INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN: 2278 – 0211

Cheaper Electrodes Having Higher Efficiency Using Salt Water And Salt Vinegar Electrolytes

S. Ramakanth
Electrical And Electronics Engineering,Visakha Institute of Engineering and Technology, Visakhapatnam

Abstract:

This paper gives how salt water and salt vinegar is used as a renewable energy source. Working of salt water and salt vinegarelectrolytes and both the combination of electrolytes, comparison of different electrodes used in the electrolytes. And choosing which is the best pair of electrodes.applications of it in many fields.

Keywords: *Electro-chemicalreaction,Electrolyte,Vinegar,corrosion.*

1. Introduction

We know that our earth covered with 70% of water and 30% of land. So water occupies more space than land but 97% is the salt water and 3% is the fresh drinking water. Many technologies are developed to use salt water for producing electrical energy. The energy produced in this way is renewable energy source. Ex**:** salt water battery, salt water generators etc. The modern battery is found in high-tech applications ranging from hearing aids and pace-makers to pocket calculators, personal stereos, radios and mobile phones. They are everywhere and completely invaluable. The origin of the power behind the battery is chemical. In the following paper I explain the how the electrolysis occur and what are the different reaction of different electrodes for the better efficiency.

1.1How These Work – Electrolysis

The voltage created in a battery is due to ionic chemistry. When a metal electrode is immersed in an electrolyte a rather complex dynamic process occurs. Let us assume that the metal electrode is initially uncharged the resistance is high; the voltage will appear to drop as current is drawn from the battery. The internal resistance of cells is a major limiting factor in the application and usefulness of a real battery.

2. Electrolyte

Seawater-activated batteries are designed to operate in an infinite electrolyte, namely, the oceans of the world. However, for design, development, and quality control purposes, it is not practical to use ocean water. Thus it is common practice throughout the industry to use simulated ocean water. A commercial product, composed of a blend of all the ingredients required, simplifies the manufacture of simulated ocean water test solutions. Batteries, activated by pouring the electrolyte into the battery where it is absorbed.By the separator, can utilize seawater when the temperature is above freezing. The use of a conducting aqueous electrolyte will result in faster voltage buildup. However, the introduction of salts in the electrolyte will increase the rate of self-discharge.

2.1. Performance Characteristics

The resistance (ohms) of the cell may be calculated using the formula

$$R = \rho \frac{l}{a}$$

Where R –resistance, Ω

*l*_ length of slot, cm

*a*_ cross-sectional area of slot, cm2

*p*_ resistance of electrolyte for temperature and salinity in which battery is operating,_ Ω cm

The voltage of a cell depends primarily on the electrochemical system involved. To increase voltage, a number of cells must be connectedin series. The capacity of a cell in ampere-hours is primarily dependent on the quantity of active material in the electrodes. The ability of a cell to produce a given current at a usable voltage depends on the area of the electrode. To decrease current density so as to increase load voltage, the electrode area must be increased. Power output depends on the temperature and salinity of the electrolyte. Power output can be increased by increasing the temperatureOr the salinity of the electrolyte and the voltage is calculated by the

Ohm's Law

V=RI

2.2. An Experimental Salt Water Electrolyte

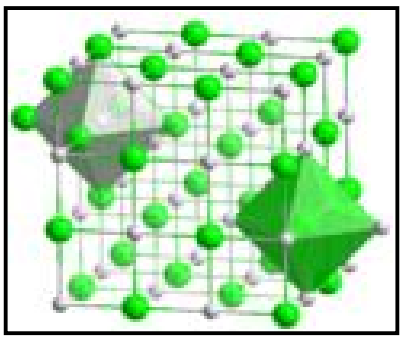

Figure 1:Behavior Of Salt (NACL) In Water

Sodium chloride, also known as salt, common salt, table salt or halite is an ionic compoundwith the formula NaCl (sodium chloride). Sodium chloride is the salt most responsible for the salinity of the ocean and of the extracellular fluid of many multicellular organisms. As the major ingredient in edible salt it is commonly used as a condiment and food preservative.

Solubility of NaCl in in water (g NaCl / 1 kg of solvent at 25 °C)	
H_2O	360

Table 1

When dissolved in water, the sodium chloride framework disintegrates as the Na^+ and Cl^- ions become surrounded by the polar water molecules. These solutions consist of metal aquo complex with the formula $[Na(H_2O)_x]^+$, where x is 8 with the Na-O distance of 250 pm. The chloride ions are also strongly solvated, each being surrounded by an average of 6 molecules of water. Solutions of sodium chloride have very different properties from pure water. The freezing point is −21.12 °C for 23.31 wt% of salt, and the boiling point of saturated salt solution is near 108.7 °C.From cold solutions, salt crystallises as the dihydrate $NaCl·2H_2O$

2.3. Reaction Of Elements With Salt(Nacl)

2.3.1. Aluminium(Al)

When aluminium element reacts with salt water.the following reaction will occur

Balancedequation

$Al + 3\ NaCl = AlCl_3 + 3\ Na$

2.3.2. Pencil Lead(Pb)

When lead element reacts with salt water the following reaction will occur.the balanced equation is

$Pb + 2\ NaCl = Pb(NaCl)2.$

2.3.3.Copper(Cu)

When copper element reacts with salt water the following reaction will occur. The balanced equation is

$Cu + NaCl = CuCl + Na$

2.3.4.Brass

There is no chemical formula for brass because it is an alloy and not a chemical compound. Brass is made by combining copper and zinc in an approximately 2 to 1 ratio. But there are a ton of different alloys, each with its own ratio of copper to zinc and each with its own mechanical properties. Brass is of 2 brassYELLOW BRASS.

60 % copper 40 % Zinc RED BRASS 85% copper 15% Zinc as a mineral however it would be Cu3Zn2

The table given below given the behavior of electrodes when a soft salt is added to the water taken in a plastic glass.And how the elements Al,cu,Pb,Brass alloy reacts with salt water and measuring the output voltage by using a digital multimeter.

S.No	Element-1	Element-2	Generated output dc voltage(v)
1	aluminium	Pencil lead	0.85
2	aluminium	copper	0.61
3	aluminium	Yellow brass	0.5
4	Pencil lead	Yellow brass	0.31
5	copper	Yellow brass	0.24
6	copper	Pencil lead	0.12

Table 2

The above values are taken when water is taken in 40-50ml and 2-3 spoons of soft salt. And the readings are noted with the multimeter with connecting wires and using clips and make sure that the elements do not touch each other and avoiding loose connections.the above table clears that what the element reacts with aluminium produce maximum voltage. The above cleared that aluminium and pencil lead behaves like a good electrodes. Whatever the value of input the behavior is same for all electrodes. The voltage levels are decreases from top to bottom as we observe in the table.

3.An Experimental Vinegar Salt Electrolyte

3.1. How The Vinegar Works And Reaction

As in the previous the salt doesn't dissolve fully in water.so the efficiency is less when we added a dilute acetic acid the salt fully decreases and the efficiency is high and solubility is high.

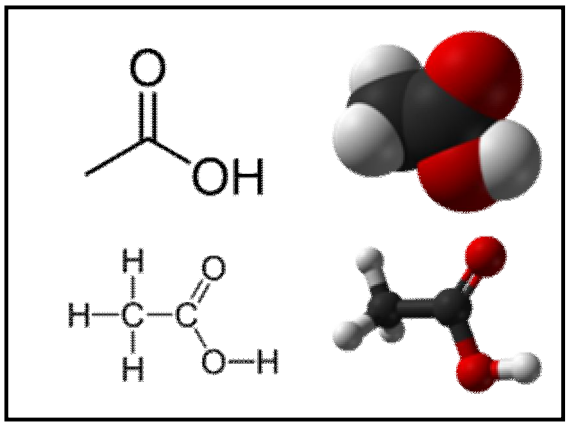

Figure 2

Acetic acid (systematically named ethanoic acid is an organic compound with the chemical formula CH_3CO_2H (also written as CH_3COOH). It is a colourless liquid that when undiluted is also called *glacial acetic acid*. Acetic acid is the main component of vinegar (apart from water; vinegar is roughly 8% acetic acid by volume), and has a distinctive sour taste and pungent smell. Besides its production as household vinegar, it is mainly produced as a precursor to polyvinylacetate and cellulose acetate. Although it is classified as a weak acid, concentrated acetic acid is corrosive, and attacks the skin.Acetic acid is one of the simplest carboxylic acids. It is an important chemical reagent and industrial chemical, mainly used in the production of cellulose acetate mainly for photographic film and polyvinyl acetate for wood glue, as well as synthetic fibres and fabrics. In households, diluted acetic acid is often used in descaling agents. In the food industry, acetic acid is used under the food additive code E260 as an acidity regulator and as a condiment. As a food additive it is approved for usage in the EU, USA and Australia and New Zealand.The global demand of acetic acid is around 6.5 million tonnes per year (Mt/a), of which approximately 1.5 Mt/a is met by recycling; the remainder is manufactured from petrochemicalfeedstock. As a chemical reagent, biological sources of acetic acid are of interest but generally uncompetitive. Vinegar is dilute acetic acid, often produced by fermentation and subsequent oxidation ofethanol.

3.2. Reaction Of Elements With Vinegar(Dilute Acetic Acid)

3.2.1. Aluminium(Al)

When aluminium element reacts with vinegar.the following reaction will occur

$2\ Al + 6\ CH_3COOH = 2\ Al(CH_3COO)_3 + 3\ H_2$

3.2.2. Pencillead (Pb)

When lead element reacts with Vinegar the following reaction will occur. The balanced equation is

$2\ Pb + 6\ CH_3COOH = 2\ Pb(CH_3COO)_3 + 3\ H_2$

3.3.3. Copper (Cu)

When copper element reacts with Vinegar the following reaction will occur. The balanced equation is

Balancedequation:

$Cu + 2\ CH_3COOH = Cu(CH_3COO)_2 + H_2$

3.3.4. Brass

There is no chemical formula for brass because it is an alloy and not a chemical compound. Brass is made by combining copper and zinc in an approximately 2 to 1 ratio. But there are a ton of different alloys, each with its own ratio of copper to zinc and each with its own mechanical properties. Brass is of 2 brass YELLOW BRASS having the following composition. In this we used yellow brass having the following percentages 60 % copper 40 % Zinc RED BRASS 85% copper 15% Zincas a mineral however it would be Cu3Zn2.

The table given below given the behavior of electrodes when a soft salt is added to the dilute acetic acid(vinegar) taken in a plastic glass. And how the elements Al,cu,Pb,Brass alloy reacts with dilute acetic acid and measuring the output voltage by using a digital multimeter.

S.No	Element-1	Element-2	Generated output dc voltage(v)
1	aluminium	Pencil lead	0.85
2	aluminium	copper	0.7
3	aluminium	Yellow brass	0.55
4	Pencil lead	Yellow brass	0.50
5	copper	Yellow brass	0.21
6	copper	Pencil lead	0.14

Table 3

The above values are taken when dilute acetic is taken from 40-50ml and 2-3 spoons of soft salt.and the readings are noted with the multimeter with connecting wires and using clips and make sure that the elements do not touch each other and avoiding loose connections.the above table clears that what the element reacts with aluminium produce maximum voltage.the above cleared that aluminium and pencil lead behaves like a good electrodes.whatever the value of input the behavior is same for all electrodes.the voltage levels are decreases from top to bottom as we observe in the table-3

4. An Experimental Salt Vinegar Water Electrolyte

The table given below given the behavior of electrodes when both the above mixtures are mixed.and how the elements Al,cu,Pb,Brass alloy reacts with both the above mixtures that is salt water and salt vinegar and measuring the output voltage by using a digital multimeter.

S.No	Element-1	Element-2	Generated output dc voltage(v)
1	aluminium	Pencil lead	0.85
2	aluminium	copper	0.65
3	aluminium	Yellow brass	0.55
4	Pencil lead	Yellow brass	0.32
5	copper	Yellow brass	0.15
6	copper	Pencil lead	0.10

Table 4

The above values are taken when the above 2 mixtures are mixed that is salt water and vinegar salt and the readings are noted with the multimeter with connecting wires and using clips and make sure that the elements do not touch each other and avoiding loose connections.the above table clears that what the element reacts with aluminium produce maximum voltage. The above cleared that aluminium and pencil lead behaves like a good electrodes. what ever the value of input the behavior is same for all electrodes. The voltage levels are decreases from top to bottom as we observe in the table-4

5. Results Output Pictures

The experiment output using the electrodes aluminium and pencil lead

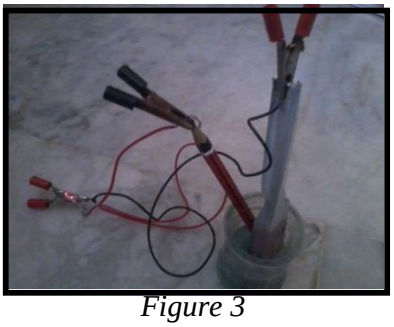

Figure 3

In the above i used pencil lead and aluminum for a better and efficient result.

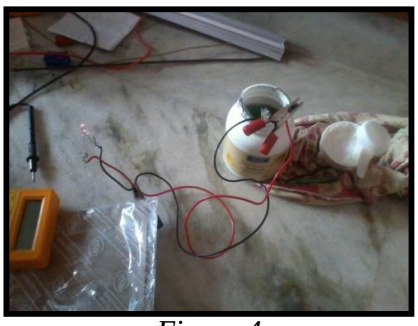

Figure 4

6. Comparison From The Above 3 Tables

It is observed that the order is not changing it is fixed that is the voltage ratings order is fixed but in the reading there is a slight variations. The second table that is vinegar salt electrolyte is the best method comparing the readings with the remaining. The efficiency is high and it is cheaper.

7. Efficiency

By using the electrodes aluminum and lead we getting maximum efficiency as shown in the above tables and it is cheaper.

8. Protecting Aluminum From Corrosion

To stop the corrosive effects, however, you must apply a protective coating to the aluminum and keep the coating maintained over time. To help protect the surface of patio furniture, lighting, railings, gates and other items made from aluminum in coastal environments and other areas where salt damage is common, protective paint coatings are generally used. Aluminum is a metal that does not hold paint well; however, so self-etching primers are frequently used to provide a good base for paint. Other types of coatings are available, as well, including powder coating, which applies pigment electrostatically to the surface along with a resin, according to the Powder Coating Institute website. This coating is then baked at high temperatures to give the aluminum a tough and attractive surface. Powder coating pigments come in a wide range of colors.

9.Applications

9.1.In The Emergency Life Jacket

In the emergency life jacket lights in the fifth series of Rough Science set in Zanzibar (BBC2 Feb. 2005). When the life jacket went into the sea it activated the battery, powering the emergency lights.

9.2. Salt Water Battery Cuts Desalination Energy Use By 80%

Half of the world's population is affected by poor water quality and water borne diseases claim the lives of 1.5 million children every year.

But conventional desalination techniques such as reverse osmosis, distillation takes more energy which means existing technologies cannot reach to the world's poorest people.

So, using a salt water battery is a new desalination technology and the energy source is concentration difference between solutions at different salinity.

The only electricity we need is to run pumps and move fluids around so it uses about 80% less electricity than reverse osmosis.

9.3.In Boats, Campers, Etc

As main source of dc power for sailboats without generators for lights, navigation and communications.

As a backup source of power for boating, camping, hunting or emergencies.

As a light weight, small footprint alternative to wet cell batteries and lanterns and as life rafts.

9.4.Salt Water Power Plant

Here the electricity is generated due to the difference in salinity in fresh water and sea water. This process is called as mixed entropy.

The mixed entropy battery alternately immerses its electrodes in river water and sea water to produce the electrical power.

The battery is filled with fresh water and charged. Then the fresh water is swapped out for salt water. The electric potential increased and the battery can discharge at a higher voltage, providing more electricity.

After the battery is discharged, the salt water is drained and fresh water is added to begin cycle again.

A good location for a mixing entropy battery power plant would be where river water enters into sea water.

10. Desalination

Salt water battery cuts desalination energy use by 80%Half of the world's population is affected by poor water quality and water borne diseases claim the lives of 1.5 million children every year.But conventional desalination techniques such as reverse osmosis, distillation takes more energy which means existing technologies cannot reach to the world's poorest people. So, using a salt water battery is a new desalination technology and the energy source is concentration difference between solutions at different salinity.The only electricity we need is to run pumps and move fluids around so it uses about 80% less electricity than reverse osmosis.

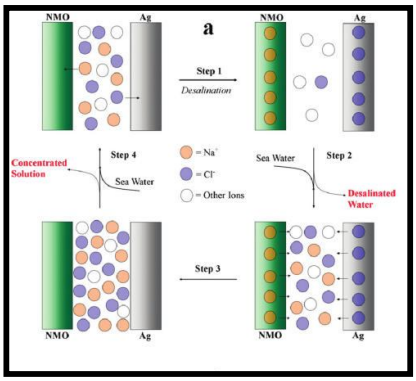

Figure 5

11.Advantages

Efficiency is high

Cost is less when compared to normal battery as it uses cheap metal magnesium and electrolyte salt water

It is non toxic because it does not contain the acids, lead metal.

Cleaning of the salt water battery is easy.

Eco friendly.

For storing the solar and wind energy effectively with less expensively compared to normal battery.

No corrosion

Converts the voltage output of a dc source to a higher voltage

Comprises a capacitor within the battery electrolyte port a method of measuring intercell short circuit.

12.Conclusion

We all know that world is facing an energy crisis so it is necessary to use renewable energy sources. More technologies should be developed for increasing the output power of the battery and also the efficiency of it. There are many power plants all over the world that generate electricity by using the salt water. We should use this renewable energy source for the development of our country. It has applications in every field. The effective use of it reduces many losses.it has the maximum efficiency and it is cheaper.

13.Reference

1. Jonathan Myer creative science available http://www.creativescience.org.uk/sea1.html
2. http://www.miniscience.com
3. http://www.ehow.com
4. Boonsri Dickinson/October 31, 2011 12:14pm PDT
5. New type of rechargeable battery-just add salt water by AlanBrandon may 5, 2011.
6. Martel, B.; Cassidy, K. (2004). Chemical Risk Analysis: A Practical Handbook. Butterworth–Heinemann.p. 369.ISBN 1-903996-65-1.
7. Dinker B. Sirdeshmukh, LalithaSirdeshmukh, K. G. Subhadra (2001). Alkali halides: a handbook of physical properties. Springer.pp. 65, 68.ISBN 3-540-42180-7.
8. Burgess, J. (1978). Metal Ions in Solution. New York: Ellis Horwood. ISBN 0-85312-027-7.
9. ^ S. F. Lincoln, D. T. Richens, A. G. Sykes "Metal Aqua Ions" Comprehensive Coordination Chemistry II Volume 1, pp. 515–555. doi:10.1016/B0-08-043748-6/01055-0
10. ^ IUPAC, Commission on Nomenclature of Organic Chemistry (1993). "Table 28(a) Carboxylic acids and related groups.Unsubstituted parent structures". A Guide to IUPAC Nomenclature of Organic Compounds (Recommendations 1993).Blackwell Scientific publications.
11. ^"Acetic Acid - PubChem Public Chemical Database". The PubChem Project. USA: National Center for Biotechnology Information.
12. IUPAC Provisional Recommendations 2004 Chapter P-12.1; page 4