Standard Operating Procedure

Thiols, mercaptans and other stench chemicals

This is an SOP template and is not complete until: 1. Lab specific information is entered into the box below 2. Lab specific protocol and procedure is added to the protocol/procedure section and 3. SOP has been signed and dated by the PI and relevant lab personnel.

Print a copy and insert into your Laboratory Safety Manual and Chemical Hygiene Plan. **Refer to instructions for assistance.**

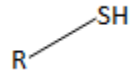
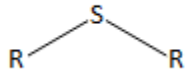
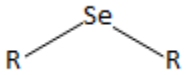
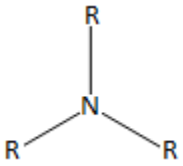
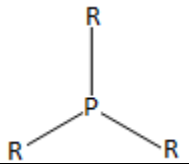
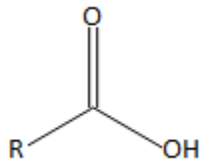
School and department:	Click here to enter text.		
SOP preparation date:	Click here to enter a date.	**SOP approval date:**	Click here to enter a date.
Principal investigator:	Click here to enter text.		
Lab manager name:	Click here to enter text.		
Laboratory phone:	Click here to enter text.	**Office phone:**	Click here to enter text.
Emergency contact:	Click here to enter text.	**Contact phone:**	Click here to enter text.

Laboratory locations covered by this SOP – building and room number
Click here to enter text.

Type of SOP:	☐ Process	☐ Hazardous chemical	☐ Hazardous class

Stench chemicals have an extremely foul smell that is detectable by the human nose in amounts as little as 1.4×10^{-4} ppb,[1] depending on the compound. While the stench may not be known to have toxic effects, it can still negatively impact laboratory workers and people outside the laboratory, even outside the building, by inducing nausea and/or vomiting, and causing reports of gas leaks or sewage problems. The odors have even been responsible for building evacuations at ASU. **Therefore, handling and disposal of stench compounds should be carefully controlled in order to minimize the release of odors.**

Stench chemicals

• Thiols (mercaptans)	
• Sulfides	
• Selenides	
• Amines	
• Phosphines.	
• Carboxylic acids with short aliphatic hydrocarbon chains, such as butyric and valeric acid.	

"R" can include any organic chains or structures.

Purpose

The chemicals in these stench families can serve a wide variety of purposes in the lab.

Physical and chemical properties – definition of chemical group

CAS:	varies	Varies 
Class:	varies	
Molecular formula:	RSH, R_2S, R_2Se, R_3N, or R_3P where R = aliphatic hydrocarbon chain or H; RCOOH where R = short aliphatic hydrocarbon chain	
Form (physical state):	varies	
Color:	varies	
Boiling point:	varies	

Preceding information may change based on specific guidance for the hazardous material.

Potential hazards and toxicity

Potential health effects	
Target organs:	varies
Inhalation:	varies
Skin:	varies
Eyes:	varies
Ingestion:	varies

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Personal protective equipment, or PPE

Respiratory protection

Respirators should be used only under any of the following circumstances:

- An employer requires the use of a respirator.
- As a last line of defense. For example, after engineering and administrative controls have been exhausted.
- As PPE in the event of a chemical spill clean-up process.
- Regulations require the use of a respirator.
- There is potential for harmful exposure due to an atmospheric contaminant, also in the absence of PEL, or Permissible Exposure Limit.
- When Permissible Exposure Limit has exceeded or when there is a possibility that PEL will be exceeded.

Lab personnel intending to use/wear a respirator mask must be trained and fit-tested by EHS. This is a regulatory requirement.
asu.edu/ehs/documents/asu-respiratory-protection-plan.pdf

Preceding information may change based on specific guidance for the hazardous material.

Hand protection

Note: Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the specific stench chemical you are using. If the stench chemical in use is known for certain to *not* permeate the gloves that you are using for an hour or more (“no data” is not sufficient), then layering of multiple pairs of gloves and removing one layer at a time may replace glove

changes during handling. However, gloves must be changed and hands washed as soon as the handling is complete and the container of stench chemical is put away.
Refer to glove selection chart from the links below:

- allsafetyproducts.biz/page/74172
- ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf
- showabestglove.com/site/default.aspx

Preceding information may change based on specific guidance for the hazardous material.

Eye protection

• Wear chemical splash goggles to protect from splash hazards and chemical vapors. A face shield may be worn over the goggles if needed.

Preceding information may change based on specific guidance for the hazardous material.

Skin and body protection

• Close-toe rubber or leather shoes unless a different shoe material is specifically required.
• Full-length pants.
• Lab coat; add a natural rubber apron if needed.

Preceding information may change based on specific guidance for the hazardous material.

Hygiene measures

• Avoid contact with skin, eyes, and clothing. Wash hands before breaks and immediately after handling the product.

Preceding information may change based on specific guidance for the hazardous material.

Engineering controls

All operations involving stench chemicals and dilutions should be carried out in a ventilated enclosure fume hood to keep airborne concentrations below recommended exposure limits. Chemical fume hoods used as containment areas for particularly hazardous chemicals must have a face velocity of 100 cfm, averaged over the face of the hood and must be certified annually. The fume hood sash should be kept as low as possible. Laboratory rooms must be at negative pressure with respect to the corridors and external environment. The laboratory/room door must be kept closed at all times.

If the stench chemical is a solid, it must be weighed and used entirely inside the fume hood. After use, the scale and its glass covering, handles, and buttons should be wiped down with bleach, aqueous sodium hypochlorite, or NaClO, or other compatible oxidant – i.e. the oxidant should not have any violent reaction with the stench chemical. Gloves should be replaced before carrying the scale out of the fume hood.

If the stench chemical is a liquid, all transfers should be performed using a syringe or cannula. Use the volume markings on the syringe and the liquid's density to determine the amount; do not weigh it on a scale. Never pour or pipette these liquids or their dilutions. Any re-usable cannulas, needles, or syringes should be cleaned with bleach or another compatible oxidant prior to re-use.

Avoid using excess amounts of stench chemicals. The reaction mixture must be handled as a stench chemical until all unreacted stench chemical is thoroughly removed from the mixture.

Depending on the potency of the stench chemical in question, a cold finger trap or bleach trap, for example, the illustrations below Figures 1 and 2. These must be used to prevent stench chemical fumes from being released into the fume hood. The process must be evaluated by the PI or other responsible party first to ensure that none of the components in the experimental setup are incompatible with bleach.

Bleach, aqueous sodium hypochlorite, or NaClO, is capable of oxidizing thiols, sulfides, selenides, phosphines, and some amines to their less-smelly counterparts, such as sulfoxides, sulfones, phosphine oxides, etc.[2, 3] Bleach can also oxidize carboxylic acids through decarboxylation.[4]

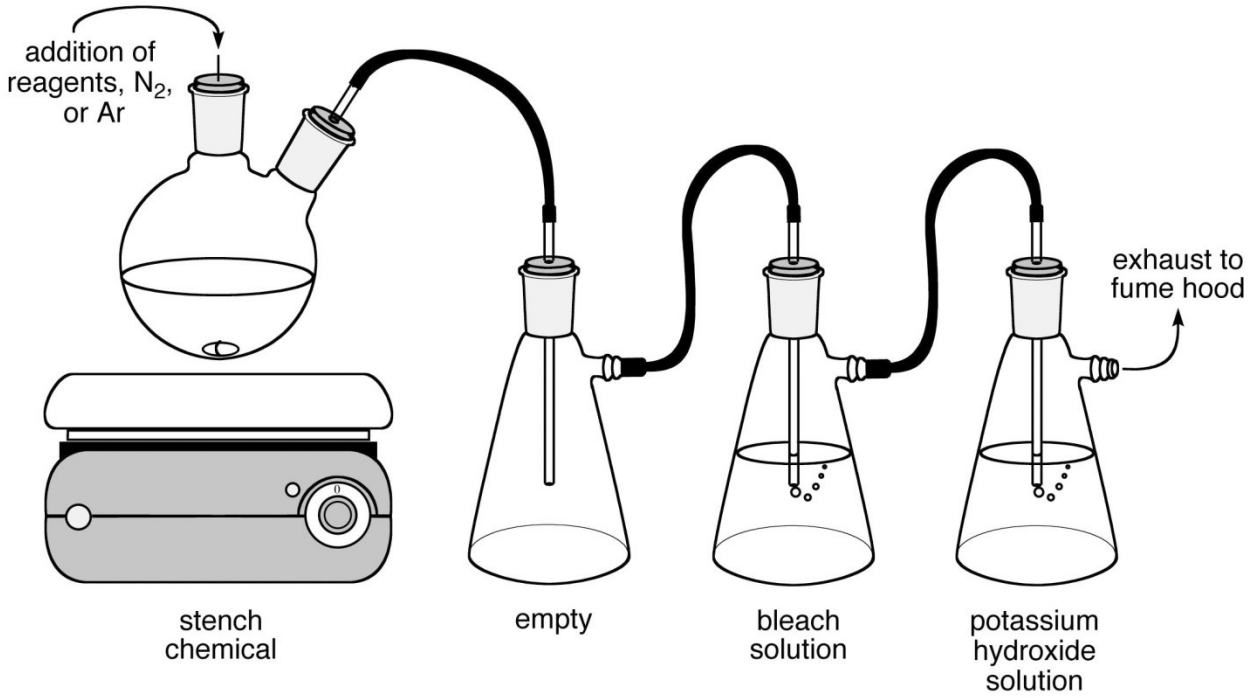

Figure 1.[2] Exhaust from a system that contains stench chemical fumes is passed through bleach. The hydrochloric acid (HCl) vapor that is generated as a by-product of oxidation is neutralized by passing through a strong base solution (0.01 M should be sufficient).

Both the oxidation and neutralization reactions are exothermic and will generate heat.[2] Depending on the amount of stench chemicals passing through the flasks, ice baths may be required in order to control the temperature.

Clorox brand bleach is typically 5-10% sodium hypochlorite by weight.[6] Other brands may have lower concentrations and therefore may be less effective in bleach traps.[7] Consult the brand's MSDS and SDS for concentration prior to use. Do not attempt to acidify the bleach solution; dropping the pH of the bleach solution will cause off-gassing of toxic Cl_2 gas.[7]

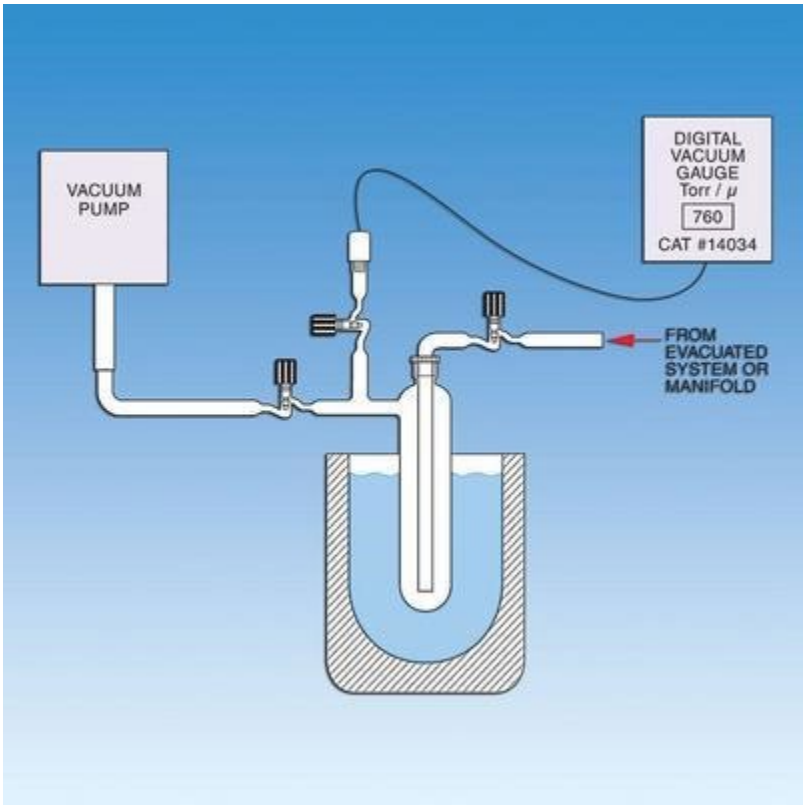

Figure 2.[5] Exhaust from a system that contains stench chemical fumes is passed through a cold finger chamber surrounded by a dewar, which should be cooled to at least -78°C (it can be filled with dry ice in acetone, or liquid nitrogen). The vacuum gauge is optional, and the air exiting the cold finger may be exhausted into the fume hood if vacuum is not needed.

The cold finger setup is ideal in cases where an experimental component may be incompatible with bleach. The portion where the stench chemicals are trapped must be emptied into a stench waste container and rinsed out with a compatible oxidant. Rinsings should also go into a stench waste container, although not necessarily into the same container as the pure stench chemical; be cautious of exothermic reactions between the oxidant and the stench chemical.

If any mixture containing a stench chemical is to be concentrated under reduced pressure – by use of a rotovap, for example – the cold finger trap must be used in between the vacuum pump and the vacuum take-off of the evaporative device. This cold finger is **in addition** to the normal condenser, and does not replace it. The entire apparatus must be located inside the fume hood, and cleaned with a compatible oxidant after use.

Preceding information may change based on specific guidance for the hazardous material.

First aid procedures

If inhaled… Move to fresh air. If the person is not breathing, give artificial respiration. Avoid mouth to mouth contact.
Call 911 from a campus phone or 480- 965-3456. Call EHS at 480-965-1823.

Preceding information may change based on specific guidance for the hazardous material.

In case of skin contact… Remove all contaminated clothing. Immediately within seconds, flush affected area for **fifteen** minutes. Call 911 from a campus phone or 480-965-3456 from a cell phone. Call EHS at 480-965-1823.

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In case of eye contact… Use nearest emergency eyewash immediately. Call 911 from a campus phone or 480-965-3456 from a cell phone.
Call EHS at 480-965-1823.

Preceding information may change based on specific guidance for the hazardous material.

If swallowed…do not induce vomiting. Never give anything by mouth to an unconscious person. Call 911 from a campus phone or 480-965-3456 from a cell phone. Call EHS at 480-965-1823.

Preceding information may change based on specific guidance for the hazardous material.

Special storage and handling requirements

Storage

- Ensure the stench chemical container is tightly closed at all times.
- If the stench chemical container still emits an odor after being wiped down and having its neck wrapped, then it must be placed inside a secondary container, such as a large jar with a lid, and the neck of the secondary container must be sealed with a compatible tape. If the secondary container is not transparent or colorless glass, then it must be properly labeled.
- The neck of the stench chemical container must be wrapped with parafilm, Teflon tape, electrical tape, or other compatible sealing tape.
- The outside of containers must be wiped down with bleach, or other compatible oxidants, after each use.

Preceding information may change based on specific guidance for the hazardous material.

Handling

- All items, including sealed containers, must be decontaminated with bleach, or another compatible oxidant, before they may be removed from the fume hood.
- Any equipment needed for the use of the stench chemical – pipettes, extra gloves, etc. – must be placed inside the fume hood so that it can be reached without removing contaminated gloves from the fume hood area.
- Any item that was touched or used at **any** point during the process, including gloves, paper towels, weighing paper, equipment handles, the fume hood sash, etc., must be considered to be contaminated with the stench chemical, and should be cleaned or disposed of accordingly.
- Ensure you are wearing the following minimum PPE: tightly fitting safety goggles and face shield, lab coat & natural rubber apron, full length pants, close-toe rubber or leather shoes, gauntlet style – or arm length – natural rubber gloves over a pair of nitrile gloves.
- Great care must be taken to reduce the spread of stench chemicals during the process. From the moment that the stench chemical bottle is picked up, avoid touching any handles, valves, or surfaces unnecessarily. Adjust gas lines and fume hood sash height prior to the process.
- Lab emergency contact information must be readily posted. Easy access to a cellular phone or land line is readily available.
- The lab where the material is being handled has an approved and certified emergency eyewash and safety shower.

Preceding information may change based on specific guidance for the hazardous material.

Spill and accident procedure

Personal precautions

Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas. Do not attempt clean-up without minimum PPE.

Environmental precautions

Prevent further leakage or spillage – if safe to do so. Do not allow product to enter drains.

Methods and materials for containment and clean-up

Consider material compatibility prior to clean-up. Verify spill kit is available.

1. Immediately assess amount spilled, follow posted ASU Emergency Response Guide procedures for hazardous materials incidents.

2. If a chemical exposure has occurred, a fellow lab worker shall call 911 and EHS at 480-965-1823.
3. Don compatible gloves and other protective PPE if not already being worn.
4. Secure and restrict access to the area of the spill to prevent spread of the chemical.
5. Use the available spill kit to stop and contain the spill. Bag the collected material.
6. Wipe down affected areas with a compatible oxidant. For spills outside the fume hood, use only oxidants that do not require the use of a fume hood, such as 3% H_2O_2 with $NaHCO_3$. Avoid the use of bleach due to the HCl byproduct. Bag the wipes separately from the collected material.
7. Label and tag as hazardous waste and submit a pick-up request to EHS using EHS Assistant.

Preceding information may change based on specific guidance for the hazardous material.

Decontamination and waste disposal procedure

Label waste

- Attach a completed ASU Hazardous Waste tag to all waste containers as soon as the first drop of waste is added to the container.
- In the “Category” section on the Hazardous Waste tag, be sure to include “Stench” as a hazard.

Store waste

- All waste exposed to or containing stench chemicals, including sharps, must be put in air-tight containers. Containers cannot leave the fume hood until they are tightly closed.
- All waste that was exposed to or contains stench chemicals, including gloves, weighing paper, paper towels, etc., must be placed in containers that are separate from other waste.
- Dry waste should be stored in a glass or plastic container that cannot be permeated or dissolved by any of the chemicals in the waste.
- Store hazardous waste in closed containers, in secondary containment and in a designated storage location.
- Waste must be under the control of the person generating and disposing of it.

Dispose of waste

- Contact ASU EHS at 480-965-1823 with questions.
- Dispose of regularly generated chemical waste within 90 days.
- Use EHS Assistant online hazardous waste pick-up request system.

Preceding information may change based on specific guidance for the hazardous material.

Protocol and procedure

Laboratory-specific procedures

Add your lab's specific procedures in this section.

Click here to enter text.

Important note: Any deviation from this SOP requires advance PI approval.

References

- Aldrich, T. B. A Chemical Study of the Secretion of the Anal Glands of *Mephitis Mephitica* (Common Skunk), with Remarks on the Physiological Properties of this Secretion. *J. Exp. Med.* **1896**, *1(2)*, 323-340.
- Elmore, P.R.; Reed, R.T.; Terkle-Huslig, T.; Welch, J.S.; Young, S.M.; Landolt, R.G. Hypochlorite-Induced Oxidative Decarboxylation of Trisubstituted Acetic Acids. *J. Org. Chem.* **1989**, *54 (4)*, 970-972.
- National Research Council. *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals;* National Academy Press: Washington, 1995.
- Oregon State University. Fact Sheet: Disinfection Using Chlorine Bleach. http://oregonstate.edu/dept/larc/sites/default/files/pdf/chlorine-fact-sheet.pdf (accessed Oct. 23, 2015).
- The Clorox Company. Clorox® Regular-Bleach$_1$. https://www.thecloroxcompany.com/downloads/msds/bleach/cloroxregular-bleach12015-06-12.pdf (accessed Oct. 23, 2015).
- University of California, Los Angeles. Standard Operating Procedures for Using Stench Chemicals. http://www.chemistry.ucla.edu/sites/default/files/safety/sop/SOP_Stench_Chemicals.pdf (accessed Oct. 23, 2015).
- VWR. High Vacuum Trap System, Ace Glass Incorporated. https://ca.vwr.com/store/catalog/product.jsp?product_id=11733826 (accessed Oct. 23, 2015).

Documentation of training

- Prior to conducting any work with this material, Principal Investigator or designee must provide to his/her laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures.
- The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate/required laboratory safety training or refresher training within the last one year.

- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the Safety Data Sheet, or SDS, provided by the manufacturer.

I have read and understand the content of this SOP.

Employee name	ASU affiliate no.	Signature	Date
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