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(54) Title: ELECTROLYSIS OF SALT WATER

(57) Abstract: The present invention is a method for producing hydrogen and oxygen from salt water, using an electrolyser having first and second electrode compartments respectively on each side of a hydrophilic ion-exchange membrane, the method comprising adding salt water to one or both of the electrode compartments, and electrolysing the salt water. The present invention is also a method of producing a biologically active solution using an electrolyser as defined above, the method comprising adding salt water to one or both of the electrode compartments, and electrolysing the salt water. Further, the present invention is a method for reducing the salt content of salt water using an electrolyser as defined above, the method comprising adding salt water to one or both electrode compartments, and electrolysing the salt water.



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ELECTROLYSIS OF SALT WATER

Field of the Invention

This invention relates to a method producing hydrogen and oxygen from
5 salt water, and to the production of biologically active salt water.

Background of the Invention

Electrolytic production of hydrogen traditionally uses highly purified water,
any contamination risks damaging the membrane, catalyst or electrode
structures. Significant efforts have gone into methods of purifying water prior to
10 the electrolysis but these tend to be energy-intensive, have high balance of plant
and high space requirements. The ability to electrolyse water without the need
for purifying would offer significant advantages. It would be particularly
beneficial if the electrolyser system could electrolyse seawater directly.

Decontamination is particularly important in hospitals, where health care-
15 associated infections (HCAIs) are a growing problem. HCAIs are caused by a
wide variety of non-biological contaminants and micro-organisms. One such
HCAI is methicillin-resistant *Staphylococcus aureus* (MRSA). The antibiotic
resistance of MRSA makes it particularly difficult to treat. Therefore, prevention
by decontamination is key.

20 Traditional methods of decontamination in hospitals include the use of
low temperature steam, boiling water, and chemical disinfectants. However,
these methods are either ineffective or leave undesirable residues which can
cause damage to the component that is being decontaminated.

WO03/048421 discloses apparatus for electrolytically producing oxidation
25 reduction potential water from aqueous salt solutions for use in disinfection,
sterilisation, decontamination, and wound cleansing. The apparatus includes an
electrolysis unit having a three-compartment cell comprising a cathode chamber,
an anode chamber, and a saline solution chamber. Water is passed through the
anode and cathode compartments.

30 WO2005/094904 also discloses disinfectant solutions comprising
electrochemically activated water obtainable from electrolysis of brine. It is
indicated as preferred that the aqueous sodium chloride solution is fed into both
the anode chamber and cathode chamber of the electrolysis cell.

Access to safe drinking water is often difficult. One of these situations is in the developing world, where as many as 50% of the population will not have access to safe drinking water. Another example is on military operations in war zones; soldiers can often run out of safe drinking water.

5 In such situations, it is not a shortage of water that is the problem, but a shortage of safe drinking water. Often, water is available, but it may be full of contaminants, or it may have too high a salt content. Seawater or brackish water may be available, but it is not safe to drink.

Desalination is used to provide safe drinking water. A common method of
10 desalination is by reverse osmosis. However, this is expensive and requires a high balance of plant.

Summary of the Invention

The present invention solves three separate, but related problems. It was initially based on the realisation that salt water can be electrolysed to form
15 hydrogen and oxygen for energy storage, which can then be used to produce potable water and energy in a fuel cell. Further, the process of electrolysis of salt water produces hydrogen in approximately the same quantities as for the electrolysis of purified water, without the need for expensive purification equipment.

20 Hydrophilic membranes as used in the invention are not degraded by the high salt content, unlike conventional membranes. It has also been found that, when salt water is electrolysed, the electrolysed solution is biologically active. A further realisation was that the electrolysis of salt water may also be used to produce potable water directly.

25 According to a first aspect, the present invention is a method for producing hydrogen and oxygen using an electrolyser having first and second electrode compartments respectively on each side of a hydrophilic ion-exchange membrane, the method comprising adding salt water to one or both of the electrode compartments. As well as producing hydrogen and oxygen for energy
30 storage, this also provides a route to producing potable water. On the recombination of these gases (for example via a fuel cell, or traditional combustion techniques), energy is released and a by-product is pure (and therefore potable) water.

According to a second aspect, the present invention is a method of producing a biologically active solution using an electrolyser as defined above, the method comprising adding salt water to one or both of the electrode compartments.

- 5 According to a third aspect, the present invention is a method for reducing the salt content of salt water using an electrolyser as defined above, the method comprising adding salt water to one or both of the electrode compartments.

Description of Preferred Embodiments

- 10 As used herein, the term "salt water" means water comprising dissolved sodium chloride (NaCl). The term encompasses both "brackish water", which contains approximately 5-35 ppt of dissolved salts, seawater, which contains approximately 35-50 ppt of dissolved salts, and brine, which contains only dissolved sodium chloride (NaCl).

- 15 The composition of seawater varies around the world, but it typically contains dissolved chloride (approximately 15-25 ppt), dissolved sodium ions (approximately 5-15 ppt), dissolved sulphate ions (approximately 1-2 ppt) and dissolved magnesium ions (approximately 1-2 ppt). Seawater may contain other dissolved substances such as potassium ions, calcium carbonate, bromide and
20 iodide.

"Brine" is water containing dissolved sodium chloride (NaCl) only, i.e. it does not contain a substantial amount of any other dissolved salt. The term "brine" is interchangeable with "sodium chloride solution" and "saline".

- 25 As used herein, a solution that is described as being "electrochemically active" or "active", means a solution which has undergone electrochemical activation. Such treatment typically involves exposure of the solution to a substantial electrical potential difference. The method of the present invention involves the electrolysis of brine to produce an electrochemically active solution. The electrochemically active solution may be biologically active.

- 30 As used herein, the term "biologically active solution" means a solution that has activity against biological organisms. The solution may be bactericidal or yeasticidal, for example. The term "solution" encompasses both water and aqueous solutions, such as brine.

As used herein, potable water means water of sufficient quality to serve as drinking water. Preferably, potable water means water containing less than 1 ppt of dissolved salts. One aspect of the present invention is a method for reducing the salt content of salt water. In one embodiment, the present invention is a method for reducing the NaCl content of salt water. Preferably, the amount of Na⁺ in one of the electrode compartments is reduced. Preferably, the amount of Na⁺ in the anode compartment is reduced (in a cell having a CE, i.e. cationic exchange, membrane).

In a preferred embodiment, the reduction in salt content is substantial. Preferably, the reduction is more than 40%, more than 50%, more than 60%, more than 70%, more than 80%, or more than 90%.

Hydrophilic ion-exchange membranes are known to those skilled in the art, see for example WO03/023890, the content of which is incorporated herein by reference. The hydrophilic membrane is preferably a hydrophilic polymer. In a preferred embodiment, the hydrophilic membrane is obtainable from the copolymerisation of hydrophilic and hydrophobic monomers that give a hydrophilic polymer on polymerisation. Preferably, the copolymerisation is conducted in the presence of water and a monomer including a strongly ionic group. Examples of suitable monomers are disclosed in WO03/023890.

In a further preferred embodiment, the hydrophilic membrane is an anion exchange solid polymer membrane (AESPE), in which the charge carriers are the OH⁻ and Cl⁻ ions. AESPE membranes are disclosed in WO2005/060018 and WO2006/032887, the contents of which are incorporated herein by reference. When an AESPE membrane is used, hydrogen is produced at the cathode. AESPE membranes are preferred as they may reduce catalyst degradation. They also allow the optimisation of the catalyst in each chamber. Further, they allow catalysts to be used, which are not compatible with CE materials.

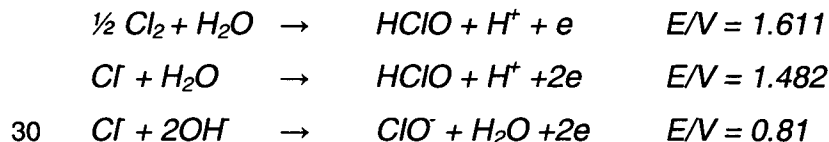
A proton exchange solid polymer membrane (more generally termed a cation exchange solid polymer membrane (CESPE)), may be used. Hydrogen is produced at the cathode and oxygen at the anode. Such a cell can be operated by supplying seawater either to the oxygen electrode, or to both electrodes.

In one embodiment, salt water may be added to each of the electrode compartments (the anode and the cathode). If using an electrolyser with a CE

membrane, then sodium ions (Na^+) will move from the anode to the cathode, such that the Na^+ content of the solution on the anode side of the membrane is reduced. The Cl^- present in the anode solution may be electrolysed to form chloride and hypochlorous acid. This may cause the anode water to become chlorinated, but the chlorine compounds may be removed before drinking. Any other positively charged ions present in the anode solution may also migrate through the membrane, to the cathode compartment such as H^+ , K^+ , Mg^{2+} and Ca^{2+} . This embodiment is illustrated in Examples 1 and 2.

In another embodiment, salt water may be added to one electrode compartment only, and the other electrode compartment may be substantially 'dry'. Preferably, salt water may be added to the anode side only of a CE membrane, and the cathode side of the membrane may be substantially dry. Since the membrane contains water, a very small amount of water may move from the membrane into the cathode compartment. However, even if this occurs, then the amount of water in the cathode compartment will be negligible. After electrolysis, the salt content of the anode solution may be reduced. This embodiment is illustrated in Example 3.

An AE (anionic exchange) electrolyser system is suitable for use in the invention. The membrane is an anionic exchange membrane. Sodium chloride solution may be added to the cathode and HPLC-grade water may be added to the anode. A CE electrolyser system may also be used in the invention. The ion exchange membrane is a cationic exchange membrane. Sodium chloride solution may be added to the anode, and HPLC-grade water may be added to the cathode. In both embodiments, chlorine is produced at the anode, but this may react further once in solution. A list of side reactions that may occur are listed below:



Hypochlorous acid (HOCl) and the hypochlorite ion (OCl^-) are present in equilibrium. It is thought that hypochlorous acid may be a more effective

disinfectant than the hypochlorite ion and therefore it may be preferable to alter the reaction conditions to favour the formation of hypochlorous acid. The equilibrium between HOCl and OCl⁻ may be manipulated by controlling the pH of the solution, for example.

5 According to a second aspect, the present invention is a method of producing a biologically active solution. In a preferred embodiment thereof, the electrolysis cell used in that method comprises a CE membrane, and has a first electrode compartment containing brine, but a second electrode compartment that is substantially dry. This produces biologically active brine.

10 There are a number of advantages to having a 'dry' electrode. One notable advantage is that 100% of the electrolysed solution can be used for decontamination; recombination of the anode and cathode solutions is unnecessary. Another advantage of having a "dry" electrode is that it may reduce the rate of degradation of the catalyst.

15 In a preferred embodiment, an electrolyser suitable for use in the invention comprises an AE membrane. Preferably, brine is added to the cathode compartment and water is added to the anode compartment. The brine and/or the water may be rendered biologically active. Having water on one side of the membrane may lead to a simplified and therefore lower-cost balance of plant.

20 An electrolyser suitable for use in a method of the invention can be sized to fit the decontamination requirements. In one embodiment, the method of the invention is performed using a small electrolyser attached to mop buckets filled with salt water, which activate the cleaning solution during use. An alternative embodiment uses a large electrolyser situated in a sterilisation room, where
25 equipment requiring sterilisation is passed through the activated brine for a pre-defined period of time.

 A further embodiment uses a small device positioned in a re-sealable container which, in addition to being an electrolyser, also has the ability to atomise the biologically active solution, for example by having an ultrasonic
30 atomiser nozzle. In one embodiment, a container is filled with brine; the brine may then be charged (by powering the electrolyser and activating the brine to a predefined level), atomised, and then used to clean, disinfect or sterilise. The device may be reused by re-filling with brine and then re-charging. This may

occur either when the device is empty, or when the brine has become inactive. The device may additionally contain a small fuel cell and gas storage facility, which can store and then use any hydrogen and/or oxygen gas that may be created during activation of the brine. This fuel cell may be used to power a monitoring device (for example, a clock, which resets on re-activation), thus giving a warning when the solution is no longer sufficiently active.

In one embodiment, the container, defined above, comprises an electrolyser having an AE membrane. The electrolyser electrolyses both water and brine, so that the water becomes biologically active.

The activated material may be used immediately on exit of the electrochemical device as a fluid, a fluid in a gas, or as a microscopic dispersion of droplets in gas. The material may be stored after activation, in controlled conditions, which may extend the activation life. The conditions to be controlled may include pressure, temperature, and UV exposure levels.

The present invention may be useful for the decontamination of large areas. The decontamination of large spaces or surfaces is useful in a variety of applications, for example in hospitals and other care facilities, cruise ships, aircraft, ventilation systems, swimming pools, schools, interior and exterior of buildings, underground tunnels and stations, cooling towers, water storage facilities, restaurants and hotels. Decontamination may be required on a routine basis to prevent infections such as MRSA or Legionella. Alternatively, it may be required on a one-off basis following an infection outbreak or a terrorist attack.

One aspect of the present invention effectively combines the production of potable water (e.g. from sea water) with the production and transmission of energy. In particular, if the output from solar photovoltaic electricity generation or wind power is used to power the seawater electrolysis process, the resulting hydrogen transmitted to areas where power is required, and the hydrogen combined with atmospheric oxygen in a fuel cell, the result is clean (low carbon footprint) energy and potable water as the outputs. This effectively removes the need for a separate desalination stage, thus reducing operating costs and environmental pollution.

There is also the possibility of generating a concentrated, mineral-rich aqueous solution from which commercially valuable minerals may be recovered.

In the case of seawater electrolysis, chlorine, alkali, sodium hypochlorite, hydroxides of calcium and magnesium, hydrochloric and sulphuric acids may be produced.

The invention will now be illustrated in the following Examples:

5 **Example 1**

Single Pass Electrolysis

An electrolyser cell with an active area of 8 cm² was set up using a cationic (OR) membrane and platinum-coated titanium catalyst. The composition of an OR membrane is disclosed in WO03/013890. The cell was
10 run at 0.555 A/cm² (4.4 A in total) at a flow rate of 70 ml/min.

The salt content of the circulating solution was measured pre and post-electrolysis at both the anode and the cathode, so that any changes in salt content due to electrolysis could be calculated.

Three different concentrations of sodium chloride were tested: 0.5; 1.5; and 3.5 wt %. The solutions were circulated around the cell on a one-pass
15 system. The results of these tests are shown in Table 1.

Table 1

Sample	Sample Salt Concentration (g/100 ml)	Percentage salt change	NaOCl Concentration (ppm)
0.5 wt % solution pre-electrolysis	0.337	N/A	10.9
0.5 wt % solution post-electrolysis (anode)	0.312	-7.4	47.8
0.5 wt % solution post-electrolysis (cathode)	0.356	+5.64	10.4
1.5 wt % solution pre-electrolysis	1.452	N/A	10.4
1.5 wt % solution post-electrolysis (anode)	1.321	-9	264.9
1.5 wt % solution post-electrolysis (cathode)	1.585	+9.2	11.2
3.5 wt % solution pre-electrolysis	3.245	N/A	12.9
3.5 wt % solution post-electrolysis (anode)	3.025	-6.8	331.0
3.5 wt % solution post-electrolysis (cathode)	3.456	+6.5	12.4

Example 2**Circulated Electrolysis**

The same cell as used in Example 1 was run with the sodium chloride
 5 solution re-circulated around both the anode and cathode for 1 hour with 3.5 wt % solution. The results are shown in Table 2.

Table 2

Sample	Sample Salt Concentration (g/100 ml)	Percentage salt change	NaOCl Concentration (ppm)
Pre-electrolysis anode	3.408	N/A	10.3
Pre-electrolysis cathode	3.524	N/A	10.2
Anode solution after 15 minutes electrolysis	2.841	-18.9	690
Cathode solution after 15 minutes electrolysis	4.039	12.3	10.5
Anode solution after 30 minutes electrolysis	2.484	-27.1	1371
Cathode solution after 30 minutes electrolysis	4.368	+24.6	10.5
Anode solution after 45 minutes electrolysis	2.028	-40.5	1386
Cathode solution after 45 minutes electrolysis	4.852	+37.7	10.6
Anode solution after 60 minutes electrolysis	1.645	-51.7	1394
Cathode solution after 60 minutes electrolysis	5.267	+49.5	10.6

Example 3

A test cell was run using a one-pass CE system with a dry cathode. The
 10 experiments were carried out using a range of sea salt concentrations from 0.5-3.65 wt %. The electrolysed solutions were tested for chlorine concentration and for salinity. The test cell was a small evaluation cell (~ 4.5 cm² active area). The test results are shown in Table 3.

Table 3

Sample	Salt concentration (g/100ml)	Percentage salt change	NaOCl concentration (ppm)
0.5 wt % solution pre-electrolysis	0.501	N/A	10.3
0.5 wt % solution post-electrolysis anode	0.478	-4.6	55.4
1.44 wt % solution pre-electrolysis	1.442	N/A	10.3
1.44 wt % solution post-electrolysis anode	1.345	-6.7	247.8
3.65 wt % solution pre-electrolysis	3.645	N/A	10.4
3.65 wt % solution post-electrolysis anode	3.450	-5.3	342.9

In Examples 1 to 3, the NaOCl that is produced in the anode has been shown to offer a decontamination effect. The NaOCl may be filtered prior to drinking, if this is necessary. Filtering methods are known to those of ordinary skill in the art.

Example 4

To simulate genuine sea water, sea salts were purchased from Sigma Aldrich. The average salinity of seawater was chosen as a base test (3.5%), which was prepared using the following components:

- 10 chloride 19290 mg/L
- sodium 10780 mg/L
- sulfate 2660 mg/L
- magnesium 1320 mg/L
- potassium 420 mg/L
- 15 calcium 400 mg/L
- carbonate/bicarbonate 200 mg/L
- strontium 8.8 mg/L
- boron 5.6 mg/L
- bromide 56 mg/L
- 20 iodide 0.24 mg/L

lithium 0.3 mg/L

fluoride 1.0 mg/L

The seawater was circulated at the anode and cathode of a PEM cell at a rate of 50 ml/min. The water did a single pass only. No re-circulation occurred.

- 5 The cell was a simple test cell comprising a Perspex cell housing/manifold with titanium electrodes and a titanium electrode mesh. Each cell had an active area of $\sim 6.6 \text{ cm}^2$. The membrane was an acidic membrane which was cured via UV polymerisation.

- 10 The electrolyser test was run at 1 Amp (150 mA/cm^2) for 20 minutes, without significant voltage rise. After 20 mins the voltage began to increase, possibly due to a contamination of catalysts from salt deposits or reactions occurring at the oxygen producing side. The voltage was approximately 4 V, significantly higher than would be expected for pure water electrolysis.

- 15 Oxygen production was approximately half that seen for pure water electrolysis, indicating that side-reactions were occurring, potentially creating alternative commercially valuable components.

Example 5

- 20 The seawater test was repeated for an alkaline membrane; the same test cell was used. Seawater made from the same components was used, and again flowed with a single pass at a rate of 50 ml/min. The membrane was an alkaline membrane which was cured by UV polymerisation.

- 25 The electrolyser test was run at 1 Amp (150 mA/cm^2) for a period of 5 hours. After an initially high voltage (5 V), the voltage dropped (within approximately 30 minutes) to 4.4 V and remained steady for the remainder of the test period. Oxygen production was approximately half that expected for pure water electrolysis, indicating that side-reactions were occurring, potentially creating alternative commercially valuable products.

Example 6

- 30 In an AE system, brine was circulated around the cathode and Millipore water was circulated around the anode. After running the cell at 1 A (approximately 140 mA/cm^2) for 1 hour, samples of the solution at both the anode and cathode were extracted. These samples were then mixed with a yeast solution in a ratio of 5:1 and, after 10 minutes, the solution was neutralised

with 5 ml of Ringer's solution. A 0.5 ml aliquot of the resulting mixture was then spread onto a nutrient agar plate and incubated for 48 hours at 37°C. The results showed that solutions from both the anode and cathode exhibited yeasticidal effects; no cultures were observed on any of the treated plates.

- 5 The experiment was repeated using a CE membrane, with brine circulated around the anode rather than the cathode. The results again showed that solutions from both the anode and cathode were yeasticidal.

 The experiment was further repeated, using both the CE and AE systems described above, but electrolysed solutions were left for 72 hours before treating
10 the yeast solution. The results showed that the solution retained enough anti-microbial activity after 72 hours, to kill the yeast.

Example 7

 Experiments were conducted using an AE cell electrolysing at 2 A (150 mA/cm²) with a flow rate of 20 ml/mm in a one-pass system. 4 M NaCl solution
15 was circulated around the cathode and HPLC water was circulated around the anode. Results showed that the electrolysed solutions had a chlorine concentration of at least 560 ppm, of which 80% is the useful free chlorine (HOCl and OCl⁻). The solutions were all shown to have yeasticidal activity.

Example 8

20 Experiments were conducted on bacteria (*E. coli*), using the AE and CE systems described in Example 6. The experiments were conducted in accordance with European Standard BSEN 1040 – "Chemical disinfectants and antiseptics – basic bactericidal activity – Test method and requirements (phase 1)". Samples were taken from the AE or CE system, and left for either 30
25 minutes or 24 hours before treating the bacteria.

 Four samples were tested:

1. A solution from the cathode side of an AE membrane test; left for approximately 30 minutes before treating bacteria.
2. A solution from the anode side of an AE membrane test; left for
30 approximately 30 minutes before treating bacteria.
3. A solution from the anode side of a CE membrane test; left for approximately 24 hours before treating bacteria.

4. A solution from the anode side of an AE membrane test; left for approximately 24 hours before treating bacteria.

A negative control (bacteria + 4 M brine solution) and a positive control (bacteria) were also tested.

5 The solutions were tested against *E. coli* K12 at three different contact times; 1, 5 and 30 minutes. The method followed was the standard method for the first phase of testing of any liquid chemical disinfectant or antiseptic. Each of the four test solutions showed bacterial survival in comparison to the controls of less than 0.0001%. The positive and negative controls showed approximately
10 80 million *E.coli* per ml.

Example 9

In an AE system, brine was circulated around the cathode and HPLC water was circulated around the anode, using a one-pass system. The cell was run at 0.5 A (approximately 70 mA/cm²) at a flow rate of 10 ml/min. A sample of
15 electrolysed water was extracted from the anode side of the cell, and tested against MRSA at three different contact times; 1, 5 and 30 minutes. At all three contact times, the test solution showed bacterial survival in comparison to the controls of less than 0.01%. The method of testing followed was the standard method for the first phase of testing of any liquid chemical disinfectant or
20 antiseptic.

A sample was also extracted from the cathode (brine) side of the cell, and tested against MRSA at three contact times; 1, 5 and 30 minutes. At all three contact times, the test solution showed bacterial survival in comparison to the controls of less than 0.01%.

Example 10

25 In an AE system, brine was circulated around the cathode and HPLC water was circulated around the anode, using a one-pass system. The cell was run at 1 A (approximately 140 mA/cm²) at a flow rate of 50 ml/min. A sample of electrolysed water was extracted from the anode and the brine from cathode of
30 the cell for testing.

In a CE system, brine was circulated around the anode and HPLC water was circulated around the cathode, using a one-pass system. The cell was run at 1 A (approximately 140 mA/cm²) at a flow rate of 50 ml/min. A sample of

electrolysed water was extracted from the cathode and the brine from anode of the cell for testing.

- The four solutions were tested against mycobacteria, which are thought to be a difficult group of bacteria to disinfect. Tests were conducted using *M. fortuitum*, a fast-growing Mycobacterium that is often used in testing as a surrogate of *M. tuberculosis*. The results are shown in table 4, below.
- 5

Table 4 – *M. fortuitum* Test Results

System	Result
CE (anode)	95.7% kill after 1 min, 99.999% kill after 5min
CE (cathode)	No effect
AE (anode)	96.6% kill after 1 min, 98.5% kill after 5 min, 99.97% kill after 30 min
AE (cathode)	No effect

CLAIMS

1. A method for producing hydrogen and oxygen from salt water, using an electrolyser having first and second electrode compartments respectively on each side of a hydrophilic ion-exchange membrane, the method comprising
5 adding salt water to one or both of the electrode compartments, and electrolysing the salt water.
2. A method according to claim 1, wherein the salt water is added to the first electrode compartment only, and the second electrode compartment is substantially dry.
- 10 3. A method according to claim 1, wherein the salt water is added to the first electrode compartment only, and water is added to the second electrode compartment.
4. A method according to any of claims 1 to 3, additionally comprising reacting the hydrogen and oxygen in a fuel cell to produce potable water.
- 15 5. A method of producing a biologically active solution using an electrolyser as defined in claim 1, the method comprising adding salt water to one or both of the electrode compartments, and electrolysing the salt water.
6. A method according to claim 5, wherein salt water is added to the first electrode compartment only, and water is added to the second electrode
20 compartment.
7. A method according to claim 5, wherein the salt water is added to the first electrode compartment only, and the second electrode compartment is substantially dry.
8. A method according to any preceding claim, wherein the membrane is a
25 cationic membrane.
9. A method according to any of claims 1 to 6, wherein the membrane is an anionic membrane.
10. A method for reducing the salt content of salt water using an electrolyser as defined in claim 1, the method comprising adding salt water to one or both
30 electrode compartments, and electrolysing the salt water.
11. A method according to claim 10, wherein the salt water is electrolysed until potable water is produced in one of the electrode compartments.

12. A method according to claim 10 or claim 11, wherein the salt water is added to the first electrode compartment only, and the second electrode compartment is substantially dry.
13. A method according to any preceding claim, wherein the salt water is
5 seawater.
14. A method according to any of claims 1 to 12, wherein the salt water is brine.
15. A method according to any of claims 1 to 12, wherein the salt water is brackish water.
- 10 16. A method according to any preceding claim, wherein the hydrophilic membrane is obtainable from the copolymerisation of hydrophilic and hydrophobic monomers that give a hydrophilic polymer on polymerisation, wherein the copolymerisation is conducted in the presence of water and a monomer including a strongly ionic group.