

The Blue Bottle

Purpose

To demonstrate a re-occurring oxidation-reduction reaction and to stimulate interest in chemical reaction mechanisms.

Materials

500 mL Florence flask	methylene blue
dextrose	potassium hydroxide
rubber stopper	reazurin

Procedure

1. Dissolve 8.0 grams of KOH in 300 mL of distilled water and place the solution in a 500 mL stoppered Florence flask.
2. 5 to 10 minutes prior to demonstration, add 10 grams of dextrose to the flask and swirl to mix.
3. Add 6-8 drops of methylene blue indicator solution (0.2 gram of crystal per 100 mL of distilled water) to the flask. A deep blue solution will result when swirled.
4. The blue color will disappear after a minute or two.
5. To demonstrate, hold a thumb over the stopper and shake. The blue color will return, then disappear again. The longer the flask is shaken, the longer it will take to disappear.

Additional Information

1. Methylene blue, an oxidation-reduction indicator, is deep blue in the oxidized state and colorless in the reduced state.
2. When the colorless solution is shaken, the oxygen in the air above the solution changes the methylene blue to its blue oxidized form. When allowed to stand, the oxidized methylene blue is gradually reduced by the dextrose to the colorless form.
3. If the demonstration is repeated many times, it will be necessary to loosen the stopper for a moment or two, so that the oxygen can be replenished.

4. A variation involves using reazurin indicator solution (0.1 gram reazurin crystals per 100 mL of distilled water) in place of the methylene blue solution.
5. Add the reazurin solution drop by drop until the solution appears a fluorescent reddish-blue. The solution will turn to a fluorescent red in about two minutes, then colorless in another one minute.
6. Shaking the flask results in the red appearance that will again disappear (Red Bottle).
7. Another variation. Add reazurin solution to the original saline dextrose solution. Wait for it to be colorless and add methylene blue solution. Wait for it to be colorless.
8. Shake gently. It will turn red. Then shake vigorously. It will change to blue, then to violet, then to red, and back to colorless.

Disposal

The solution can be poured down the drain with excess water.

Reference

ICE Demonstration Workshop, University of Arizona, 1987.

Shakharshiri, Bassam; Chemical Demonstrations, Volume II, 1985