

# Occupational Health Guideline for Copper Dusts and Mists

## INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

## SUBSTANCE IDENTIFICATION

- Formulas of example compounds:  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ;  $\text{CuCl}$
- Example compounds: Copper sulfate dust or mist; cuprous chloride dust
- Appearance and odor: Odorless solids

## PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for copper dusts or mists is 1 milligram of copper dusts or mists per cubic meter of air ( $\text{mg}/\text{m}^3$ ) averaged over an eight-hour work shift.

## HEALTH HAZARD INFORMATION

- **Routes of exposure**  
Copper dusts or mists can affect the body if they are inhaled or if they come in contact with the eyes or skin. They can also affect the body if they are swallowed.
- **Effects of overexposure**
  1. **Short-term Exposure:** Powdered copper or dusts or mists of copper salts may cause a feeling of illness similar to the common cold with sensations of chills and stuffiness of the head. Small copper particles may enter the eye and cause irritation, discoloration, and damage.
  2. **Long-term Exposure:** Repeated or prolonged exposure to copper dusts or mists may cause skin irritation or discoloration of the skin or hair.
  3. **Reporting Signs and Symptoms:** A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to copper dusts or mists.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to copper dusts and mists at potentially hazardous levels:

1. **Initial Medical Screening:** Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from copper dusts and mists exposure.

—Chronic respiratory disease: Copper dusts or mists cause respiratory irritation in animals. In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of copper dusts or mists might cause exacerbation of symptoms due to their irritant properties.

—Liver disease: Copper dusts or mists cause liver damage in animals. Persons with pre-existing liver disease may be more susceptible to the effects of these agents.

—Kidney disease: Copper dusts or mists cause kidney damage in animals. The importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Skin disease: Skin sensitization in human subjects has occurred. Persons with pre-existing skin disorders may be more susceptible to the effects of these agents.

—Hematopoietic disorders: Anemia has occurred in animals given copper salts orally. Persons with pre-existing blood disorders may be more susceptible to the effects of these agents.

—Wilson's disease: Persons with pre-existing Wilson's disease may be more susceptible to the effects of these agents.

2. **Periodic Medical Examination:** Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

Inhalation of dusts and mists of copper and copper salts results in irritation of the upper respiratory tract, with occasional ulceration and perforation of the nasal septum. Inhalation of copper and its compounds by animals caused injury to the lungs and liver with

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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Occupational Safety and Health Administration

hemochromatosis. Access of sheep to salt licks containing 5 to 9% copper sulfate caused the sudden onset of hemolytic anemia, icterus, and hemoglobinuria followed by death in a day or two; at necropsy, the liver, kidneys, and spleen showed severe degenerative changes. Workers exposed to copper dust in concentrations of 0.075 to 0.120 mg/m<sup>3</sup> complained of mild nasal discomfort. Exposure to the dust of copper acetate produced sneezing, coughing, digestive disorders, and fever. Metal workers exposed to complex copper salts in dust form complained of metallic taste with irritation of nasal and oral mucosa; atrophic changes in the mucous membranes were noted in subjects exposed for long periods of time. On ingestion, copper salts act as irritants and cause nausea, vomiting, abdominal pain, hemorrhagic gastritis, and diarrhea. Copper salts splashed in the eye cause conjunctivitis, corneal ulceration, and turbidity, and may produce palpebral edema. Copper particles embedded in the eye result in pronounced foreign-body reaction with characteristic discoloration of ocular tissue. Allergic contact dermatitis due to copper exposure, although rare, has been reported. Greenish discoloration of the skin and hair of some copper workers has been observed. Although copper is an essential element for health, excessive amounts can produce harmful effects.

## CHEMICAL AND PHYSICAL PROPERTIES

### • Physical data

1. Molecular weight: CuSO<sub>4</sub>: 249.7; CuCl<sub>2</sub>: 99
2. Boiling point (760 mm Hg): Not applicable
3. Specific gravity (water = 1): Greater than 1
4. Vapor density (air = 1 at boiling point of copper dusts or mists): Not applicable
5. Melting point: Higher than 100 C (212 F). For example, copper sulfate = 150 C (302 F); cuprous chloride = 430 C (806 F)
6. Vapor pressure at 20 C (68 F): Not applicable
7. Solubility in water, g/100 g water at 20 C (68 F): Ranges from very low (e.g. cuprous chloride = 0.006) to high (e.g. copper sulfate = 35)
8. Evaporation rate (butyl acetate = 1): Not applicable

### • Reactivity

1. Conditions contributing to instability: Extreme heat
2. Incompatibilities: Copper dusts or mists may react with acetylene gas to form copper acetylides, which are solids that are sensitive to shock. Some copper mists may react with magnesium metal to form flammable hydrogen gas.
3. Hazardous decomposition products: None
4. Special precautions: None

### • Flammability

1. Ignition temperature: Copper dusts = 700 C (1292 F)

### • Warning properties

According to Grant, copper acetoarsenite, copper chloride, copper sulfate, copper carbonate and oxide, and copper metal all produce local irritant effects when in contact with the eye. The *Documentation of TLVs* also notes that copper salts on the eye may cause "conjunctivitis or even ulceration and turbidity of the cornea." Concentrations producing these effects are not given.

## MONITORING AND MEASUREMENT PROCEDURES

### • General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

### • Method

Sampling and analyses may be performed by collection of copper dusts or mists on a cellulose ester membrane filter, followed by treatment with nitric acid, solution in hydrochloric acid, and atomic absorption spectrophotometric analysis. An analytical method for copper dusts or mists is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

## RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

## PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch

minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with copper salts or liquids containing copper salts.

- If employees' clothing may have become contaminated with powdered copper, copper salts, or liquids containing copper salts, employees should change into uncontaminated clothing before leaving the work premises.

- Clothing contaminated with copper salts should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of copper salts from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the copper salts, the person performing the operation should be informed of copper salts' hazardous properties.

- Non-impervious clothing which becomes contaminated with copper salts should be removed promptly and not reworn until the copper salts are removed from the clothing.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where powdered copper or dusts, mists, or liquids containing copper salts may contact the eyes.

## SANITATION

- Skin that becomes contaminated with copper salts should be promptly washed or showered with soap or mild detergent and water to remove any copper salts.

- Eating and smoking should not be permitted in areas where powdered copper, copper salts, or liquids containing copper salts are handled, processed, or stored.

- Employees who handle powdered copper, copper salts, or liquids containing copper salts should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

## COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to copper dusts or mists may occur and control methods which may be effective in each case:

Operation	Controls
Liberation during mining, extracting, and refining copper ore; during fabrication and manufacture of copper rod, wire, piping, and tubing for use in electrical, plumbing, and building industries; during manufacture of domestic utensils; during manufacture of alloys	Local exhaust ventilation; general dilution ventilation; personal protective equipment

## Operation

Liberation from production and application of fungicides, insecticides, and germicides for soil, feed, grain, textile, water and sewage treatments; during use of copper salts for paint pigments and coloring agents, electroplating baths, wood preservation, automotive emission controls, textile treatment, and organic synthesis

## Controls

Local exhaust ventilation; general dilution ventilation; personal protective equipment

## EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

### • Eye Exposure

If copper dusts or mists get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with these chemicals.

### • Skin Exposure

If copper salts or liquids containing copper salts get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If copper salts or liquids containing copper salts penetrate through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

### • Breathing

If a person breathes in large amounts of copper dusts or mists, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

### • Swallowing

When powdered copper, copper salts, or liquids containing copper salts have been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

### • Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and

know the locations of rescue equipment before the need arises.

## SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of release until cleanup has been completed.

- If copper dusts or mists are spilled or released, the following steps should be taken:

1. Ventilate area of release.

2. Collect spilled material in the most convenient and safe manner for reclamation, or for disposal in a secured sanitary landfill. Liquid containing copper should be absorbed in vermiculite, dry sand, earth, or a similar material.

- Waste disposal method:

Copper dusts or mists and copper compounds may be disposed of in sealed containers in a secured sanitary landfill.

## REFERENCES

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## RESPIRATORY PROTECTION FOR COPPER DUSTS AND MISTS

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### Condition

### Minimum Respiratory Protection\* Required Above 1 mg/m<sup>3</sup>

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#### Particulate Concentration

50 mg/m<sup>3</sup> or less

A high efficiency particulate filter respirator with a full facepiece.  
Any supplied-air respirator with a full facepiece, helmet, or hood.  
Any self-contained breathing apparatus with a full facepiece.

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2000 mg/m<sup>3</sup> or less

A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.

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Greater than 2000 mg/m<sup>3</sup> or  
entry and escape from  
unknown concentrations

Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

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Fire Fighting

Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

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\*Only NIOSH-approved or MSHA-approved equipment should be used.

