Electrolytic Reaction

Electrolytic Reactions do not occur spontaneously, they can be forced to take place by supplying electrical energy by an external current.

Faraday's law

One Faraday is one mole of electrons, with notations 1F=1 mol of electrons where F stands for Faraday. One coulomb is the amount of charge that moves at any given point in circuit when a current of 1 ampere is supplied for 1 second.

Faraday's law states that during electrolysis, the passage of 1 faraday through the circuit brings about the oxidation of one equivalent weight of a substance at an electrode (anode) and the reduction of one equivalent weight at the other electrode (cathode). Note that in all cells, oxidation occurs at the anode and reduction occurs at the cathode (in terms of electrons).

Problem solving example

If you want to plate out m=50g of copper from an aqueous solution of $CuSO_4$. Assuming 100% efficiency, how many coulombs of charge is required.

Solution

In this example we deal with electrolysis. When an electric current is applied to a solution containing ions, the ions will be reduced or oxidized to their electronically neutral state.

We realize that there are Cu^{2+} ions in the solution. In order to plate out copper, two electrons must be added to obtain the copper atom Cu^0. Since Cu^{2+} must gain electrons, it is be reduced. The amount of electricity that produces a specific amount of reduction (or oxidation) is related by q=nF (Faraday's law). Here, q is the quantity of electricity in coulombs, n is the number of equivalent oxidized or reduced ions, and F is faradays. The number of equivalent oxidized or reduced ions equals the equivalent weight of material, M_{eq},which is one half of an atomic mass of copper, since a copper ion requires two electrons for reduction. We obtain the atomic mass of the copper from the Periodic Table tool which is provided by MatDeck from the Toolbox menu.

```
m := 50
M_cu:=63.546
Meq := M_cu / 2
```

$$N := \frac{m}{Meq}$$

A faraday is 1F=96500 coulombs, or one mol of electrons. The required amount of coulombs is:

$$q := N \cdot 96500\ C$$

$$q = 151858.496\ C$$