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(54) **USE OF AN ELECTROLYTE COMPOSITION FOR ELECTROLYSIS OF BRINE, METHOD FOR ELECTROLYSIS OF BRINE, AND FOR PREPARATION OF SODIUM HYDROXIDE**

VERWENDUNG EINER ELEKTROLYTZUSAMMENSETZUNG ZUR ELEKTROLYSE VON KOCHSALZLÖSUNG, VERFAHREN ZUR ELEKTROLYSE VON KOCHSALZLÖSUNG UND ZUR HERSTELLUNG VON NATRIUMHYDROXID

UTILISATION D'UNE COMPOSITION ELECTROLYTIQUE POUR L'ELECTROLYSE DE LA SAUMURE, PROCEDE D'ELECTROLYSE DE LA SAUMURE ET DE PREPARATION D'HYDROXYDE DE SODIUM

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Description

BACKGROUND OF THE INVENTION

(a) Field of the Invention

[0001] The present invention relates to the use of an electrolyte composition for electrolysis of brine and a method for electrolysis of brine and sodium hydroxide prepared therefrom, and particularly to the use of an electrolyte composition for electrolysis of brine and a method for electrolysis of brine which minimize electric resistance of an electrode plate and thus can reduce power consumption, do not require separation of an electrolytic cell by interrupting electrolysis in order to replace an electrode plate and thus makes electrolysis efficient, and which can reduce the cost required for maintaining and repairing an electrolytic cell and thus can economically prepare sodium hydroxide, and sodium hydroxide prepared therefrom.

(b) Description of the Related Art

[0002] Sodium hydroxide (NaOH) is a pure white solid, and its aqueous solution shows strong alkalinity. Sodium hydroxide is a widely used material for preparation of pulp, fiber, dye, rubber, soap, etc., and is widely used for a desiccant because it has a strong deliquescing property.

[0003] Methods for preparing sodium hydroxide include a Leblanc process that prepares sodium hydroxide by adding sulfuric acid to crude salt to cause thermolysis, an ammonia soda process that prepares sodium hydroxide by reacting soda lime with $Ca(OH)_2$, and an electrolysis process that prepares sodium hydroxide by electrolyzing brine, etc. Presently, the electrolysis process is the most widely used, and it includes a diaphragm process, a mercury process, and an ion-exchange membrane process.

[0004] A diaphragm process prepares sodium hydroxide by installing a diaphragm made of asbestos between a graphite anode and an iron cathode so that chlorine coming from the anode may not react with sodium hydroxide coming from the cathode, and a mercury process prepares sodium hydroxide using mercury as a cathode material. However, the diaphragm process has a problem of practical use because the concentration of sodium hydroxide prepared is merely 10 to 13%, and thus the concentration processes must be repeated several times. The mercury process is not presently used because of environmental contamination problems of the heavy metal mercury.

[0005] An ion-exchange membrane process is most widely used, in which an ion-exchange membrane is installed inside an electrolytic cell to divide the electrolytic cell into a cation chamber and an anion chamber with brine as an electrolyte, an anode plate and a cathode plate are respectively installed in the cation chamber and the anion chamber, and electric power is supplied to the two electrode plates to obtain chlorine gas from the anode and hydrogen and sodium hydroxide from the cathode.

[0006] Fig. 3 is a cross-sectional view of an apparatus for electrolysis of brine by an ion-exchange membrane process. As shown in Fig. 3, an electrolytic cell (11) is comprised of a cation chamber (12) and an anion chamber (13), and a membrane (14) dividing the cation chamber (12) and the anion chamber (13) is installed therebetween.

[0007] To the cation chamber (12), brine is injected through a brine injection tube (15), waste brine that remains after reaction and chlorine gas produced during electrolysis are stored in a cation chamber discharge tank (17) after passing through a cation chamber discharge tube (16), chlorine gas is discharged again through a chlorine gas discharge tube (18), and brine that remains after reaction and unreacted brine are discharged through a waste brine discharge tube (19).

[0008] Pure water is injected into the anion chamber (13) through a pure water injection tube (20), and a sodium hydroxide aqueous solution and hydrogen gas, reactants produced in the anion chamber (13), are stored in an anion chamber discharge tank (22) after passing through an anion chamber discharge tube (21). Hydrogen gas is discharged again through a hydrogen gas discharge tube (23), and the sodium hydroxide aqueous solution is discharged through a sodium hydroxide aqueous solution discharge tube (24).

[0009] The cation chamber (12) and the anion chamber (13) are respectively equipped with an anode plate (25) and a cathode plate (26).

[0010] Fig. 1 shows a chemical equation involved in electrolysis of brine by the existing ion-exchange membrane process. As shown in Fig. 1, as electrolysis proceeds, hydrogen ions remaining in an anion chamber are attached to a cathode plate surface to increase electric resistance of a cathode plate, thereby increasing power consumption during electrolysis.

[0011] Generally, in order to restrain the increase in resistance of an electrode plate, the electrode plate surface is previously coated or plated with compounds such as $AuCl_3$, $RuCl_3$, $IrCl_3$, etc., or it is fired at 400 to 500 °C and inserted into an electrolytic cell. If electrolyzing brine by the above method, compounds such as $AuCl_3$, $RuCl_3$, $IrCl_3$, etc. coated or plated on the electrode plate surface will be continuously oxidized to continuously increase electric resistance of the electrode plate surface. Therefore, there is a problem that in proportion to the increased electric resistance, more power is consumed in electrolysis and the production cost of sodium hydroxide increases.

[0012] In order to overcome these problems, the ion-exchange membrane is replaced every 2 years, the cathode plate every four years, and the anode plate every 6 years, or compounds such as Au, Ru, Ir, etc. attached to the electrode plate are removed and compounds such as $AuCl_3$, $RuCl_3$, $IrCl_3$, etc. are coated or plated again

on the electrode plate to renew it. However, the renewal of an electrode plate requires much time and human and material resources, and the electrolytic cell cannot be operated during the time required for renewal, and thus productivity is reduced.

SUMMARY OF THE INVENTION

[0013] The present invention is made in order to solve the problems of the prior arts, and it is an object of the present invention to provide an electrolyte composition for electrolysis of brine comprising an aqueous solution of a platinum compound that minimizes electric resistance of an electrode plate and thus can reduce power consumption, that needs no interruption of electrolysis to separate an electrolytic cell in order to replace an electrode plate and thus makes an electrolysis process efficient, and that can reduce the cost required for maintenance and repair of an electrolytic cell to thus economically prepare sodium hydroxide.

[0014] It is another object of the present invention to provide a method for electrolysis of brine that injects the electrolysis composition for electrolysis of brine comprising an aqueous solution of a platinum compound into an electrolytic cell to prepare sodium hydroxide.

[0015] It is another object of the present invention to provide sodium hydroxide prepared by the above method.

[0016] It is another object of the present invention to provide an apparatus for electrolysis of brine.

[0017] In order to achieve these objects, the present invention provides the use of an electrolyte composition for electrolysis of brine comprising an aqueous solution of a platinum compound.

[0018] The present invention also provides a method for electrolysis of brine comprising injecting brine and pure water respectively into a cation chamber and an anion chamber divided by a separation membrane installed inside an electrolytic cell through a brine injection tube and a pure water injection tube and applying a power source to an anode plate and a cathode plate installed in the cation chamber and the anion chamber to separate produced chlorine gas, hydrogen gas, and sodium hydroxide aqueous solution, characterized in that an aqueous solution of a platinum compound is injected into the anion chamber through the pure water injection tube.

[0019] The present invention also provides a method for preparation of sodium hydroxide as defined in claim 10.

[0020] The present invention also provides an apparatus for electrolysis of brine comprising a cation chamber and an anion chamber divided by a separation membrane installed in an electrolytic cell; an anode plate and a cathode plate equipped in the cation chamber and the anion chamber; a brine injection tube connected to the cation chamber; a pure water injection tube connected to the anion chamber; and a platinum compound aqueous solution injection tube connected to the pure water injection tube.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 shows a Chemical Equation involved in electrolysis of brine by an ion-exchange membrane process.

Fig. 2 shows a Chemical Equation involved in the electrolysis of brine of the present invention.

Fig. 3 is a cross-sectional view of an apparatus for electrolysis of brine by an ion-exchange membrane process of the prior art.

Fig. 4 is a cross-sectional view of the apparatus for electrolysis of brine of the present invention.

Fig. 5 shows operating voltages of the electrolytic cells of Example 6 and Comparative Examples 1 to 3 with the lapse of operation time.

Explanation of reference numerals in Figures.

[0022]

11, 111: Electrolytic cell

12, 112: Cation chamber

13, 113: Anion chamber

14, 114: Separation membrane

15, 115: Brine injection tube

16, 116: Cation chamber discharge tube

17, 117: Cation chamber discharge tank

18, 118: Chlorine gas discharge tube

19, 119: Waste brine discharge tube

20, 120: Pure water injection tube

21, 121: Anion chamber discharge tube

22, 122: Anion chamber discharge tank

23, 123: Hydrogen gas discharge tube

24, 124: Sodium hydroxide aqueous solution discharge tube

25, 125: Anode plate

26, 126: Cathode plate

127: Platinum compound aqueous solution injection tube

DETAILED DESCRIPTION AND THE PREFERRED EMBODIMENTS

[0023] The present invention will now be explained in detail.

[0024] The present invention is characterized by adding a platinum compound to an electrolyte composition for electrolysis of brine, particularly in an aqueous solution phase. The platinum compound is preferably selected from hexachloroplatinate (IV) ($H_2PtCl_6 \cdot 6H_2O$), potassium tetrachloroplatinate (II) (K_2PtCl_4), diaminodinitroplatinum (II) ($Pt(NH_3)_2(NO)_2$), hexaaminoplatinum (IV) chloride ($Pt(NH_3)_6Cl_4$), tetraamine platinum (II) chloride ($Pt(NH_3)_4Cl_2$), hydrogen hexahydroxoplatinate (IV) ($H_2Pt(OH)_6$) and sodium tetrachloroplatinate (II) ($Na_2PtCl_4 \cdot 6H_2O$). Hydrogen hexahydroxoplatinate (IV) ($H_2Pt(OH)_6$), separated into platinum ions, hydrogen ions, and hydroxide ions in an aqueous solution, is most preferable.

[0025] Fig. 2 shows a chemical equation of electrolysis of brine when hydrogen hexahydroxoplatinate (IV) is introduced into an electrolytic cell. Saturated brine is injected into a cation chamber, and pure water and a platinum compound aqueous solution are injected into an anion chamber. In the present invention, the liquid mixture of the pure water and the platinum compound aqueous solution is referred to as an electrolytic composition for electrolysis of brine.

[0026] As shown in Fig. 2, Pt^{4+} platinum ions in the platinum compound aqueous solution move to a cathode plate surface. Platinum ions have superior electrical conductivity and corrosion resistance for strong alkali. In addition, a cathode plate plated with platinum ions has comparatively low electric resistance compared to a cathode plate plated with a material other than platinum ions or an unplated cathode plate, and it also has strong corrosion resistance to a strong alkali sodium hydroxide aqueous solution produced in an anion chamber and thus can prevent corrosion of a cathode.

[0027] The contents of platinum compounds in the platinum compound aqueous solution are preferably 0.1 to 10 wt%. If the contents are less than 0.1 wt%, an increase in electric resistance of a cathode plate surface cannot be prevented, and if the contents are more than 10 wt%, power consumption will not be simply proportional to the contents of the expensive platinum compounds, thus making it uneconomical.

[0028] In addition, the amount of the platinum compound aqueous solution in the electrolyte composition for electrolysis of brine used in the present invention comprising an aqueous solution of the platinum compound is preferably 0.1 to 0.2 liter per 1 liter of pure water injected into an anion chamber. If the amount is less than 0.1 liter per 1 liter of pure water, the amount of prepared sodium hydroxide will be small, and if the amount is more than 0.2 liter, electric resistance of an electrode plate will not decrease in proportion to the amount of expensive platinum compounds, thus making it uneconomical.

[0029] The method for electrolysis of brine of the present invention, which comprises injecting brine and pure water respectively into a cation chamber and an anion chamber divided by a separation membrane installed in an electrolytic cell through a brine injection tube and a pure water injection tube and applying a power source to an anode plate and a cathode plate installed in the cation chamber and the anion chamber to separate produced chlorine gas, hydrogen gas, and sodium hydroxide aqueous solution, is characterized in that an aqueous solution of the platinum compound is injected into the anion chamber through the pure water injection tube.

[0030] An apparatus for electrolysis used in the electrolysis method of the present invention will be explained referring to Fig. 4. Fig. 4 is a cross-sectional view of the apparatus for electrolysis of brine of the present invention.

[0031] As shown in Fig. 4, an electrolytic cell (111) is composed of a cation chamber (112) and an anion chamber (113), and a separation membrane (114) dividing the cation chamber (112) and the anion chamber (113) is installed therebetween. In addition, inside the cation chamber (112) and the anion chamber (113), an anode plate (125) and a cathode plate (126) are respectively installed.

[0032] In the cation chamber (112), brine is injected through a brine injection tube (115), waste brine that remains after reaction and chlorine gas produced during electrolysis are stored in a cation chamber discharge tank (117) after passing through a cation chamber discharge tube (116), chlorine gas is discharged again through a chlorine gas discharge tube (118), and brine that remains after reaction and unreacted brine are discharged through a waste brine discharge tube (119).

[0033] In the anion chamber (113), pure water is injected through a pure water injection tube (120), and hydrogen gas and sodium hydroxide aqueous solution, reactants produced in the anion chamber (113), are stored in an anion chamber discharge tank (122) after passing through an anion chamber discharge tube (121). Hydrogen gas is discharged again through a hydrogen gas discharge tube (123), and a sodium hydroxide aqueous solution is discharged through a sodium hydroxide aqueous solution discharge tube (124).

[0034] The method for electrolysis of the present invention is characterized by mixing an aqueous solution of a platinum compound with pure water and injecting the mixture in the anion chamber (113). In order to mix the aqueous solution of the platinum compound with pure water and inject it into the anion chamber (113), the aqueous solution of the platinum compound is initially mixed with pure water and the mixture is injected into the pure

water injection tube (120), or a platinum compound aqueous solution injection tube (127) connecting with the pure water injection tube (120) is separately installed to inject the aqueous solution of the platinum compound into the anion chamber through the platinum compound aqueous solution injection tube (127).

[0035] If the aqueous solution, of the platinum compound is injected through another injection tube of an electrolytic cell or through a platinum compound aqueous solution injection tube connecting with another injection tube, the objects of the present invention cannot be sufficiently achieved. For example, if the platinum compound aqueous solution injection tube is connected with the anion chamber discharge tube (121) and the aqueous solution of a platinum compound is injected through it, most of the platinum in the platinum compound aqueous solution is discharged to the anion chamber discharge tank (122) by discharge pressure of the sodium hydroxide aqueous solution and hydrogen gas discharged from the anion chamber, and thus the cathode plate (126) surface is not coated therewith.

[0036] However, if the platinum compound aqueous solution is injected into the anion chamber (113) through the pure water injection tube (120), the platinum cation ingredient of the platinum compound aqueous solution moves to the cathode plate (126) by electrodeposition and is coated on the cathode plate (126), and thus an electric resistance of the cathode plate surface decreases to reduce power consumption for electrolysis.

[0037] The platinum compound is preferably selected from a group consisting of hexachloroplatinate (IV) ($H_2PtCl_6 \cdot (H_2O)$, potassium tetrachloroplatinate (II) (K_2PtCl_4), diaminodinitroplatinum (II) ($Pt(NH_3)_2(NO_2)$, hexaaminoplatinum (IV) chloride ($Pt(NH_3)_6Cl_4$), tetraamine platinum (II) chloride ($Pt(NH_3)_4Cl_2$), hydrogen hexahydroxoplatinate (IV) ($H_2Pt(OH)_6$), and sodium tetrachloroplatinate (II) ($Na_2PtCl_4 \cdot 6H_2O$). Hydrogen hexahydroxoplatinate (IV) ($H_2Pt(OH)_6$ is most preferable because it is separated into platinum ions, hydrogen ions, and hydroxide ions in an aqueous solution.

[0038] Fig. 2 shows a chemical equation involved in electrolysis of brine by injecting hydrogen hexahydroxoplatinate (IV) into an electrolytic cell. Brine is injected into a cation chamber, and pure water and a platinum compound aqueous solution are injected into an anion chamber.

[0039] As shown in Fig. 2, Pt^{4+} platinum ions of the platinum compound aqueous solution move to a cathode plate surface by electrodeposition. Platinum ions have superior electrical conductivity and corrosion resistance for strong alkali. In addition, a cathode plate plated with platinum ions has comparatively low electric resistance compared to a cathode plate plated with a material other than platinum ions or an unplated cathode plate, and it also has strong corrosion resistance for a strong alkali sodium hydroxide aqueous solution and thus can prevent corrosion of the cathode plate.

[0040] The contents of platinum compounds in the platinum compound aqueous solution are preferably 0.1 to 10 wt%. If the contents are less than 0.1 wt%, an increase in electric resistance of a cathode plate surface cannot be prevented, and if the contents are more than 10 wt%, power consumption will not be simply proportional to the contents of the expensive platinum compounds, thus making it uneconomical.

[0041] In addition, the amount of the platinum compound aqueous solution in the electrolyte composition for electrolysis of brine used in the present invention comprising an aqueous solution of the platinum compound is preferably 0.1 to 0.2 liter per 1 liter of pure water injected into an anion chamber. If the amount is less than 0.1 liter per 1 liter of pure water, the amount of prepared sodium hydroxide will be small, and if the amount is more than 0.2 liter, electrical resistance of an electrode plate will not decrease in proportion to the amount of expensive platinum compounds, thus making it uneconomical.

[0042] As shown in Fig. 4, if the platinum compound aqueous solution is injected into the pure water injection tube to electrolyze brine, an aqueous solution of sodium hydroxide is produced in the anion chamber of the electrolytic cell. As a method for separating sodium hydroxide from the aqueous solution of sodium hydroxide, any method generally used in the art can be employed.

[0043] The present invention also provides an apparatus for electrolysis of brine comprising a cation chamber and an anion chamber divided by a separation membrane in an electrolytic cell; an anode plate and a cathode plate respectively installed in the cation chamber and the anion chamber; a brine injection tube connected with the cation chamber; a pure water injection tube connected with the anion chamber; and a platinum compound aqueous solution injection tube connected with the pure water injection tube.

[0044] As explained, if brine is electrolyzed using the electrolyte composition for electrolysis of brine comprising an aqueous solution of a platinum compound and the method for electrolysis of brine of the present invention, electric resistance of an electrode plate can be minimized to reduce power consumption, and there is no need to interrupt electrolysis to separate an electrolytic cell in order to change an electrode plate and thus the electrolysis process is efficient, the cost required for maintenance and repair of an electrolytic cell can be reduced, and thus sodium hydroxide can be economically prepared. In addition, the method is environmentally acceptable because it does not include the heavy metal mercury, as does the mercury process.

[0045] The present invention will be explained in more detail with reference to the following Examples and Comparative Examples. However, these are to illustrate the present invention and the present invention is not limited to them.

Example 1

[0046] To 1 liter of pure water, 10 g of hexachloropla-

tinate (IV) ($H_2PtCl_6 \cdot 6H_2O$) were added to prepare an aqueous solution of hexachloroplatinate (IV). The aqueous solution and pure water were respectively injected into a platinum compound aqueous solution injection tube and a pure water injection tube in an electrolytic cell. Brine was injected into the electrolytic cell and an electrolyte composition comprising the prepared platinum compound aqueous solution was injected into a cathode circulation tube for 3 minutes to electrolyze brine to prepare a sodium hydroxide aqueous solution. The total amount of injected pure water was 10 liters, and that of the hexachloroplatinate (IV) aqueous solution was 1 liter.

Example 2

[0047] A sodium hydroxide aqueous solution was prepared by the same method as in Example 1, except that potassium tetrachloroplatinate (II) (K_2PtCl_4) was used as a platinum compound.

Example 3

[0048] A sodium hydroxide aqueous solution was prepared by the same method as in Example 1, except that diaminodinitroplatinum (II) ($Pt(NH_3)_2(NO)_2$) was used as a platinum compound.

Example 4

[0049] A sodium hydroxide aqueous solution was prepared by the same method as in Example 1, except that hexaaminoplatinum (IV) chloride ($Pt(NH_3)_6Cl4$) was used as a platinum compound.

Example 5

[0050] A sodium hydroxide aqueous solution was prepared by the same method as in Example 1, except that tetraamine platinum (II) chloride ($Pt(NH_3)_4Cl_2$) was used as a platinum compound.

Example 6

[0051] A sodium hydroxide aqueous solution was prepared by the same method as in Example 1, except that hydrogen hexahydroxoplatinate (IV) ($H_2Pt(OH)_6$) was used as a platinum compound.

Example 7

[0052] A sodium hydroxide aqueous solution was prepared by the same method as in Example 1, except that sodium tetrachloroplatinate (II) ($Na_2PtCl_4\ 6H_2O$) was used as a platinum compound.

Comparative Example 1

[0053] A sodium hydroxide aqueous solution was prepared by the same method as in Example 1, except that 20 g of $AuCl_3$ were dissolved in 1 liter of pure water instead of the platinum compound and the aqueous solution thereof used, and the product AZEC MD66.69, manufactured by Japan Asahi Glass Co., Ltd was used as an electrolytic cell.

Comparative Example 2

[0054] A sodium hydroxide aqueous solution was prepared by the same method as in Example 1, except that 20 g of $RuCl_3$ was dissolved in 1 liter of pure water instead of the platinum compound, and the aqueous solution thereof was used.

Comparative Example 3

[0055] A sodium hydroxide aqueous solution was prepared by the same method as in Example 1, except that 20 g of $IrCl_3$ was dissolved in 1 liter of pure water instead of the platinum compound, and the aqueous solution thereof was used.

Comparison of operating voltage

[0056] Fig. 5 shows the operating voltages of the electrolytic cells of Example 6 and Comparative Examples 1 to 3 with the lapse of operation time. The initial operating voltages were all set to 6.65 V.

[0057] As shown in Fig. 5, when $RuCl_3$ and $IrCl_3$ aqueous solutions of Comparative Examples 2 and 3 were injected to electrolyze, the operating voltages of the electrolytic cells gradually increased with the lapse of time. In addition, when adding the $AuCl_3$ aqueous solution of Comparative Example 1 to electrolyze, the operating voltage increased more than in Comparative Examples 2 and 3. It is considered that electric resistance of the cathode plate increased due to Au, Ru, and Ir of the $AuCl_3$, $RuCl_3$, and $IrCl_3$ aqueous solutions injected into the anion chamber with the lapse of the operation time.

[0058] However, when the platinum compound aqueous solution of Example 6 was injected into an electrolytic cell to operate the electrolytic cell, the operating voltage decreased with the lapse of operation time. Particularly, after 15 minutes of operation, the operating voltage decreased to 6.5 V, and then stabilized at 6.42 V. This is because platinum cations of the hydrogen hexahydroxoplatinate (IV) ($H_2Pt(OH)_6$) aqueous solution were electrodeposited on a cathode plate surface by electrodeposition to decrease electric resistance of the electrode plate surface.

[0059] As explained, if the platinum compound aqueous solution of the present invention is injected into a platinum compound aqueous solution injection tube connected with a pure water injection tube to electrolyze brine, electric resistance of an electrode plate decreases and thus operating voltage decreases, and therefore power consumption for electrolysis can be reduced and

sodium hydroxide can be economically prepared.

[0060] If brine is electrolyzed using the electrolyte composition for electrolysis of brine comprising a platinum compound aqueous solution and a method for electrolysis of brine using the same of the present invention, electric resistance of an electrode plate is minimized to reduce power consumption, there is no need to interrupt the electrolysis process to separate an electrolytic cell in order to replace an electrode plate, and thus the electrolysis process is efficient and the cost required for maintenance and repair of an electrolytic cell can be reduced and sodium hydroxide can be economically prepared.

Claims

1. Use of an electrolyte composition comprising an aqueous solution of a platinum compound in the electrolysis of brine.

2. The use according to Claim 1, wherein the platinum compound is selected from the group consisting of hexachloroplatinate(IV) ($H_2PtCl_6 \cdot 6H_2O$), potassium tetrachloroplatinate(II) (K_2PtCl_4), diaminodinitroplatinum(II) ($Pt(NH_3)_2(NO)_2$), hexaaminoplatinum (IV) chloride ($Pt(NH_3)_6Cl_4$), tetraamine platinum(II) chloride ($Pt(NH_3)_4Cl_2$), hydrogen hexahydroxoplatinate (IV) ($H_2Pt(OH)_6$), and sodium tetrachloroplatinate(II) ($Na_2PtCl_4 \cdot 6H_2O$).

3. The use according to Claim 1, wherein the contents of the platinum compound in the aqueous solution of the platinum compound are 0.1 to 10 wt%.

4. The use according to Claim 1, wherein the aqueous solution of the platinum compound is used in the amount of 0.1 to 2 liters per 1 liter of pure water.

5. A method for electrolysis of brine, comprising injecting brine and pure water respectively to a cation chamber and an anion chamber divided by a separation membrane installed in an electrolytic cell through a brine injection tube and a pure water injection tube, and applying a power source to an anode plate and a cathode plate installed in the cation chamber and anion chamber to separate produced chloride gas, hydrogen gas, and sodium hydroxide aqueous solution, **characterized in that** an aqueous solution of a platinum compound is injected into the anion chamber through the pure water injection tube.

6. The method for electrolysis of brine according to Claim 5, wherein the aqueous solution of the platinum compound is injected through a separate platinum compound aqueous solution injection tube connected with the pure water injection tube.

7. The method for electrolysis of brine according to Claim 5, wherein the platinum compound is selected from a group consisting of hexachloroplatinate (IV) ($H_2PtCl_6 \cdot 6H_2O$), potassium tetrachloroplatinate(II) (K_2PtCl_4), diaminodinitroplatinum(II) ($Pt(NH_3)_2(NO)_2$), hexaaminoplatinum (IV) chloride ($Pt(NH_3)_6Cl_4$), tetraamine platinum(II) chloride ($Pt(NH_3)_4Cl_2$), hydrogen hexahydroxoplatinate (IV) ($H_2Pt(OH)_6$), and sodium tetrachloroplatinate(II) ($Na_2PtCl_4 \cdot 6H_2O$).

8. The method for electrolysis of brine according to Claim 5, wherein the contents of the platinum compound in the aqueous solution of the platinum compound are 0.1 to 10 wt%.

9. The method for electrolysis of brine according to Claim 5, wherein the aqueous solution of the platinum compound is used in an amount of 0.1 to 2 liters per 1 liter of pure water.

10. A method for manufacturing sodium hydroxide, comprising the steps of:

    electrolyzing brine by the method according to any one of Claims 5 to 9, to produce an aqueous solution of sodium hydroxide; and
    separating sodium hydroxide from the aqueous solution of sodium hydroxide.

11. An apparatus for electrolysis of brine, comprising:

    a cation chamber and an anion chamber divided by a separation membrane installed in an electrolytic cell;
    an anode plate and a cathode plate respectively equipped in the cation chamber and the anion chamber;
    a brine injection tube connected with the cation chamber;
    a pure water injection tube connected with the anion chamber; and
    a platinum compound aqueous solution injection tube connected with the pure water injection tube.

Patentansprüche

1. Verwendung einer Elektrolytzusaminensetzung, die eine wässrige Lösung aus einer Platinverbindung umfasst, in der Elektrolyse von Salzwasser.

2. Verwendung gemäss Anspruch 1, worin die Platinverbindung aus der Gruppe ausgewählt ist, die aus Hexachloroplatinat(IV) ($H_2PtCl_6 \cdot 6H_2O$), Kaliumtetrachloroplatinat (II) (K_2PtCl_4), Diammindinitroplatin (II) ($Pt(NH_3)_2(NO)_2$), Hexaamminplatin (IV)-chlorid

($Pt(NH_3)_6Cl_4$), Tetraamminplatin (II)-chlorid ($Pt(NH_3)_4Cl_2$), Hydrogenhexahydroxoplatinat(IV) ($H_2Pt(OH)_6$) und Natriumtetrachloroplatinat(II) ($Na_2PtCl_4 \cdot 6H_2O$) besteht.

3. Verwendung gemäss Anspruch 1, worin der Gehalt der Platinverbindung in der wässrigen Lösung aus der Platinverbindung 0,1 bis 10 Gew.% ist.

4. Verwendung gemäss Anspruch 1, worin die wässrige Lösung aus der Platinverbindung in einer Menge von 0,1 bis 2ℓ auf 1ℓ reines Wasser verwendet wird.

5. Verfahren zur Elektrolyse von Salzwasser, das das Injizieren von Salzwasser und reinem Wasser in eine Kationenkammer bzw. eine Anionenkammer, die durch eine Trennmembran getrennt sind, die in einer Elektrolysezelle installiert ist, durch einen Injektionsschlauch für Salzwasser und einen Injektionsschlauch für reines Wasser und das Anlegen einer Stromquelle an ein Anodenblech und ein Kathodenblech, die in der Kationenkammer und in der Anionenkammer installiert sind, zur Trennung von erzeugtem Chlorgas, Wasserstoffgas und wässriger Natriumhydroxidlösung umfasst, **dadurch gekennzeichnet, dass** eine wässrige Lösung aus einer Platinverbindung in die Anionenkammer durch den Injektionsschlauch für reines Wasser injiziert wird.

6. Verfahren zur Elektrolyse von Salzwasser gemäss Anspruch 5, worin die wässrige Lösung aus der Platinverbindung durch einen separaten Injektionsschlauch für die wässrige Lösung aus Platinverbindung injiziert wird, der mit dem Injektionsschlauch für reines Wasser verbunden ist.

7. Verfahren zur Elektrolyse von Salzwasser gemäss Anspruch 5, worin die Platinverbindung aus der Gruppe ausgewählt ist, die aus Hexachloroplatinat (IV) ($H_2PtCl_6 \cdot 6H_2O$), Kaliumtetrachloroplatinat (II) (K_2PtCl_4), Diammindinitroplatin (II) ($Pt(NH_3)_2(NO)_2$), Hexaamminplatin(IV)-chlorid -($Pt(NH_3)_6Cl_4$), Tetraamminplatin(II)-chlorid ($Pt(NH_3)_4Cl_2$), Hydrogenhexahydroxoplatinat(IV) ($H_2Pt(OH)_6$) und Natriumtetrachloroplatinat (II) ($Na_2PtCl_4 \cdot 6H_2O$) besteht.

8. Verfahren zur Elektrolyse von Salzwasser gemäss Anspruch 5, worin der Gehalt der Platinverbindung in der wässrigen Lösung aus der Platinverbindung 0,1 bis 10 Gew.% ist.

9. Verfahren zur Elektrolyse von Salzwasser gemäss Anspruch 5, worin die wässrige Lösung aus der Platinverbindung in einer Menge von 0,1 bis 2 ℓ auf 1 ℓ reines Wasser verwendet wird.

10. Verfahren zur Herstellung von Natriumhydroxid, das die folgenden Schritte umfasst:

Elektrolysieren von Salzwasser durch das Verfahren gemäss einem der Ansprüche 5 bis 9, um eine wässrige Lösung aus Natriumhydroxid herzustellen; und

Abtrennen von Natriumhydroxid von der wässrigen Lösung aus Natriumhydroxid.

11. Vorrichtung zur Elektrolyse von Salzwasser, die folgendes umfasst:

eine Kationenkammer und eine Anionenkammer, die durch eine Trennmembran getrennt sind, die in einer Elektrolysezelle installiert ist;
ein Anodenblech und ein Kathodenblech, die in der Kationenkammer bzw. Anionenkammer installiert sind;
einen Injektionsschlauch für Salzwasser, der mit der Kationenkammer verbunden ist;
einen Injektionsschlauch für reines Wasser, der mit der Anionenkammer verbunden ist; und
einen Injektionsschlauch für wässrige Lösung aus Platinverbindung, der mit dem Injektionsschlauch für reines Wasser verbunden ist.

Revendications

1. Utilisation d'une composition d'électrolyte comprenant une solution aqueuse d'un composé de platine dans l'électrolyse d'une saumure.

2. Utilisation selon la revendication 1, dans laquelle le composé de platine est choisi dans le groupe constitué par l'hexachloroplatinate (IV) ($H_2PtCl_6 \cdot 6H_2O$), le tétrachloroplatinate (II) de potassium (K_2PtCl_4), le diaminodinitroplatine (II) ($Pt(NH_3)_2(NO)_2$), le chlorure d'hexaaminoplatine (IV) ($Pt(NH_3)_6Cl_4$), le chlorure de tétraamine platine (II) ($Pt(NH_3)_4Cl_2$), l'hexahydroxoplatinate (IV) d'hydrogène ($H_2Pt(OH)_6$), et le tétrachloroplatinate (II) de sodium ($Na_2PtCl_4 \cdot 6H_2O$).

3. Utilisation selon la revendication 1, dans laquelle les teneurs en composé de platine dans la solution aqueuse du composé de platine sont de 0,1 à 10 % en poids.

4. Utilisation selon la revendication 1, dans laquelle la solution aqueuse du composé de platine est utilisée dans une quantité de 0,1 à 2 litres par litre d'eau pure.

5. Procédé pour l'électrolyse d'une saumure, comprenant l'injection d'une saumure et d'eau pure respectivement vers une chambre de cations et une chambre d'anions séparées par une membrane de séparation installées dans une cellule électrolytique par l'intermédiaire d'un tube d'injection de saumure et d'un tube d'injection d'eau pure, et l'application d'une source d'énergie à une plaque d'anode et une plaque

de cathode installées dans la chambre de cations et la chambre d'anions pour séparer le chlore gazeux, l'hydrogène gazeux, et la solution aqueuse d'hydroxyde de sodium produits, **caractérisé en ce que** une solution aqueuse d'un composé de platine est injectée dans la chambre d'anions par l'intermédiaire du tube d'injection d'eau pure.

6. Procédé pour l'électrolyse d'une saumure selon la revendication 5, dans lequel la solution aqueuse du composé de platine est injectée par l'intermédiaire d'un tube d'injection de solution aqueuse d'un composé de platine séparé connecté au tube d'injection d'eau pure.

7. Procédé pour l'électrolyse d'une saumure selon la revendication 5, dans laquelle le composé de platine est choisi dans le groupe constitué par l'hexachloroplatinate (IV) ($H_2PtCl_6 \cdot EH_2O$), le tétrachloroplatinate (II) de potassium (K_2PtCl_4), le diaminodinitroplatine (II) ($Pt(NH_3)_2(NO)_2$), le chlorure d'hexaaminoplatine (IV) ($Pt(NH_3)_6Cl_4$), le chlorure de tétraamine platine (II) ($Pt(NH_3)_4Cl_2$), l'hexahydroxoplatinate (IV) d'hydrogène ($H_2Pt(OH)_6$), et le tétrachloroplatinate (II) de sodium ($Na_2PtCl_4 \cdot 6H_2O$).

8. Procédé pour l'électrolyse d'une saumure selon la revendication 5, dans lequel les teneurs en composé de platine dans la solution aqueuse du composé de platine sont de 0,1 à 10 % en poids.

9. Procédé pour l'électrolyse d'une saumure selon la revendication 5, dans lequel la solution aqueuse du composé de platine est utilisée dans une quantité de 0,1 à 2 litres par litre d'eau pure.

10. Procédé pour fabriquer de l'hydroxyde de sodium, comprenant les étapes de :

électrolyser une saumure par le procédé selon l'une quelconque des revendications 5 à 9, pour produire une solution aqueuse d'hydroxyde de sodium; et
séparer l'hydroxyde de sodium de la solution aqueuse d'hydroxyde de sodium.

11. Appareil pour l'électrolyse d'une saumure, comprenant :

une chambre de cations et une chambre d'anions séparées par une membrane de séparation installées dans une cellule électrolytique;
une plaque d'anode et une plaque de cathode respectivement montées dans la chambre de cations et la chambre d'anions;
un tube d'injection de saumure connecté à la chambre de cations;
un tube d'injection, d'eau pure connecté à la chambre d'anions; et
un tube d'injection de solution aqueuse d'un composé de platine connecté au tube d'injection d'eau pure.

FIG.1

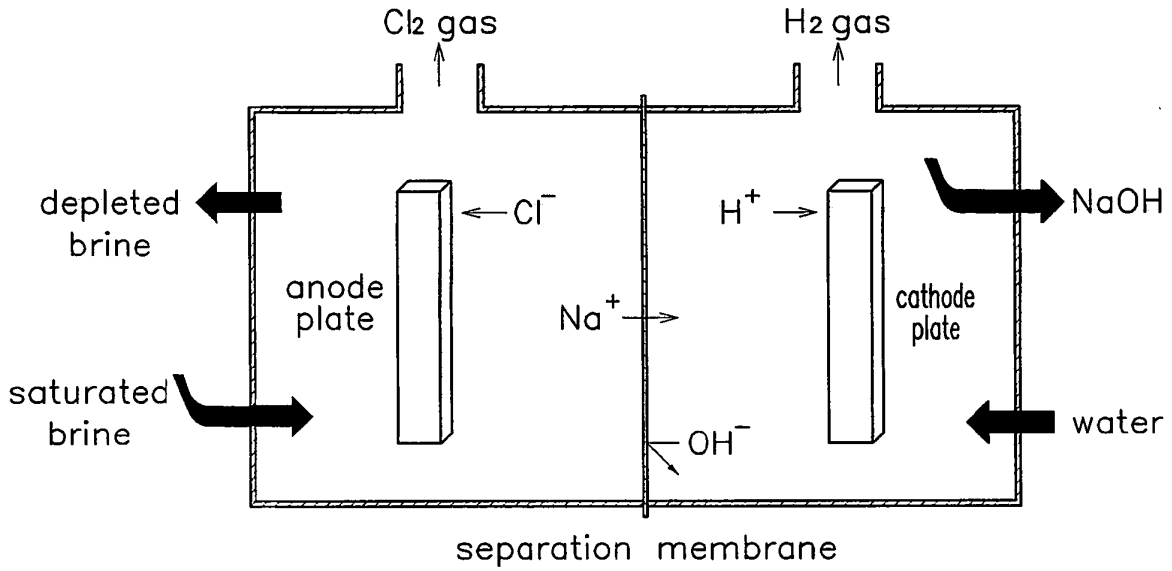
Cl2 gas
H2 gas
depleted brine
Cl⁻
H⁺
NaOH
anode plate
Na⁺
cathode plate
saturated brine
OH⁻
water
separation membrane

FIG.2

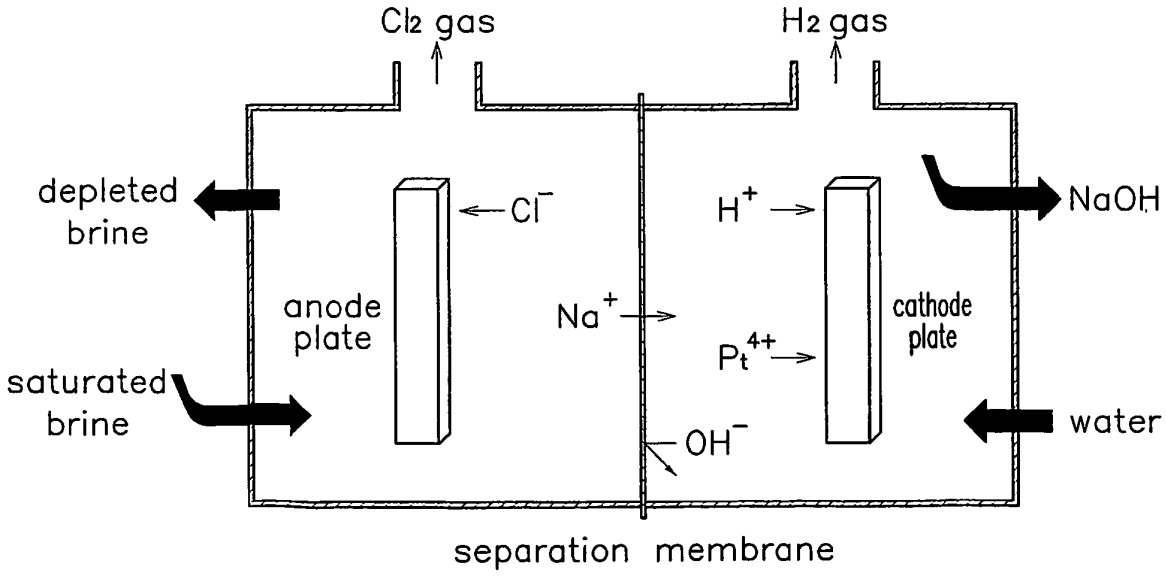
Cl2 gas
H2 gas
depleted brine
Cl⁻
H⁺
NaOH
anode plate
Na⁺
cathode plate
Pt⁴⁺
saturated brine
OH⁻
water
separation membrane

FIG.3

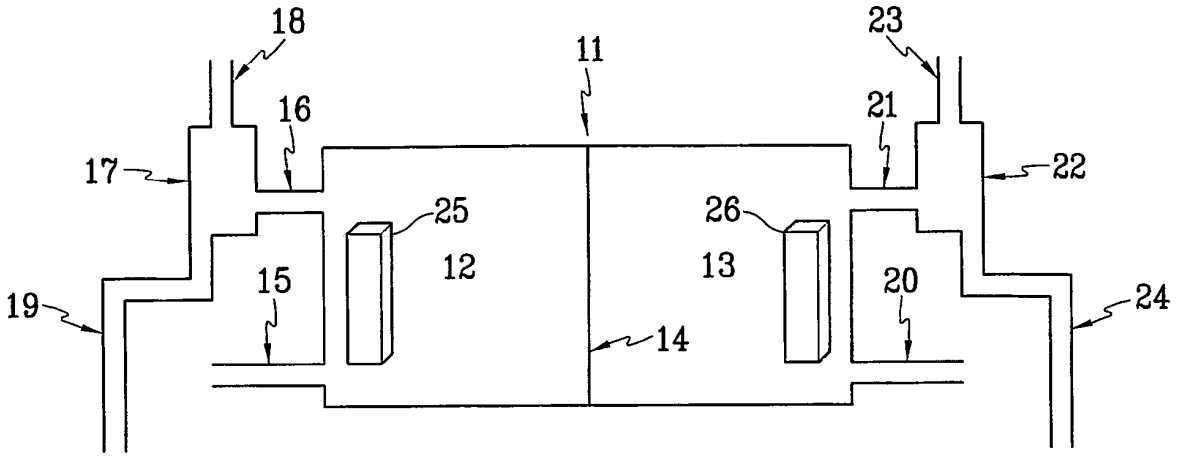
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FIG.4

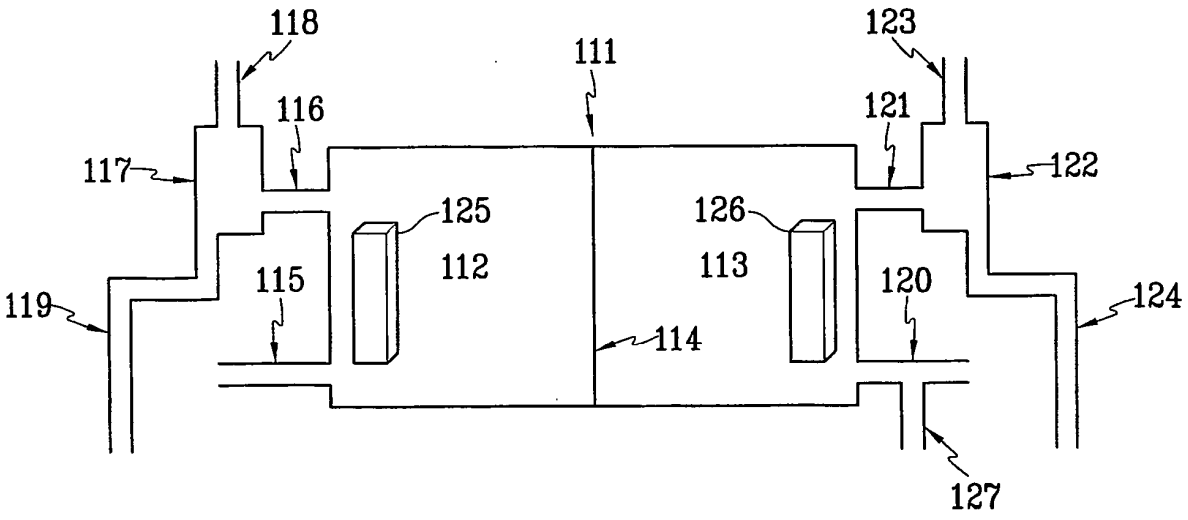
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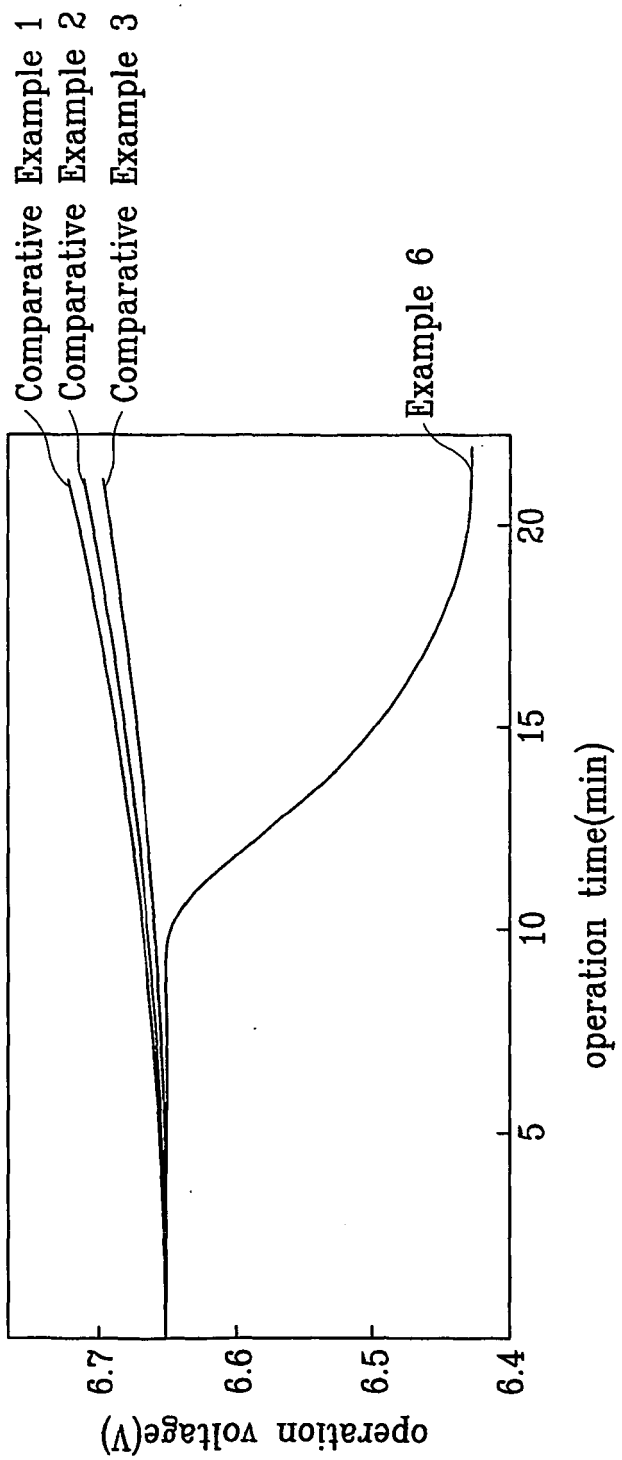
FIG.5


Comparative Example 1
Comparative Example 2
Comparative Example 3
Example 6
operation voltage(V)
6.7
6.6
6.5
6.4
5
10
15
20
operation time(min)