

Kinetics - The Iodine Clock Reaction (#5)

THE OSCILLATING IODINE CLOCK REACTION

When three colorless solutions are stirred together, the result shortly becomes amber, and then quite suddenly blue. The colorless, amber, and blue sequence of colors is repeated in a cycle of several seconds for some minutes. This is a good "gee whiz" demo. It can also be shown in Chem 480AB as an example of an oscillating reaction.

MATERIALS

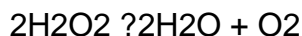
- solution 1: hydrogen peroxide, ca. 12%
- solution 2: potassium iodate in aq. sulfuric acid
- solution 3: aq. Malonic acid, manganese(II) sulfate, and starch
- 1000mL beaker
- magnetic stirrer & stir bar

PRESENTATION

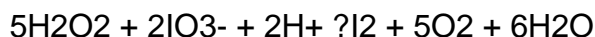
- Set the 1000mL beaker onto the magnetic stirrer and add the stir bar
- Fill the beaker with up to 250mL of solution 1
- Add an equal amount of solution 2 (this does not have to be exact)
- Begin stirring the solution
- Add an equal part of solution 3
- The reaction will begin within 30 seconds and continue for at least a few minutes

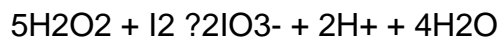
DISCUSSION

This reaction, called the *Briggs-Rauscher Reaction*, does not really oscillate in the sense that the reactants are restored to their initial state. The net reaction, which is simply



proceeds inexorably onward. What oscillates is the concentration of I_2 in the reaction mixture (made observable by the presence of starch). IO_3^- is the catalyst for the decomposition of hydrogen peroxide according to the reactions





Although this explains part of what is going on, it does not make clear why I_2 is present during some stages of the reaction (giving it a blue color because of the complex I_2 forms with starch) and absent during others. An extensive discussion of this reaction and of oscillating reactions in general is given in the Reference.

HAZARDS (MSDS Links)

Iodine (main product): <http://www.sciencelab.com/msds.php?msdsId=9927547> ^[1]

Potassium Iodate: <http://www.sciencelab.com/msds.php?msdsId=9927231> ^[2]

Malonic acid: http://wardsci.com/images/pdf/msds/Malonic_Acid_438.00.pdf ^[3]

Hydrogen Peroxide (12%): <http://www.reagent.co.uk/uploads/documents/HYDROGEN-PEROXIDE-12-Percent-w-w-MSDS.pdf> ^[4]

Sulfuric Acid (<1M): <http://www.sciencelab.com/msds.php?msdsId=9925146> ^[5]

Manganese II Sulfate: <http://www.labchem.net/msds/75541.pdf> ^[6]

References:

B. Z. Shaksashiri, *Chemical Demonstrations*, Vol. 2, p. 249.

T. S. Briggs and W. C. Rauscher, *J. Chem. Educ.*, **50**, 496 (1973).

[Undergraduate](#) ^[7]

Department of Chemistry and Biochemistry at The University of Arizona
P.O. Box 210041, 1306 East University Blvd., Tucson, AZ 85721-0041
Phone: 520.621.6354 Fax: 520.621.8407

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http://www.chem.arizona.edu/lecture_demos/the_iodine_clock_reaction

Links:

- [1] <http://www.sciencelab.com/msds.php?msdsId=9927547>
- [2] <http://www.sciencelab.com/msds.php?msdsId=9927231>
- [3] http://wardsci.com/images/pdf/msds/Malonic_Acid_438.00.pdf
- [4] <http://www.reagent.co.uk/uploads/documents/HYDROGEN-PEROXIDE-12-Percent-w-w-MSDS.pdf>
- [5] <http://www.sciencelab.com/msds.php?msdsId=9925146>
- [6] <http://www.labchem.net/msds/75541.pdf>
- [7] <http://www.chem.arizona.edu/taxonomy/term/11>