Briggs-Rauscher Oscillating Reaction

Dr. Pennington is often found missing his Alma Maters colors: that University of Michigan blue and gold! Here in College Station, swarmed by maroon and white, and Howdy, how can Dr. Pennington celebrate the big blue and gold? With chemicals of course! He is a chemist after all, so this all sounds rather perfect.

All you will need is a 1-liter glass Erlenmeyer flask, a stirrer plate, a magnetic stir bar, and 250 ml of each of the following solutions:

- Solution A: Add 43 grams of Potassium Iodate (KIO_3) too 800 mL of water. Stir in 4.5 ml of Sulfuric Acid (H_2SO_4). Continue stirring until the potassium iodate has dissolved. Dilute the solution to 1 liter with water.

- Solution B: Add 15.6 grams of Malonic Acid ($HOOCCH_2COOH$) and 3.4 grams of Manganese Sulfate Monohydrate ($MnSO_4 . H_20$) to 800 mL of water. Add 4 grams of vitex (soluble) starch. Stir until dissolved and dilute the solution to 1L with water.

- Solution C: Dilute 400 ml of 30% Hydrogen Peroxide (H_20_2) to 1 L with water.

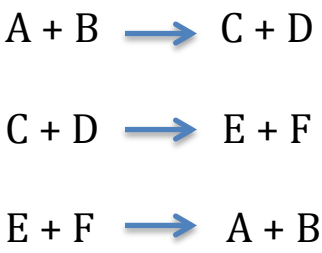
Next, plug in the stirrer plate, place the magnetic stir bar in the beaker, and place the beaker on the stir plate. Pour 250 ml each of solutions A and B into the beaker, then turn on the stir plate and adjust the speech to produce a large tornado. After solutions A and B have mixed, pour in 250 ml solution C. Voilà! Blue and Gold! The reaction will produce the color changes for about 5 minutes, then eventually become a dark blue color permanently.

This demonstration involves elemental iodine which, when inhaled, can cause respiratory distress. You must wear gloves and safety glasses, and perform the demonstration in a well-ventilated area, preferably under a chemical hood. During the Chemistry Road Show, a beaker is placed over the mouth of the reaction flask to prevent the iodine from escaping. Use caution when handling the chemical solutions as they contain strong irritants and oxidizing agents.

As far a cleanup, 10 grams of sodium thiosulfate may be added SLOWLY to the reaction mixture. The sodium thiosulfate reduces leftover iodine to iodide. This reaction is very exothermic. It is also prone to froth and bubble over the sides of the flask. The addition of sodium thiosulfate should be done in a sink or in a tray to catch any overflow. Once quenched, the reaction mixture can safely be poured down the drain and rinse with water.

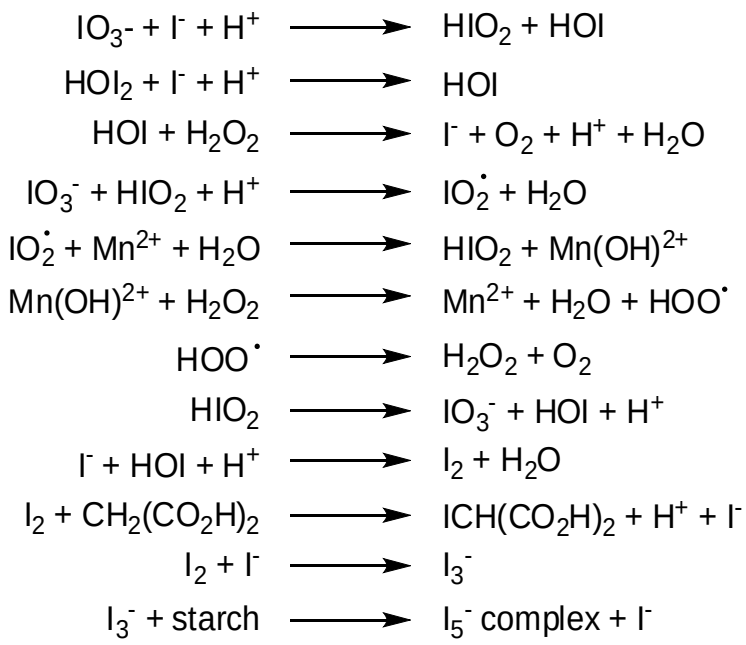
Now let's look at the basic chemistry of this reaction. Essentially, three separate chemical reactions are occurring, but the products of the first reaction are

the reactants of the second reaction. The products of the second reaction are the reactants of the third reaction, and the products of the third reaction are the reactants of the first reaction, thus restarting the entire cycle.



The amber color results from the production of iodide (I_2), the clear color results from iodide being consumed more quickly than it is produced, and the blue color results from iodine ions (I^-) and iodide binding to the starch in the solution.

A more detailed representation of the processes that occur in the Briggs-Rauscher reaction are best represented by the following equations:



The observed colors during the oscillating cycle are due to the presence of either I_2 (amber colored) or the I_5^- starch complex (blue colored).

References:

Shakhashiri, B.Z. 1985. *Chemical Demonstrations – A Handbook for Teachers of Chemistry*, Vol. 2 The University of Wisconsin Press: Madison. P. 248-256.

About.com, Chemistry Education.
http://chemistry.about.com/cs/demonstrations/a/aa050204a.htm.