

Laboratory Safety Standard Operating Procedure (SOP)
(for the use of hazardous materials or equipment)

NAME OF PROCEDURE: Belousov-Zhabotinsky Reaction (Engineering Open House exhibit)

PREPARED BY: John Doe

REVISION DATE: 02/22/10

LOCATION – This procedure may be performed at the following location(s):

[indicate room / building of exhibit]

HAZARDS – The materials and equipment associated with this procedure present the following exposure or physical health hazards. Safety precautions are prudent and mandatory:

Malonic Acid

WARNING! CAUSES EYE IRRITATION. MAY CAUSE IRRITATION TO SKIN AND RESPIRATORY TRACT. MAY BE HARMFUL IF SWALLOWED.¹

Potassium Bromate

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE OR FORM SHOCK SENSITIVE MATERIALS. MAY BE FATAL IF SWALLOWED. HARMFUL IF INHALED OR ABSORBED THROUGH SKIN. CAUSES IRRITATION TO SKIN, EYES AND RESPIRATORY TRACT. MAY CAUSE KIDNEY DAMAGE.¹

Potassium Bromide

WARNING! HARMFUL IF SWALLOWED OR INHALED. AFFECTS CENTRAL NERVOUS SYSTEM, BRAIN AND EYES. MAY CAUSE IRRITATION TO SKIN, EYES, AND RESPIRATORY TRACT.¹

Sulfuric Acid

POISON! DANGER! CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY TISSUE. MAY BE FATAL IF SWALLOWED OR CONTACTED WITH SKIN. HARMFUL IF INHALED. AFFECTS TEETH. WATER REACTIVE. CANCER HAZARD. STRONG INORGANIC ACID MISTS CONTAINING SULFURIC ACID CAN CAUSE CANCER. Risk of cancer depends on duration and level of exposure.¹

Ferriin Solution

Caution! May cause respiratory tract irritation. May cause skin irritation. May cause eye irritation. The toxicological properties of this material have not been fully investigated. Target Organs: No data found.²

1 - JT Baker MSDS

2 - Fisher MSDS

ENGINEERING CONTROLS – Prior to performing this procedure, the following safety equipment or device features must be available and ready for use (e.g., chemical fume hood, glove box, gas cabinet, pressure-relief valve, automatic shut-off, intrinsically safe hot plate):

General ventilation.

ADMINISTRATIVE CONTROLS – This procedure requires the following training (e.g., pyrophorics handling, corrosive gas techniques), **techniques** (e.g., use spatula when weighing powder, warm cryogenically cooled material in stages), **work practices** (e.g., attended operation only, working alone prohibited, notify lab occupants), and **warning devices** (e.g., toxic gas detection, smoke detectors):

Only approved exhibitors may perform reaction.

Follow procedures described at:

http://www.uni-regensburg.de/Fakultaeten/nat_Fak_IV/Organische_Chemie/Didaktik/Keusch/D-oscill-e.htm
(see attached).

All observers to remain behind barricade.

PROTECTIVE EQUIPMENT – Prior to performing this procedure, the following personal protective equipment must be obtained and ready for use (e.g., safety eyewear, acid resistant gloves, lab coat, chemical splash apron, closed toed shoers, long pants):

Safety glasses, lab coat, disposable nitrile gloves.
(Long pants, closed-toed shoes required.)

WASTE DISPOSAL – This procedure will result in the follow regulated waste which must be disposed of in compliance with environmental regulations:

Collect and submit all liquids through the DRS Chemical Waste Disposal Program.

ACCIDENTAL SPILL – In the event that a hazardous material spills during this procedure, be prepared to execute the following emergency procedure:

THIS PROCEDURE INVOLVES ONLY SMALL QUANTITIES:

Wipe up all spills immediately. Use broom / dust pan for all solids. Papertowels for liquids. Wipe down with damp paper towels to ensure no residues remain.

IF LARGE STORAGE CONTAINER INVOLVED:

Absorb sulfuric acid with spill pads located at [**indicate room / building**]. For spills larger than 1L, call 911 immediately.

PRIOR APPROVAL – This procedure is considered hazardous enough to warrant prior approval from the Principal Investigator.

- YES -

- NO -

CERTIFICATION – I have read and understand the above SOP. I agree to contact my Supervisor or Lab Manager if I plan to modify this procedure.

Signature

Name (Print)

Date

Building & Room #

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Demonstration Experiment on Video

Belousov-Zhabotinsky-Reaction

Objective: Mechanism of an Oscillating Reaction

Peter Keusch

Disclaimer: The experiment described below is not recommended to be performed on your own. If you attempt to reproduce this experiment, the author accepts no responsibility or liability for loss, damage or injury resulting from errors, omissions or the use or misuse of any information contained in this page. Any users of the procedure provided on this website assume all responsibility for the safe handling of hazardous chemicals.

German version

Chemicals: malonic acid
potassium bromate
potassium bromide
conc. sulfuric acid
ferroin solution

Ferroin solution: 0.35 g of ferrum sulfate heptahydrate and 0.88 g of 1.10-phenanthroline hydrochloride are dissolved in 35 ml dist water. The solution is made up to 50 mL with dist. water.

Apparatus and glass wares: magnetic stirrer
magnetic stirring bar
stirring bar remover
crystallizing dish 115 · 65

4 beakers 100 mL
 beaker 50 mL
 measuring cylinder 100 mL

Hazards and safety precautions:



Potassium bromate is a strong oxidizer - contact with combustible materials may cause fire. Harmful if swallowed. Possible human carcinogen. Eye, skin and respiratory irritant.



Conc. sulfuric acid is highly toxic. Causes severe burns.



Malonic acid is harmful if swallowed, inhaled or absorbed through the skin. High concentrations are very destructive of mucous membranes.

Safety goggles and protective gloves must be worn. Effective ventilation!

Experimental procedure:

Four solutions are prepared:

Solution A: 6.75 g of KBrO_3 in 80 mL of dist. water

Solution B: 15.6 g of malonic acid in 100 mL of dist. water

Solution C: 1.3 g of KBr in 70 mL of dist. water

Solution D: 14 mL of conc. H_2SO_4 in of 65 mL dist. water. The mixture is allowed to cool to room temperature.



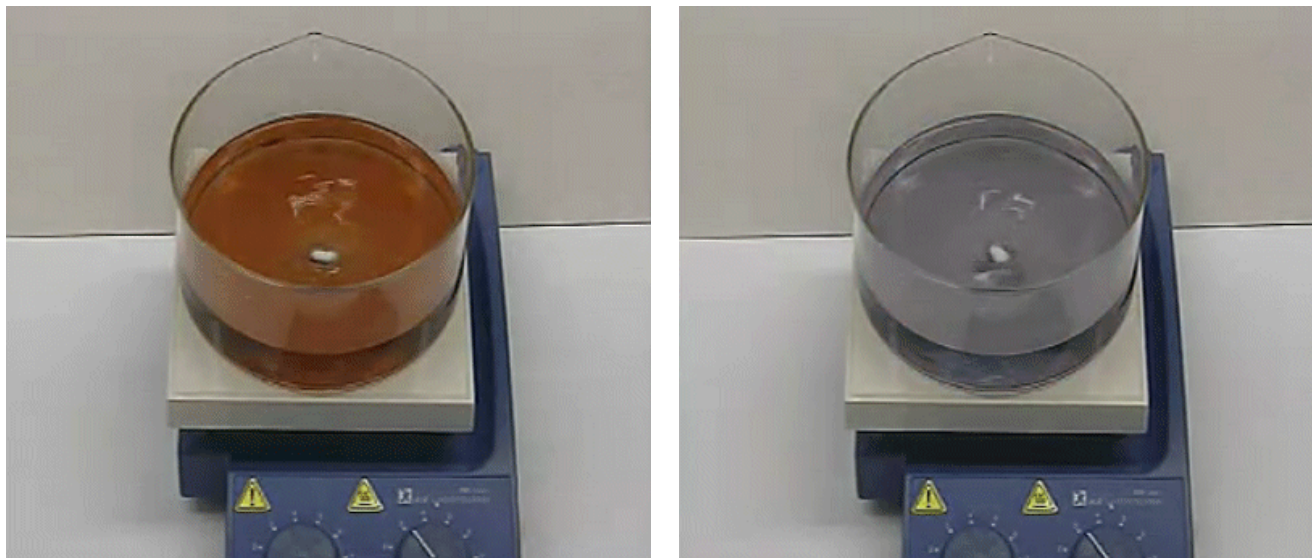
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The four solutions are poured into a crystallizing dish containing 400 mL of dist. water while stirring on a magnetic stirrer. After the yellow-brown color (bromine) has disappeared, 2 mL of ferroin solution are added to the mixture.

Result:

Ferroin-indicator added creates a red color. After approximately 75 seconds the color of the solution turns to a

blue, that will disappear after a short time and a red color will appear again. Thus the color oscillates between red and blue.



[Video clip](#) (Download RealPlayer .rm Datei)

Discussion:

Rubin R. Aliev: [Belousov-Zhabotinsky-Reaction - Scheme of the elementary processes](#)

Reference:

[Demonstration Experiment on Video](#) [Briggs-Rauscher Oscillating Reaction](#)

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