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(54) **ELECTROLYSIS CELL, ELECTROLYSIS DEVICE FOR CHLOR-ALKALI ELECTROLYSIS AND USE OF AN ELECTROLYSIS CELL FOR CHLOR-ALKALI ELECTROLYSIS**

(57) The invention relates to an electrolysis cell (1) for chlor-alkali electrolysis, comprising an anode chamber (2) for accommodating an anode (4) and for accommodating an electrolytic solution, wherein the anode chamber (2) comprises a circulation structure (5) for improving circulation of the electrolytic solution and at least one baffle plate (6) for improving horizontal homogeneity of the electrolytic solution, as well as to an electrolysis device including such an electrolysis cell (1) and the use of the electrolysis cell (1) for chlor-alkali electrolysis.

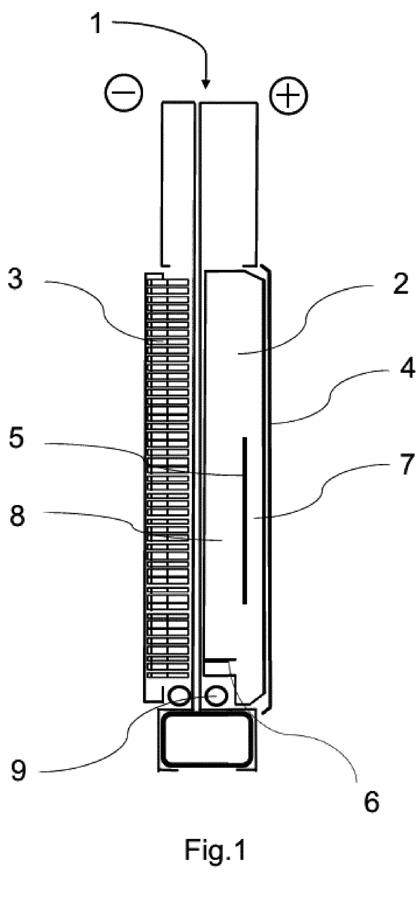

Fig.1

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Description

[0001] The present invention relates to an electrolysis cell and an electrolysis device for chlor-alkali electrolysis as well as the use thereof for chlor-alkali electrolysis.

[0002] The chlor-alkali electrolysis is a process for producing chlorine gas, hydrogen and hydroxide gas from aqueous alkali chloride solution using electrical energy and an electrolysis cell. Generally, sodium or potassium chloride is used as alkali chloride. The reaction equation for the electrolysis of aqueous sodium chloride is:

$$2\ NaCl + 2\ H_2O \rightarrow Cl_2 + H_2 + 2\ NaOH$$

[0003] The general setup of electrolysis cells and electrolysis devices for chlor-alkali electrolysis is well known from prior art. For example, US 6,282,774 B1, WO 2009/007366 A2, WO 2004/040040 A1, and WO 2010/055152 A1 relate to electrolysis cells and electrolysis devices for chlor-alkali electrolysis.

[0004] During the electrolysis process, electrolytic solution is consumed on the electrode surface and gas is produced on the electrode surface. In other words, the density, the temperature, and the composition of the electrolytic solution changes on the surface of the electrodes and air bubbles are generated on the electrodes' surfaces. Air bubbles or an inhomogeneous distribution of electrolyte, density, and temperature in the electrolytic solution are detrimental to a stable and efficient electrolysis process.

[0005] DE 44 15 146 A1 aims at improving the efficiency of the chlor-alkali electrolysis by using specially shaped electrodes, which prevent gas accumulation thereon. Such electrolysis cells have a lower specific current consumption and distribute the current evenly over the electrode and membrane surfaces, which has a favorable effect on the service life of the membranes and of the electrodes.

[0006] US 6,503,377 B1 also aims at removing gas bubbles from the electrodes at a higher rate. The electrodes have been specifically shaped in order to accumulate and drive away the produced gas bubbles. This effects a circulation around the surface of the electrodes.

[0007] US 2006/0042935 A1 mentions the use of a vertical baffle plate or cylindrical duct in order to achieve a more homogenous distribution of electrolytes within the electrolytic solution.

[0008] Thus, several attempts have been made to improve stability and efficiency of the electrolysis process. However, there is a need to further improve the stability and efficiency of the electrolysis process. The present invention has been made in the light of this problem and aims at improving homogeneity of the electrolytic solution in order to improve stability and efficiency of the electrolysis process.

[0009] In a first aspect of the invention, the inventors suggest an electrolysis cell for chlor-alkali electrolysis, comprising an anode chamber for accommodating an anode and for accommodating an electrolytic solution characterized in that the anode chamber comprises a circulation structure for improving circulation of the electrolytic solution and at least one baffle plate for improving homogeneity of the electrolytic solution, preferably for improving horizontal homogeneity of the electrolytic solution.

[0010] The circulation structure and the at least one baffle plate are different structures. The inventors have found that the use of these structures improves the homogeneity of the electrolytic solution with regard to the concentration of chemical molecules within the electrolytic solution in an unexpected way. The demonstrated effect can also be assumed for the homogeneity of the density and temperature within the electrolytic solution.

[0011] The electrolytic solution may be denoted as anolyte solution. The electrolytic solution preferably comprises aqueous sodium chloride or aqueous potassium chloride. The electrolytic solution preferably comprises water and 100 to 400 g/L, more preferably 150 to 300 g/L, even more preferably 180 to 280 g/L of sodium chloride or potassium chloride. Preferably, the anode chamber comprises the electrolytic solution.

[0012] The term "homogeneity of the electrolytic solution" means that density and/or temperature and/or the concentration of sodium chloride and/or potassium chloride in the electrolytic solution is even or similar at different locations within the anode chamber.

[0013] The term "improving homogeneity of the electrolytic solution" means that density and/or temperature and/or the concentration of sodium chloride and/or potassium chloride in the electrolytic solution is made more even or similar at different locations within the anode chamber. In other words, the term "improving homogeneity of the electrolytic solution" means that density and/or temperature and/or the concentration of sodium chloride and/or potassium chloride in the electrolytic solution is approximated/aligned/brought into line/equaled at different locations within the anode chamber.

[0014] The term "improving horizontal homogeneity of the electrolytic solution" means that density and/or temperature and/or the concentration of sodium chloride and/or potassium chloride in the electrolytic solution is made more even or similar at different locations within the anode chamber, wherein the electrolytic solution is considered as a stack of horizontal layers, wherein the density and/or temperature and/or the concentration of sodium chloride and/or potassium chloride in the electrolytic solution is made more even or similar within at least one horizontal layer. Preferably this at least one horizontal layer is at the bottom end (in the direction of the center of gravity) of the anode chamber and/or close to an inlet of the anode chamber.

[0015] The term "similar density and/or temperature and/or concentration of sodium chloride and/or potassium chloride in the electrolytic solution" means a maximal difference of 5, 10, 15, 20, 25, 30, or 35 % across different locations within the anode chamber and/or within the horizontal layer.

[0016] Preferably, the anode chamber comprises an anode. Preferably, the anode is arranged essentially vertically within the anode chamber. Preferably, the anode chamber has the longest dimension/expansiveness in the vertical direction.

[0017] The anode may be one single structural element or comprise several structural elements. The anode may have the form of a mesh.

[0018] The electrolysis cell for chlor-alkali electrolysis may comprise further elements, which are known to the person skilled in the art and which are helpful for conducting chlor-alkali electrolysis.

[0019] Such an element is for example a cathode chamber for accommodating a cathode and for accommodating catholyte solution. In one embodiment, the electrolysis cell comprises a cathode chamber for accommodating a cathode and for accommodating catholyte. In one embodiment, the cathode chamber comprises a cathode and catholyte. The cathode may be one single structural element or comprise several structural elements. The cathode may have the form of a mesh.

[0020] Preferably, the anode chamber and cathode chamber are separated by an ion-exchange membrane. Preferably, the membrane is semi-permeable. In other words, the membrane preferably allows exchange of sodium and/or potassium ions between anode chamber and cathode chamber. In other words, the electrolysis cell preferably comprises an ion-exchange membrane.

[0021] As a result of the circulation structure, circulation of the electrolytic solution is improved within the anode chamber. However, the improved circulation is also helpful for a cathode reaction, since flux of alkali across an ion-exchange membrane is increased.

[0022] The electrolysis cell may further comprise elements known to the person skilled in the art such as a gas and liquid separator, a current distributor, inlets, product outlets etc. For example, the anode chamber may have at least one inlet for a stream comprising water and 150 to 450 g/L, preferably 200 to 400 g/L, more preferably 250 to 350 g/L, most preferably about 300 g/L, of sodium chloride and/or potassium chloride. Further, the anode chamber may have one product outlet for chlorine gas, preferably at the top end of the anode chamber (away from the center of gravity). Further, the anode chamber may have one outlet for a stream comprising aqueous sodium chloride and/or potassium chloride.

[0023] The anode chamber has a top end (away from the center of gravity) and a bottom end (in the direction of the center of gravity).

[0024] The electrolysis cell may be a zero-gap cell.

[0025] The verbs "to comprise" and "to contain" and their conjugations comprise the verb "to consist of" and its conjugations.

[0026] The term "at least one" comprises the term "one". The term "one" comprises the terms "at least one".

[0027] Preferred embodiments are included in the claims.

[0028] Preferably, the circulation structure is a structure for effecting circulation of the electrolytic solution around the circulation structure. In other words, it is preferred that the circulation of the electrolytic solution around the circulation structure is in the form of a loop. This allows increasing homogeneity in the entire anode chamber, if the circulation structure is correspondingly designed.

[0029] Preferably, the circulation structure is a structure for effecting essentially vertical circulation of the electrolytic solution.

[0030] The anode in the anode chamber generates chlorine gas bubbles from the electrolytic solution. These gas bubbles have a lower density than the surrounding electrolytic solution and stream to the top end of the anode chamber (away from the center of gravity). The rising gas bubbles drag further electrolytic solution from lower parts of the anode chamber. This "gas lift effect" is made use of in the present invention. Arranging a circulation structure adjacent to a section of the anode results in that the gas lift effect creates a high degree of vertical circulation. A high degree of circulation allows mixing of the electrolytic solution and improves homogeneity of the electrolytic solution. Therefore, the circulation structure is preferably a structure for improving vertical homogeneity of the electrolytic solution.

[0031] The term "improving vertical homogeneity of the electrolytic solution" means that density and/or temperature and/or the concentration of sodium chloride and/or potassium chloride in the electrolytic solution is made more even or similar across different vertical locations within the anode chamber.

[0032] Preferably, the circulation structure forms at least one downcomer within the anode chamber. The term "downcomer" shall denote an at least partly delimited region of the anode chamber that extends in a vertical direction and is open at its top and at its bottom end. More preferably, the circulation structure forms a plurality of downcomers within the anode chamber. The shape of a downcomer allows a particularly good vertical circulation for improving vertical homogeneity.

[0033] Preferably, the circulation structure and/or the at least one downcomer is arranged essentially in parallel to the anode. In case the electrolysis cell does not comprise an anode (e.g. before assembly), the circulation structure and/or the at least one downcomer is arranged essentially in parallel to the space intended for the anode.

[0034] Preferably, the circulation structure and/or the at least one downcomer divides the anode chamber into an upflow section and a downflow section, each comprising electrolytic solution. The upflow section is characterized by gas bubbles streaming from the anode to the top end of the anode chamber (away from the center of gravity).

[0035] Preferably, the upflow section is arranged between the anode and the circulation structure and/or the at least one downcomer.

[0036] In one embodiment, the upflow section is arranged between a surface of the circulation structure and/or the at least one downcomer facing the anode and the anode. Further, the downflow section is arranged on the side of the surface of the circulation structure and/or the downcomer facing away from the anode.

[0037] Preferably, the ratio of the cross section of the upflow section to the cross section of the downflow section is 1 or less than 1, preferably 0.8 to 0.3, more preferably 0.6 to 0.4, most preferably about 0.43. This ratio allows a particular homogenous electrolytic solution.

[0038] Preferably, the cross section of the upflow section plus the cross section of the downflow section is 5 to 100 cm^2, more preferably 7 to 50 cm^2.

[0039] In one embodiment, the at least one downcomer has/forms a V-shape (from top view). In another embodiment, the at least one downcomer has/forms the shape of a trough (from top view). In another embodiment, the at least one downcomer has/forms the shape of one half of a regular hexagon (from top view). The above shapes allow excellent circulation. Preferably, a/the peak of the V points towards the anode. Preferably, the trough is open towards the anode.

[0040] Preferably, the anode and/or the circulation structure and/or the at least one downcomer extend along a height section of the anode chamber.

[0041] Preferably, the circulation structure and/or the at least one downcomer has a height of 50 to 100 %, preferably of 60 to 98 %, more preferably of 70 to 96 %, of the height of the anode. This height allows a particular homogenous electrolytic solution. In one embodiment 92 to 99 % are preferred, and 93 to 98 % are even more preferred. In another embodiment, 60 to 85 % are preferred, and 65 to 80 % are even more preferred.

[0042] Preferably, the circulation structure and/or the at least one downcomer extends along 50 to 100 %, preferably 60 to 98 %, more preferably 70 to 96 %, of the height of the anode. This height allows a particular homogenous electrolytic solution. In one embodiment 92 to 99 % are preferred, and 93 to 98 % are even more preferred. In another embodiment, 60 to 85 % are preferred, and 65 to 80 % are even more preferred.

[0043] Preferably, the anode has a length of 100 to 160 cm, more preferably of 120 to 140 cm.

[0044] Preferably, the circulation structure and/or the at least one downcomer has a length of 50 to 160 cm, more preferably of 60 to 140 cm.

[0045] It is common, in particular in zero-gap cells, that the ion-exchange membrane is pressed against the anode by a pressure from the cathode chamber and it is preferred to mechanically stabilize the anode. Preferably, the circulation structure and/or the at least one downcomer is a structure for (mechanically) supporting the anode. Preferably, the circulation structure and/or the at least one downcomer (mechanically) supports the anode, in particular against pressure from the cathode chamber.

[0046] In one embodiment, one baffle plate is preferred.

[0047] Preferably, the at least one baffle plate is arranged horizontally or essentially horizontally. The term "essentially horizontally" means "horizontal" or "with a slope smaller than 45, 30, 20, 10, or 5 ° compared to a horizontal line". A horizontal baffle plate is particularly useful for improving homogeneity in combination with the vertical circulation effected by the circulation structure.

[0048] Preferably, each baffle plate has a length of 10 to 235 cm, preferably of 26 to 235 cm, and/or a width of 5 to 20 cm, preferably of 7 to 15 cm.

[0049] Preferably, the baffle plate is horizontal and/or plane.

[0050] The baffle plate may have perforations for causing perturbations, which improves homogeneity of the electrolytic solution in the anode chamber.

[0051] Preferably, the at least one baffle plate is arranged such that a stream from at least one inlet of the anode chamber collides with the baffle plate. In other words, a stream from at least one inlet of the anode chamber is directed to the baffle plate. Preferably, the at least one inlet of the anode chamber is at the bottom end (in the direction of the center of gravity) of the anode chamber. The stream comprises water and 150 to 450 g/L, preferably 200 to 400 g/L, more preferably 250 to 350 g/L, most preferably about 300 g/L, of sodium chloride and/or potassium chloride. The baffle plate causes perturbations, which improves mixing with the electrolytic solution in the anode chamber and improves homogeneity of the electrolytic solution in the anode chamber.

[0052] Preferably, the at least one baffle plate is arranged such that a stream of electrolytic solution from the circulation structure and/or the at least one downcomer (i.e. from the downflow section) collides with the baffle plate. In other words, a stream of electrolytic solution from the circulation structure and/or the at least one downcomer (i.e. from the downflow section) is directed to the baffle plate. This improves homogeneity of the electrolytic solution in the anode chamber.

[0053] Preferably, the at least one baffle plate is arranged such that a stream from at least one inlet of the anode chamber collides with the baffle plate and a stream of electrolytic solution from the circulation structure and/or the at least one downcomer (i.e. from the downflow section) collides with the baffle plate. This embodiment particularly improves mixing of the electrolytic solution in the anode chamber and improves homogeneity of the electrolytic solution in the anode chamber. In one embodiment, the stream from at least one inlet of the anode chamber collides with a bottom surface of the at least one baffle plate and a stream of electrolytic solution from a bottom end of the circulation structure and/or the at least one downcomer (i.e. from the downflow section) collides with a top surface of the baffle plate. Preferably, the at least one inlet of the anode chamber is at the bottom end (in the direction of the center of gravity) of the anode chamber.

[0054] In a second aspect of the invention, the invention is directed to an electrolysis device for chlor-alkali electrolysis, comprising at least one electrolysis cell according to the invention.

[0055] Such an electrolysis device may be denoted as electrolyzer.

[0056] Preferably, the electrolysis device comprises a plurality of electrolysis cells according to the invention.

[0057] The electrolysis device may be a filter press electrolyzer and/or a bipolar ion-exchange membrane process electrolyzer.

[0058] The electrolysis device for chlor-alkali electrolysis may comprise further elements, which are known to the person skilled in the art and which are helpful for conducting chlor-alkali electrolysis.

[0059] In a third aspect of the invention, the invention is directed to the use of an electrolysis cell according to the invention or of an electrolysis device according to the invention for chlor-alkali electrolysis.

[0060] Embodiments described herein of each aspect of the invention may be combined in any manner. Further, the embodiments described for the three aspects of the invention may be combined in any manner.

[0061] Selected embodiments of the invention are now described using the following figures:

Fig. 1 shows an electrolysis cell according to the invention for chlor-alkali electrolysis.

Fig. 2 shows one baffle plate arranged such that a stream from two inlets of the anode chamber collides with the baffle plate.

Fig. 3A and 3B show downcomers supporting the anode.

[0062] An electrolysis cell 1 according to the invention for chlor-alkali electrolysis is shown in Fig. 1.

[0063] The electrolysis cell 1 comprises an anode chamber 2 and a cathode chamber 3. The anode chamber 2 comprises anode 4, an electrolytic solution (not shown), a circulation structure 5, and one baffle plate 6. The electrolytic solution comprises water and approximately 180 to 280 g/L of sodium chloride. The anode 4 and the circulation structure 5 extend along a height section of the anode chamber 2.

[0064] The circulation structure 5 divides the anode chamber 2 into an upflow section 7 and a downflow section 8. The ratio of the cross section of the upflow section 7 to the cross section of the downflow section 8 is below 1. The circulation structure 5 effects a gas lift effect and creates a high degree of essentially vertical circulation of the electrolytic solution around the circulation structure 5:
The anode 4 generates chlorine gas bubbles from the electrolytic solution. These gas bubbles have a lower density than the surrounding electrolytic solution and stream to the top end of the anode chamber 2, which characterizes upflow section 7. The rising gas bubbles drag electrolytic solution from lower parts of the anode chamber 2. Simultaneously, electrolytic solution is dragged and/or ousted by the gas bubbles from the top end of the anode chamber 2, which creates downflow section 8. A stream of electrolytic solution from the downflow section 8 collides a top surface of the baffle plate 6. The high degree of vertical circulation allows mixing of the electrolytic solution and improves homogeneity of the electrolytic solution.

[0065] An electrolysis device according to the invention comprises at least one electrolysis cell 1 according to the invention, preferably a plurality of electrolysis cells 1.

[0066] As shown in Fig. 1, the baffle plate 6 and the inlets 9 are arranged at the bottom end (in the direction of the center of gravity) of the anode chamber 2. The horizontal baffle plate 6 is shown in more detail in Fig. 2.

[0067] The baffle plate 6 is arranged such that a stream from two inlets 9 of the anode chamber 2 collides with the baffle plate 6. The stream comprises water and about 300 g/L of sodium chloride. The baffle plate 6 causes perturbations, which enforces mixing of the stream with the electrolytic solution comprising water and approximately 180 to 280 g/L of sodium chloride. This improves homogeneity, in particular horizontal homogeneity, of the electrolytic solution in the anode chamber 2.

[0068] As can be seen in Fig. 1, a stream of electrolytic solution from the downflow section 8 collides with the baffle plate 6 as well. This results in a particular homogenous electrolytic solution in the anode chamber 2.

[0069] Fig. 3A and 3B show preferred embodiments of the downcomers from top view. The circulation structure 5 forms downcomers. The downcomers mechanically support the anode 4 against an ion-exchange membrane, which may be pressed against the anode 4 by pressure from the cathode chamber. In Fig. 3A, the downcomers have the shape of a trough. The troughs are open towards the anode 4. In Fig. 3B, the downcomers have the shape of one half of a regular hexagon. In Fig. 3A and Fig. 3B, the downcomers form a V-shape. The peak of the V points towards the anode 4.

[0070] Effects achieved by selected embodiments of the invention are now described using experiments:
In order to test the influence of the ratio of the cross section of the upflow section 7 to the cross section of the downflow section 8 the following experiments 1 and 2 were conducted.

[0071] An electrolysis cell 1 in line with the present invention and Fig. 1 was prepared.

[0072] The circulation structure 5 divided the anode chamber 2 into an upflow section 7 and a downflow section 8. In experiment 1, the ratio of the cross section of the upflow section 7 to the cross section of the downflow section 8 was 1.

[0073] Chlor-alkali electrolysis was started in the electrolysis cell. Aqueous sodium chloride comprising 300 g/L sodium chloride was fed into the cell. The concentration of sodium chloride in the electrolytic solution was measured at 18 different locations at six different heights of the electrolysis cell. The results are shown in Table 1.

Table 1: Concentration of sodium chloride in the electrolytic solution at 18 different locations of the electrolysis cell (values in g/L).

209	202	204
211	218	213
223	220	218
225	220	225
230	220	225
232	227	227

[0074] The highest detected concentration difference between the 18 locations was 30 g/L (232 g/L - 202 g/L).

[0075] Experiment 2 was conducted in analogue manner. In experiment 2, the ratio of the cross section of the upflow section 7 to the cross section of the downflow section 8 was 0.43. The results are shown in Table 2.

Table 2: Concentration of sodium chloride in the electrolytic solution at 18 different locations of the electrolysis cell (values in g/L).

204	204	200
218	218	213
218	218	222
220	219	222
220	218	220
218	217	217

[0076] The highest detected concentration difference between the 18 locations was 22 g/L (222 g/L - 200 g/L).

[0077] The maximal difference between the 18 locations was lower in experiment 2. Further, the concentration differences in experiment 2 were lower across the height of the cell.

[0078] Thus, a ratio of the cross section of the upflow section 7 to the cross section of the downflow section 8 of below 1 is superior for having a homogenous electrolytic solution.

[0079] In order to test the influence of the height of the circulation structure 5 compared to the height of the anode 4 the following experiments 3 to 5 were conducted.

[0080] An electrolysis cell 1 in line with the present invention and Fig. 1 was prepared.

[0081] In experiment 3, the height of the circulation structure 5 was 71 % of the height of the anode 4.

[0082] Chlor-alkali electrolysis was started in the electrolysis cell. Aqueous sodium chloride comprising 300 g/L sodium chloride was fed into the cell. The concentration of sodium chloride in the electrolytic solution was measured at six different locations at six different heights of the electrolysis cell in two different runs (i.e. n = 2). The results are shown in Table 3.

Table 3: Concentration of sodium chloride in the electrolytic solution at six different locations at six different heights of the electrolysis cell in two different runs (values in g/L).

	1st run	2nd run
Height 1	205	203
Height 2	204	202
Height 3	204	206
Height 4	217	216
Height 5	215	216
Height 6	216	222
Max. value	217	222
Min. value	204	202
Average value of max. values	220	
Average value of min. values	203	
Difference	17	

[0083] The highest average concentration difference was 17 g/L.

[0084] Experiment 4 was conducted in analogue manner. In experiment 4, the height of the circulation structure 5 was 91 % of the height of the anode 4. The results are shown in Table 4.

Table 4: Concentration of sodium chloride in the electrolytic solution at six different locations at six different heights of the electrolysis cell in two different runs (values in g/L).

	1st run	2nd run
Height 1	199	204
Height 2	203	206
Height 3	211	212
Height 4	222	222
Height 5	220	222
Height 6	219	222
Max. value	222	222
Min. value	199	204
Average value of max. values	222	
Average value of min. values	202	
Difference	21	

[0085] The highest average concentration difference was 21 g/L.

[0086] Experiment 5 was conducted in a similar manner. In experiment 5, the height of the downcomers was 96 % of the height of the anode 4.

[0087] Chlor-alkali electrolysis was started in the electrolysis cell. Aqueous sodium chloride comprising 300 g/L sodium chloride was fed into the cell. The concentration of sodium chloride in the electrolytic solution was measured at five different locations at five different heights of the electrolysis cell in three different runs (i.e. n = 3). The results are shown in Table 5.

Table 5: Concentration of sodium chloride in the electrolytic solution at five different locations at five different heights of the electrolysis cell in three different runs (values in g/L).

	1st run	2nd run	3rd run
Height 1	197	194	193
Height 2	199	193	197
Height 3	199	195	199
Height 4	209	204	206
Height 5	211	204	210
Max. value	211	204	210
Min. value	197	193	193
Average value of max. values	208		
Average value of min. values	194		
Difference	14		

[0088] The highest average concentration difference was 14 g/L.

[0089] In order to test the influence of the baffle plate 6 the following experiments 6 to 7 were conducted.

[0090] An electrolysis cell 1 in line with the present invention and Fig. 1, 2 was prepared. The horizontal baffle plate 6 was arranged horizontally. The baffle plate was arranged such that a stream from two inlets 9 of the anode chamber 2 collides with the baffle plate 6.

[0091] Chlor-alkali electrolysis was started in the electrolysis cell. Aqueous sodium chloride comprising 300 g/L sodium chloride was fed into the cell. The concentration of sodium chloride in the electrolytic solution was measured at three different locations at the same height at the bottom end of the electrolysis cell. The results are shown in Table 6.

Table 6: Concentration of sodium chloride in the electrolytic solution at three different locations at the same height at the bottom end of the electrolysis cell (values in g/L).

227	226	223

[0092] The highest detected concentration difference between the three locations was 4 g/L (227 g/L - 223 g/L).

[0093] Experiment 7 was conducted in analogue manner. In this control experiment not according to the invention, no baffle plate 6 was used. The results are shown in Table 7.

Table 7: Concentration of sodium chloride in the electrolytic solution at three different locations at the same height at the bottom end of the electrolysis cell (values in g/L).

214	212	228

[0094] The highest detected concentration difference between the three locations was 16 g/L (228 g/L - 212 g/L).

[0095] This experiment clearly shows that the baffle plate 6 improves horizontal homogeneity of the electrolytic solution.

List of reference signs

[0096]

1 electrolysis cell
2 anode chamber
3 cathode chamber
4 anode
5 circulation structure
6 baffle plate
7 upflow section
8 downflow section

9 inlet

Claims

1. An electrolysis cell (1) for chlor-alkali electrolysis, comprising an anode chamber (2) for accommodating an anode (4) and for accommodating an electrolytic solution **characterized in that** the anode chamber (2) comprises a circulation structure (5) for improving circulation of the electrolytic solution and at least one baffle plate (6) for improving horizontal homogeneity of the electrolytic solution.

2. An electrolysis cell (1) at least according to claim 1, **characterized in that** the circulation structure (5) is a structure for effecting circulation of the electrolytic solution around the circulation structure.

3. An electrolysis cell (1) at least according to claim 1 or 2, **characterized in that** the circulation structure (5) is a structure for effecting essentially vertical circulation of the electrolytic solution and preferably wherein the circulation structure (5) is a structure for improving vertical homogeneity of the electrolytic solution.

4. An electrolysis cell (1) at least according to any of the preceding claims, **characterized in that** the circulation structure (5) is arranged essentially in parallel to the anode (4).

5. An electrolysis cell (1) at least according to any of the preceding claims, **characterized in that** the circulation structure (5) divides the anode chamber (2) into an upflow section (7) and a downflow section (8).

6. An electrolysis cell (1) at least according to claim 5, **characterized in that** the ratio of the cross section of the upflow section (7) to the cross section of the downflow section (8) is 1 or less than 1, preferably 0.8 to 0.3, more preferably about 0.43.

7. An electrolysis cell (1) at least according to any of the preceding claims, **characterized in that** the circulation structure (5) has a height of 50 to 100 %, preferably of 60 to 98 %, more preferably of 70 to 96 %, of the height of the anode (4).

8. An electrolysis cell (1) at least according to any of the preceding claims, **characterized in that** the circulation structure (5) is a structure for supporting the anode (4) and/or supports the anode (4).

9. An electrolysis cell (1) at least according to any of the preceding claims, **characterized in that** the circulation structure (5) forms at least one downcomer within the anode chamber (2).

10. An electrolysis cell (1) at least according to claim 9, **characterized in that** the at least one downcomer has a V-shape.

11. An electrolysis cell (1) at least according to any of the preceding claims, **characterized in that** the at least one baffle plate (6) is arranged essentially horizontally.

12. An electrolysis cell (1) at least according to any of the preceding claims, **characterized in that** the at least one baffle plate (6) is arranged such that a stream from at least one inlet (9) of the anode chamber (2) collides with the baffle plate (6).

13. An electrolysis cell (1) at least according to any of the preceding claims, in particular according to claim 12, **characterized in that** a stream of electrolytic solution from the circulation structure (5) collides with the baffle plate (6).

14. An electrolysis device for chlor-alkali electrolysis, comprising at least one electrolysis cell (1) according to at least one of claims 1 to 13.

15. The use of an electrolysis cell (1) according to at least one of claims 1 to 13 or of an electrolysis device according to claim 14 for chlor-alkali electrolysis.

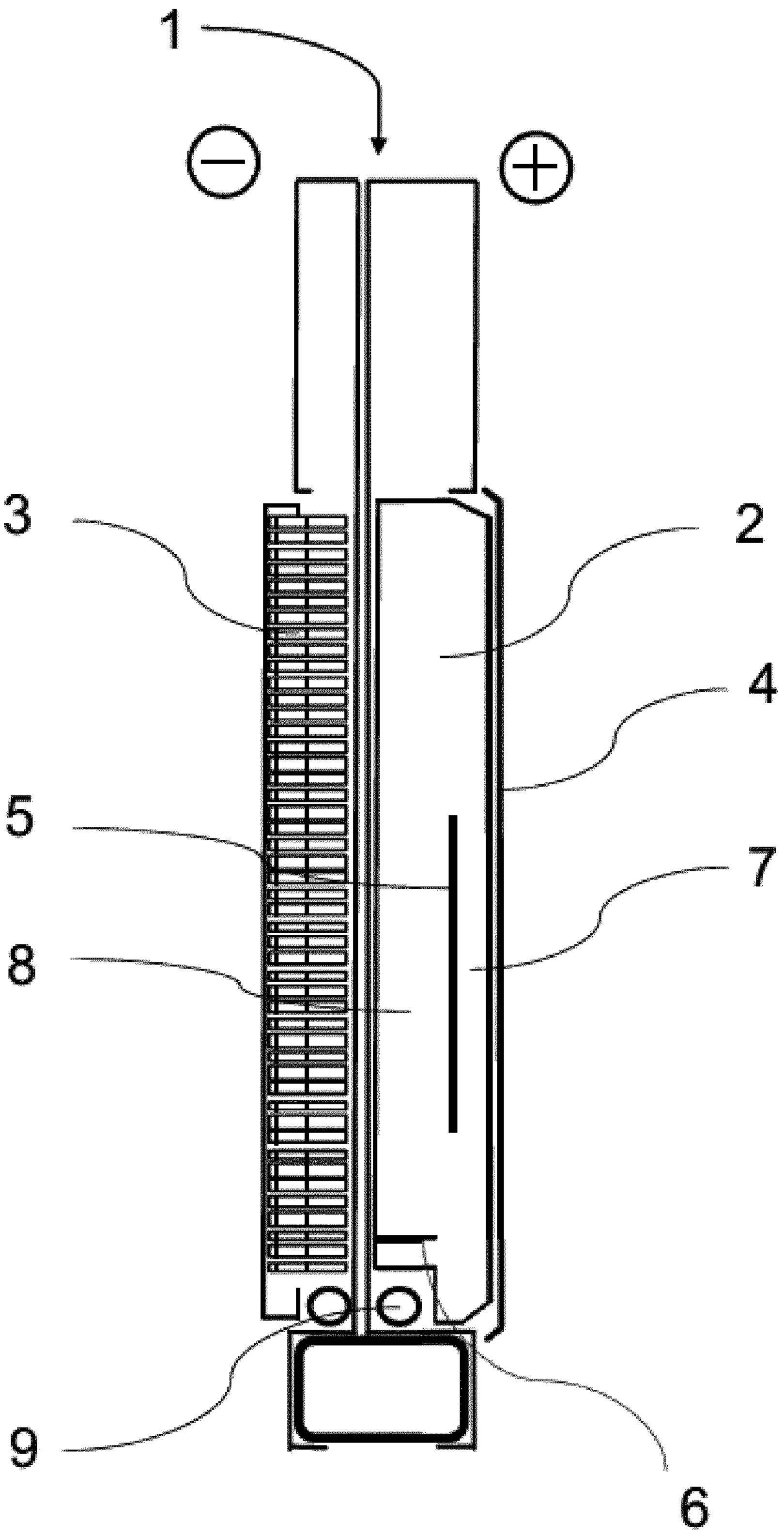

Fig.1

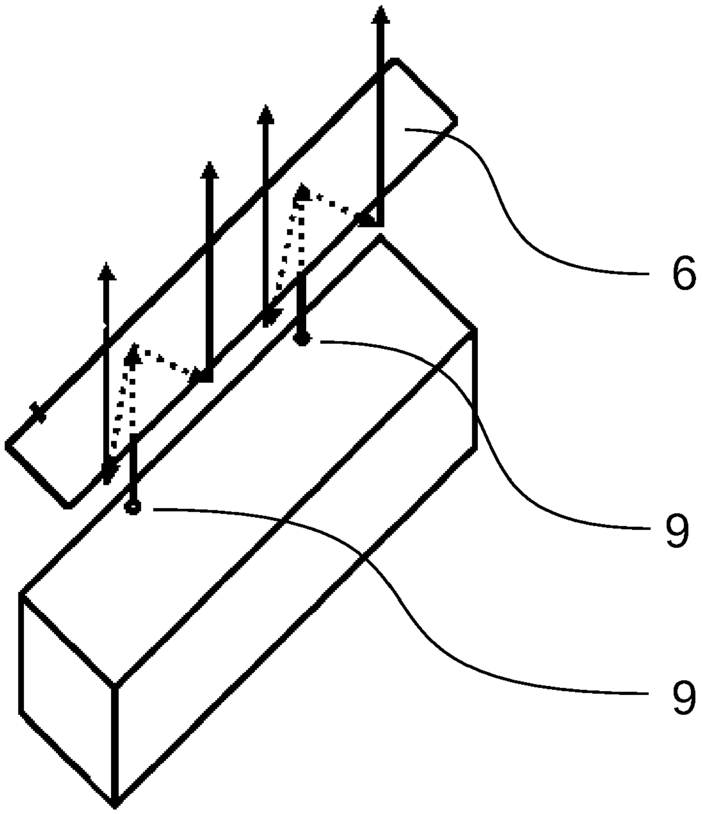

Fig. 2

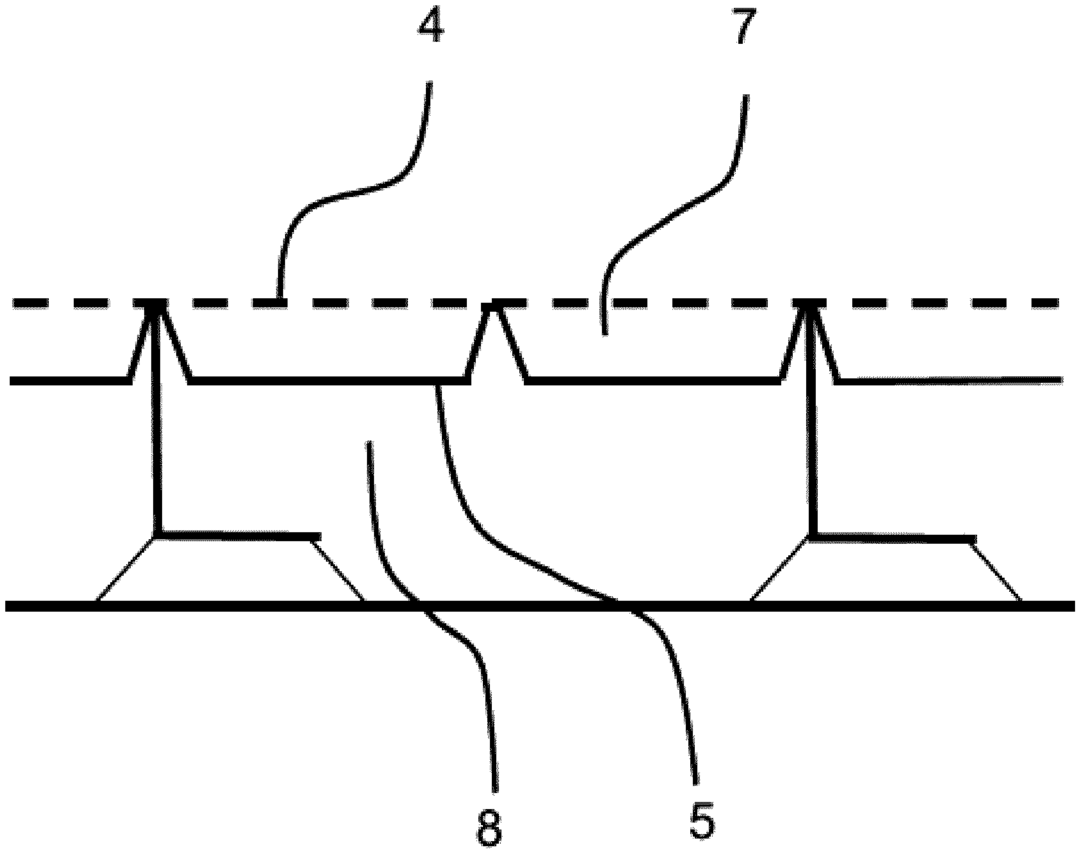

Fig. 3 A

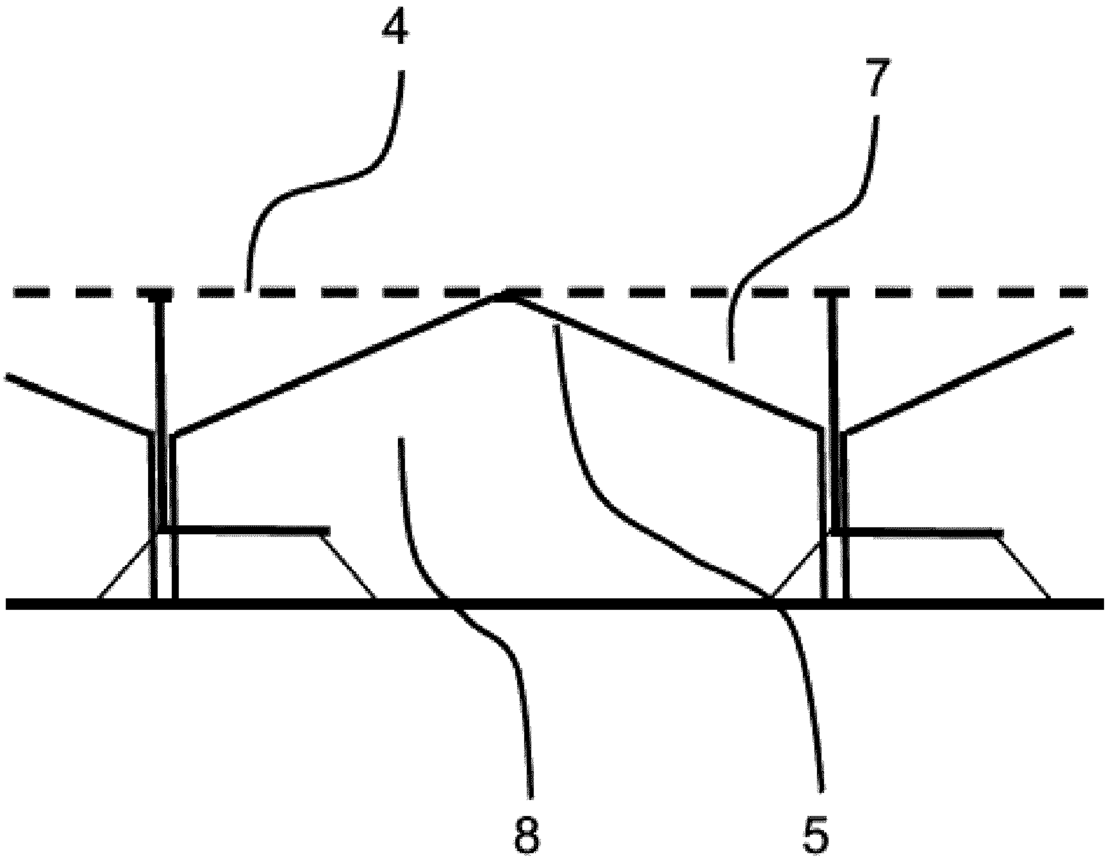

Fig. 3 B

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EUROPEAN SEARCH REPORT

Application Number
EP 21 15 9816

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
Munich	5 August 2021	Ritter, Thomas

CATEGORY OF CITED DOCUMENTS

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