

## **Handling of Hazardous Chemicals: Potassium (or Sodium) Cyanide**

### **MSU Department of Chemistry**

Use of potassium or sodium cyanide is to be limited to applications for which no suitable substitute is available. Any purchase or use of these compounds must be authorized through the office of the department's Laboratory/Safety/Waste Coordinator.

#### **I. Identification of Primary Hazards**

Potassium and sodium cyanide are highly toxic compounds. They may be ingested or absorbed through the skin. In reaction with water or acid, these compounds produce hydrogen cyanide gas. This may be inhaled, producing the most probable route of exposure in the laboratory.

The individual(s) responsible for dispensing or using potassium/sodium cyanide should read this entire document and the material safety data sheet (Appendix 1). If this material is used in an instructional laboratory, each student should read the material safety data sheet or the Lab Chemical Safety Summary (Appendix 2).

#### **II. Storage and Handling**

##### **A. Storage**

All containers of sodium or potassium cyanide are to be stored in *locked* cabinets. Keys to these cabinets shall be accessible to only those persons familiar with proper handling precautions. These compounds are to be stored in areas protected from possible contact with water or acid. It is preferable that these compounds be stored only in the designated locked hazardous materials storage cabinet in the chemistry stockroom. Storage at satellite locations should be discouraged, and the quantity stored should be kept to a minimum. All containers should be clearly labeled with the chemical name, and marked as toxic.

A copy of this document and all attachments shall be kept at each storage site. A current inventory of potassium/sodium cyanide shall be maintained.

##### **B. Handling**

###### **1. Posting of Laboratory**

Before beginning work with sodium or potassium cyanide, the doorway(s) should be posted as follows: "Danger. Cyanide compounds in use. Authorized entry only. In case of emergency, *do not enter*. Call 911". See Appendix 3. Near the laboratory phone, post the emergency notification fact sheet shown in Appendix 4. Provide specific information for the location and experimental conditions in use.

## 2. Designation of Work Area

Potassium and sodium cyanide shall be dispensed and handled only in an operational fume hood. Before commencing work, the average face velocity of the fume hood should be checked. This must be 80-120 fpm at the working sash height. If a minimum face velocity of 80 fpm is not attained with sash fully opened, clearly mark the maximum sash position where this velocity is achieved. A fume hood that will not maintain a face velocity of at least 80 fpm at a reasonable working sash position should *not* be used. If the fume hood is equipped with a flow alarm, confirm that it is working properly by blocking airflow to the sensor (use a piece of paper to cover the opening). The monitor alarm should sound. If the fume hood is not equipped with an operational audible alarm, affix a tissue paper streamer to the sash at each end to serve as an indicator of air flow into the hood. The fume hood should be posted as shown in Appendix 5.

Mark a work area on the floor outside the fume hood extending three feet in front of the hood, and two feet on each side of the hood. When cyanide compounds are used only on a temporary basis, this area may be marked using masking tape or a similar material. Only the person(s) assigned to use/dispense cyanide should enter this work area. No more than two individuals should be in this area at any time. *No* containers of acid or acidic waste are permitted in this work area.

Mark a work area inside the fume hood beginning six inches back from the plane of the hood sash. All operations using cyanide compounds (opening containers, dispensing, etc.) should be performed behind this line. *No* containers of acid or acidic waste are permitted in this work area.

## 3. Preparation of Work Area

To contain possible spills, place a tray or pan in the working area of the fume hood. It is helpful to have on hand a high-pH buffer solution (i.e. pH 10) and a container of household bleach. You may also wish to have a bottle (with a wide mouth *or* with a funnel) for waste generated. All materials necessary for completion of the laboratory task should be placed in the fume hood. If it is necessary to weigh potassium or sodium cyanide, a balance should be temporarily placed in the fume hood.

Confirm that a type ABC dry chemical extinguisher is available for use in the laboratory. If necessary, temporarily substitute an extinguisher of this type for any water or CO<sub>2</sub> extinguishers in the laboratory.

This entire documentation packet should be immediately available to the individuals in the cyanide work area, but just outside the designated work zone.

## 4. Personal Protective Equipment

All personnel entering the designated work area must wear chemical splash goggles and protective gloves. PVC, nitrile, or neoprene gloves may be used. A lab coat or other protective clothing is advised. Shorts and sandals are prohibited, as are other types of clothing leaving large expanses of skin exposed.

#### 5. Notification

The supervising professor and lab/safety/waste coordinator should be contacted prior to commencing work with cyanide compounds.

#### 6. Use

The cyanide compound may be removed from the locked cabinet *only* after previous steps have been completed. Cyanide compounds should *never* be used by an individual working alone in a laboratory. The container of cyanide compound should be placed directly into the working area of the designated fume hood. All glassware, utensils, and PPE with possible contact with the material must remain in the fume hood until decontaminated.

Before adding a cyanide compound to any solution (or adding any solution to a cyanide compound), the user should ascertain that the solution is basic. This may be accomplished by inference based on components of a mixture. However, if there is any doubt regarding the solution pH, it must be measured directly using a calibrated pH meter or pH test strips. Cyanide compounds should never be dispensed into neutral or acidic aqueous solutions.

Dilute *basic* solutions of cyanide compounds may be handled safely outside the fume hood. However, any spill or contact involving these solutions constitutes an emergency situation requiring immediate laboratory evacuation and probable emergency medical response. All work outside a fume hood constitutes a significant risk, and should be discouraged. *Never* add acid to a cyanide solution. Discharge the cyanide compound as soon as experimentally feasible. Waste containing cyanide compounds is hazardous and should be disposed of accordingly.

#### 7. Decontamination of Work Area

Utensils, glassware, and other surfaces contaminated with cyanide compounds must be decontaminated at the end of the laboratory work session. This should be completed in the fume hood before removing any of the items. Wash all contaminated surfaces into a tub or large beaker using a pH 10 buffer solution. Rinse these surfaces into the beaker using a dilute bleach solution. Add 30 mL household bleach and mix thoroughly. Allow to react for three hours. Neutralize using a dilute acid and pour down drain in hood. This will discharge up to about one gram of potassium cyanide. Larger quantities of cyanide should be treated as a major spill. Refer to the emergency response procedure.

## 8. Waste

In most instances, laboratory procedures will incorporate a final step converting cyanide to a less toxic material for disposal. Follow experimental instructions explicitly. This is the preferred method for dealing with cyanide wastes. If cyanide compounds are *not* discharged as part of the experimental procedure, cyanide waste should be collected in a bottle in the cyanide work area hood. This container should *not* be used for other waste. Under no circumstances should acid be added to this container. Label as follows: "Hazardous Waste. Contains cyanide compounds. Toxic. Do not add acid. Contents: (list all compounds present, with approximate concentration of each). pH: (list pH of contents). Volume: (list total waste volume)." See Appendix 6.

Empty containers of potassium or sodium cyanide should be treated according to the decontamination procedure above. Once decontaminated, the bottle may be discarded as non-hazardous broken glass.

## 9. Completion of Work

Confirm that all experimental work with cyanide compounds has been completed, and that all waste has been discharged or placed into a hazardous waste container. Replace cyanide compound in locked cabinet. Remove warning signs and store information packet with the cyanide compound.

### III. Emergency Response

#### A. Spill

If a spill is contained in the designated fume hood, and involves less than one gram of material, follow the decontamination procedure listed in II.B.7.

A spill contained in the designated fume hood involving greater than one gram of material should be treated as a major spill. Call for backup response from the department's Laboratory/Safety/Waste coordinator at 6390 *or* the office of Environmental Safety and Health at 3480. Meanwhile, close the sash to the fume hood, and clear all laboratory personnel from the cyanide work area.

Any spill not contained in the designated fume hood should be treated as a major spill. Evacuate the laboratory immediately and call for backup response from the department's Laboratory/Safety/Waste Coordinator at 6390 *or* the office of Environmental Safety and Health at 3480. An exposure is very likely in a non-contained spill. Follow guidelines in section C, below.

Any release of potassium or sodium cyanide to a sink or drain presents a very serious exposure risk. Evacuate the laboratory immediately and call for backup response from the

Laboratory/Safety/Waste Coordinator at 6390 *or* the office of Environmental Safety and Health at 3480. If they recommend immediate evacuation of the building, pull the nearest fire alarm as you exit. Follow exposure guidelines in section C, below.

## B. Hood Failure

Failure of the fume hood to provide adequate airflow will be indicated by an audible alarm and/or indication by tissue paper strips. All work in the hood should be ceased immediately, and the hood sash should be closed completely. No personnel should be permitted inside the cyanide work area until the fume hood has been repaired. Proper operation should be confirmed as outlined in section II.B.2 prior to resumption of experimental activities in the cyanide work area. If there is any possibility of inhalation exposure, follow guidelines in section C, below. If the cyanide compounds in the hood may have come in contact with non-basic aqueous solutions, evacuate the laboratory immediately and call for backup response from the Laboratory/Safety/Waste Coordinator at 6390 *or* the office of Environmental Safety and Health at 3480. If they recommend immediate evacuation of the building, pull the nearest fire alarm as you exit.

## C. Exposure

In *any* exposure to cyanide compounds, immediate emergency response is crucial. Ambulance and emergency room personnel will have cyanide antidote kits available. Call 911 to report the emergency. Use the emergency call sheet in Appendix 4 as an aid in providing complete information. Because of the danger of collateral exposure, no first aid response should be made by any individual not properly trained and protected from exposure. Laboratory evacuation will normally be required, and building evacuation may be necessary. Contact the department's Laboratory/Safety/Waste coordinator at 6390 for assistance. Designate an individual to direct emergency response personnel to the right location on arrival. This person should wait at the west entrance to the building.

Keep a written log of any emergency assistance administered on site by MSU personnel. Provide this log and the MSDS to emergency response personnel upon arrival. See Appendix 7.

Symptoms of exposure may include healthy pink to red skin color. If physical injury or oxygen deficiency is involved, the skin color may be bluish (this discoloration is known as *cyanosis*). Reddening of the eyes, pupil dilation, nausea, breathing difficulty, or dizziness may also be symptoms.

### 1. Inhalation

Inhalation exposure is most likely to occur when solutions of cyanide compounds are neutralized or acidified, producing hydrogen cyanide (HCN) gas. Thus, the actual

exposure is to the volatile hydrogen cyanide rather than the solid cyanide salt. Hydrogen cyanide has an odor similar to bitter almonds, but this is not detectable by everyone. Lack of perceptible odor should not be construed as absence of HCN.

In case of an inhalation exposure, move the victim to fresh air. Keep a conscious victim warm, and in a restful position. Monitor condition closely until medical help arrives. If the victim becomes unconscious, but is breathing, administer oxygen if it is available. *Do not* give mouth-to-mouth resuscitation, as the risk of collateral exposure is significant.

## 2. Eye/Skin Contact

Immediately flush the eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Consider the possibility of subsequent inhalation exposure, and follow the inhalation guidelines above.

## 3. Ingestion

If the victim is conscious, immediately give activated charcoal slurry. *Never* give anything by mouth to an unconscious person. Do not induce vomiting. Consider the possibility of subsequent inhalation exposure, and follow the inhalation guidelines above.

## D. Fire

In the event of a fire in a cyanide work area, use a dry powder ABC extinguisher. Avoid the use of CO<sub>2</sub> or water extinguishers.

## **Appendix 1**

Material Safety Data Sheet (MSDS)  
Potassium Cyanide  
Published by Mallinckrodt Baker, Inc.  
Effective 9/15/98

## **Appendix 2**

Lab Chemical Safety Summary (LCSS)  
Sodium Cyanide and Potassium Cyanide  
National Academy of Sciences, 1995



Cyanide compounds in use.

Authorized entry only.

In case of emergency,  
*do not enter.* Call 911.





CYANIDE COMPOUNDS IN USE.

GOGGLES AND GLOVES REQUIRED

**NO ACIDS PERMITTED!**

This work area restricted to two people.  
Authorized entry only.

In case of emergency, *evacuate.*  
Call 911.

**Appendix 6**  
**Labeling of Hazardous Waste**

Label waste bottles as shown below.

|   |  |
|---|--|
| <b>HAZARDOUS WASTE</b><br><b>CONTAINS CYANIDE COMPOUNDS</b><br><b><i>TOXIC</i></b><br><b><i>DO NOT ADD ACID</i></b> |  |
| Contents:   | <i>List each compound present, with approximate concentration of each.</i> |
| pH  | <i>List pH of contents.</i>  |
| Volume  | <i>List total waste volume.</i>  |

**Appendix 7**  
**Log of On-Site Treatment, Cyanide Exposure**

*Record below any treatment given on-site, or other details that may be important to medical personnel.*

|  |  |                                 |               |
|--|--|---------------------------------|---------------|
| Name of victim   |  | Approximate age                 |               |
| MedicAlert or other medical information available  |  |                                 |               |
| Date of Exposure   |  | Time of exposure                |               |
| Specific chemicals involved (circle, cross out, or enter)                                |  | Estimated quantity              | Concentration |
| sodium/potassium cyanide   |  |                                 |               |
| hydrogen cyanide   |  |                                 |               |
| acid(s)  |  |                                 |               |
| other:   |  |                                 |               |
| Probable route of exposure (inhalation, skin contact, eye contact, ingestion, injection) |  |                                 |               |
| Time emergency reported (911):   |  |                                 |               |
| Victim conscious?  |  | Time victim became unconscious: |               |
| Victim breathing?  |  | Time victim stopped breathing.  |               |
| Air/oxygen administered?   |  | Time initiated, how?            |               |
| Victim has pulse?  |  | Time pulse stopped              |               |
| CPR administered?  |  | Time started                    |               |
| Activated charcoal given?  |  | Time                            |               |
| Skin/eyes flushed?   |  | Start time:<br>Stop time:       |               |