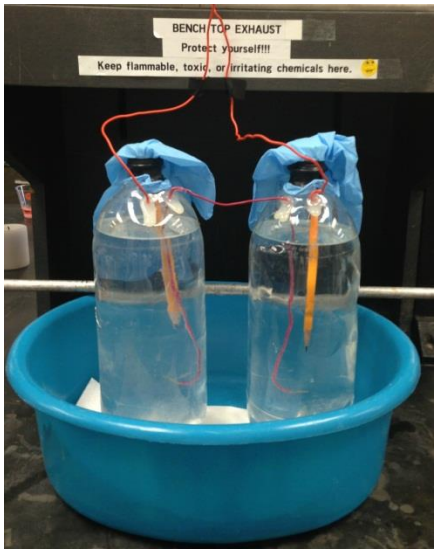
California State University of Bakersfield, Department of Chemistry

Electrolysis of Water



Standards:

HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-4. Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

Introduction:

Combustible fuels are in limited supply on planet Earth. Fossil fuels will become more and more expensive and will one day be completely used up. Synthetic fuels like ethanol require a substantial input of resources to create. Alternative power sources like solar or wind will never be viable alternatives as they are highly inefficient. The world needs sensible fuel alternatives. Water is an abundant resource. Salt water, fresh water and even ice contain two highly combustible elements: oxygen and hydrogen. Fortunately for use, these two elements are bonded together very tightly in the water molecule or else we would be surrounded by highly combustible gases! If we can find safe and effective ways to split them apart (electrolysis) and collect them for fuel, we can solve our future fuel issues. This experiment seeks to help us understand how easy it can be to split the water molecule into its two constituents and collect the two gases separately.

Materials:

- 10% salt water solution
- Electricity (Two 9V batteries work well)
- Steel electrical wire
- Pencils
- Pencil sharpener
- Tape
- Two 2L bottles
- Hot glue gun with glue sticks
- Two small bags or latex gloves
- Duct tape

Safety:

- Always have an adult with you to help you during your experiment.
- Always wear eye protection and gloves when doing chemistry experiments

Procedure:

1. In our electrical setup, we will be using pencil leads as our electrodes (electrical contacts). Regular cooper wire would corrode too fast to run our electrolysis machine very long. The carbon in pencil graphite is conductive, but will not corrode. To use the pencils as electrodes, sharpen both ends and expose the carbon graphite. Once sharpened, attach the steel wire to one end of each electrode. Wrap the wire tightly around the exposed graphite and tape it in place. Duct tape works well for fixing the wires in place.

2. Cut a hole in each 2L bottle at about 2 inches above the bottom. Thread a straw between each bottle and use hot glue to secure in place so it doesn't leak. Wrap a thin strip of duct tape around the top and bottom of each bottle to secure together. Cut a small hole in each top to thread the electrode wire through it so the electrode bottom is not touching the bottom of the bottle and hot glue into place. Fill each bottle about ¾ with a 10% salt solution.

3. Attach a small bag or latex glove to the top of each bottle. These will collect the gases.

4. Connect two 9V batteries in series. Attach one electrode wire to each side, completing the circuit.

5. You should see bubbles coming off each electrode (pencil tip). You will notice one side is definitely generating more (the hydrogen side).

6. While the electrolysis is slow, do not let the bags or gloves collect too much gas as the gases are highly explosive.

Data and Observations:

Record your observations in this space

What did you see? Anything you were not expecting? Describe it here.

Which side creates the most gas (has more bubbles?) Why?

How can we show it is oxygen or hydrogen in the bags/gloves?

References:

1. Finucane, W. Create Tomorrow's Fuel Today: split Hydrogen and Oxygen From Water with a Pencil and a Battery. Mad science. http://mad-science.wonderhowto.com/how-to/create-tomorrows-fuel-today-split-hydrogen-and-oxygen-from-water-with-pencils-and-batter. (accessed 08/01/2013)