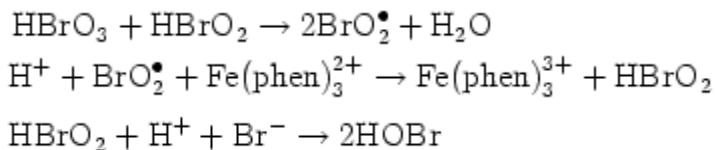


Reaction Risk Assessment Form

Acknowledgment: Imperial College London, Department of Chemistry

Write all your reaction here including work-up and purification method (e.g., chromatography). Use the form below to risk assess ALL associated reaction and process conditions (e.g., heating, cooling, vacuum), particular hazards (e.g., exotherm, gas evolution, flooding, asphyxiation, burns – hot or cold, explosion), quench procedures, and waste disposal as well as the chemicals to be used, including your expected product, solvents, and known byproducts.



Vavilin, V. A. and Zaikin, A. N., *The effect of solution stirring on the rate of autocatalytic reaction*, Kinet. Catal. **12**, 309-13 (1971).

Reaction ID: Belousov-Zhabotinsky Reaction

						Chemical hazards and routes of exposure										
						Route of exposure: 1 – Inhalation 2 – Skin / eye contact 3 – Ingestion	Carcinogen / teratogen / mutagen	Very toxic / toxic	Harmful / Irritant	Explosive	Pyrophoric	Highly flammable / Flammable	Oxidizer	Corrosive	Lachrymator	Other (specify):
Compound	FW	SG	Quantity	mmols	equiv											
malonic acid	104.07	1.63	15.6 g	150	---	2	-	-	X	-	-	-	-	-	-	-
potassium bromate	167.00	3.27	6.75 g	40	---	2	-	-	X	-	-	-	X	-	-	-
potassium bromide	119.00	2.75	1.3 g	11	---	2	-	-	X	-	-	-	-	-	-	-
sulfuric acid (conc.)	98.08	1.84	14 ml	---	---	1,2	X	X	X	-	-	-	X	X	-	-
ferroin solution	N/A	1.001	2 ml	---	---	2	-	-	X	-	-	-	-	-	-	-
Repeat experiment (select one) No / Yes – previous assessment located at:																
Reaction Category (select one):						A	B	C	D							
Standard protocol followed? http://www.uni-regensburg.de/Fakultaeten/nat_Fak_IV/Organische_Chemie/Didaktik/Keusch/D-oscill-e.htm (see attached)																
Reaction conditions and associated processes (heat, cooling, pressure, vacuum, etc.) and hazards: n/a																
Control Measures: (select all that apply)		Safety glasses: <input checked="" type="checkbox"/>		Lab coat: <input checked="" type="checkbox"/>		Chemical Fume Hood:			Glove Box:							
		Gloves (type): disposable				Nitrile: <input checked="" type="checkbox"/> Other:										
		Scrubber (type):				Other:										
Special emergency procedures for this process: N/A																
Reaction and/or reagent quench: N/A (Give quench type and possible hazard)																
Waste disposal (select as appropriate)		Chlorinated Waste		Hydrocarbon Waste		Silica Waste		Other (specify): via DRS Chem Disposal Program								
Co-worker signature: John Doe		Designated Supervisor Signature: Prof. Smith														
Date: 02/19/10		Date: 02/22/10														

Completing the Reaction Risk Assessment Form

The Risk Assessment Form contains space in which all hazardous substances being used may be listed, and the associated hazards noted by selecting the appropriate column. Safety data and hazard information may be obtained from several sources, including the following useful web sites:

<http://www.sigma-aldrich.com>

<http://physchem.ox.ac.uk/MSDS/>

<http://www.msdssearch.com/DBLinksN.htm>

The form also contains space for any special containment, work-up or emergency procedures to be recorded.

Reaction Categories

Risk assessments require reactions to be placed into categories **A-D** as follows, requiring decreasing levels of supervision:

- A** This activity **must** be directly supervised.
- B** The advice and approval of your supervisor must be sought before the task is started.
- C** The work involves risks requiring careful attention to the safety related aspects of it. The worker has been trained in the task and has demonstrated competence.
- D** Tasks in this category carry no undue risks.

Reactions involving substances which are carcinogens, mutagens or teratogens; pose risk of serious eye damage; are pyrophoric, highly toxic, or pose an explosion risk **are by default placed in category A**. A list of specific substances likely to be in this category is given on the back of the Reaction Safety Training Record.

Once a researcher has demonstrated competence in the use of these substances, the Principal Investigator has the discretion to amend their category (e.g., **A** to **B** or **C**) by signing the appropriate place on the back of the Reaction Safety Training Record.

Which category should be used?

For the reagents and procedures listed on the back of the Reaction Safety Training Record, the category is clear - they are category **A** unless the supervisor has downgraded them by signing the back of the Reaction Safety Training Record. For other reactions, the choice of category may be subjective and will depend on the worker's experience. In the early stages of a PhD, and for undergraduate project students, most reactions (apart from those involving category **A** procedures) will be in category **B**. As the researcher's experience increases, some reactions can be placed in lower categories. In all cases, the supervisor should check that the appropriate category is chosen.

Clearly, postdoctoral workers may already have significant experience in performing category **A** procedures prior to joining the University, and the Principal Investigator may downgrade these immediately to **B** or **C** by signing the appropriate places on their Reaction Safety Training Record.

Who should sign Risk Assessments?

One sensible policy is that postdoctoral workers are allowed to sign their own risk assessments and those of other workers provided that (a) their supervisor has signed their Reaction Safety Training Record to indicate their competence (i.e., has downgraded the relevant procedures to category **C**); and (b) provided that they are willing to do so. Graduate students, however, should not be allowed to sign risk assessments.

By definition, risk assessments for category **A** and **B** reactions must be checked and signed **before** experimental work is performed. For category **C** and **D** reactions, risk assessments should still be completed before the experimental work is performed, but the assessments need not be signed beforehand. However, they must be checked and signed regularly by a competent person and supervisors are responsible for ensuring this is done.

 Search

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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.



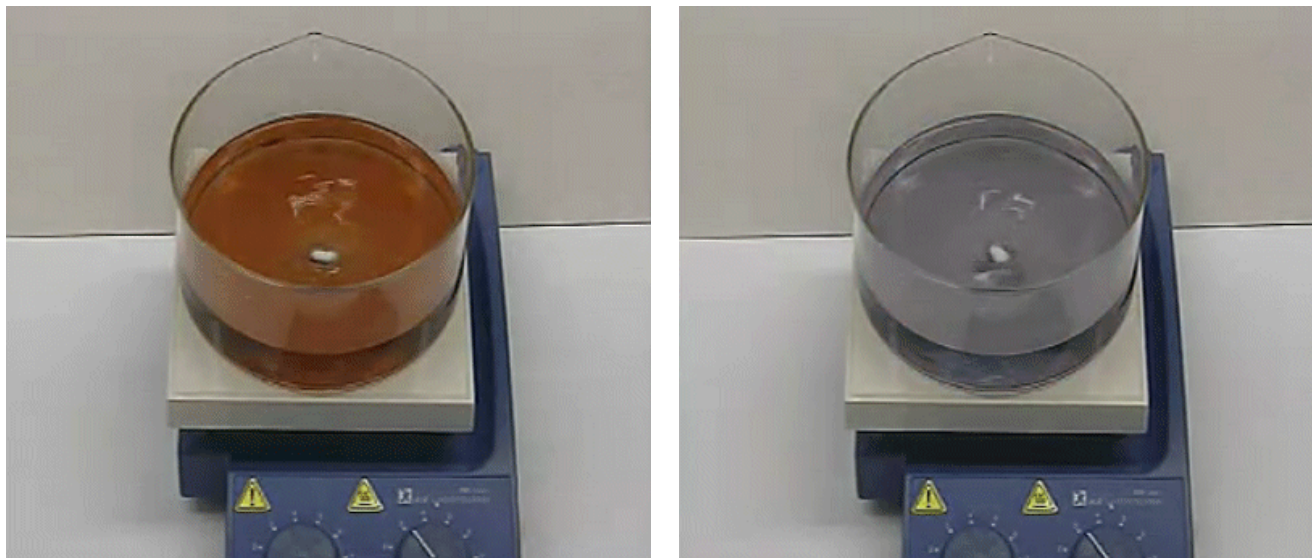
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The four solutions are poured into a crystallizing dish containing 400 mL of dist. water while stirring on a magnetic stirrer. After the yellow-brown color (bromine) has disappeared, 2 mL of ferroin solution are added to the mixture.

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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