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Colourful electrolysis vortex in a magnetic field

Colourful electrolysis vortex instructions

In this experiment, a magnet and a coloured solution show the processes involved in water electrolysis.

Water electrolysis requires an electric current to pass through water and, in addition to the formation of the elements hydrogen and oxygen, leads to acid–base chemical reactions and phenomena, in this case under the effect of a magnetic field.

Materials

- Petri dishes
- Carbon electrodes
- Crocodile clips and cables
- Tap water
- A sulfate or nitrate salt, e.g., sodium sulfate, magnesium sulfate, sodium nitrate)
- Sodium bicarbonate (baking soda, sodium hydrogen carbonate)
- Universal indicator solution
- Power supply (9 V) or 9 V battery
- Disc-shaped neodymium magnet

Safety notes

Neodymium magnets generate strong magnetic fields and forces that can cause injury if they snap together. Keep them well separated and handle with caution.

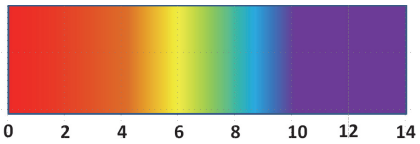
Avoid letting the electrodes or metal parts of the crocodile clips touch once they are connected to the power supply. This causes a short circuit, which could lead to overheating of the batteries or the power-supply unit.

Procedure

1. Prepare a sodium sulfate or nitrate salt solution in tap water ($c \approx 0.1$ mol/l or 0.5 g/50 ml).

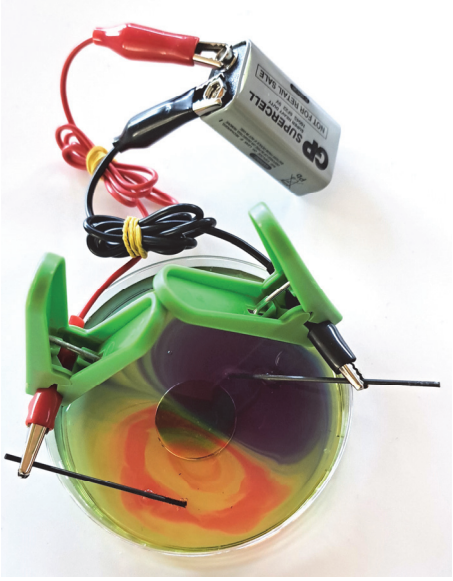
   Alternative: add a spatula tip of sodium sulfate directly to tap water (20 ml) in a Petri dish.

2. Add a few drops of universal pH indicator. The solution should be slightly alkaline (see the pH scale below). If not, add a few grains of sodium bicarbonate and stir to adjust the pH to neutral or slightly alkaline. The solution should be green at the start of the experiment.



Universal indicator solution at different pH values
Image courtesy of the author

3. Pour about 20 mL of the solution into a Petri dish so that it is about half full. Place the Petri dish on the disc-shaped neodymium magnet. Connect one end of each carbon electrode to each pole/outlet of a 9 V battery or a power-supply unit and place the other end in the solution.



Experimental setup before starting electrolysis. Once the electrode tips are placed in the solution at opposite ends of the dish, pegs can be used to hold them in place or you can carefully hold the crocodile clips by the plastic insulation material. Just don't let them touch each other.
Image courtesy of the author

4. Let the experiment run for a little while and observe any changes. Write down your observations.
5. After disconnecting the electrodes from the power source and removing them, try swirling the dish gently to mix the two halves. What do you see?
6. Discuss the results and explain what you see.
7. What variables could you change? Formulate a hypothesis about how this would change the results.
8. Discuss your suggested change with the teacher (to make sure it's safe) and then try out the change to test the hypothesis.
9. If your teacher gives you different materials to carry out variations of the experiment, follow the same procedure with the new material.