Electrolysis Feasibility Test 2

Objective: To test how feasible electrolysis is for use as a flow visualization on MSD project P13456.

Materials Used:

- Power supply
- Multimeter
- Water container
- Water
- Sodium Bicarbonate (Baking soda)
- Copper wire – 2 ½ inches in length

Test Setup / Procedure:

1. Fill water container with 7 cups of room temperature tap water.
2. Suspend electrodes in water such that half is submerged and they are set ½ in apart.
3. Place desired voltage on electrodes.
4. Record current draw.
5. Video bubble formation.
6. Turn off power, dissolve 1 Tsp of Sodium Bicarbonate and repeat.

Results:

In total, five setups were tested. All tests included sodium bicarbonate, which served as an electrolyte. The electrodes were set to ½ in apart from one another.

Table 1: Data gathered from electrolysis of various set ups.

	Voltage [V]	Current [mA]	Power [W]	Sodium Bicarbonate [Tsp]
Setup 1	12	580	6.96	1
Setup 2	24	200	4.80	1
Setup 3	24	400	9.60	2
Setup 4	24	610	14.64	3
Setup 5	24	740	17.76	4

Figure 1: The electrodes (left-cathode, right-anode) after all testing were complete.

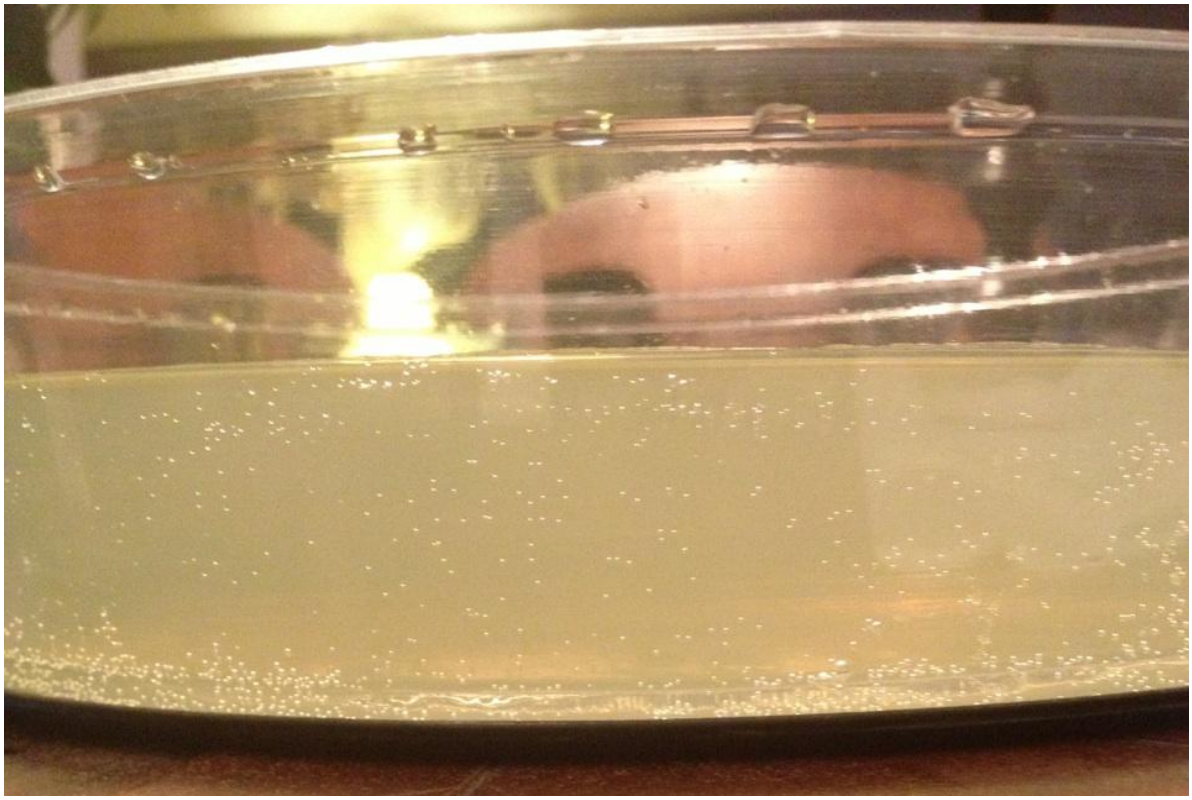

Figure 2: Water color after all testing was complete.

Discussion:

The main purpose of this re-test was to better understand the electrodes necessary for adequate bubble formation. For this test, copper wire of 2 ½ inches was used for both the anode and cathode. Based on previous results it was only necessary to test with two operating voltages. 12V was tested once and the remaining tests were done using 24V. These results can be found above in table 1.

Figure 1 shows the corrosion or residue left behind by the sodium bicarbonate after it has been energized in the water. The left wire shown in figure 1 was used as the cathode, where the hydrogen bubbles form. The wire is looped at the end to better control where the hydrogen bubbles will form. The right wire was used as the anode. Seen by this photo, there is a black build up as a result of the sodium bicarbonate reacting with the water. The buildup began almost instantaneously after power was supplied to the electrodes. Throughout the testing the buildup continued which in affected began to decrease the resistance in the wire therefore reducing the rate at which electrolysis was happening.

Figure 2 is a photo taken after all experimentation was complete. Seen here the water is discolored due to the chemical reaction that the copper wire had with the energized water. The water began to develop a green tint to it. The tint was not nearly as visible from the top view.

As expected the sodium bicarbonate increased the rate at which electrolysis was happening. This re-test used teaspoons as opposed to tablespoons which was used during the previous test. The main purpose for this change was to better judge how sodium bicarbonate acts as an electrolyte.

Videos have been captured and are shown outside of this document. These videos will better show the bubble formation as water is circulated around the bowl. Some of the disadvantages observed include the following: for the best results, electrodes must be kept close to one another, an electrolyte is absolutely necessary for the low voltage operating ranges; copper electrodes cannot be used as the performance begins to deteriorate after ~10minutes of operation.

As for a result on feasibility, electrolysis remains a potential flow visualization technique. To better understand how feasible this can be, platinum, tellurium or stainless steel can be used as the electrode in this experiment. These metals are highly conductive while at the same time are resistive to corrosion. This will allow us to better understand the lifetime materials as well.