This invention uses alternating galvanized steel and perforated aluminum plates to increase the extraction rate of hydrogen from salt water by electrolysis. The galvanized steel plates are wired together to form the anode while the perforated aluminum plates are also wired together to form the cathode around which the hydrogen is extracted. The perforated aluminum also reacts with the sodium hydroxide, produced during electrolysis, to release even more hydrogen from the solution. The myriad of perforations in the aluminum plates creates numerous contact points with the solution so that the electrical current can extract the hydrogen more efficiently from the salt water.
METAL PLATE STACK FOR SALT WATER ELECTROLYSIS

FIELD OF THE INVENTION

[0001] Technical Field: Electrical and Chemical Engineering.

[0002] This invention uses galvanized steel plates as an anode and perforated aluminum plates as the cathode to increase the production of hydrogen from salt water by electrolysis.

BACKGROUND OF THE INVENTION

[0003] I have been experimenting with the electrolysis of salt water (Ocean water) for a number of years. The naturally occurring salt acts as an electrolyte in the water enabling a more efficient flow of electrons and the abundance of ocean water makes it an ideal solution from which to extract large quantities of hydrogen.

[0004] Electrolysis of salt water is not a new idea and has been demonstrated since the 1800’s. Many classes in schools today even study electrolysis of water and use salt as the electrolytic agent. While these types of electrolysis experiments can easily produce limited quantities of hydrogen, it was my goal to greatly increase the output of hydrogen from this electrolysis process.

[0005] I started out using carbon rods in the salt water to prevent rust and corrosion but the rods had a low rate of electrolysis. I next tried working with a nano-nickel electrode produced in California. The electrodes are produced on steel and started to rust right away. The amount of hydrogen produced by these expensive electrodes was similar to that of the carbon rods so that I could not see any advantage in their usage.

[0006] One of the bi-products of salt-water electrolysis is sodium hydroxide. While researching about the safe handling of this solution, I found that a combination of aluminum and sodium hydroxide would result in the increased production of hydrogen.

[0007] I thought that plates made of aluminum, perforated with many holes, would therefore make an ideal cathode around which to produce hydrogen by electrolysis. The anode plates would need to be corrosion resistant so I used galvanized steel plates. Both materials were readily available at a metal supply depot and I purchased them and experimented with various configurations until a maximum output was achieved. The combination of these plates has proven to be very effective. I found that the most productive configuration was an even number of galvanized plates so that the first and last plates are solid and help direct the produced gas upwards. These galvanized plates are combined with an odd number of alternating perforated aluminum plates. This combination proved to be effective in maximizing the hydrogen produced.

[0008] While several electrolysis cell patents use metal plates for their electrodes, none of the patents or applications utilizes a perforated aluminum plate for the cathode and a galvanized steel plate for the anode. In the electrolysis of salt water I have found these to be very efficient and desire a patent for this unique application.

SUMMARY OF THE INVENTION

[0009] This combination of metal plates, bolts, washers, nuts, wire and couplers represents years of experimentation in order to effectively produce hydrogen from electrolysis of salt water. Using flat metal plates as the electrodes has proven effective. Perforated aluminum plates used as the cathode, provide a larger surface area for electrical contact with the salt water, enabling increased formation of hydrogen than would be possible with a smooth plate.

[0100] The perforated cathode plates are surrounded on both sides by smooth anode plates that are made from galvanized steel. These plates facilitate electron flow as well as directing the gases produced in an upward direction. In the preferred embodiment an odd number of aluminum cathode plates and an even number of galvanized steel anode plates are used to form the electrolysis stack. I have used, for example fifteen plates, eight of which were galvanized steel and seven that were perforated aluminum. The two outside plates of the stack are galvanized steel and the perforated aluminum plates alternate position with the steel throughout the stack.

[0110] Perforated aluminum is used as the cathode plate as mentioned in the background, due to its ability to combine with sodium hydroxide and produce larger quantities of hydrogen. Sodium hydroxide is one of the by-products of the electrolysis of salt water and the solution’s contact with the aluminum results in the following:

\[ 2Al(s) + 6NaOH(aq) \rightarrow 3H_2(g) + 2Na_3AlO_3(aq) \]

[0112] By using aluminum plates for the cathode, more hydrogen will be produced over time than would normally be possible using another material. Since the aluminum will gradually deteriorate, these plates will require replacement and maintenance in order to continue working effectively.

[0113] The various galvanized steel anode plates are joined together by push on couplers and wires to form a continuous electrode that is then connected to the positive terminal of a direct current power supply. The perforated aluminum cathode plates are also joined to each other by couplers and wires and then also supplied with direct current but from the negative terminal of the power supply. Non-conductive plastic or rubber washers, bolts and nuts are used to insulate and position the various plates in their proper locations in the stack.

[0114] The plates would be fully submerged in salt water and the hydrogen and chlorine gases produced would rise to the surface of the water. The two gases would gather in a tank above the salt water and be separated by filters before being piped to separate storage tanks.

BRIEF DESCRIPTION OF THE DRAWINGS

[0115] FIG. 1 is a perspective view of an assembled stack of the metal plate electrodes.

[0116] FIG. 2 is a front view of the two different plates used in the stack.

[0117] FIG. 3 is a side view of an electrolysis stack showing all the plates, spacers and connectors that are used.

DETAILED DESCRIPTION OF THE INVENTION

[0118] Referring to FIG. 1 there is shown a perspective view of the metal plates arranged in alternating sequence to form an electrolysis stack.

[0119] The galvanized steel plates are on either side of a perforated aluminum plate. The galvanized plates act as the anode while the aluminum plates are the cathode around which the hydrogen bubbles are formed during electrolysis.

[0120] The aluminum plates are joined together by female nylon couplers and appropriate gauge wire to form a continuous link between all the plates. A male disconnect provides easy connection to the direct current power supply’s negative terminal output wire.

[0121] The galvanized steel plates are also all joined together by couplers and wires to form another continuous link. Each plate then becomes the anode when the male dis-
connect 10 is attached to a power supply wire that provides direct current from the positive pole of the direct current power source.

[0022] To prevent current from flowing from an anode to a cathode plate it is necessary to use plastic bolts 8, plastic washers 6 as spacers and plastic bolts 7 to fasten the stack together.

[0023] This drawing illustrates seven plates in the stack but any odd number of plates may be used to create the electrolysis stacks with the only limitation being the length of the plastic bolts 8.

[0024] Referring to FIG. 2 there is shown a front view of the two types of metal plates used in creating the electrolysis stack. Also illustrated at the bottom of the plates are the nylon couplers and their wires that join plates of the same metal together.

[0025] FIG. 2 shows the galvanized steel plate 1 on the left with the perforated aluminum plate 2 on the right. Four holes 12 are drilled into each plate to facilitate the four plastic bolts 8 as illustrated in FIG. 1. Each plate also has two tabs 11 cut into the side of the plate. On the galvanized plates 1 the two tabs 11 are on the left side and on the aluminum plates 2 the tabs are on the right.

[0026] These cut out tabs 11 allow for a female nylon coupler 13 & 18 to be slipped over them so that the appropriate gauged wire 5 can supply current to each of the plates in the stack. All of the aluminum plates are joined together to form the cathode electrodes while all of the galvanized plates are joined together to form the anode electrodes. Plastic washers and bolts are necessary to insulate the plates from each other during electrolysis.

[0027] Referring to FIG. 3 there is shown the side view of a seven plate electrolysis stack. There are four galvanized steel plates 1 and three perforated aluminum plates 2 in this illustration. The plates are separated by plastic washers 6 to prevent current flow directly from an anode to a cathode plate.

[0028] Each aluminum plate 2 is connected to another aluminum plate by the use of appropriate gauged wire 5 connected to the plates by slip-on female nylon couplers 3. The wire 5 is crimped inside the couplers 3 and the couplers slide onto the tabs of the plates that were cut out during their manufacturing. The aluminum plate closest to the bolt end (left side of FIG. 3) also has a current supply wire 20 with a male connector on its end. This connector attaches to the female coupler 23 that is on the wire to the negative terminal of the direct current power source.

[0029] The galvanized plates 1 are also connected to each other by the same means using wire and slip-on female nylon couplers 18 to join all of them together to also form one electrical path. The front plate, closest to the bolt end, has a current supply wire 21 attached to it as well. A wire from the positive terminal of the direct current power supply is attached to the supply wire 21 by a female coupler 22 that enables all of the galvanized plates to function as anodes during the electrolysis of the salt water.

[0030] Bolts 8, washers 6 and nuts 7 are all made of plastic in order to prevent a short circuit between the anode and cathode plates. Care must be taken that no aluminum cathode plate touches a galvanized anode plate once the stack is assembled.

[0031] Decreasing the space between the anode and cathode plates increases the production of the gases during electrolysis. It is advantageous therefore to put the plates as close to each other as physically possible when assembling an electrolysis stack. The minimum distance is determined by two factors when building a stack. The first is the thickness of the plastic washers that are used to separate the plates in the stack, and the second is the ability to slide on the female couplers over their corresponding plate’s tab. I found that a plate spacing of two millimetres was the closest that I could install the plates in order to meet these two conditions.

1. A system for producing hydrogen from salt water by electrolysis using alternating metal plates as the anode and cathode. The anode plates are made from galvanized steel and the cathode plates are made from aluminum with numerous holes perforating them. In the preferred embodiment these plates form a stack of even numbered galvanized plates and an odd number of perforated aluminum plates. The galvanized steel plates are joined together by appropriate gauged wire and couplers and then attached to the positive pole of a direct current power supply in order to form the anode. The perforated aluminum plates are also joined together by wire and couplers and attached to the negative terminal in order to form the cathode around which the hydrogen is extracted. Plastic or rubber washers, bolts and nuts are used to insulate the anode plates from electrical current in the cathode plates in order to prevent a short circuit. The completed series of plates form a stack, held in place by the bolts, washers and nuts, and they are then submerged in the salt water with the electrical current supplied when ready for the electrolysis to begin. The resulting hydrogen and chlorine gases would gather above the water’s surface, be separated by filters, collected and safely stored in separate tanks.

2. A system according to claim 1, characterized by using aluminum plates with numerous holes or perforations to form the cathode in an electrolysis stack of alternating metal plates. The numerous perforations provide abundant contact points for the electrolysis of the salt water resulting in a dramatic increase in the extraction of the hydrogen. The aluminum composition of the cathode will also react with the sodium hydroxide produced during electrolysis, to release more hydrogen from the solution that would be possible using another metal for the cathode plate. This chemical reaction between the aluminum plates and the sodium hydroxide will slowly cause the aluminum plates to deteriorate eventually necessitating their replacement as part of routine maintenance.

3. A system according to claim 1, characterized by using alternating metal plates, the one made from galvanized steel and the other made from aluminum with numerous perforations throughout the plate. These are mounted on plastic bolts to form a stack of plates usable for the electrolysis of salt water. In the preferred embodiment there is a galvanized steel plate at the beginning and end positions of the stack. The perforated aluminum and galvanized steel plates are alternated in position and held in place by non-conductive washers and bolts. Each perforated aluminum plate would thus be sandwiched by a galvanized plate in front of and behind it in the stack. The preferred embodiment would thus require an even number of galvanized steel plates and an odd number of perforated aluminum plates. An electrolysis stack will function with an even number of aluminum plates, but the preferred embodiment contains an extra galvanized steel plate at one end of the stack.

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