International Platinum Groups Metals Association (IPA)

Guidance Document
'Safe Use of Platinum Group Metals in the Workplace'

Questions and Answers

1. **What is the purpose of this guide?**
    - To assist those responsible for the health protection of workers exposed to complex halogenated platinum salts (CHPS) and other platinum group metals (PGMs).

2. **Who are the target groups of this guide?**
    a. Occupational physicians and nurses
    b. Industrial hygienists
    c. Safety engineers
    d. Health and safety engineers
    e. Operational and business managers

3. **What is the focus of this guide?**
    a. The identification of key hazards and risks associated with occupational exposures to platinum group metals.
    b. The description of possible components of a comprehensive occupational health program for worker protection.
    c. Outlining opportunities for the proper control of certain soluble complex salts of platinum which are respiratory sensitisers.
    d. The guide is not intended to be relied upon as a definitive or exhaustive source – readers are encouraged to obtain further information, such as that available in supplier safety datasheet. Furthermore, legal conditions and requirements are constantly evolving and readers are required to verify compliance with applicable local regulations related to worker medical surveillance.

4. **What are PGMs used for?**
    a. PGMs have many inherent properties which make them of significant benefit to society. In many of their applications, substitutes for PGMs are either not feasible or are considerably inferior in performance.
    b. Applications of PGMs range from environmental protection (pollution control catalysts) to health care (as ingredients in pharmaceuticals and as medical treatments) to production of many useful chemicals and consumer products (please refer to chapter 3 for further details).

5. **Where are PGMs sourced from?**
    a. Major deposits of PGMs are found in South Africa, Zimbabwe, the USA, Canada, and Russia. South Africa is the largest producer of PGMs, followed by Russia (where PGMs are mined as a by-product from Nickel production).
    b. PGMs are extracted either from newly-mined primary ore or from used, scrap, or by-product metal.

6. **Who are the authors of this guide?**
    a. The guide has been prepared by independent consultants in collaboration with specialists within the member companies of the IPA.
    b. The guide has been peer reviewed by independent experts.

7. **Which PGM compounds is this guide focusing on?**
    - This guide focuses mainly on the respiratory sensitisation caused by platinum compounds, as the evidence for respiratory sensitisation due to industrial exposures to non-platinum PGMs is less compelling. In a few instances, positive testing to salts of palladium, rhodium, iridium, or ruthenium has been recorded in workers with significant co-exposure to CHPS. The responses, often seen in conjunction with a positive skin prick test (SPT) to CHPS, are most likely attributable to cross-sensitisation reactions to CHPS, or are otherwise complicated by uncertainties over delineation of the causative agent – please refer to chapter 6, 6.5 for further information.

8. **Which platinum compounds can cause respiratory sensitisation?**
    a. Only platinum compounds possessing labile leaving groups have been shown to be respiratory sensitisers and these require stringent workplace control standards.
    b. Species that are respiratory sensitisers in industrial settings are largely confined to complex halogenated platinum salts (CHPS). Please refer to chapter 4 for further details.

9. **How does sensitisation occur?**
    a. Sensitisation is believed to commence when a platinum complex (hapten) binds to a protein, presenting the key antigenic stimulus to the immune system.
    b. Antibodies, most often immunoglobin E (IgE), mount a response to the antigen – this reaction is also the basis of the diagnostic test for platinum salt sensitivity (via skin prick testing).
    c. Induction predominantly occurs via inhalation, but dermal exposure may be also important.
    d. Factors that may predispose workers to platinum salt sensitivity (PSS) include smoking, genetic influences and co-exposure to other respiratory irritants.

e. Workers exposed to CHPS who become sensitised are initially asymptomatic.
f. The period between first exposure and sensitisation is typically between several months and 3 years.

10. Where can occupational exposure to CHPS occur?

a. Industrial processing of PGMs has the potential for a variety of occupational exposures to PGMs.
b. Processes with potential exposure are materials handling, dissolution of PGM concentrates, separation and refining processes, manufacture of supported catalysts, PGM salts and powders, manufacturing processes for smaller scale products.
c. Particularly in refining operations where workers are potentially exposed to PGMs and their chemical derivatives.

11. How can occupational exposure occur?

a. Exposure can occur through contact with PGM solutions, solids, aerosols, particulates or fume.
b. The route of exposure can be by inhalation, ingestion or skin contact.

12. Can exposure to PGMs also occur in non-occupational areas?

a. Non-occupational exposure may occur from both natural and man-made sources of PGMs but is much more limited than occupational exposure.
b. It occurs mainly due to the natural environmental load of PGMs in geological deposits, trace levels in soils, water and foodstuffs.
c. Small amounts of PGMs can also be discharged from processing and manufacturing facilities and the release of PGM containing materials from some end-uses (please refer to chapters 4 and 5 for further details).

13. What are the potential health effects caused by occupational exposure to PGMs?

- Exposure of workers to complex halogenated platinum salts (CHPS) can cause respiratory sensitisation (called Platinum Salt Sensitisation, or PSS)
    i. Characteristics of symptomatic PSS
        1. Conjunctivitis
        2. and/or rhinitis
        3. And with continued exposure: occupational asthma
    ii. Please refer to chapter 7 for details on clinical features.

14. How can respiratory sensitisation in platinum workers be diagnosed?

a. The principal tools for surveillance, investigation and diagnosis of PSS include:
    i. Questionnaires for assessing clinical symptoms
    ii. Objective tests of immunological response to confirm sensitisation (e.g. SPT)
    iii. Respiratory function tests to confirm or exclude occupational asthma

b. Skin prick testing (SPT)
    i. Depending on the specific statutory requirements and conditions of the respective jurisdiction, SPT can be the method of choice for the surveillance of exposed workers.
    ii. Physicians or nurses can administer a standard solution of sodium hexachloroplatinate in a sensitive, specific and cost effective way to test for sensitisation to platinum salts.
    iii. Based on current knowledge, long-term surveillance using sodium hexachloroplatinate for SPT on control subjects otherwise unexposed to chloroplatinates has not resulted in cases of induced sensitisation (further details see Chapter 7).
    iv. In instances when SPT occasionally fails to identify symptomatic workers, it may be appropriate to conduct bronchial challenge tests (by experienced physicians or clinicians only).
    v. Please refer to chapter 7 for details.

15. Are there any other groups at risk of exposure to PSS?

a. PSS has been observed in chemotherapy patients receiving infusions of platinum-containing anti-cancer drugs (i.e., “platins”).
b. Health care workers may also be exposed to platins; however, respiratory sensitisation has not been reported in health care workers.

16. Is there a risk of PSS from exposure to other Platinum compounds?

- Respiratory sensitisation has not been observed in workers exposed to elemental platinum or other platinum compounds that do not contain labile coordinated ligands as present in CHPS.

17. Will all workers exposed to CHPS develop PSS?

a. Although all CHPS-exposed workers should be considered “at risk” for respiratory sensitisation, only less than 10% of exposed workers become sensitised and this is expected to fall as more advanced controls become available that reduce worker exposure.
b. PSS affects only a proportion of those exposed and usually does so within the first two to three years of exposure.
c. Sensitised workers should be removed from settings using CHPS.

18. How can workers be protected from sensitisation?

a. The protection of workers from exposure to chemical agents is a regulatory requirement.
b. A comprehensive, well-executed workplace chemical monitoring program will help to reduce the risk of exposure of workers to PGMs and other related workplace contaminates by:
    i. Understanding of applicable occupational exposure limits and standards.
    ii. Implementing air and surface monitoring programs that allow for collection of exposure data and comparison of worker exposures to these values.
    iii. Please find details information in chapter 8.

19. What measures can be used to control exposure in the workplace?

- Companies have to put in place measures to effectively manage the level of exposure for a workplace activity with emphasis on the control of inhalation exposures (chapter 9).
    i. Chemicals with higher toxicity (e.g. CHPS) and Pt-containing anticancer drugs require stringent exposure control.
        1. The exposure potential needs to be evaluated through workplace monitoring or estimated using predictive tools and models.
        2. The selection of the optimal control technology is driven by the workplace, the activity causing the exposure, and desired target exposure level for a hazardous substance.
        3. Local legal requirements need to be considered.
    ii. The elimination or substitution of the hazardous material are preferred options of exposure control.
    iii. If neither is possible, the most effective engineering controls are the next best option. The most effective ones are barrier systems designed to provide total containment.
    iv. Additional, administrative controls and personal protective equipment (PPE) will further ensure that exposure is being reduced.

20. Where can I find any relevant applicable regulation?

a. Occupational exposure limits (OELs) are used as an important control to protect workers' health from adverse effects of exposure to chemicals and are available in most territories.
b. Due to technical considerations (analytical limitations), specific OELs for chloroplatinate salts are not currently available, but OELs for total soluble Pt are used instead as a surrogate monitoring standard.
c. Where defined as hazardous, PGM chemical substances are subject to a number of regulatory controls and hazard communication duties. Such regulations include but are not limited to risk assessment of workplace activities, hazard identification and communication, exposure monitoring, exposure controls, and training and awareness.

d. New chemical management systems, typified by the EU REACH regulation and its equivalents elsewhere, impose other specific requirements, e.g., substance registration and risk assessment.
e. Due to constantly evolving legal conditions and requirements in the respective jurisdictions, employers must determine compliance with applicable laws and regulations in each individual case.
f. Where hazardous chemicals are manufactured, used, or stored, chemical control regulations and workplace EHS management systems dictate that up-to-date hazard and safe handling information must be available and provided to the workforce.