

COPPER VOLTAMETER CATALOG GS-432

THE EXPERIMENTS OR DEMONSTRATIONS DESCRIBED IN THESE INSTRUCTIONS MAY INVOLVE HAZARDS FROM CARELESS HANDLING OR INCORRECT PROCEDURES. THIS EQUIPMENT SHOULD BE USED ONLY UNDER THE STRICT GUIDANCE AND SUPERVISION OF A QUALIFIED, CERTIFIED SCIENCE TEACHER.

Michael Faraday (1791-1867) worked extensively with electrolysis and formulated two fundamental laws. The first states that the amount of material liberated by a reaction is proportional to the total quantity of electricity that has passed through the cell. That is to say, proportional to the amount of current and the time during which it flowed. Faraday's work also showed the amount of an element plated out of a solution or produced as a gas was directly related to the atomic mass and valence of that element. The second law of electrolysis states that 96,540 coulombs produces A/V grams of an element, where A equals the atomic mass and V is its valence. The quantity of 96,540 coulombs is called a Faraday.

The GS-432 copper voltameter is used to confirm Faraday's second law of electrolysis. A procedure is as follows:

Dissolve 95 grams of copper sulfate in 700 ml of distilled water in the battery jar. SLOWLY AND CAREFULLY add 90 ml of sulfuric acid. Considerable heat will be liberated so handle the battery jar with care. Remove the center copper plate, weigh it carefully, and then re-install it in position.

Place the top, with all the copper plates installed, in position on the battery jar. Connect the black binding post (center plate with single connecting strap) to the minus side of the power supply. Connect the red binding post (two outside plates with two connecting straps) to the positive terminal. The power supply should be rated for at least 2 amperes at 6 VDC. Use a series connected 10 ohm, 50 watt rheostat between the power supply and the GS-432 Voltameter to adjust the current.

Atomic weight of copper = 63.54

Valence of copper = 2

One coulomb = one ampere-second

The electrodes should be thoroughly cleaned before storage. They are interchangeable and, from time to time, their positions should be varied. The copper sulfate-sulfuric acid solution should be correctly labeled and stored for use on another occasion.



Perhaps the first question that comes to mind is why must we add copper sulfate to the cell? If we start with copper electrodes, water and sulfuric acid, the first thing that will happen when we turn the power on is electrolysis of the water. Hydrogen will be liberated at the cathode and oxygen at the two anodes. Then slowly a bluish tint will appear near the anodes as the copper forms copper sulfate with the help of the electric current. And of course some of these copper ions plate out at the cathode, but the electrolysis of the water interferes to such an extent that the deposit is a porous, mushy mud.

What we really want to have happen is somewhat different. By pre-establishing a reasonable level of copper ions in the solutions, we create a condition wherein the current will cause a copper ion to plate out at the cathode while another goes into solution at the anode, thereby keeping the concentration of the solution constant. With a high level of copper ions in the solution, there is excellent conductivity and no electrolysis of the water occurs at low current levels. The new deposit on the cathode will be fairly shiny and smooth. In electroplating shops, proprietary additives are put into the solution to help the copper ions plate out to a very smooth matte or shiny surface as may be desired.