Oscillating Orange and Blue – New Version

Purpose

To demonstrate an oscillating chemical reaction in University colors.

Materials

three 1 L flasks or beakers	hot plate
1 100mL beaker	Potassium iodate, KIO_3
1 50mL beaker	30% Hydrogen peroxide, H_2O_2
4 L Beaker	Concentrated Sulfuric acid, H_2SO_4
magnetic stirrer / bar	Malonic acid, $CH_2(CO_2H)_2$
Soluble starch	Manganese(II) sulfate monohydrate, $MnSO_4$

Procedure

Preparation

1. Solution A: In a 1 L flask or beaker, add 410mL of H_2O_2 and fill to the 1L mark with DI water.

2. Solution B: In a 1 L flask or beaker, add 43g of potassium iodate to 800mL of water. Add 4.3mL of concentrated H_2SO_4 to this mixture. Warm and stir the mixture until all the potassium iodate has dissolved. Fill to the 1L mark with DI water.

3. Solution C: In a 1L flask or beaker, dissolve 16g of malonic acid and 3.4g of manganese(II) sulfate monohydrate in 500mL of DI water. In the 100mL beaker, heat 50mL of DI water to a boil. In the 50mL beaker, mix 0.3g of soluble starch with approximately 5mL of DI water and stir the mixture to a slurry. Pour this slurry into the 50mL of boiling water continuing to heat and stir the mixture for 2 minutes. Pour this starch solution into the solution of malonic acid and manganese(II) sulfate, then fill to the 1L mark with DI water.

Presentation

1. Set the 4 L beaker on the hot plate, and add the magnetic stirrer.

2. Add Solution A to the 4 L beaker. Turn on the magnetic stirrer and stir at a rate to produce a vortex.

3. Add solution B.

4. Add solution C.

5. Adjust stirring to produce vortex.

6. Observe color changes.

Additional Information

1. Color should oscillate from orange blue colorless.

2. Reaction will occur for up to 15 minutes.

3. This demonstration involves a series of complex reactions. In the first series of reactions oxygen gas and iodine are formed.

4. The iodine reacts with starch to produce the blue color.

5. As the iodine is used up the color fades but reforms as iodine concentration increases.

Disposal

Solutions can be poured down the drain with excess water.

Reference

Shakhashiri, Bassam; Chemical Demonstrations, Volume 2, 1983. 248-256