve a certain mixing of the fermentation broth and also, for example, an improved mixing of the supply gas supplied via the respective filter membrane with the fermentation broth. With the embodiment according to claim 10, for example, the aforementioned mixing and/or blending can be further improved.

In the fermenter system according to claim 12, the pore size of the filter membranes can be specifically adjusted to determine, for example, whether a target product should remain in the fermenter vessel and/or in the filtration device housing or be removed therefrom together with the permeate. In addition, the pore size can be used, for example, to influence and/or define the size of the gas bubbles of the supply gas fed via the respective filter membrane.

The embodiment of claim 15 can be useful, for example (e.g. in combination with claim 12, first alternative), in order, for example, to continuously remove unstable or sensitive proteins from the fermentation broth with the permeate, so that these can be quickly fed to further processing. This can also apply if the pauses between the removal intervals are short when the target products are removed at intervals. Furthermore, this may apply (e.g. in combination with claim 12, second alternative) if the target products are continuously removed/discharged directly from the fermenter vessel. Continuous (e.g. permanent) removal of the target products is often used if, for example, the target products, e.g. metabolic products, are themselves harmful, e.g. toxic, to the organisms present in the fermentation broth, so that failure to remove them would lead to the organisms dying, e.g. via self-poisoning, and thus to the production of the target products coming to a halt.

The invention is explained further below by means of non-limiting embodiments with reference to the drawing. The drawing shows:

FIG. 1 is a schematic representation of a fermenter device according to one embodiment of the invention,

FIG. 2 an enlarged, cropped cross-sectional view of a filter membrane body of the embodiment of FIG. 1,

Figures 3A to 3F schematic cross-sectional views of various embodiments of a fermenter device with a dynamic cross-flow filtration device arranged thereon in different ways, and

Figures 3G and 3H a top view of different embodiments of a fermenter device, in which several dynamic cross-flow filtration devices are arranged along a circumference of a fermenter vessel of a fermenter device.

It is understood that other embodiments may be used and structural or logical changes may be made without departing from the scope of protection of the present invention. It is understood that the features of the embodiments described herein may be combined with each other, unless specifically stated otherwise. Therefore, the following description is not to be construed in a limiting sense, and the scope of protection of the present invention is defined by the appended claims.

FIG. 1 shows a fermenter device 1, comprising a fermenter container 3 with a container interior 5 for holding a fermentation broth 7.

Furthermore, the fermenter device 1 has a dynamic cross-flow filtration device 9, which in turn has two filter membrane body sets 11, each with a plurality of disc-shaped filter membrane bodies 13 or filter membrane discs, which each have a body interior 17 or disc interior surrounded by a filter membrane 15 (as illustrated, for example, in FIG. 2), which is in fluid communication with the container interior 5, and which are movably, here rotationally

movable, arranged and drivable by means of a rotary drive device, not shown, in order to generate a cross-flow along the associated filter membrane 15 in the fermentation broth 7 in the event of their movement, and which are arranged in stacks one behind the other and at a distance from one another in the stacking direction. Furthermore, the dynamic cross-flow filtration device 9 has a body connection line 19 or disc connection line associated with the respective filter membrane body set 11, which is fluid-connected to the body interior 17 of the respective filter membrane body 13 of the associated filter membrane body set 11.

The fermenter device 1 also has a permeate discharge line 21, which is connected to one (via solid line 21) or both (via solid line 21 + dashed line aligned therewith) of the two body connection lines 19 for discharging permeate that has passed through the filter membrane 15 of the respective filter membrane body 13 and via its body interior 17 into the respective body connection line 19 connected to the permeate discharge line 21. The fermenter device 1 also has a supply gas source 23, which is fluid-connected via a supply line 25 to one (via solid line 25) or both (via solid line 25 + horizontally adjoining dashed line) of the two body connection lines 19 for supplying supply gas, which is required by enzymes and/or organisms contained in the fermentation broth 7, via the respective body connection line 19 connected to the supply gas source 23 and the respective body interior 17 fluidly connected thereto and through the filter membrane 15 surrounding this respective body interior 17 into the container interior 5 (here directly into the container interior 5).

The respective body connection line 19 is designed as a hollow rotary shaft on which the associated filter membrane bodies 13 are arranged in a rotationally fixed manner in order to be moved in rotation by a rotation of the rotary shaft. As illustrated in FIG. 1, the filter membrane bodies 13 of two neighbouring rotating shafts are arranged to mesh with one another.

The respective body connection line 19 can, for example, be fluid-connected or fluid-connectable both to the at least one permeate discharge line 21 and to the supply gas source 23 (e.g. via at least one valve in each case). Alternatively, the body connection line 19, which is fluid-connected to the supply gas source 23, may not be connected to the permeate

discharge line 21 and/or may not be arranged to be connectable to the permeate discharge line 21.

In the embodiment of Figure 1, two filter membrane sets 11 are provided, each with several filter membrane bodies 13, but it is also possible to provide only (e.g. only at least) one filter membrane set 11 with, in extreme cases, only one filter membrane body 13 per respective filter membrane set 11. Furthermore, a plurality, e.g. 3, 4, 5 or more, of such filter membrane sets 11 can also be provided.

As shown in Figures 3A to 3F, at least one cooling device 27 can be arranged in the area of the dynamic cross-flow filtration device 9.

As illustrated in Figures 3A to 3F, the dynamic cross-flow filtration device 9 can have an independent filtration device housing 29 which has a housing interior 31 in which the respective filter membrane body set 11 is arranged, and which is attached to the outside of the fermenter container 3, wherein the housing interior 31 communicates fluidly with the container interior 5 via a connecting opening 33. As shown in Figures 3A to 3C and 3G, the connecting opening 33 can be formed in an integral connecting wall 35, which is part of or co-defines both a container outer wall of the fermenter container 3 and a housing outer wall of the filtration device housing 29. However, as shown in Figures 3D to 3F and 3H, the filtration device housing 29 and the fermenter container 3 can also be designed and arranged separately from one another, with the housing interior 31 of the dynamic cross-flow filtration device 9 and the container interior 5 of the fermenter container 3 being in fluid communication via lines arranged between them, in which flow control valves are arranged. In the embodiments of Figures 3A to 3C, the filter membrane bodies 13 are practically in direct contact with the fermentation broth 7 due to the integral connecting wall 35, so that supply gas can also be fed via the filter membrane bodies 13 directly into the container interior 5 of the fermenter container 3, whereas in the embodiments of Figures 3D to 3F there is (more likely) indirect contact between the filter membrane bodies 13 and the filtration broth 7 held in the fermenter vessel 3, so that supply gas can also only be fed indirectly via the filter membrane bodies 13 into the vessel interior 5 of the fermenter vessel 3.

As illustrated in Figures 3G and 3H, a fermenter device 1 may also comprise a plurality of dynamic cross-flow filtration devices 9 arranged, for example, along its perimeter, e.g. along the cross-sectional perimeter of its fermenter vessel 3, which may further improve filtration efficiency.

However, the respective filter membrane body set 11 or the filter membrane body sets 11 can also be located directly in the container interior 5 of the fermenter container 3, as in the embodiment of FIG. 1.

The fermenter device 1 may further comprise a waste water connection 37, to which the at least one permeate discharge line 21 is fluid-connected and/or fluid-connectable for disposing, e.g. for disposal without utilisation, of the permeate discharged via the at least one permeate discharge line 21.

Alternatively (or possibly also in addition to such a waste water connection 37), the fermenter device 1 can have a permeate discharge container 43, which is connected to the at least one permeate discharge line 21 for receiving the permeate discharged via the permeate discharge line 21.

In addition, the fermenter device 1 can have a feed supply connection 39, to which the fermenter container 3 is connected via a feed supply line 41 for supplying broth feed into the container interior 5.

Optionally, the fermenter device 1 may also comprise a nutrient substrate source 45 which is fluidly connected or fluidly connectable (via e.g. a valve) to at least one or a number or each of the two body connection lines 19 via a nutrient substrate supply line 47 for supplying nutrient substrate required by enzymes and/or organisms contained in the fermentation broth 7 via the respective body connection line 45 connected to the nutrient substrate source 45. a valve) for supplying nutrient substrate, which is required by enzymes and/or organisms contained in the fermentation broth 7, via the respective body connection line 19 connected to the nutrient substrate source 45 via the respective body interior space 17 fluidly connected thereto and through the filter membrane 15 surrounding this respective body interior space

17 into the container interior space 5. The nutrient substrate source 45 is fluid-connected (e.g. via a valve) to at least one of the respective body connection line 19, which is fluid-connected to the supply gas source 23 via a supply line 25, in order to be able to feed the nutrient substrate into the fermenter vessel 2 via this respective body connection line 19.

In the embodiments of Figures 3C and 3D, the fermenter device 1 is provided with an additional mixing device 49, which has an agitator and/or mixer that can be rotated and driven in rotation in the fermenter vessel 3. According to the invention, and thus in all embodiments, for example, at least one of the respective filter membrane body 13 can have one or more projections (not shown here), for example one or more fins and/or one or more wings, by means of which mixing of the fermentation broth 7 is effected at least supported and/or without any other additional mixing device, such as for example without the additional mixing device 49 explained above.

The fermenter device 1 according to the embodiment of Figure 1 further comprises a control device 51. The control device 51 is connected to a gas supply control valve 53, which is present in the fluid path with the respective body connection line 19 connected to the supply gas source 23, and is arranged to control the gas supply control valve 53 for controlling the supply gas supply into the fermenter vessel 3. The control device 51 is further connected to a discharge valve 55, which is present in the fluid path with the respective body connection line 19 connected to the permeate discharge line 21, and is arranged to control the discharge valve 55 to control the discharge of permeate to the at least one permeate discharge line 21. In addition, if the fermenter device 1 has the previously described feed supply connection 39, the control device 51 may be connected to a feed supply valve 57, which is present in the fluid path with the feed supply line 41, and may be arranged to control the feed supply valve 57 to control the broth feed supply into the fermenter vessel 3. Furthermore, if the fermenter device 1 comprises the previously described nutrient substrate source 45, the control device 51 may be connected to a nutrient substrate feed valve 59, which is present in the fluid path with the nutrient substrate feed line 47, and may be arranged to control the nutrient substrate feed valve 59 for controlling the nutrient substrate feed into the fermenter vessel 3.

Figure 1 and Figures 3A to 3F show a fermenter system with the fermenter device 1 and with the fermentation broth 7, which is contained in the fermenter container 3. The fermentation broth 7 contains target products, e.g. metabolism products, which have a product size. The filter membranes 15 have pores (not shown) with a pore size. This pore size can either be larger than the product size, if the fermenter device 1 has the permeate discharge container 43, so that the target products obtained can be discharged with the permeate from the fermentation broth 7 into the permeate discharge container 43 connected to the permeate discharge line 21, or, if the fermenter device 1 has the waste water connection 37, be smaller than the product size, so that the target products obtained in the fermentation broth 7 can be retained in the fermentation broth 7 by means of the respective filter membrane 15, whereby the fermentation broth 7 can be enriched with the target products. The fermentation vessel 3 may further comprise a target product removal port 61 for removing fermentation broth 7 enriched with target products from the fermentation vessel 3.

A method for operating the fermenter device 1 or for operating the fermenter system has: controlled supply of supply gas via the respective body connection line 19 connected to the supply gas source 23 to the fermentation broth 7 held in the fermenter container 3 and controlled discharge of permeate from the fermentation broth 7 held in the fermenter container 3 via the respective body connection line 19 connected to the permeate discharge line 21.

Controlled feeding can be carried out in such a way that the supply gas is fed to the fermentation broth 7 at intervals, e.g. at regular intervals.

The controlled discharge can take place in such a way that the permeate is continuously discharged from the fermenter tank 3.

The controlled supply of supply gas and the controlled discharge of permeate can be carried out in such a way that the supply of supply gas takes place at different times or at the same time as the controlled discharge of permeate.

If the fermenter device 1 has the waste water connection 37, the controlled discharge of permeate can be carried out in such a way that the permeate is disposed of via the waste water connection 37 connected to the permeate discharge line 21, e.g. is disposed of without being utilised. Alternatively, if the fermenter device 1 has the permeate discharge tank 43, the controlled discharge of permeate can take place in such a way that the permeate discharged via the permeate discharge line 21 is fed into the permeate discharge tank 43 for further utilisation of target products contained in the permeate.

In the fermentation broth 7, target products, e.g. metabolism products, can be obtained which have a product size, and wherein the filter membranes 15 have pores with a pore size. The pore size can be larger than the product size, provided that the fermenter device 1 has the permeate discharge container 43, so that the target products obtained are discharged with the permeate from the fermentation broth 7 into a permeate discharge container 43 connected to the permeate discharge line 21. Alternatively, if the fermentation device 1 has the waste water connection 37, the pore size can be smaller than the product size, so that the target products obtained in the fermentation broth 7 are retained in the fermentation broth 7 by means of the respective filter membrane 15, whereby the fermentation broth 7 is enriched with the target products.

P A T E N T K R A V

1. Fermenteringsindretning (1), der har:

en fermenteringsbeholder (3) med et beholderinderrum (5) til optagelse af en fermenteringssuppe (7),

i det mindste en dynamisk tværstrømsfiltreringsindretning (9), som har

i det mindste et filtermembranlegeme-sæt (11) med i det mindste en eller flere filtermembranlegemer (13), optionalt i det mindste en eller flere filtermembranskiver, som hver især har et af en filtermembran (15) omgivet legemeinderrum (17), optionalt skiveinderrum, som står i fluidkommunikation med beholderinderrummet (5), og som er anbragt bevægeligt, optionalt rotationsbevægeligt, for i tilfælde af sin/deres bevægelse at generere en tværstrømning langs den tilhørende filtermembran (15) på den respektive filtermembrans (15) overflade, og som optionalt er anbragt stabelagtigt bag hinanden samt med afstand til hinanden i stabelretningen, og

hver især en legemeforbindelsesledning (19), optionalt skiveforbindelsesledning, som er tilordnet til det respektive filtermembranlegeme-sæt (11), og som er fluidforbundet med legemeinderrummet (17) af det respektive filtermembranlegeme (13) i det tilordnede filtermembranlegeme-sæt (11),

i det mindste en permeatbortledningsledning (21), der er forbundet med i det mindste en af de respektive legemeforbindelsesledninger (19) med henblik på bortledning af permeat, som gennem filtermembranen (15) i det respektive filtermembranlegeme (13) og via dettes legemeinderrum (17) er kommet ind i den respektive legemeforbindelsesledning (19), der er forbundet med den i det mindste ene permeatbortledningsledning (21),

kendetegnet ved

en forsyningsgaskilde (23), der er fluidforbundet med i det mindste en af de respektive legemeforbindelsesledninger (19) via en forsyningsledning (25) til tilførsel af forsyningsgas, som behøves af enzymer og/eller organismer, der er indeholdt i fermenteringssuppen (7), via den respektive med forsyningsgaskilden

(23) forbundne legemeforbindelsesledning (19) og det respektive med denne fluidforbundne legemeinderrum (17) samt gennem den filtermembran (15), der omgiver dette respektive legemeinderrum (17), ind i beholderinderrummet (5).

2. Fermenteringsindretning (1) ifølge krav 1, hvor den respektive legemeforbindelsesledning (19) er udformet som hul drejeaksel, på hvilken det/de tilordnede filtermembranlegeme(r) (13) er drejefast anbragt for ved en drejning af drejeakslen at bevæges roterende, hvor optionalt den i det mindste ene dynamiske tværstrømsfiltreringsindretning (9) har flere filtermembranlegeme-sæt (11) med hver især flere filtermembranlegemer (13), hvor filtermembranlegemerne (13) er anbragt, så de fra i det mindste to tilstødende drejeaksler griber kæmmende ind i hinanden.

3. Fermenteringsindretning (1) ifølge krav 1 eller 2, hvor den respektive legemeforbindelsesledning (19) er fluidforbundet såvel med den i det mindste ene permeatbortledningsledning (21) som med forsyningsgaskilden (23), eller hvor i det mindste en, men ikke alle, af de respektive med forsyningsgaskilden (23) fluidforbundne legemeforbindelsesledninger (19) ikke er forbundet med nogen af de i det mindste ene permeatbortledningsledninger (21) og/eller ikke er indrettet forbindbart med nogen af de i det mindste ene permeatbortledningsledninger (21).

4. Fermenteringsindretning (1) ifølge et af kravene 1 til 3, hvor der i området af den i det mindste ene dynamiske tværstrømsfiltreringsindretning (9) er anbragt i det mindste en køleanordning (27).

5. Fermenteringsindretning (1) ifølge et af kravene 1 til 4, hvor den i det mindste ene dynamiske tværstrømsfiltreringsindretning (9) har et selvstændigt filtreringsindretningshus (29), som har et husinderrum (31), i hvilket det respektive filtermembranlegeme-sæt (11) er anbragt, og som er anbragt udvendigt på fermenteringsbeholderen (3), hvor husinderrummet (31) kommunikerer fluidt med beholderinderrummet (5) via en forbindelsesåbning (33).

6. Fermenteringsindretning (1) ifølge krav 5, hvor forbindelsesåbningen (33) er udformet i en integral forbindelsesvæg (35), der er såvel del af en beholderydervæg på fermenteringsbeholderen (3) som en husydervæg på filtreringsindretningshuset (29).

7. Fermenteringsindretning (1) ifølge et af kravene 1 til 4, hvor det respektive filtermembranlegeme-sæt (11) befinder sig direkte i fermenteringsbeholderens (3) beholderinderrum (5).

8. Fermenteringsindretning (1) ifølge et af kravene 1 til 7, som endvidere har en spildevandstilslutning (37), med hvilken den i det mindste ene permeatbortledningsledning (21) er forbundet med henblik på bortskaffelse, optionalt til udnyttelsesfri bortskaffelse, af det via den i det mindste ene permeatbortledningsledning (21) bortledte permeat, og/eller som endvidere har en feed-tilførselstilslutning (39), med hvilken fermenteringsbeholderen (3) er forbundet via en feed-tilførselsledning (41) til tilførsel af suppe-feed til beholderinderrummet (5).

9. Fermenteringsindretning (1) ifølge et af kravene 1 til 7, der endvidere har en permeatbortledningsbeholder (43), der er forbundet med den i det mindste ene permeatbortledningsledning (21) med henblik på optagelse af det via permeatbortledningsledningen (21) bortledte permeat, og/eller som endvidere har en feed-tilførselstilslutning (39), med hvilken fermenteringsbeholderen (3) er forbundet via en feed-tilførselsledning (41) til tilførsel af suppe-feed til beholderinderrummet (5).

10. Fermenteringsindretning (1) ifølge et af kravene 1 til 9, hvor i det mindste et af de respektive filtermembranlegemer (13) har et eller flere fremspring, optionalt en eller flere finner og /eller en eller flere vinger, ved hjælp af hvilke en gennemblanding af fermenteringssuppen i det mindste understøttes og/eller

bevirkes uden anden ekstra blandeindretning (49).

11. Fermenteringsindretning (1) ifølge et af kravene 1 til 10, der endvidere har en styreindretning (51),
som er forbundet med i det mindste en gastilførselspumpe og/eller med i det mindste en gastilførselsstyreventil (53), som foreligger i fluidbanen med den respektive med forsyningsgaskilden (23) forbundne legemeforbindelsesledning (19), og er indrettet til at styre den respektive gastilførselspumpe og/eller den respektive gastilførselsstyreventil (53) med henblik på styring af forsyningsgastilførslen til fermenteringsbeholderen (3), og/eller
som er forbundet med i det mindste en bortledningsventil (55) og/eller med i det mindste en bortledningspumpe, som foreligger i fluidbanen med den respektive med den i det mindste ene permeatbortledningsledning (21) forbundne legemeforbindelsesledning (19), og er indrettet til at styre den respektive bortledningsventil (55) og/eller den respektive bortledningspumpe med henblik på styring af permeatbortledningen til den i det mindste ene permeatbortledningsledning (21), og/eller,
såfremt i kombination med krav 8, anden option, eller krav 9, anden option, som er forbundet med i det mindste en feed-tilførselsventil (57) og/eller med i det mindste en feed-tilførselspumpe, som foreligger i fluidbanen med feed-tilførselsledningen (41), og er indrettet til at styre den respektive feed-tilførselspumpe og/eller den respektive feed-tilførselsventil (57) med henblik på styring af suppe-feed-tilførslen til fermenteringsbeholderen (3).

12. Fermenteringssystem med en fermenteringsindretning (1) ifølge et af kravene 1 til 11 og med en fermenteringssuppe (7), der er optaget i fermenteringsbeholderen (3) og foreligger i målprodukterne, optionalt metabolismeprodukter, som har en produktstørrelse, og hvor filtermembranerne (15) har porer med en porestørrelse, som
Ifølge et første alternativ såfremt i kombination med krav 9, første option, er større end produktstørrelsen, således at de udvundne målprodukter med permeatet fra

fermenteringssuppen (7) kan bortledes til den permeatbortledningsbeholder (43), der er tilsluttet til den i det mindste ene permeatbortledningsledning (21), eller ifølge et andet alternativ såfremt i kombination med krav 8, første option, er mindre end produktstørrelsen, således at de udvundne målprodukter i fermenteringssuppen (7) ved hjælp af den respektive filtermembran (15) kan tilbageholdes i fermenteringssuppen (7), hvorved fermenteringssuppen (7) kan beriges med målprodukterne, hvor, optionalt, fermenteringsbeholderen (3) har en målproduktudtagningstilslutning (61) til udtagning af fermenteringssuppe (7), der er beriget med målprodukter, fra fermenteringsbeholderen (3).

13. Fremgangsmåde til drift af en fermenteringsindretning (1) ifølge krav 11 eller til drift af et fermenteringssystem ifølge krav 12, som har en fermenteringsindretning (1) ifølge krav 11, der har:
styret tilførsel af forsyningsgas via den respektive med forsyningsgaskilden (23) forbundne legemeforbindelsesledning (19) til en i fermenteringsbeholderen (3) optaget fermenteringssuppe (7) og
styret bortledning af permeat fra den i fermenteringsbeholderen (3) optagne fermenteringssuppe (7) via den respektive med den i det mindste ene permeatbortledningsledning (21) forbundne legemeforbindelsesledning (19).

14. Fremgangsmåde ifølge krav 13, hvorved den styrede tilførsel sker sådan, at forsyningsgassen tilføres til fermenteringssuppen (7) i intervaller, optionalt i regelmæssige intervaller.

15. Fremgangsmåde ifølge krav 13 eller 14, hvorved den styrede bortledning sker sådan, at permeatet kontinuerligt bortledes fra fermenteringsbeholderen (3).

16. Fremgangsmåde ifølge et af kravene 13 til 15, hvorved den styrede tilførsel af forsyningsgas og den styrede bortledning af permeat sker sådan, at tilførslen af forsyningsgas sker tidsmæssigt forskudt eller samtidig med den styrede bortledning af permeat.

17. Fremgangsmåde ifølge et af kravene 13 til 16,
hvorved, såfremt i kombination med krav 8, første option, den styrede bortledning af permeat sker sådan, at permeatet bortskaffes via den med den i det mindste ene permeatbortledningsledning (21) forbundne spildevandstilslutning (37), optionalt bortskaffes udnyttelsesfrit, eller
hvorved, såfremt i kombination med krav 9, første option, den styrede bortledning af permeat sker sådan, at det via den i det mindste ene permeatbortledningsledning (21) bortledte permeat tilføres til permeatbortledningsbeholderen (43) med henblik på genanvendelse af målprodukter, der er indeholdt i permeatet.

18. Fremgangsmåde ifølge et af kravene 13 til 17, hvorved der i fermenteringssuppen (7) udvindes målprodukter, optionalt metabolismeprodukter, som har en produktstørrelse, og hvorved filtermembranerne (15) har porer med en porestørrelse,
som, såfremt i kombination med krav 8, første option, er større end produktstørrelsen, således at de udvundne målprodukter med permeatet bortledes fra fermenteringssuppen (7) til en permeatbortledningsbeholder (43), der er tilsluttet til den i det mindste ene permeatbortledningsledning (21), eller
som, såfremt i kombination med krav 9, første option, er mindre end produktstørrelsen, således at de udvundne målprodukter i fermenteringssuppen (7) ved hjælp af den respektive filtermembran (15) tilbageholdes i fermenteringssuppen (7), hvorved fermenteringssuppen (7) beriges med målprodukterne.

FIG. 1

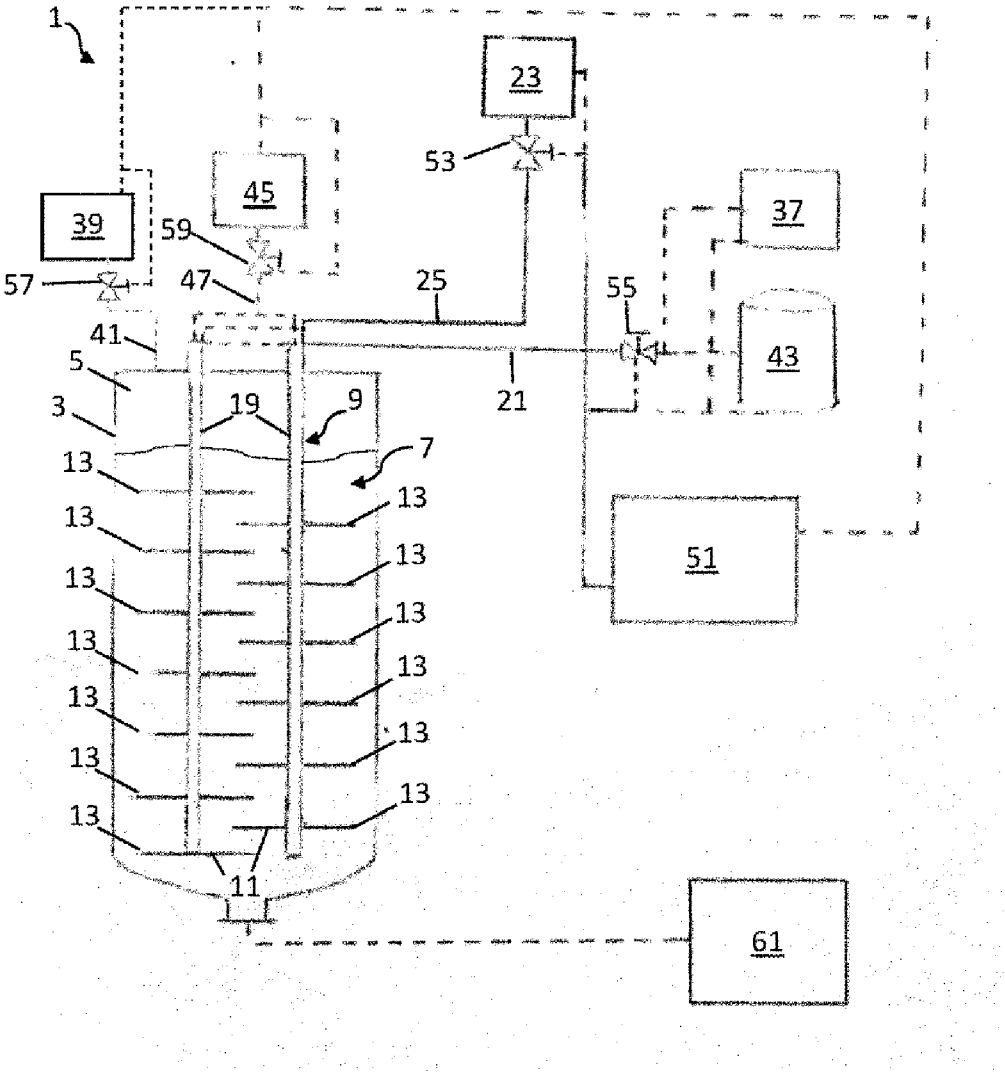

FIG. 2

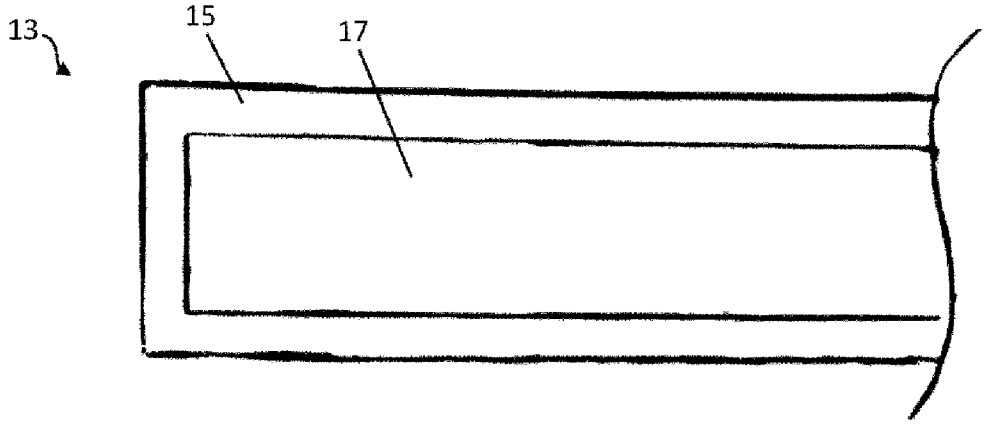

FIG. 3