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| **Brueckner Lab-Specific Standard Operating Procedure (LSOP)****Bromine (Br2) – Use as bromination reagent and fumigant for TLC plates** |
| **Principal Investigator(PI):** Christian Brueckner |
| **Building:** Chemistry | **Lab(s) Covered by LSOP:** R413/R415 |
| **Department:** Chemistry | **Lab Phone Number(s):** 6-6596/6-6598 |
| **Bromine (Br2)** |  | **Acute toxicity** refers to those adverse effects occurring following oral or dermal administration of a single dose of a substance.**Skin corrosion** is the production of irreversible damage to the skin; namely, visible necrosis through the epidermis and into the dermis, following the application of a test substance.***Environmentally Damaging*** causing acute hazards to the aquatic environment. |
| **SECTION 1 – HAZARDOUS CHEMICAL(S) or PROCESS(ES) and HAZARDS INVOLVED** |
| Bromine (Br2) is a red-brown fuming liquid at room temperature. It is extremely corrosive and toxic. Exposure to bromine may lead to burns in the digestive tract, respiratory tract, skin, and eyes. It is hazardous if inhaled, ingested, or absorbed through skin. High exposures may cause pulmonary edema. Repeated exposures may cause headache, dizziness, nausea, and vomiting. Br2 is not combustible but is a strong oxidizing agent, enhancing the combustion of other substances. Chronic health of effects of bromine may last for years. Carcinogenic Hazards: Not available. Reproductive Hazards: May cause damage to male reproductive system. |
| **SECTION 2 – ADMINISTRATIVE CONTROLS** |
| * Anyone using the chemicals and procedures described herein needs to have undergone the annual EH&S [Chemical Hygiene Training](http://www.ehs.uconn.edu/Chemical/?p=training):
* Be aware of the applicable safety data sheets (MSDS): <http://www.msds.com>.
* [Working Alone](http://policy.uconn.edu/2012/07/30/working-alone-policy/) is not permitted when using chemicals or processes described in this LSOP.
* Any reaction flask containing bromine needs to be clearly labelled.
* For the fumigation of TLCs, keep a bottle at hand (to be always stored under the fume hood) that contains only 1-2 mL bromine.
* Large scale use of bromine should be performed during normal business hours (i.e., 8:00 am-5:00 pm Mon-Fri), especially when they involve quantities larger than 1 mL pure bromine.
* An eyewash and safety shower must be in the immediate work area where bromine is used.
* If there are any questions regarding the safe and proper use of this chemical remain, do not begin to use the chemical/start the process before clarification was received; ask a senior member of the group or the PI.
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| **SECTION 3- ENGINEERING CONTROLS** |
| * All work with bromine must be conducted in a chemical fume hood, with the sash at the lowest working height and with sliding sash panels (if applicable) aligned to form a barrier between the researcher and the experiment.
* Chemical fume hoods must have been tested by EHS within the last year. If the hood is not working properly, contact Facilities (486-3113) to repair the hood or EH&S to retest (486-3613)
* In no circumstances is the work with liquid bromine outside of a fume hood permissible.
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| **SECTION 4 – WORK PRACTICES** |
| Bromine must be handled and stored in a cool and dry place; protect from sunlight.All containers must be clearly labeled with the chemical name and hazard classes and kept tightly-sealed.Empty containers of bromine must be handled carefully since product residues may still be harmful: Leave all contaminated glassware open in the fume hood for at least a day before they are cleaned or disposed of.All solvents that are being recovered by rotary evaporation from a reaction that involved liquid bromine should be disposed of; they cannot be recycled.A dilute aqueous solution of sodium bisulfite (NaHSO3) or thiosulfate (Na2S2O3) efficiently quenches bromine. |
| **SECTION 5 – PERSONAL PROTECTIVE EQUIPMENT (PPE)** |
| * At a minimum, a lab coat, long pants as well as closed-toed footwear and chemical safety glasses that meet American National Standards Institute (ANSI) standard Z-87.1 must be worn when handling bromine.
* Chemical splash goggles are required when handling larger than 5 mL of liquid bromine.
* Double nitrile gloves or heavy-duty neoprene gloves must be worn while handling bromine.
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| **SECTION 6 – STORAGE** |
| * Store Br2 as indicated in safety data sheets (SDSs): <http://www.msds.com/>
* Ensure labels on original bottles remain legible and prominently displayed to identify contents.
* Ensure both original and secondary containers remain intact and are stored with tight-fitting caps or lids.
* Store only a minimal quantity of bromine under fume hood.
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| **SECTION 7 – SPILL AND ACCIDENT PROCEDURES** |
| * Evacuate the laboratory immediately if any quantity larger than 1 mL of liquid bromine is spilled outside the fume hood – do not attempt to clean up the spill, leave immediately.
* Close door(s) to lab and post a “**NO ENTRY**” sign(s) explicitly mentioning the type of hazard.
* Activate the fire alarm and call **911** explicitly mentioning the spill of the quantity of bromine.
* Do not re-enter area until instructed to do so by an emergency personnel.

**Report any incident to the PI and fill out the** [**accident form**](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiF3bPe1dPXAhVRRN8KHX4wDf4QFggmMAA&url=https%3A%2F%2Fchemistry.uconn.edu%2Fwp-content%2Fuploads%2Fsites%2F1259%2F2015%2F09%2FIncident-Report-Form.doc&usg=AOvVaw3Uov8IQ2Z-Kan) |
| **SECTION 8 – FIRST AID PROCEDURES** |
| *Eyes** Immediately move to the eyewash station, hold eyelids open and flush with water. Remove contact lenses while flushing (if applicable).
* Have another person from the lab dial **911** and specifically mention bromine exposure.
* Continue flushing the eyes until emergency personnel arrive.

*Skin** Immediately move to safety shower or other water source and begin rinsing affected area(s). Remove contaminated clothing (if applicable) while flushing.
* Have another person from the lab dial **911** if intense skin irritation is observed and specifically mention bromine exposure.
* Keep rinsing affected area(s) until emergency personnel arrive.

*Ingestion** Immediately rinse the mouth with cold water.
* Do NOT induce vomiting.
* Have another person from the lab dial **911** and specifically mention bromineexposure.

*Inhalation** Move to fresh air.
* Dial **911** and inform emergency responders that the accident involved bromine.

**Report any incident to the PI and fill out the** [**accident form**](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiF3bPe1dPXAhVRRN8KHX4wDf4QFggmMAA&url=https%3A%2F%2Fchemistry.uconn.edu%2Fwp-content%2Fuploads%2Fsites%2F1259%2F2015%2F09%2FIncident-Report-Form.doc&usg=AOvVaw3Uov8IQ2Z-Kan) |
| **SECTION 9 – WASTE MANAGEMENT** |
| * All waste streams containing unreacted bromine should be quenched with aqueous solution of sodium bisulfite (NaHSO3) or thiosulfate (Na2S2O3).
* All waste must be labeled with “Hazardous Waste” stickers or tags, use full chemical names to describe the waste (i.e., no chemical abbreviations or symbols), be stored in sturdy containers with tight-fitting caps or lids, and be stored alone or with other compatible chemicals.
* Hazardous wastes must be stored at or near a green “Satellite Accumulation Area” sign prior to disposal by EHS. Once the containers are 80% filled, fill our EH&S chemical [waste pickup form](http://ehs.uconn.edu/Regulated%20Waste%20Management/index.php)
* The [Chemical Waste Disposal Manual](http://ehs.uconn.edu/Chemical/ChemWasteDisp.pdf) must be used as a reference.
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| **SECTION 10 – DECONTAMINATION PROCEDURES** |
| Work Area | * Equipment can be decontaminated through rinse with copious amounts of water and/or aqueous solution of sodium bisulfite (NaHSO3) or thiosulfate (Na2S2O3), followed by water; use of surfactants in the last step is recommended.
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| Personal Hygiene | * Use standard chemical hygiene practices regarding PPE (see above).
* Wash hand thoroughly after handling bromine
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| **SECTION 11 – SPECIFIC PROCEDURE** |
| A representative literature procedure describing the use of bromine to identify dipyrromethanes on a siica gel TLC plate is describe in Boyle, R. W.; Brückner, C.; Posakony, J. J.; James, B. R.; Dolphin, D. ‘Synthesis of 5,15-Diphenylporphyrin’ *Org. Synth.* **1999**, *76*, 287–293.Bromine vapor, applied to the TLC by pipette that was filled with the brown fumes from the headspace of a bromine bottle, wafted over a developed TLC plate identifies the generally colorless dipyrromethanes through an instantaneous color change to bright red. Other oligopyrranes provide other, also often diagnostic, colors upon fumigation. This fumigation must proceed in a fume hood only, with the TLC plate resting on the TLC jar glass lid (watch glass), or anywhere else where it is resting on an inert surface and is not being held by hand. |

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| **SECTION 12A. APPROVAL** |
| I have reviewed, understand and agree to follow this lab-specific standard operating procedure (LSOP) for the use of bromine*.* Failure to follow this LSOP or lab-specific training guidelines is a violation of the [*University Health & Safety Policy*](http://policy.uconn.edu/2011/05/19/health-and-safety-policy/) and [*University Code of Conduct*](http://policy.uconn.edu/2011/05/17/employee-code-of-conduct/).Further approval and/or review of this LSOP by the PI is required if any of the following events occur:* A significant change in amount (i.e., doubling of the scale of reaction) or substitution of the chemicals in the procedure is planned
* A major change in the agreed-upon experimental set-up is planned (heating instead of room T, etc.)
* Any signs of a failure in safety design or equipment are observed
* Any signs or symptoms of a chemical exposure to any personnel are observed
* Unexpected and/or potentially dangerous experimental results occur (e.g., fire, uncontrolled buildup of heat and/or pressure, etc.)
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| **Researcher Name/Signature** | **Trainer Name/Signature** | **Training Date** |
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| **SECTION 12B. PRINCIPAL INVESTIGATOR CERTIFICATION** |
| I approve the contents of the lab-specific standard operating procedure listed above. |
| **PI Signature:** | **Date:** |
| **A HARD OR ELECTRONIC COPY (https://bruckner.research.uconn.edu/safety-resources/) OF EACH LAB-SPECIFIC STANDARD OPERATING PROCEDURE MUST BE READILY AVAILBALE IN THE LAB.** |