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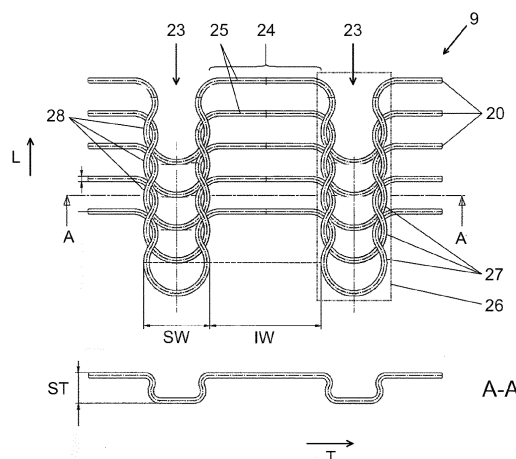
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(54) PERCOLATOR FOR USE IN AN ELECTROLYSIS CELL

(57) The invention relates to a percolator (9) for use in an electrolysis cell, the percolator (9) being designed as a textile mesh structure made of at least one thread system (20) and extending in a longitudinal (L) and a transverse direction (T), wherein the textile mesh structure comprises strands (23) that extend in the longitudinal direction (L) and are disposed at regular intervals (24) from one another in the transverse direction (T), wherein the strands (23) have a strand width (SW) and a strand

thickness (ST) that defines an overall thickness of the percolator (9) in an unloaded state, and wherein the strands (23) are connected by connecting threads (25) spanning the intervals (24) between adjacent strands (23), which intervals (24) have an interval width (IW) in the range of 0.5 to 3 times the strand width (SW), as well as an electrolysis cell and an electrolyzer comprising such a percolator, and a method to of operating such an electrolyzer.

**Fig. 3****EP 4 516 966 A1**

Description

Background of the invention

[0001] The invention relates to a percolator for use in an electrolysis cell according to the preamble of claim 1, as well as an electrolysis cell and an electrolyzer comprising a percolator according to the preambles of claims 10 and 12, and a method to of operating such an electrolyzer according to claim 15.

[0002] Chlorine is of enormous industrial importance. Well-known applications are for example polycarbonate, polyurethane, drugs, semiconductor silicon and Teflon. A prominent example of a chlorine-containing end product is polyvinyl chloride, which is used, among other things, in cable insulation, floor coverings or artificial leather. Overall, chlorine is involved in about 60% of chemical production (A. Behr, D.W. Agar, J. Jörissen, A.J. Vorholt, Einführung in die Technische Chemie, Springer-Verlag GmbH Germany 2016).

[0003] Caustic soda is also important in industry and is used, for example, in the aluminum, paper, textile and chemical industries, as well as for water treatment.

[0004] An important manufacturing process for the production of chlorine and caustic soda is chlor-alkali electrolysis, and within chlor-alkali electrolysis especially the so-called oxygen depolarized cathode (ODC) technology. A special oxygen-depolarized cathode is used in an electrolysis cell on the cathode side, through which caustic soda flows. This type of cathode is characterized by the fact that it has a highly porous oxygen diffusion surface behind of which oxygen is introduced into the cell. The oxygen is reduced to hydroxide ions together with water at the ODC. An electrocatalyst may be applied to the ODC to support the reaction. The electrocatalyst may comprise silver, for example. During this process - in contrast to the reduction of the water that occurs in conventional chlor-alkali electrolysis - no hydrogen gas is generated, resulting in a decreasing of the operating cell voltage by about 1 V. This corresponds to a saving in electrical energy of about 25% compared to conventional chlor-alkali electrolysis technology.

[0005] In ODC chlor-alkali electrolysis as described above, the distribution of the electrolyte in the cathode half-cell between the membrane and the ODC may be effected by the electrolyte flowing through a so-called percolator, which is arranged as a planar element between the membrane and the ODC. The general setup of an ODC electrolysis cell with a percolator is described e.g. in WO 2003/042430 A2.

[0006] In such an electrolysis cell, the percolator ensures the proper functioning of the pore systems of the ODC throughout the complete area of the cathode. This is achieved by electrolyte flowing through the percolator from the top to the bottom of the cell, thereby forming a falling film and avoiding a hydrostatic column to form on the electrolyte side of the ODC. The better the performance of the percolator, the less is the pressure differ-

ence of electrolyte between the top and the bottom of the cell, such that an essentially fixed, optimized pressure difference between the electrolyte and the gas side of the ODC can be established throughout the complete area of the ODC.

[0007] Generally, the geometry, structure and thickness of the percolator in such an electrolysis cell determines the flow rate of the electrolyte in the cell, at which the percolator is completely wetted by percolating electrolyte, without a hydrostatic column to form. Thus, for a given percolator there is a predetermined flow rate at which the electrolysis cell is to be operated, defining a narrow range of permissible operating currents for the electrolysis reaction.

[0008] If an electrolysis cell is to be operated at a higher current density in order to achieve increased chlorine or caustic soda production, it is necessary to set a correspondingly higher flow rate of electrolyte, not only to improve the supply of reaction educts, but also to enhance heat removal from the cell. In known electrolysis cells, it is then necessary to change the percolator, i.e. to shut down the electrolyzer, remove the old percolator and install a new one. This causes a considerable assembly effort. Also, according to conventional design, it may be necessary to turn down current density to remove excess heat from the cell, because the flow rate of electrolyte cannot be enhanced for cooling purposes, due to the fixed percolator properties.

Brief Summary of Invention

[0009] The object of the invention is to provide a percolator, an electrolysis cell and an electrolyzer, as well as a method to operate the electrolyzer that allow for a more flexible operation with respect to the permissible current densities and electrolyte flow rates.

[0010] This object is achieved by a percolator for use in an electrolysis cell according to the features of claim 1.

[0011] Hereby a percolator for use in an electrolysis cell is provided, the percolator extending in a longitudinal and a transverse direction. The percolator is designed as a textile mesh structure made of at least one thread system. The textile mesh structure comprises strands that extend in the longitudinal direction and are disposed at regular intervals from one another in the transverse direction. The strands have a strand width and a strand thickness that defines an overall thickness of the percolator in an unloaded state. The strands are connected by connecting threads spanning the intervals between adjacent strands, which intervals have an interval width in the range of 0.5 to 3 times the strand width.

[0012] The percolator being designed as a textile mesh structure has the advantage that the individual threads of the at least one thread system forming the textile mesh are interlaced within the textile mesh without being fixed to each other at their crossing points. This results in an overall structural stability of the textile mesh, which nonetheless allows for a high amount of compressibility in the

thickness direction of the percolator.

[0013] Moreover, textile mesh structures have the advantage that they can be fabricated in various ways so as to exhibit the 3D structure defined in claim 1. The percolator according to the invention is characterized by longitudinal strands that define the thickness of the percolator and i.e. in operation of the electrolysis fill the gap between the separator and the electrode. The interval between the strands is spanned by connecting threads. The intervals between the strands form longitudinal channels for the flow of electrolyte, resulting in a large free flow cross-section in the unloaded state of the percolator. Under load, however, due to the textile structure of the strands, the strand thickness decreases and the strand width increases, both effects resulting in a decreased free-flow cross-section for the electrolyte. Thus, by compressing the percolator within an electrolysis cell in a compartment flown through by electrolyte, the flow rate of electrolyte can be very sensitively controlled through compressing the percolator by external forces.

[0014] The interval width in the range of 0.5 to 3 times the strand width (in the unloaded state) has turned out to be an optimal choice for solving the trade-off between high electrolyte throughput at a low percolator thickness and a low hydrostatic pressure differences building up between the top and the bottom of the cell.

[0015] In advantageous embodiments, the textile mesh structure of the percolator is made of polytetrafluoroethylene (PTFE), perfluoroalkoxy alkane (PFA), polysulfone (PSU), polypropylene random copolymer (PP-R), temperature resistant polypropylene (TROL®) or polyethylene (PE). These plastic materials have proven to be chemically resistant under the harsh conditions within an electrolysis cell. Moreover, the materials exhibit an inherent rigidity to the threads that provides the textile mesh structure of the percolator with a restoring force, that it reliably returns into its original shape, when external compressive forces are relieved.

[0016] Preferably, the strands have an elasticity in a thickness direction of the percolator which, at a surface pressure of the percolator in a range from 50 to 300 mbar, preferably 110 to 190 mbar, causes a reversible compression of the strands to a compressed strand thickness in the range of 0.1 to 0.5 times the strand thickness in the unloaded state. These surface level pressures are preferred, because they achieve a sufficient compression of the percolator at typical compression force levels of electrolyzer stacks.

[0017] In some embodiments, the textile mesh structure is a weft-knitted fabric made from one thread system, wherein the strands are formed by wales of the weft-knitted fabric each comprising a sequence of stitches, in which each stitch is suspended from its precursor in the longitudinal direction and wherein the stitches of transversely adjacent wales are connected by the connecting threads to form a stitch course extending in the transverse direction. Percolators of this type may be produced with comparatively low production effort, due to only one

thread system being used in the weft-knitting process.

[0018] In other preferred embodiments, the textile mesh structure is a warp-knitted fabric made from at least a first and a second thread system. The strands are formed from the first thread system and have a plait-like structure and the connecting threads are formed from the second thread system, with the connecting threads and the strands being interlaced. The use of a warp-knitted fabric made from at least two thread systems has the advantage that the properties of the strands and the connecting threads can be tailored individually to their purposes. In particular, the strands are fabricated to provide the compressibility properties of the percolator, while the connecting threads merely need to provide the regular spacing of the strands, but should not occupy too much of the volume of the electrolyte channels formed in the intervals between the strands.

[0019] To this end, it is preferred if the connecting threads of the second thread system form a grid pattern between the strands, which introduces an additional stability of the fabric against parallel displacement of the strands. In particular, it is preferred if the connecting threads form zigzag lines between adjacent strands.

[0020] Further, in preferred embodiments, the threads of the first thread system have a greater thread thickness than the connecting threads of the second thread system. Larger thread thicknesses within the strands have the advantage of providing sufficient restoring force even for larger percolator thicknesses, while the smaller thread thicknesses of the connecting threads obstruct the electrolyte flow within the intervals between the strands to a lesser extent. In particular, it is preferred if the thread thickness of the first thread system is at least twice as large as the thread thickness of the second thread system.

[0021] The object is further solved by an electrolysis cell for electrolytic treatment of a liquid electrolyte, comprising a cathode half-shell accommodating a cathode and an anode half-shell accommodating an anode. The half-shells of the electrolysis cell are separated from one another by a separator. A percolator of the above-described design is arranged within the cathode half-cell and/or the anode half-cell. Preferably, the percolator is arranged within the cathode half-shell and the cathode is an oxygen depolarized cathode. Even more preferred, the percolator is arranged in the gap between the separator and the oxygen depolarized cathode.

[0022] The object is also solved by an electrolyzer comprising a cell rack, a cell stack comprising a plurality of electrolysis cells describes above, which are suspended in the cell rack, and feed and discharge piping connected to the electrolysis cells of the cell stack for connecting the electrolyzer to a liquid electrolyte cycle. The feed piping and the discharge piping are connected within the electrolysis cells via the percolator. Moreover, the electrolyzer comprises compression means to apply a variable compressive force onto the cell stack. Under the variable compressive forces of the compressing

means acting on the cell stack, the percolators within the cells are compressed to a variable extent, allowing the electrolyte flow through the cells to be varied, without exchanging the percolator.

[0023] Preferably, the electrolyzer further comprises an electronic control unit for controlling the compressive force exerted by the compression means. Such a control unit allows the electrolyte flow to be controlled online, i.e. during production, e.g. as part of an overall plant control system.

[0024] It is further advantageous if the electrolyzer comprises at least one flow-meter connected to the electronic control unit for measuring the throughput of liquid electrolyte percolating through the percolator forming a control-loop for the flow of liquid electrolyte. The closed-loop control allows for an even more accurate control of the electrolyte flow.

[0025] Finally, the object is solved by a method of operating the electrolyzer as described above, wherein the compressive force exerted by the compression means onto the cell stack is adjusted in such a way, that a throughput of liquid electrolyte percolating through the percolator is adjusted to a target value by a reversible compression of the strands of the percolator within the electrolysis cells.

[0026] Further advantages of the invention are described in the following with regard to the embodiments shown in the attached drawings.

Brief Description of Drawings

[0027]

- Fig. 1 shows schematically an electrolyzer according to the invention comprising a stack of inventive electrolysis cells and electronically controlled compression means,
- Fig. 2 shows schematically a detailed view of one of the electrolysis cells of the cell stack of Fig. 1,
- Fig. 3 shows schematically a first embodiment of the percolator according to the invention with the textile mesh structure being a weft-knitted fabric made from one thread system,
- Fig. 4 shows schematically a second embodiment of the percolator according to the invention with the textile mesh structure being a warp-knitted fabric made from two thread systems,
- Fig. 5A and 5B show schematically the compression of the percolator under external load,
- Fig. 6 shows schematically the flow rate of electrolyte through the percolator as a function of external pressure and temperature of the electrolyte.

Detailed Description of Invention

[0028] In the drawings same parts are consistently identified by the same reference signs and are therefore generally described and referred to only once.

[0029] In Fig. 1, an electrolyzer 100 according to the invention is shown. The electrolyzer 100 comprises a cell rack 110 and a cell stack 120 formed by a plurality of electrolysis cells 1 suspended in the cell rack 110. In addition, the electrolyzer 100 comprises feed and discharge piping 130, 131 connected to the electrolysis cells 1 of the cell stack 120 for connecting the electrolyzer 100 to a liquid electrolyte cycle. The feed piping 130 and the discharge piping 131 are connected within the electrolysis cells 1 via a percolator 9 according to the invention that is described in more detail below. Besides the feed and discharge piping 130, 131 shown in Fig. 1 that are connected via the percolator 9 the electrolyzer 100 comprises additional pipeworks (not shown) for providing additional electrolysis educts and discharging electrolysis products. For operation of the electrolyzer 10, a voltage can be applied to the outer halfshells 2, 7 of the outmost electrolysis cells 1 of the cell stack 120, resulting in an electrical current flowing through all electrolysis cells 1 of the cell stack 120 that are connected in series by the backwalls of their half-shells 2, 7.

[0030] Further, the electrolyzer 100 comprises compression means 140 to apply a variable compressive force onto the cell stack 120. The compression means 140 may for example be formed by hydraulic cylinders. The variable compressive force may in this case be varied by varying the pressure of the hydraulic medium actuating the cylinders. For reasons of simplicity, details of the hydraulic circuit actuating the hydraulic cylinders have been omitted.

[0031] As shown in Fig. 1, the electrolyzer 100 may comprise an electronic control unit 150 for controlling the compressive force exerted by the compression means 140. Further, the electrolyzer 100 may comprise at least one flow-meter 160 connected to the electronic control unit 150 for measuring the throughput of liquid electrolyte percolating through the percolator 9 forming a control-loop for the flow of liquid electrolyte. Based on a comparison of the flow value measured by the flow-meter 160 and a target value of the electronic control unit 150, the force exerted by the compression means 140 may be adapted to reach the target value. The measured flow value may be transmitted to the electronic control unit 150, e.g. via a signal line 152, and the compression means 140 may be controlled by the electronic control unit 150, e.g. via a control line 151.

[0032] Fig. 2 shows a more detailed view of one of the electrolysis cells 1 of Fig. 1. The electrolysis cell 1 for electrolytic treatment of a liquid electrolyte comprises a cathode half-shell 7 accommodating a cathode 10 and an anode half-shell 2 accommodating an anode 3. The half-shells 2, 7 are separated from one another by a separator 16, for example an ion exchange membrane or a dia-

phragm. The separator 16 is pressed between the two half-shells 2, 7 and sealed by circumferential seals 8.

[0033] A percolator 9 of the design to be described in more detail below may be arranged within the cathode half-cell 7 and/or the anode half-cell 2. In the electrolysis cell 1 shown in Fig. 2, the percolator 9 is arranged in the cathode half-cell 7 and the cathode 10 is an oxygen depolarized cathode.

[0034] On the left hand side, the anode half-shell 2 is shown. In the anode half-shell 2, anolyte, typically brine, is provided through anolyte inlet 5 and depleted anolyte as well as produced chlorine is discharged through anolyte outlet 6. The interior of the anode half-shell 2 is only shown very schematically in Fig. 2. The anode 3, e.g. being an expanded metal sheet or metal mesh, typically made from titanium is supported on an anode support structure 4 within the anode half-shell 2. The anode support structure 4 has the purpose to support the anode 4 over its complete surface area and to conduct the electrical current between the backwall of the half-shell 2 and the anode 3. The anode support structure 4 often comprises vertically extending ribs (not shown) that form vertical channels within the half-shell 2 through which the anolyte flows from anolyte inlet 5 to anolyte outlet 6.

[0035] In the cathode half-shell 7, the cathode 10 is supported on the backwall by means of a cathode support structure 12 and a current distributor 11. The cathode support structure 12 provides mechanical support and electrical conductivity between the cathode 10 and the cathode half-shell 7. The current distributor 11 serves the purpose of equalized current distribution over the complete surface area of the cathode 10.

[0036] The oxygen depolarized cathode 10 separates the cathode half-shell 7 into two compartments. In operation, the compartment on the side that faces the half-shell 7 is supplied with fresh oxygen via the oxygen inlet port 17. Typically, oxygen is supplied with a 10-20% excess with respect to the amount required for electrolysis and excess oxygen is discharged via oxygen outlet port 14.

[0037] The compartment on the side of the cathode 10 that faces the separator 16 comprises the percolator 9. Catholyte, typically caustic soda, is supplied to the top of the percolator 9 via catholyte inlet port 13 and percolates through the percolator 9 down to the bottom of the electrolysis cell 1, from which it is discharged through catholyte outlet port 15. On its way down, the catholyte gets more concentrated by the ions formed within the oxygen depolarized cathode 10 and the ions permeating through the separator 16.

[0038] For an optimal performance of the oxygen depolarized cathode 10 the pressure balance between the two compartments should be adjusted such that the oxygen enters the porous material of the cathode 10 to a sufficient extent, while it does not permeate through the cathode 10 into the catholyte. Since oxygen pressure will be almost equal throughout the area of the cathode 10, a hydrostatic column of catholyte is to be inhibited on the catholyte side of the cathode 10. This is achieved by the

use of percolator 9.

[0039] Fig. 3 shows the structure of a percolator 9 according to a first embodiment of the invention in a detailed view. The percolator 9 for use in the electrolysis cell 1 (cf. Fig. 1 and 2) extends in a longitudinal L and a transverse direction T. The percolator 9 is designed as a textile mesh structure made of one thread system 20, wherein the textile mesh structure comprises strands 23 that extend in the longitudinal direction L and are disposed at regular intervals 24 from one another in the transverse direction T.

[0040] The strands 23 have a strand width SW and a strand thickness ST that defines an overall thickness of the percolator 9 in an unloaded state. The strands 23 are connected by connecting threads 25 spanning the intervals 24 between adjacent strands 23, which intervals 24 have an interval width IW in the range of 0.5 to 3 times the strand width SW.

[0041] The strands 23 of the percolator 9 are preferably disposed at an interval width IW in the range between 0.3 mm and 12 mm. The strand width SW of the strands in the unloaded state of the percolator 9 is preferably in the range of 0.6 mm to 4 mm. The overall thickness of the percolator 9 in an unloaded state is preferably within the range of 0.6 mm to 5 mm.

[0042] Preferably, the textile mesh structure is made of polytetrafluoroethylene (PTFE), perfluoroalkoxy alkane (PFA), polysulfone (PSU), polypropylene random copolymer (PP-R), temperature resistant polypropylene (TROL®) or polyethylene (PE). These materials show a sufficient chemical stability for use in an electrochemical cell. Moreover, their inherent mechanical stiffness creates a restoring force of the textile to restore its original shape, once external compressive forces are relieved. In addition, the hydrophobic character of those materials supports in inhibiting a hydrostatic column of electrolyte to form within the percolator 9.

[0043] In preferred embodiments, the strands 23 have an elasticity in a thickness direction of the percolator 9 which, at a surface pressure of the percolator 9 in a range from 50 to 300 mbar, preferably 110 to 190 mbar, causes a reversible compression of the strands 23 to a compressed strand thickness CST1, CST2 in the range of 0.1 to 0.5 times the strand thickness ST in the unloaded state.

[0044] In the first embodiment of the percolator shown in Fig. 3, the textile mesh structure is a weft-knitted fabric made from one thread system 20. The strands 23 are formed by wales 26 of the weft-knitted fabric. Each wale 26 comprises a sequence of stitches 27, 28 in which each stitch is suspended from its precursor in the longitudinal direction L. The stitches 27, 28 of transversely adjacent wales 26 are connected by the connecting threads 25 to form a stitch course extending in the transverse direction T.

[0045] In the lower part of Fig. 3 a sectional view of the percolator 9 is shown. In the sectional view, the three-dimensional structure of the strands 3 becomes visible. Due to the stitches 27, 28 each being suspended from its

precursor in the longitudinal direction L, the threads of the thread system 20 overlap, with the overlapping points forming lines extending in the longitudinal direction, that delimit the wales 26. The overlapping points are arranged such that within the wales 26 the threads of the thread system 20 extend in a plane that is shifted in relation to the plane of the connecting threads 25. The structure of the wales 26 thereby defines the strand thickness ST of the strands 23 in the unloaded state.

[0046] In Fig. 4 the structure of a percolator 9 according to a second embodiment of the invention is shown in a detailed view. The percolator 9 of the second embodiment is characterized in that the textile mesh structure is a warp-knitted fabric made from at least a first 21 and a second thread system 22. The strands 23 of the textile mesh structure are formed from the first thread system 21 and have a plait-like structure. The connecting threads 25 are formed from the second thread system 22, wherein the connecting threads 25 and the strands 23 are interlaced.

[0047] By using at least two different thread systems to manufacture strands 23 and connecting threads 25 the thread properties can be optimized to the respective function of the strands 23 and connecting threads 25. Preferably, the threads of the first thread system 21 have a greater thread thickness than the connecting threads 25 of the second thread system 22. In particular, it is preferred if the thread thickness of the first thread system 21 is at least twice as large as the thread thickness of the second thread system 22.

[0048] In order to improve dimensional stability of the textile mesh structure within the percolator plane with low thread thicknesses of the connecting threads 25, it is preferred that the connecting threads of the second thread system form a grid pattern between the strands 23. In particular, it is preferred, if the connecting threads 25 form zigzag lines between adjacent strands 23, as shown in Fig. 4.

[0049] In all other respects, the description of the first embodiment shown in Fig. 3 is applicable to the second embodiment shown in Fig. 4, accordingly.

[0050] Fig. 5A and 5B show schematically cross-section of the percolators according to Fig. 3 and 4 under the action of an external surface pressure p1 and p2, respectively. In Fig. 5A the external surface pressure p1 is just large enough to hold the percolator 9 in its position between the cathode 10 and the separator 6. The strands 23 of the percolator 9 are only slightly compressed, resulting in a first compressed strand thickness CST1.

[0051] Fig. 5B shows the same situation at a higher surface pressure p2. The strands 23 are compressed to a lower second compressed strand thickness CST2. Thus, the resulting thickness of the percolator 9 is reduced and the intervals between the strands 23 get partly occupied by the deformed strands 23. Both effects result in less free flow volume for the electrolyte through the percolator 9.

[0052] Fig. 6 visualizes this effect in a pressure / elec-

trolyte flow diagram. When the external surface pressure acting on the percolator 9 is increased from p1 to p2, the electrolyte flow decreases from V1/t to V2/t. The absolute amount of electrolyte flowing through the percolator 9, in addition, depends on the temperature of the electrolyte, wherein a higher electrolyte temperature generally promotes the flow.

[0053] Based on these findings the electrolyzer 100 of Fig. 1 can be operated according to a method, in which the compressive force exerted by the compression means 140 onto the cell stack 120 is adjusted in such a way, that a throughput of liquid electrolyte percolating through the percolator 9 is adjusted to a target value by a reversible compression of the strands 23 of the percolator 9 within the electrolysis cells 1.

List of Reference Signs

[0054]

1	electrolysis cell
2	anode half-shell
3	anode
4	anode support structure
5	anolyte inlet
6	anolyte outlet
7	cathode half-shell
8	gasket
9	percolator
10	cathode
11	current distributor
12	cathode support structure
13	catholyte inlet port
14	oxygen outlet port
15	catholyte outlet port
16	separator
17	oxygen inlet port
20, 21, 22	thread system
23	strand
24	interval
25	connecting thread
26	wale
27, 28	stitches
100	electrolyzer
110	cell rack
120	cell stack
130	feed piping
131	discharge piping
140	compression means
150	electronic control unit
151	control line
152	signal line
160	flow meter
CST1, CST2	compressed strand thickness
IW	interval width
L	longitudinal direction
T	transverse direction

SW strand width
ST strand thickness

Claims

1. Percolator for use in an electrolysis cell (1), the percolator (9) extending in a longitudinal (L) and a transverse direction (T), **characterized in that** the percolator (9) is designed as a textile mesh structure made of at least one thread system (20, 21, 22), the textile mesh structure comprising strands (23) that extend in the longitudinal direction (L) and are disposed at regular intervals (24) from one another in the transverse direction (T), wherein the strands (23) have a strand width (SW) and a strand thickness (ST) that defines an overall thickness of the percolator (9) in an unloaded state, and wherein the strands (23) are connected by connecting threads (25) spanning the intervals (24) between adjacent strands (23), which intervals (24) have an interval width (IW) in the range of 0.5 to 3 times the strand width (SW). 5
2. Percolator according to claim 1, **characterized in that** the textile mesh structure is made of polytetrafluoroethylene (PTFE), perfluoroalkoxy alkane (PFA), polysulfone (PSU), polypropylene random copolymer (PP-R), temperature resistant polypropylene (TROL®) or polyethylene (PE). 10
3. Percolator according to claim 1 or 2, **characterized in that** the strands (23) have an elasticity in a thickness direction of the percolator (9) which, at a surface pressure of the percolator (9) in a range from 50 to 300 mbar, preferably 110 to 190 mbar, causes a reversible compression of the strands (23) to a compressed strand thickness (CST1, CST2) in the range of 0.1 to 0.5 times the strand thickness (ST) in the unloaded state. 15
4. Percolator according to any one of the claims 1 to 3, **characterized in that** the textile mesh structure is a weft-knitted fabric made from one thread system (20), wherein the strands (23) are formed by wales (26) of the weft-knitted fabric each comprising a sequence of stitches (27, 28) in which each stitch is suspended from its precursor in the longitudinal direction (L) and wherein the stitches (27, 28) of transversely adjacent wales (26) are connected by the connecting threads (25) to form a stitch course extending in the transverse direction (T). 20
5. Percolator according to any one of the claims 1 to 3, **characterized in that** the textile mesh structure is a warp-knitted fabric made from at least a first (21) and a second thread system (22), wherein the strands (23) are formed from the first thread system (21) and have a plait-like structure and wherein the connecting threads (25) are formed from the second thread system (22), with the connecting threads (25) and the strands (23) being interlaced. 25
6. Percolator according to claim 5, **characterized in that** the connecting threads (25) of the second thread system (22) form a grid pattern between the strands (23). 30
7. Percolator according to claim 5 or 6, **characterized in that** the connecting threads (25) form zigzag lines between adjacent strands (23). 35
8. Percolator according to any one of the claims 5 to 7, **characterized in that** the threads of the first thread system (21) have a greater thread thickness than the connecting threads (25) of the second thread system (22). 40
9. Percolator according to claim 8, **characterized in that** the thread thickness of the first thread system (21) is at least twice as large as the thread thickness of the second thread system (22). 45
10. Electrolysis cell for electrolytic treatment of a liquid electrolyte, comprising a cathode half-shell (7) accommodating a cathode (10), an anode half-shell (2) accommodating an anode (3), the half-shells (2, 7) being separated from one another by a separator (16), **characterized in that** a percolator (9) according to any one of the claims 1 to 9 is arranged within the cathode half-cell (7) and/or the anode half-cell (2). 50
11. Electrolysis cell according to claim 10, **characterized in that** the percolator (9) is arranged within the cathode half-shell (7) and the cathode (10) is an oxygen depolarized cathode. 55
12. Electrolyzer comprising
 - a cell rack (110),
 - a cell stack (120) comprising a plurality of electrolysis cells (1) according to claim 10 or 11 suspended in the cell rack (110),
 - feed and discharge piping (130, 131) connected to the electrolysis cells (1) of the cell stack (120) for connecting the electrolyzer (100) to a liquid electrolyte cycle, wherein the feed piping (130) and the discharge piping (131) are connected within the electrolysis cells (1) via the percolator (9), and
 - compression means (140) to apply a variable compressive force onto the cell stack (120).
13. Electrolyzer according to claim 12, **characterized in that** the electrolyzer (100) comprises an electronic control unit (150) for controlling the compressive force exerted by the compression means (140). 60

14. Electrolyzer according to claim 13, **characterized in that** the electrolyzer (100) comprises at least one flow-meter (160) connected to the electronic control unit (150) for measuring the throughput of liquid electrolyte percolating through the percolator (9) forming a control-loop for the flow of liquid electrolyte. 5
15. Method of operating the electrolyzer (100) according to any one of the claims 12 to 14, **characterized in that** the compressive force exerted by the compression means (140) onto the cell stack (120) is adjusted in such a way, that a throughput of liquid electrolyte percolating through the percolator (9) is adjusted to a target value by a reversible compression of the strands (23) of the percolator (9) within the electrolysis cells (1). 10 15

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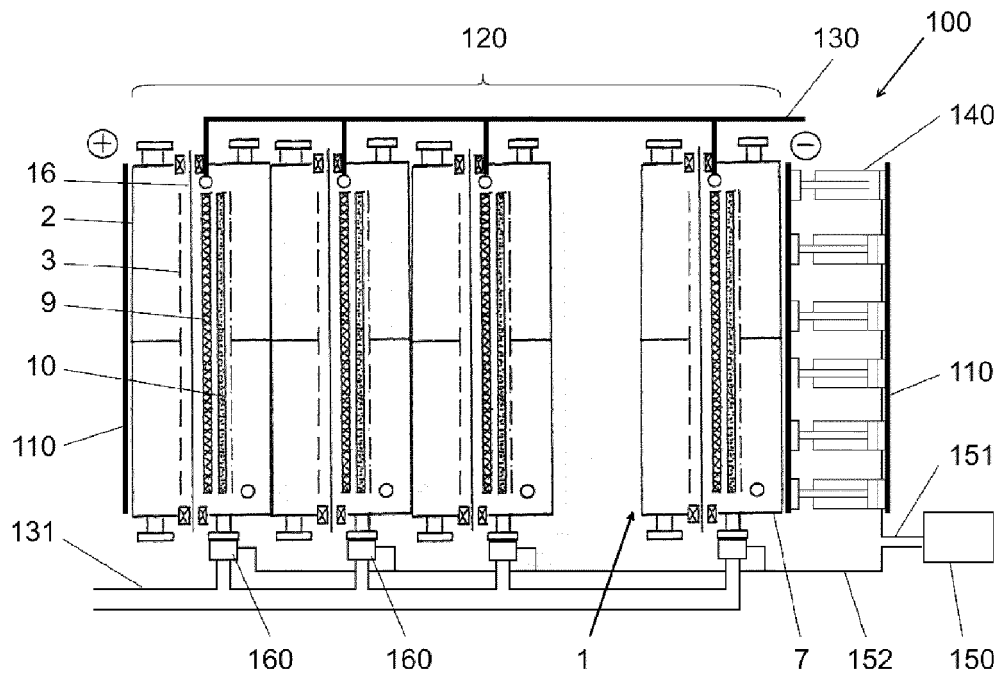


Fig. 1

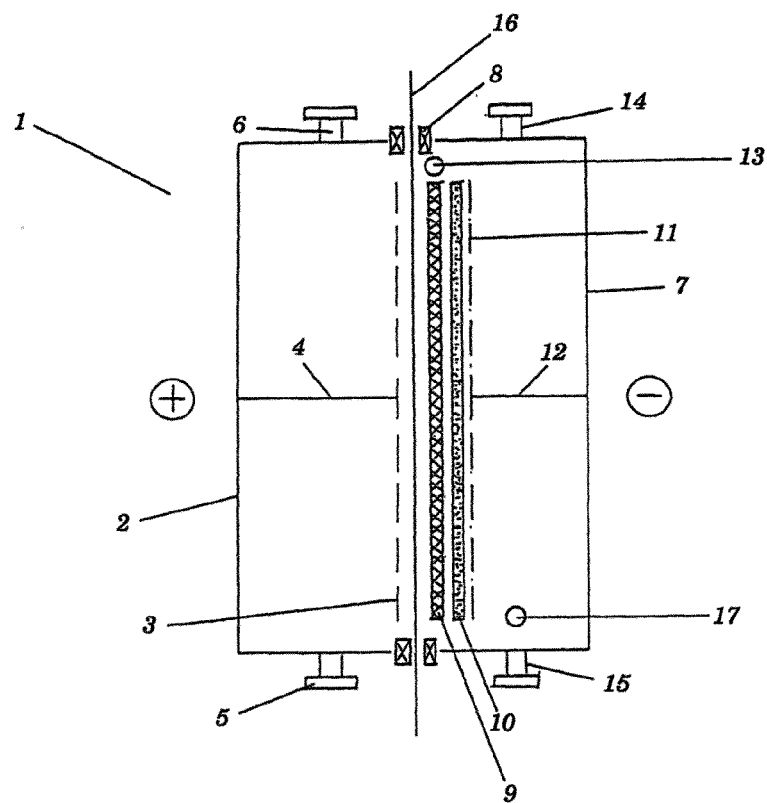


Fig. 2

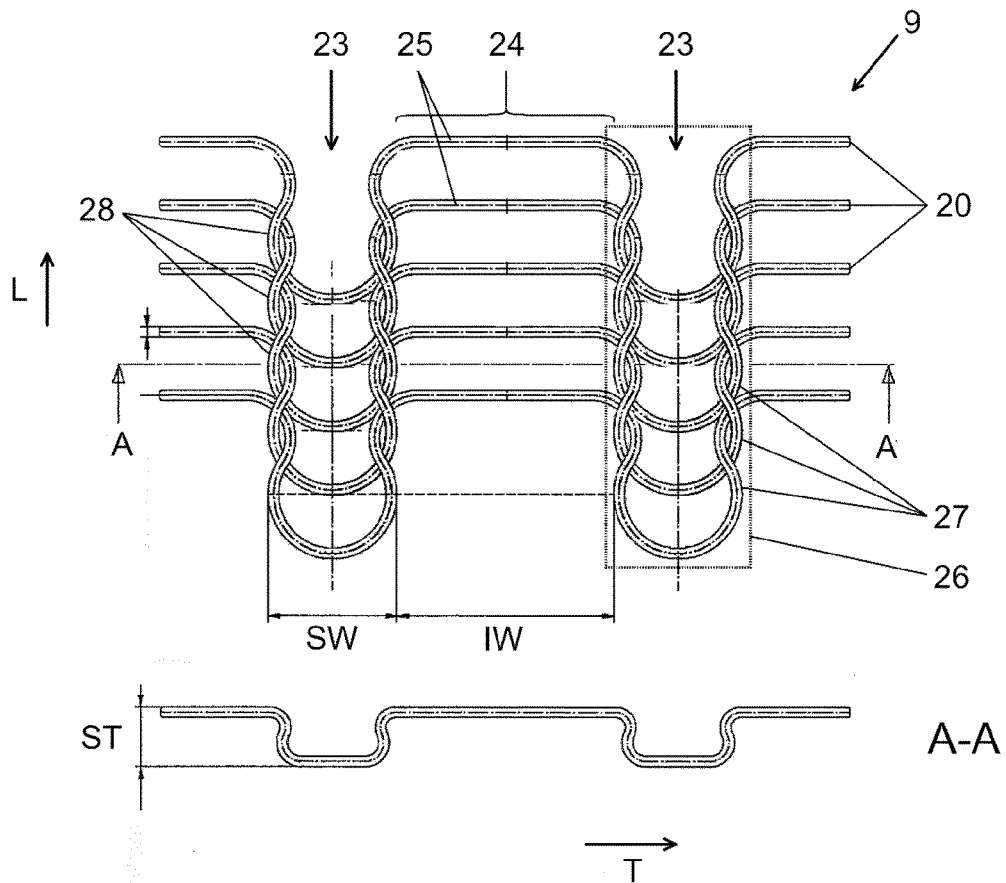


Fig. 3

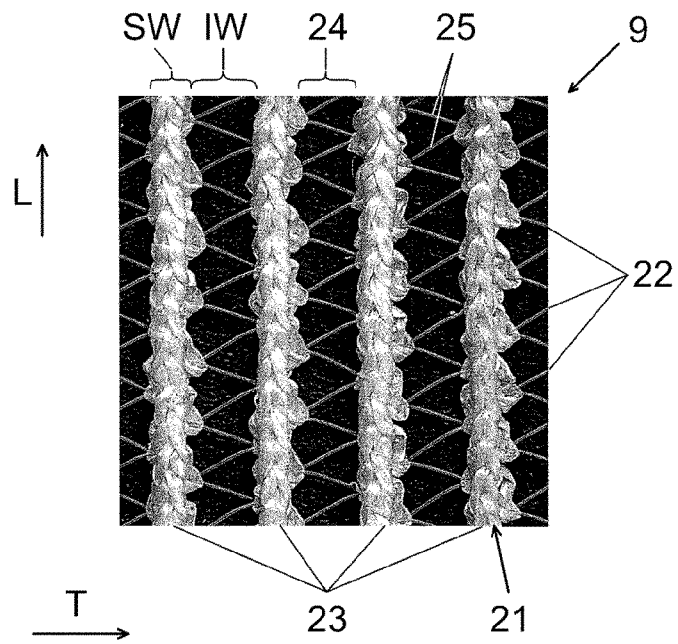


Fig. 4

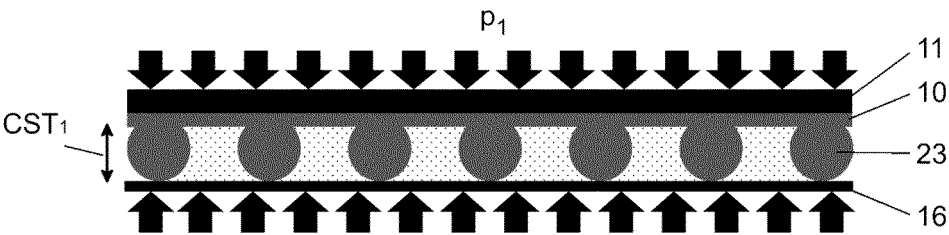


Fig. 5A

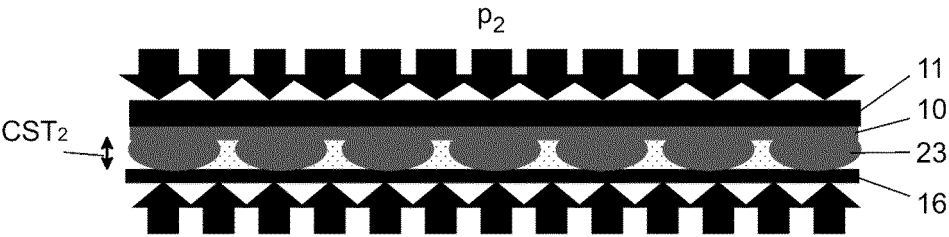


Fig. 5B

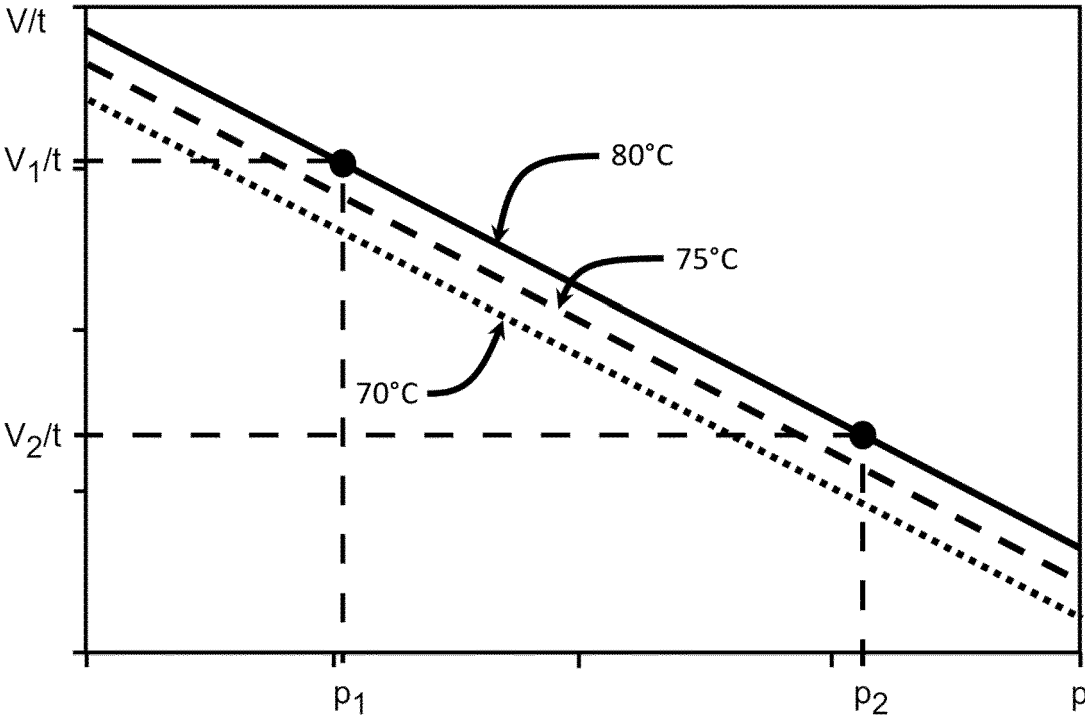


Fig. 6



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Application Number

EP 23 19 3747

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