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Laboratory Use of Cyanide Salts Safety Guidelines



1. Purpose / Background

Cyanides have a white crystalline or granular powder appearance and the dry salts are odorless but the reaction with atmospheric moisture may produce hydrogen cyanide which has a faint odor of bitter almonds. They are slightly soluble in water and when mixed with acids will produce lethal hydrogen cyanide gas. Cyanides are used in chemical synthesis and electroplating.

Toxicity

Sodium and potassium cyanide are both highly toxic via inhalation, ingestion and skin absorption. Exposure to salts or aqueous solutions to eye (mucous membranes) or skin to as little as 50-150 mg can cause collapse and death. Aqueous solutions of HCN are readily absorbed through the skin and eyes, absorption of 50 mg can be fatal. OSHA has a permissible exposure limit (PEL) of 10 ppm (11 mg/m³) skin. The American Conference of Governmental Industrial Hygienists (ACGIH) recommends threshold limit value (TLV-TWA), time weighted average over an 8 hour day, of 5 mg/kg (KCN) skin. The oral rat lethal dose 50 (LD50), where 50% of the population of test animals died, is 6.4 mg/kg for sodium cyanide and 5 mg/kg for potassium cyanide

Hydrogen cyanide gas has a bitter almond odor which is detectable at 1-5 ppm. However, 20-60% of population can't detect this odor. It is highly toxic with an inhalation toxicity of LC50 (rat) 63 ppm (40 min). Inhalation exposure to low levels, 18-36 ppm for several hours, can cause weakness, headache, confusion, dizziness, rapid breathing, nausea and vomiting. It is also a flammable gas.

2. Scope

This document is intended for any researcher that will use cyanide salts.


3. Prerequisites

This document should be reviewed by the researcher and DLC EHS Coordinator before ordering and using cyanide salts.

4. Procedures

4.1 Cyanide handling: It is the responsibility of all users to follow these general recommendations before using cyanide salts in their labs.

- Contact the EHS office x2-3477 or e-mail environment@mit.edu and your department's EHS Coordinator to request a lab hazard assessment of the procedure.
- Review and understand the Safety Data Sheet (SDS) thoroughly before beginning work, search for SDS <http://ehs.mit.edu/site/content/msds-and-chemical-safety-information>

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- Use a safer alternative, if feasible consult with your PI they may be aware of some. You can also look on the green chemical alternative purchasing web site <http://ehs.mit.edu/site/content/green-chemical-alternatives-purchasing-wizard>
- Complete lab specific procedure and submit to your department's EHS Coordinator and the EHS office x2-3477 or e-mail environment@mit.edu for review. <http://ehs.mit.edu/site/content/laboratory-specific-procedure-template>
- Purchase the smallest feasible quantity of cyanide.
- Store cyanide in a secured area, separated from all acids, nitrites, nitrates, water, steam I heat, chlorates, and strong bases. Store cyanide in a sealable secondary container (ideally polypropylene). Always remove cyanide from its secondary container in a chemical fume hood to allow any accumulated gas to be vented safely.
- Ensure emergency procedures are developed and maintained.
- If after lab hazard review, EHS considers there to be a risk of significant exposure due to processes, amounts, concentrations, or possible accidents the procedure will be forwarded to MIT Occupational Medicine for review.

4.2 Safe work practices


4.2.1 Maintain immediate access to this information during work involving cyanide.

- Do not work alone on procedures involving cyanide, or reactions that generate cyanide or hydrogen cyanide. A second person ("buddy") must be available to implement emergency response procedures. Notify others in the immediate area when you are working with cyanide.
- Review these procedures and your lab specific Cyanide emergency instructions and with your buddy and ensure that s/he is with you for the duration of the procedure that may generate cyanide.
- Personal Protective Equipment; wear eye protection, splash goggles and a face shield should be worn to protect eyes, nose and mouth where there is a chance of splash or splatter. A lab coat and clothing that cover your legs and feet. Gloves that are resistant to cyanide breakthrough i.e. PVC, nitrile or neoprene and consider double gloving if using thin disposable gloves. Before use gloves should always be check for leaks or tears. .
- Ventilation; all operations should be done in a properly functioning chemical fume hood and adequate local exhaust where hydrogen cyanide may be released. Ensure that the chemical fume monitor is operational prior to using cyanide by raising the hood sash to its' full open position or covering the sensor until alarm sounds. If alarm sounds, the monitor is operational and the sash can be returned to the proper working height. If alarm does not sound contact EHS 2-3477.
- Always wash hands immediately after working with cyanide compounds.

4.3 Emergency Procedures

4.3.1 If an exposure occurs by inhalation or ingestion:

- Alert others in the lab and exit the area immediately to a safe location with fresh air. (Note: if you do not leave the potential cyanide release area, Cambridge Emergency Medical Services (EMS) ambulance personnel cannot enter a potentially contaminated area.)

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- *For a medical emergency and treatment* for a confirmed or suspected cyanide exposure dial 100 or 617-253-1212 immediately to reach MIT Campus Police for Advanced Life Support (ALS) ambulance service equipped with a CYANOKIT for first aid treatment of cyanide poisoning. The person who calls must *describe situation clearly*, for example:
 - Is there clear evidence that a cyanide exposure actually occurred (e.g. cyanide splash, multiple people affected)
 - Is the person exhibiting breathing difficulty or chest pains or not?
 - Has the person improve upon leaving the area?
 - What are the specific symptoms?
 - What is the route of exposure?
- Clean all spilled materials from the person's body if it can be done safely. Wear gloves to protect yourself from contact. Protect yourself. Do not enter a contaminated zone.
- Monitor the person for respiratory distress such as cough or difficult breathing, loss of consciousness.
- Send a bystander to meet the emergency responders at the ground floor so they will find you promptly.
- When Emergency Medical Services arrives, notify them what actions have been taken so they can continue with proper first aid administration.

4.3.2 If an exposure occurs by skin or eye contact:

- Skin Contact; immediately wash with soap & water, remove contaminated clothing
- Eye Contact; wash with copious amounts of water for 15 min. occasionally lifting upper & lower lids.
- For minor exposure call MIT Medical [617-253-4481] to seek advice and medical attention. If major exposure, dial 100 or 617-253-1212 immediately for ALS ambulance service. The person who calls must *describe situation clearly* see instructions above for Medical Emergency and Treatment.
- Send Material Safety Data Sheet (MSDS) with exposed employee to the emergency treating facility
- Note that individuals with preexisting diseases of the nervous system may have increased susceptibility to the toxicity of excessive exposures


Resource for further information 24/7: Poison Control Center (1-800-682-9211)

4.3.3 Spills or leaks

- Do not attempt to clean up large or small spills of cyanide solutions outside the fume hood: evacuate the area, close and post all entrances to the lab prohibiting entrance and call Environment, Health and Safety using a campus phone 2-3477 or 617-452-3477 during the day and 100 or 617-253-121 nights and weekends.
- Small spills of solutions can be cleaned up if contained in the fume hood and wearing appropriate PPE, at a minimum safety glasses, protective gloves made of PVC, nitrile or neoprene and safety glasses.
- Small spills of dry salts can be collected safely wearing appropriate PPE (same as above) using a brush and dust pan.

An official hardcopy of this document exists in the EHS Office or on the EHS website.

See Legal Disclaimer at: <http://ehs.mit.edu/site/content/legal-disclaimer>

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5. Roles & Responsibilities

5.1 Researcher

- To review document, prepare operational SOP, and notify DLC Coordinator and EHS Office of intended use and to follow all safety protocols listed in this document and SOP and to maintain an inventory of cyanide salts and compounds.

5.2 DLC Coordinator

- To read this document, meet with researcher and review operational SOP and make sure all safety training, controls and procedures are in place prior to work beginning

5.3 EHS Office


- Meet with researcher and DLC Coordinator to review operational SOP and make sure all safety training, controls and procedures are in place prior to work beginning

6. Training

Each employee working in a lab that handles cyanide (or procedures that generate cyanide) must receive instruction on the dangers of cyanides and be trained in:

- How cyanide can affect the body: it is inhaled as a vapor or dust; the liquid or vapor is absorbed through the skin; it is swallowed.
- Local Health Effects-The vapor or liquid will cause irritation of the mucous membranes in the eyes, nose, and throat and may cause skin irritation.
- General Health Effects I Symptoms
Early or Mild Cyanide Poisoning:
 - general weakness, heaviness of the arms and legs
 - difficulty breathing
 - headache, giddiness, nausea, vomiting
 - irritation of the nose, mouth, and throat
- Severe Cyanide Poisoning:*
 - nausea
 - cyanosis
 - unconsciousness
 - convulsion
- Prevention of exposure (proper lab protocol, use of laboratory apparatus and chemical fume hood, personal protective equipment)
- Review of SDS and lab specific SOP
- Emergency/Evacuation procedures
- Response procedures for a suspected cyanide
- Buddy System for work with cyanide, in order to:
 - recognize cyanide exposure and poisoning
 - carry out rescue or emergency procedures

NOTE: Upon request, the MIT EHS Office will provide hazard communication training for persons that could be exposed to cyanide.

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Notify the EHS Office 617-452-3477 or campus phone x2-3477 and include your department, building and room where you will be performing the cyanide procedure.

7. Monitoring Requirements

7.1 Waste

Cyanide-containing waste must be collected in closed containers in a Hazardous Waste Satellite Accumulation Area with a Hazardous Waste red tag. Check the "Toxic" box and any other hazards associated with the waste stream. Treat the empty container as hazardous waste. Take extreme care not to mix with incompatibles highly toxic hydrogen cyanide gas could be produced.

7.2 Purchasing

The MIT Procurement Department through its *Purchasing Policies and Procedures* has established Institute-wide restrictions on the purchase of certain highly toxic chemicals including sodium and potassium cyanide. For detailed information on the purchase of these materials see http://vpf.mit.edu/site/procurement/policies_procedures/policies_and_procedure_manual/4_0_requisitions_other_special_processing/4_2_requisitions_for_hazardous_or_dangerous_materials_processing_procedures_09_06 Prior-approval by authorized MIT agents is required when purchasing these materials. Each requisition for the purchase of these chemicals must bear the approval signature of an Institute member with the title: Department Head, Laboratory Director, Professor, M.D., or Pharmacist.

7.3 Security

Access to all hazardous chemicals, including toxic and corrosive substances, should be restricted. These materials should be stored in laboratories or storerooms that are kept locked when laboratory personnel are not present. In the case of unusually toxic or hazardous materials including cyanide compounds, additional precautions should be taken such as keeping the materials in locked storage cabinets or storerooms. Suspected thefts of cyanide salts should be reported immediately to campus police dial 100. See the EHS web site for information on chemical security <https://ehs.mit.edu/site/content/chemical-security>

8. Record Management

Researcher shall maintain inventory of cyanide salts and compounds.

9. References

9.1. Standards

OSHA regulation 29CFR 1910.1450 Occupational Exposure to Hazardous Chemicals in Laboratories

10. Definitions

N/A