Petri Dish Electrolysis

Purpose

Demonstrate the decomposition of water through electrolysis; investigate oxidation and reduction reactions, by observe resulting changes in pH.

Background Information

Oxidation is the process in which atoms lose electrons. Reduction is the process in which atoms gain electrons. The conducting surfaces at which electric current passes into and out of the solution are called electrodes. The electrode where oxidation occurs is called the anode, while the electrode where reduction occurs is called the cathode. In an electrolytic cell, the anode is (+) and the cathode is (–).

Universal indicator is an acid–base indicator that is different colors at different pH values (Table 1). Excess OH^- ions produced at the cathode cause the pH to increase, resulting in a color change of the universal indicator solution from green (neutral, pH 7) to purple (basic, pH ≥ 10). Excess H^+ ions produced at the anode cause the pH to decrease, resulting in a color change of the universal indicator solution from green to orange-red (acidic, pH ≤ 4).

Table 1. Universal Indicator Color Changes

pH	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Color	Red	Orange	Yellow	Green	Blue/green	Dark blue	Purple

Materials

- Sodium sulfate solution, Na_2SO_4, 1 M, 20 mL
- Bogen Universal indicator solution, 2–3 mL
- Petri dish
- Battery cap with alligator clip leads
- Battery, 9-V
- Pencil lead, 0.9 mm (or 2 short pieces)
- Stirring rod

Safety Precautions

Universal indicator is an alcohol-based solution and is flammable; do not use near an open flame. Wear chemical splash goggles and a chemical-resistant apron.

Procedure

1. Pour enough sodium sulfate solution into half of a Petri dish to just cover the bottom – about 20 mL in each.
2. Add 2–3 mL of universal indicator to each solution to give each a rich, transparent green color. Gently stir to get a uniform color.
3. Break a long pencil lead in half, or obtain two smaller halves. Attach the leads to opposite sides of the Petri dish bottom with the alligator clips. Make sure the tip of each lead is submerged in the green solution and the alligator clips remain out of the solution. The solution in the Petri dish top will serve as a control.

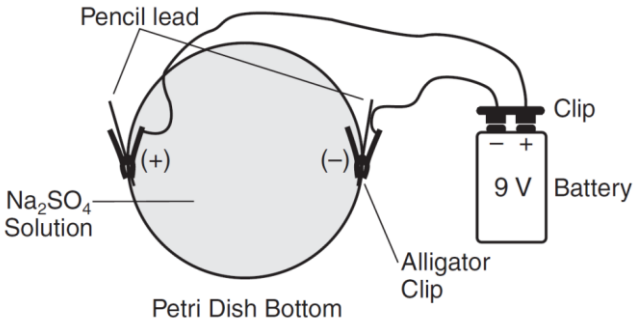

Figure 1.

Note: *Place extend the pencil leads further into the dish than the diagram shows.*

4. To start the demonstration, clip the 9-volt battery into the snaps on the battery cap (Figure 1).
5. Let the experiment run for 5 – 10 minutes. Observe and record all changes as the current flows through the electrolysis solution. Be specific—compare the changes at the pencil leads attached to the positive (+) and negative (–) terminals of the battery. Record your observations in the observations section.
6. Disconnect the alligator clips from the Petri dish and carefully remove the carbon pencil leads from the solution. Rinse the pencil leads with water from a wash bottle and gently pat dry with a paper towel.
7. Stir the sodium sulfate solution in the Petri dish and observe the final indicator color of the solution after mixing. Record your observations in the section below.
8. If you need more observations, repeat! This time, instead of clipping the alligator leads to the Petri dish, hold the alligator clips with the pencil lead attached in your hands. Move the leads around in the solution and make a little art!

Observations

1. Is a gas being produced? How do you know?

Conclusion based on your observations. Write a balanced chemical equation for the reaction you observed.

Conclusion based on your observations. Identify which gas is hydrogen and which gas is oxygen based on the rate of bubbling. Explain each.

Positive electrode:

Negative electrode:

2. Are the rates of color production the same at each electrode? Which color formed first?

Conclusion based on your observations. Identify which gas is hydrogen and which gas is oxygen based on the rate of color formation.

Positive electrode:

Negative electrode:

3. Describe more specifically the colors that form at each electrode. Record the specific colors at the positive electrode and at the negative electrode. Do the colors change with time?

    Positive electrode:

    Negative electrode:

Conclusion based on your observations. What pH changes are responsible for the changing colors? Use the table to record specific pH values.

Positive electrode:

Negative electrode:

Conclusion based on your observations. Identify which gas is hydrogen and which is oxygen based on the change in pH at each electrode. Explain

Positive electrode:

Negative electrode:

4. In the final step when you swirled the sodium sulfate solution, what color did it turn?

Conclusion based on your observations. What pH changes are responsible for the changing color?

Disposal & Clean Up

The sodium sulfate solution may be disposed of down the drain with excess water. Gently rinse and dry the pencil leads. Wash the Petri dishes thoroughly with soapy water, rinse thoroughly and dry. Return all supplies to the front lab station.