

Occupational Health Guideline for Soluble Platinum Salts (as Platinum)

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.

APPLICABILITY

The general guidelines contained in this document apply to all soluble platinum salts (as platinum). Physical and chemical properties of several specific compounds are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION

Sodium chloroplatinate

- Formula: $\text{Na}_2\text{PtCl}_6 \cdot 6\text{H}_2\text{O}$
- Synonyms: None
- Appearance and odor: Yellow-orange, odorless solid.

Ammonium chloroplatinate

- Formula: $(\text{NH}_4)_2\text{PtCl}_6$
- Synonyms: Ammonium hexachloroplatinate
- Appearance: Yellow-orange solid.

Platinum tetrachloride

- Formula: PtCl_4
- Synonyms: Platinum (IV) chloride
- Appearance: Brown-red crystals.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for soluble platinum salts is 0.002 milligram of soluble platinum salts (as platinum) per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

Soluble platinum salts 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:* Soluble platinum salts may cause irritation of the eyes, nose, and throat.

2. *Long-term Exposure:* Repeated exposure to soluble platinum salts may cause both respiratory and skin allergies. The respiratory reaction starts with sneezing and a runny nose. These effects may be followed by chest tightness, shortness of breath, blue discoloration of the skin, and wheezing. The skin reaction consists of an itchy red rash.

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 soluble platinum salts.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to soluble platinum salts 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. Persons with a history of asthma, allergies, or known sensitization to soluble platinum salts would be expected to be at increased risk from exposure. Examination of the respiratory system should be stressed. The skin should be examined for evidence of chronic disorders.

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

• Summary of toxicology

Soluble platinum salts in the form of dusts and sprays cause asthma, skin sensitization, and eye irritation; elemental platinum does not produce these effects.

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.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Workers repeatedly exposed to platinum salts in concentrations of from 2 to 20 $\mu\text{g}/\text{m}^3$ of workroom air developed irritation of the nose and upper respiratory tract with sneezing and running of the eyes, leading to cough, chest tightness, asthmatic wheezing with dyspnea and cyanosis, which became progressively more severe with further exposure. A relative lymphocytosis is commonly present. Skin exposure results in contact dermatitis with pruritis and urticaria; an eczematous eruption often results. Some exposed individuals experience both dermal and respiratory effects due to sensitization; the majority of individuals exposed repeatedly to platinum salts develop some allergic symptoms. Removal from platinum salt exposure results in almost immediate relief of asthma; the dermatitis usually clears in 1 to 2 days but may be persistent. In the eyes, the dusts cause a burning sensation, lacrimation, and conjunctival hyperemia sometimes associated with photophobia.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data—Sodium chloroplatinate

1. Molecular weight: 561.9
2. Boiling point (760 mm Hg): Not applicable
3. Specific gravity (water = 1): 2.5
4. Vapor density (air = 1 at boiling point of soluble platinum salts): Not applicable
5. Melting point: Loses water at 100 C (212 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 50
8. Evaporation rate (butyl acetate = 1): Not applicable

• Physical data—Ammonium chloroplatinate

1. Molecular weight: 443.9
2. Boiling point (760 mm Hg): Not applicable
3. Specific gravity (water = 1): 3.1
4. Vapor density (air = 1 at boiling point of soluble platinum salts): Not applicable
5. Melting point: Decomposes
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 0.7
8. Evaporation rate (butyl acetate = 1): Not applicable

• Physical data—Platinum tetrachloride

1. Molecular weight: 336.9
2. Boiling point (760 mm Hg): Not applicable
3. Specific gravity (water = 1): 4.3
4. Vapor density (air = 1 at boiling point of soluble platinum salts): Not applicable
5. Melting point: Decomposes at 370 C (698 F)
6. Vapor pressure at 20 C (68 F): Not applicable
7. Solubility in water, g/100 g water at 25 C (77 F): 58.7
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: High temperatures may cause formation of poisonous chlorine gas.
2. Incompatibilities: None
3. Hazardous decomposition products: Toxic gases and vapors (such as chlorine) may be released when chlorine-containing soluble platinum salts decompose.
4. Special precautions: None

• Flammability

1. Not combustible

• Warning properties

Grant reports that "the dusts of soluble platinum salts cause a burning sensation in the eyes, lacrimation, and conjunctival hyperemia, sometimes associated with photophobia, which suggests that the corneal epithelium may be involved." However, no quantitative information concerning the concentrations of the dusts which produce these symptoms is 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 soluble platinum salts on a filter, followed by treatment with nitric and perchloric acids, solution in acid, and atomic absorption analysis. An analytical method for soluble platinum salts is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4). (order number PB 265 029).

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 Enforce-

ment 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 soluble platinum salts or liquids containing soluble platinum salts, where skin contact may occur.

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

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

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

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

SANITATION

- Skin that becomes contaminated with soluble platinum salts should be promptly washed or showered to remove any soluble platinum salts.

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

- Employees who handle soluble platinum salts or liquids containing soluble platinum salts should wash their hands thoroughly before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to soluble platinum salts may occur and control methods which may be effective in each case:

Operation

Use as catalysts in production of high octane gasoline; nitric and sulfuric acids; vinyl esters, petrochemicals, and pharmaceuticals

Use and re-use in reclamation of platinum ore; use in electroplating industry

Use in photographic and related industries as a photographic paper sensitizer

Controls

Process enclosure; local exhaust ventilation; general dilution ventilation; personal protective equipment

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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 soluble platinum salts or liquids containing soluble platinum salts 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 these chemicals.

• Skin Exposure

If soluble platinum salts or liquids containing soluble platinum salts get on the skin, promptly flush the contaminated skin with water. If soluble platinum salts or liquids containing soluble platinum salts penetrate through the clothing, remove the clothing promptly and flush the skin with water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of soluble platinum salts, 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 soluble platinum salts or liquids containing soluble platinum 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. Under-

stand 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 soluble platinum salts or liquids containing soluble platinum salts are spilled, the following steps should be taken:
 1. Ventilate area of spill.
 2. Collect spilled material in the most convenient and safe manner for reclamation or for disposal in a secured sanitary landfill. Liquids containing soluble platinum salts should be absorbed in vermiculite, dry sand, earth, or a similar material.
- Waste disposal method:
Soluble platinum salts may be disposed of in sealed containers in a secured sanitary landfill.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Platinum (Soluble Salts as Pt)," *Documen-*

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RESPIRATORY PROTECTION FOR SOLUBLE PLATINUM SALTS (AS PLATINUM)

Condition	Minimum Respiratory Protection* Required Above 0.002 mg/m ³
Particulate Concentration	
0.1 mg/m ³ 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.
2 mg/m ³ or less	A powered air-purifying respirator with a high efficiency particulate filter and a full facepiece, helmet, or hood.
4 mg/m ³ 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.
Greater than 4 mg/m ³ 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.

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