

Electric writing

Introduction

This demonstration resurfaced when we were in the process of clearing out old paperwork, prior to our move from Edinburgh to Fife. It had originally been done by one of our Senior Associates in 1988! Here we gave it a slight twist by changing the solution and the electrode used as the pen. It generated a great deal of interest when displayed at the National Chemistry Teachers' Conference in St. Andrews. Ah - the old ones are still the best!

It can be used for S1/S2 in *Changing Materials, Level E* to show changes in appearance in chemical reactions and in Standard Grade, and Intermediate 1 and 2 to show chemical reactions. It also makes an eye-catching experiment for an open-evening/parents' night.

What you will need

Chemicals

potassium chloride, 1M solution
(3.725g/50 cm³ of solution)

bromothymol blue indicator solution

Equipment

atomiser spray bottle, 60 cm³

filter paper

white tile

d.c. supply, low voltage

2 x leads (one with a crocodile clip, the other with a 4 mm jack plug)

hair dryer

gloves, disposable

eye protection (goggles)

The demonstration

Place 6 cm³ of the indicator in the atomiser and top up with 50 cm³ of potassium chloride solution.

Label as *electric ink*. This has prompted many a question as to its composition!

Place the filter paper on the white tile and connect it via the crocodile clip to the low voltage supply (set at 10 V dc) as shown in Fig. 1 with the *pen* connected to the negative electrode (cathode).

Spray the filter paper with the potassium chloride/indicator mixture until it goes a pale yellow colour. The paper will have been bleached previously by an acidic solution. Hence the yellow colour of the indicator.

The paper should be quite wet but not so the solution is running off it.

Switch on the power supply and use

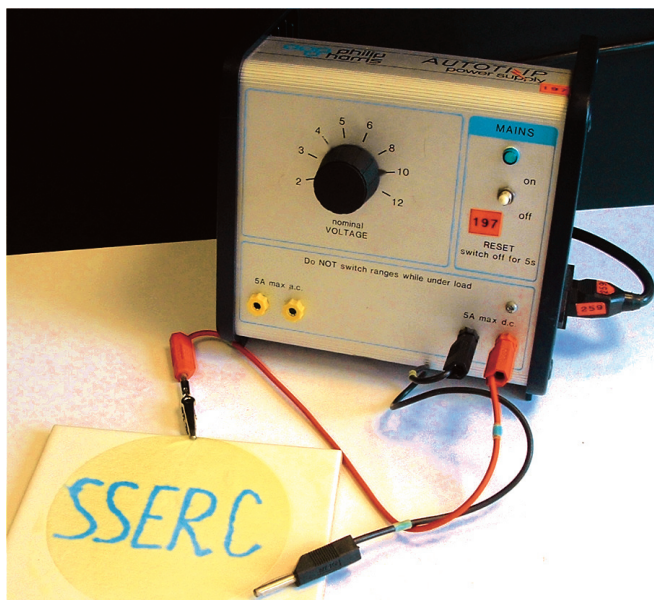


Figure 1 - Apparatus for electric writing

the *electric pen* (4 mm plug) to write a message on the wet filter paper. Dry the paper and watch the message fade away. Spray with distilled water and it magically reappears.

What makes it happen?

Water molecules in the solution are reduced at the black 4 mm plug (cathode, -ve) producing hydroxyl ions making the solution near to the *pen* alkaline. The resulting colour change in the indicator is from yellow to blue.

Various adaptations are possible :-

(a) Replace the bromo-thymol blue indicator with phenolphthalein and the message appears in pink.

It can be dried to make it fade and re-sprayed with water to make it reappear as before.



Figure 2 - with phenolphthalein

(b) Duplicate the original experiment by replacing the 1M potassium chloride solution with 1M potassium iodide solution but with no indicator. Change the electrodes round so the 4 mm plug *pen* is connected to the positive terminal of the power supply and the crocodile clip to the negative.

Now when a message is written by the *pen* the iodide ions are oxidised to iodine molecules and the message appears brown.

(c) Add 10 cm³ of a 1% starch solution to 50 cm³ of the 1M potassium iodide solution and the message appears blue/black due to the reaction of the iodine molecules with the starch.

Suggestion: have all four experiments available to pupils to stimulate discussion of the different colours.



Figure 3 - with iodine



Figure 4 - with starch/iodine

Chemical	Main Hazard	Control Measures
Bromo-thymol blue	HARMFUL if ingested in quantity or inhaled as dust. FLAMMABLE solution.	Avoid raising dust. Wear eye protection and ensure ignition sources are absent.
Phenolphthalein	HARMFUL by ingestion. IRRITANT to eyes and respiratory system. FLAMMABLE solution.	Avoid raising dust. Wear eye protection and ensure ignition sources are absent.

Table 1 - Safety measures