Occupational Health Guideline for Rotenone

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

- Formula: $C_{23}H_{22}O_6$
- Synonyms: Rotenone, commercial; tubatoxin; "cube"; derrin
- Appearance and odor: Colorless to red, odorless solid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for rotenone is 5 milligrams of rotenone per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Rotenone can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

- **Effects of overexposure**

Exposure to rotenone may cause irritation of the eyes and skin. Symptoms of absorption of rotenone dust (inferred mostly from animal studies) include numbness of the mouth, nausea, vomiting, gastric pain, pulmonary irritation, trembling, loss of coordination, convulsions, stupor, and cessation of breathing. In animal experiments, exposure to rotenone dust has caused liver and kidney damage and has produced tumors.

- **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 rotenone.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to rotenone at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the central nervous system, eyes, respiratory tract, and liver should be stressed.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

- **Summary of toxicology**

Rotenone dust affects the nervous system and causes convulsions in animals. Animals repeatedly fed derris powder (a botanical source containing 9.6% rotenone) at levels from 312 to 5000 ppm developed focal liver necrosis and mild kidney damage. Of 40 female rats given daily intraperitoneal injections of rotenone in sunflower oil of 1.7 mg/kg for 42 days, over 60% developed mammary tumors 6 to 11 months after the end of treatment; most of the tumors were mammary adenomas; one was a differentiated adenocarcinoma; none of the control animals had tumors when examined 19 months after treatment. The lethal oral dose in humans is estimated to be 0.3 to 0.5 g/kg. In humans, inhalation of dust is expected to cause pulmonary irritation. Symptoms of absorption in humans (inferred mostly from animal studies) may include numbness of oral mucous membranes, nausea, vomiting, and abdominal pain. There may be muscle tremors, incoordination, clonic convulsions, and stupor. The dust is irritating to the eyes and skin.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 394.4
  2. Boiling point (760 mm Hg): Decomposes

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3. Specific gravity (water = 1): 1 (approximately)
4. Vapor density (air = 1 at boiling point of rotenone): Not applicable
5. Melting point: 163 C (325 F) or 181 C (358 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 0.00002
8. Evaporation rate (butyl acetate = 1): Not applicable

• **Reactivity**

1. Conditions contributing to instability: None.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: None.
4. Special precautions: None.

• **Flammability**

1. Flash point: Data not available
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Data not available
4. Extinguishant: Foam, carbon dioxide, dry chemical, water.

• **Warning properties**

Since the vapor pressure of rotenone is negligible, warning properties are not considered.
Rotenone is not known to be an eye irritant.

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**

An analytical method for rotenone is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 5, 1979, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00349-1).

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 rotenone or liquids containing rotenone.

• If employees' clothing has had any possibility of being contaminated with rotenone or liquids containing rotenone, employees should change into uncontaminated clothing before leaving the work premises.

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

• Non-impervious clothing which becomes contaminated with rotenone should be removed promptly and not reworn until the rotenone is removed from the clothing.

• Employees should be provided with and required to use dust- and splash-proof safety goggles where rotenone or liquids containing rotenone may contact the eyes.

SANITATION

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

• Eating and smoking should not be permitted in areas where rotenone or liquids containing rotenone is handled, processed, or stored.

• Employees who handle rotenone or liquids containing rotenone 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 rotenone may occur and control methods which may be effective in each case:

Operation	Controls
Formulation of pesticides	Process enclosure; local exhaust ventilation; wet methods
Application on agricultural crops and livestock as an insecticide and ascaricide	Personal protective equipment
Manufacture of rotenone	Process enclosure; local exhaust ventilation; wet methods; 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 rotenone or liquids containing rotenone get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

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

• **Breathing**

If a person breathes in large amounts of rotenone, 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 rotenone or liquids containing rotenone 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 spills until cleanup has been completed.

• If rotenone is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. For small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities can be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber.

• Waste disposal methods:

Rotenone may be disposed of

1. By making packages of rotenone in paper or other flammable material and burning in a suitable combustion chamber.
2. By dissolving rotenone in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber.

REFERENCES

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RESPIRATORY PROTECTION FOR ROTENONE (COMMERCIAL)

Condition	Minimum Respiratory Protection* Required Above 5 mg/m³
Particulate Concentration	
50 mg/m³ or less	Any chemical cartridge respirator with an organic vapor cartridge(s) and dust and mist filter(s), including pesticide respirators which meet the requirements of this class. Any supplied-air respirator. Any self-contained breathing apparatus.
250 mg/m³ or less	A chemical cartridge respirator with a full facepiece, organic vapor cartridge(s), and dust and mist filter(s), including pesticide respirators which meet the requirements of this class. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust and mist filter, including pesticide respirators which meet the requirements of this class. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
5000 mg/m³ or less	A powered air-purifying respirator with an organic vapor cartridge and high efficiency particulate filter, including pesticide respirators which meet the requirements of this class. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 5000 mg/m³ 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.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class. Any escape self-contained breathing apparatus.

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