

Electrochemical half-cell

159159

The invention relates to an electrochemical half-cell which is suitable in particular for the electrochemical production of chlorine from aqueous solutions of an alkali metal chloride by means of a gas diffusion electrode.

DE 196 22 744 has disclosed an electrolysis cell for the production of chlorine and sodium hydroxide solution by electrolysis by means of gas diffusion electrodes using pressure compensation between the height-dependent pressure of the sodium hydroxide solution in front of the gas diffusion electrode and the constant pressure of the oxygen behind the gas diffusion electrode and with the oxygen being guided through gas pockets.

In the case of alkali metal halide electrolysis, the gas diffusion electrode is operated as an oxygen-consuming cathode. The gas diffusion electrode is in this case an open-pored membrane. It is arranged between the electrolyte and gas space and allows oxygen reduction at the three-phase boundary between electrolyte, catalyst and oxygen. The gas diffusion electrode can be produced, for example, using the process described in DE-A 37 10 168. However, the gas diffusion electrode is only sealed up to a finite pressure drop between gas side and liquid side. If the gas pressure is too high, gas breaks through the electrode and the function of the electrode is destroyed. On the other hand, if the liquid pressure is too high, the three-phase boundary is initially displaced toward the gas side, or alternatively liquid breaks through from the electrolyte into the gas space.

To compensate for the height-dependent pressure in the electrolyte, it has been proposed in DE 196 22 744 for the gas space to be divided into a plurality of gas pockets. The electrochemical half-cell (Figs. 1 and 2) has an electrode space into which electrolyte is fed via a filling connection piece 12 or the like. Via corresponding connections, the electrolyte also passes into a liquid space 14. The half-cell illustrated is separated from a further half-cell by means of an ion exchange membrane 16. Furthermore, a plurality of gas pockets 18, 20, 22, 24 are provided above one another. The gas pockets 18, 20, 22, 24 are separated from the electrode



G00002

space 10 by a gas diffusion electrode 36, which in DE 196 22 744 serves as cathode. The individual gas pockets 18, 20, 22, 24 are connected to one another via connecting passages 26, which, by way of example, are gas bells. Depending on the pressure inside the individual gas pockets, the gas which is present in the gas pockets 18, 20, 22, 24 flows through outlet openings 28 into the connecting passages 26 and from these through inlet openings 30 into the gas pocket above. The direction of flow of the oxygen which is present by way of example in the gas pockets is illustrated in Fig. 1 by the dashed arrows 32. The bottom gas pocket 18 is connected to a gas-feed device, for example via a feed connection piece 34. The gas from the upper gas pocket 24 also passes via outlet openings 28 into the backspace 14 of the half-cell, from where it is discharged together with the electrolyte via a connection piece 11. The provision of a plurality of, or at least two, gas pockets arranged above one another results in pressure compensation, so that higher electrolysis cells can be produced. Condensate which forms in the gas pockets also passes into the liquid space 14 via the gas outlets 28 of the gas pockets 18, 20, 22, 24.

Since all the gas which is introduced into the bottom gas pocket 18 via the gas feed 34 is collected in the connecting passage 26 and/or by the gas bell, a high flow velocity is produced inside the gas bell. Consequently, drops of electrolyte can be entrained into the next gas pocket 20 up, which has an adverse effect on the functioning of the gas diffusion electrode, since the gas diffusion electrode comes into contact with the electrolyte droplets in the gas inlet region of the gas pocket, i.e. active electrode surface is partially lost. The fact that relatively large quantities of electrolyte pass into the gas pocket and accordingly have to be removed again also has an adverse effect. It has been found that this electrolyte cannot always be completely removed from the gas pocket and therefore accumulates in this gas pocket. The accumulation of electrolyte in the gas pocket is prompted by the fact that the gas/liquid outlet of the gas pocket is located opposite the gas inlet location. The increased supply of liquid manifests itself for example through an increase in the electrolysis voltage.

It is an object of the invention to provide an electrochemical half-cell having gas pockets in which the risk of electrolyte entering the gas pockets is reduced.

According to the invention, the object is achieved by the features described in claim 1.

5 According to the invention, a retaining element is arranged inside the connecting passage which connects at least two gas pockets to one another. The retaining element is used to retain electrolyte located in the connecting passage. By way of example, the retaining element may be a retaining element configured in labyrinth form. The result of this is that droplets which are entrained by the gas stream are
10 retained by the retaining element, since they are unable to pass through the in particular labyrinth-like structure of the retaining element. The retaining element at least ensures that a large proportion of the electrode does not pass the retaining element. This prevents the functioning of the electrode from being impaired by electrolyte entering the gas pockets.

15

The retaining element used is preferably a mesh, cloth, braided fabric, nonwoven or foam. It is in particular an irregular cloth, such as a felt-like material preferably made from metal, plastic or ceramic. In an inexpensive configuration, it may be a knotted ball of metal wire.

20

A further essential element of the invention is the preferred arrangement of the retaining element in the connecting passage. In this context, it is preferable for the retaining element to be arranged in the region of the inlet opening. This has the advantage that no electrolyte or at most extremely small quantities of electrolyte can
25 pass the retaining element. It is preferable for the retaining element to be arranged in that part of the connecting passage which is filled with gas, in which case the retaining element is arranged closer to the inlet opening than to the electrolyte surface. In this region of the connecting passage, it is particularly preferable for the retaining element to be arranged in the half which is connected to the inlet opening,
30 i.e., with vertically arranged connecting passages, in the top half of the gas-filled part of the connecting passages. It is particularly preferable for the retaining element to be arranged in the top third.

It is particularly advantageous for the connecting passage or the gas bell to extend over the height of two gas pockets. At the bottom edge of the lower gas pocket, the gas passes out of the gas pocket and is directly collected by the connecting passage, which acts as a gas-collecting device, and is passed to the gas inlet opening of the gas pocket above. The gas inlet opening is preferably located at the top edge of the gas pocket. Depending on the pressure conditions, a corresponding liquid level is established in the connecting passage. The retaining element is arranged above this liquid level.

10 The invention is explained in more detail below with reference to the appended drawings, in which:

Fig. 1 shows a diagrammatic cross section through the half-cell according to the invention parallel to the gas diffusion electrode according to the prior art.

15

Fig. 2 shows an excerpt from a diagrammatic sectional view on line A-A' in Fig. 1, and

Fig. 3 shows a diagrammatic sectional view, basically corresponding to the sectional view illustrated in Fig. 2, through a preferred embodiment of the invention.

20

The structure of the electrochemical half-cell according to the invention fundamentally corresponds to the structure which has been described with reference to Figs. 1 and 2. Therefore, identical or similar components are denoted by the same reference symbols in Fig. 3.

25

According to the invention, a retaining element 40 is arranged in the connecting passage 26 which, as illustrated by way of example in Fig. 3, connects the two gas pockets 20, 22. The retaining element 40 is, for example, adhesively bonded into the connecting passage 26 or held frictionally therein. Gas emerges from the lower gas pocket 20 in Fig. 3 through the outlet opening 28 arranged in the lower region of the gas pocket 20. The gas is collected by the connecting passage 26, which is open at

30

the bottom, and rises upward therein. Electrolyte 42 is located inside the connecting passage 26 as a function of the pressure. The height position of an electrolyte surface 44 is dependent on the pressure conditions. The gas which emerges from the outlet opening 28 flows upward in the direction indicated by arrow 46 and at the electrolyte surface 44 enters a gas-filled region 48 of the connecting passage 26. In the process, electrolyte 42 is entrained by the gas bubbles 40 into the gas-filled region 48. The entrained electrolyte is then retained or separated out by the retaining element 40, so that no electrolyte or only small quantities of electrolyte reach the region 52 above the retaining element 40. After it has passed through the retaining element 40, the gas then passes into the gas pocket 22 above through the inlet opening 30 arranged in the upper region of the gas pocket.

Corresponding connecting passages 26 with retaining elements 40 arranged and provided in accordance with the invention, as described with reference to Fig. 3, are also arranged in the connecting passages 26 which connect the other gas pockets 18, 20, 22, 24 (Fig. 1).

Patent Claims

1. An electrochemical half-cell, in particular for the electrochemical production of chlorine from aqueous solutions of an alkaline metal chloride, comprising
5 at least
- an electrode space (10) for holding electrolyte, the electrode space having an electrolyte feed (12) and an electrolyte discharge (11),
- 10 a plurality of gas pockets (18, 20, 22, 24) for holding gas, the bottom gas pocket (18) having a gas feed (34),
- a connecting passage (26) which connects two gas pockets (20, 22) to one another, the gas flowing through an outlet opening (28) of a first gas pocket
15 (20) into the connecting passage (26) and from the latter through an inlet opening (30) into a second gas pocket (22),
- a gas diffusion electrode (36) which separates the electrode space (10) from the gas pockets (18, 20, 22, 24), and
20 characterized by
- a retaining element (40) arranged in the connecting passage (26) for retaining electrolyte located in the connecting passage (26).
25
2. The electrochemical half-cell as claimed in claim 1, characterized in that the retaining element (40) is based on a mesh, cloth, braided fabric, nonwoven or foam made from plastic, metal or ceramic.
- 30 3. The electrochemical half-cell as claimed in either of claims 1 and 2, characterized in that the retaining element (40) is arranged in the region of the inlet opening (30).

4. The electrochemical half-cell as claimed in one of claims 1 to 3, characterized in that the connecting passage (26) is partially filled with electrolyte and partially filled with gas, and the retaining element (40) is arranged closer to the inlet opening (30) than to the electrolyte surface (44).
- 5 5. The electrochemical half-cell as claimed in claim 4, characterized in that the retaining element is arranged in that half of the gas-filled part (48) of the connecting passage (26) which is connected to the inlet opening (30).
- 10 6. The electrochemical half-cell as claimed in one of claims 1 to 5, characterized in that the outlet opening (28) is arranged in the lower region of a gas pocket (20), and the inlet opening (30) is arranged in the upper region of a gas pocket (22).