Claims:

1. A device for the flexible use of power, comprising an electrolysis cell for chlor-alkali electrolysis having an anode half-cell, a cathode half-cell and a cation exchange membrane that separates the anode half-cell and the cathode half-cell from one another, an anode arranged in the anode half-cell for evolution of chlorine, an oxygen-consuming electrode arranged in the cathode half-cell as cathode, and a conduit for supply of gaseous oxygen to the cathode half-cell, characterized in that the device has at least one conduit for purging of the cathode half-cell with inert gas, a gas separator for separating out hydrogen formed at the cathode, and a conduit connected to said gas separator for purging of the gas separator with inert gas.

2. The device of Claim 1, characterized in that

   a) the cathode half-cell has an electrolyte space through which electrolyte flows between the cation exchange membrane and the oxygen-consuming electrode;

   b) a gas space, to which oxygen can be supplied via the conduit for supply of gaseous oxygen, adjoins the oxygen-consuming cathode at a surface facing away from the electrolyte; and

   c) the cathode half-cell has at least one conduit for purging said gas space with an inert gas.

3. The device of Claim 2, characterized in that the gas space is divided into a plurality of gas pockets arranged vertically one on top of another and the gas pockets each have orifices for pressure equalization with the electrolyte space.

4. The device of Claim 2 or 3, characterized in that it has a gas collector for hydrogen at the upper end of the electrolyte space.

5. The device according to any one of Claims 1 to 4, characterized in that the oxygen-consuming electrode has a porous hydrophobic gas diffusion layer containing metallic silver and a fluorinated polymer.

6. The device according to any one of Claims 1 to 5, characterized in that it comprises a conduit with which inert gas can be withdrawn from the cathode half-cell, and at this conduit there are arranged sensors with which the content of oxygen and hydrogen in the inert gas can be measured.

7. The device according to any one of Claims 1 to 6, characterized in that it comprises a plurality of electrolysers arranged in parallel, each of the electrolysers comprising a plurality of electrolysis cells having cathode half-cells, and a common conduit for supply of gaseous oxygen to the cathode half-cells of the electrolyser and a common conduit for purging of the cathode half-cells of the electrolyser with inert gas, and the device comprises separate conduits for supply of oxygen to the electrolysers and separate conduits for supply of inert gas to the electrolysers.

8. A method for the flexible use of power, characterized in that, in a device according to any one of Claims 1 to 7, chlorine is produced by chlor-alkali electrolysis, wherein

a) when power supply is low, the oxygen-consuming electrode is supplied with gaseous oxygen, and oxygen is reduced at the oxygen-consuming electrode at a first cell voltage, and

b) when high supply is high, the oxygen-consuming electrode is not supplied with oxygen, and hydrogen is generated at the cathode at a second cell voltage which is higher than the first cell voltage.

9. The method of Claim 8, characterized in that, when changing from hydrogen generation at the second cell voltage to oxygen reduction at the first cell voltage, the cell voltage is reduced until essentially no current flows, and the cathode half-cell is purged with an inert gas, before gaseous oxygen is supplied to the oxygen-consuming electrode.

10. The method of Claim 8 or 9, characterized in that, when changing from oxygen reduction at the first cell voltage to hydrogen generation at the second cell voltage, the cell voltage is reduced until essentially no current flows, and the cathode half-cell is purged with an inert gas, before hydrogen is generated at the cathode.

11. The method according to any one of Claims 8 to 10, comprising the steps of

a) defining a threshold value for a power supply,

b) determining the power supply,

c) operating the electrolysis cell with the first cell voltage with supply of gaseous oxygen to the oxygen-consuming electrode when the power supply is below the threshold value and operating the electrolysis cell with the second cell voltage without supply of oxygen to the oxygen-consuming electrode when the power supply is above the threshold value, and

d) repeating steps b) and c).

12. The method according to any one of Claims 8 to 11, characterized in that nitrogen is used as the inert gas.

13. The method according to any one of Claims 8 to 12, characterized in that, after a switchover from oxygen reduction at the first cell voltage to hydrogen generation at the second cell voltage, a gas mixture comprising hydrogen and inert gas is withdrawn from the cathode half-cell and hydrogen is separated from this gas mixture through a membrane.

14. The method according to any one of Claims 8 to 13, characterized in that the device has a plurality of electrolysis cells according to any one of Claims 1 to 6, and the proportion of the electrolysis cells to which no oxygen is supplied and in which hydrogen is generated at the cathode is altered as a function of the power supply.

15. The method according to any one of Claims 8 to 14, characterized in that a prediction of the expected power supply is made, a minimum duration for operation with the first and with the second cell voltage is set, and a switchover between operation with the first cell voltage with supply of gaseous oxygen to operation with the second cell voltage without supply of oxygen is performed only when the predicted duration of a low or high power supply is longer than the minimum duration set.

Claims:

1. Device for flexible use of power, comprising an electrolysis cell for chlor-alkali electrolysis having an anode half-cell, a cathode half-cell and a cation exchange membrane that separates the anode half-cell and the cathode half-cell from one another, an anode arranged in the anode half-cell for evolution of chlorine, an oxygen-consuming electrode arranged in the cathode half-cell as cathode, and a conduit for supply of gaseous oxygen to the cathode half-cell, characterized in that the device has at least one conduit for purging of the cathode half-cell with inert gas.

2. Device according to Claim 1, characterized in that it additionally has a gas separator for separating out hydrogen formed at the cathode, and a conduit connected to said gas separator for purging of the gas separator with inert gas.

3. Device according to Claim 1 or 2, characterized in that

a) the cathode half-cell has an electrolyte space through which electrolyte flows between the cation exchange membrane and the oxygen-consuming electrode;

b) a gas space, to which oxygen can be supplied via the conduit for supply of gaseous oxygen, adjoins the oxygen-consuming cathode at a surface facing away from the electrolyte; and

c) the cathode half-cell has at least one conduit for purging said gas space with an inert gas.

4. Device according to Claim 3, characterized in that the gas space is divided into a plurality of gas pockets arranged vertically one on top of another and the gas pockets each have orifices for pressure equalization with the electrolyte space.

5. Device according to one of Claims 3 and 4, characterized in that it has a gas collector for hydrogen at the upper end of the electrolyte space.

6. Device according to any one of Claims 1 to 5, characterized in that the oxygen-consuming electrode has a porous hydrophobic gas diffusion layer containing metallic silver and a fluorinated polymer.

7. Device according to any one of Claims 1 to 6, characterized in that it comprises a conduit with which inert gas can be withdrawn from the cathode half-cell, and at this conduit there are arranged sensors with which the content of oxygen and hydrogen in the inert gas can be measured.

8. Device according to any one of Claims 1 to 7, characterized in that it comprises a plurality of electrolysers arranged in parallel, each of the electrolysers comprising a plurality of electrolysis cells having cathode half-cells, and a common conduit for supply of gaseous oxygen to the cathode half-cells of the electrolyser and a common conduit for purging of the cathode half-cells of the electrolyser with inert gas, and the device comprises separate conduits for supply of oxygen to the electrolysers and separate conduits for supply of inert gas to the electrolysers.

9. Method for flexible use of power, characterized in ~~that, in a device according to any one of Claims 1~~

to 8, chlorine is produced by chlor-alkali electrolysis, wherein

a) when power supply is low, the oxygen-consuming electrode is supplied with gaseous oxygen, and oxygen is reduced at the oxygen-consuming electrode at a first cell voltage, and

b) when high supply is high, the oxygen-consuming electrode is not supplied with oxygen, and hydrogen is generated at the cathode at a second cell voltage which is higher than the first cell voltage.

10. Method according to Claim 9, characterized in that, when changing from hydrogen generation at the second cell voltage to oxygen reduction at the first cell voltage, the cell voltage is reduced until essentially no current flows, and the cathode half-cell is purged with an inert gas, before gaseous oxygen is supplied to the oxygen-consuming electrode.

11. Method according to Claim 9 or 10, characterized in that, when changing from oxygen reduction at the first cell voltage to hydrogen generation at the second cell voltage, the cell voltage is reduced until essentially no current flows, and the cathode half-cell is purged with an inert gas, before hydrogen is generated at the cathode.

12. Method according to any one of Claims 9 to 11, comprising the steps of

a) defining a threshold value for a power supply,

b) determining the power supply,

c) operating the electrolysis cell with the first cell voltage with supply of gaseous oxygen to the

oxygen-consuming electrode when the power supply is below the threshold value and operating the electrolysis cell with the second cell voltage without supply of oxygen to the oxygen-consuming electrode when the power supply is above the threshold value, and

d) repeating steps b) and c).

13. Method according to any one of Claims 9 to 12, characterized in that nitrogen is used as the inert gas.

14. Method according to any one of Claims 9 to 13, characterized in that, after a switchover from oxygen reduction at the first cell voltage to hydrogen generation at the second cell voltage, a gas mixture comprising hydrogen and inert gas is withdrawn from the cathode half-cell and hydrogen is separated from this gas mixture through a membrane.

15. Method according to any one of Claims 9 to 14, characterized in that the device has a plurality of electrolysis cells according to any one of Claims 1 to 7, and the proportion of the electrolysis cells to which no oxygen is supplied and in which hydrogen is generated at the cathode is altered as a function of the power supply.

16. Method according to any one of Claims 9 to 15, characterized in that a prediction of the expected power supply is made, a minimum duration for operation with the first and with the second cell voltage is set, and a switchover between operation with the first cell voltage with supply of gaseous oxygen to operation with the second cell voltage without supply of oxygen is performed only when the predicted

duration of a low or high power supply is longer than the minimum duration set.