Industrial use cadmium by-products: Human health tier II assessment

13 February 2015

Chemicals in this assessment

Chemical Name in the Inventory	CAS Number
Cadmium, dross	69011-69-4
Cadmium, sponge	69011-70-7

Preface

This assessment was carried out by staff of the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) using the Inventory Multi-tiered Assessment and Prioritisation (IMAP) framework.

The IMAP framework addresses the human health and environmental impacts of previously unassessed industrial chemicals listed on the Australian Inventory of Chemical Substances (the Inventory).

The framework was developed with significant input from stakeholders and provides a more rapid, flexible and transparent approach for the assessment of chemicals listed on the Inventory.

Stage One of the implementation of this framework, which lasted four years from 1 July 2012, examined 3000 chemicals meeting characteristics identified by stakeholders as needing priority assessment. This included chemicals for which NICNAS already held exposure information, chemicals identified as a concern or for which regulatory action had been taken overseas, and chemicals detected in international studies analysing chemicals present in babies' umbilical cord blood.

Stage Two of IMAP began in July 2016. We are continuing to assess chemicals on the Inventory, including chemicals identified as a concern for which action has been taken overseas and chemicals that can be rapidly identified and assessed by using Stage One information. We are also continuing to publish information for chemicals on the Inventory that pose a low risk to human health or the environment or both. This work provides efficiencies and enables us to identify higher risk chemicals requiring assessment.

The IMAP framework is a science and risk-based model designed to align the assessment effort with the human health and environmental impacts of chemicals. It has three tiers of assessment, with the assessment effort increasing with each tier. The Tier I assessment is a high throughput approach using tabulated electronic data. The Tier II assessment is an evaluation of risk on a substance-by-substance or chemical category-by-category basis. Tier III assessments are conducted to address specific concerns that could not be resolved during the Tier II assessment.

These assessments are carried out by staff employed by the Australian Government Department of Health and the Australian Government Department of the Environment and Energy. The human health and environment risk assessments are conducted and published separately, using information available at the time, and may be undertaken at different tiers.

This chemical or group of chemicals are being assessed at Tier II because the Tier I assessment indicated that it needed further investigation.

For more detail on this program please visit:**www.nicnas.gov.au**

Disclaimer

ACRONYMS & ABBREVIATIONS

Grouping Rationale

The inorganic chemicals in this group are UVCBs (unknown or variable composition, complex reaction products or biological materials), which are industrial use cadmium by-products, extracted from lead or zinc refinery for recovery and purification. In purified form they are a mixture of cadmium metal and cadmium oxide: (Sharma KD et al., 1984; Hewitt and Wall, 2000; Scoullos D et al., 2001; Wiberg and Wiberg, 2001; Moradkhania D et al., 2012; Zinc REACH Consortia, 2014)

- **Cadmium dross** (also known as lead smelter cadmium slag) is a scum formed on the surface of molten cadmium and primarily consists of cadmium oxide residues and cadmium metal (< 80%), to a lesser extent zinc (0.37 %) and small amounts of the alloying elements (such as sodium carbonate at 8.84%). The scum is extracted/isolated from the surface through mechanical separation and the cadmium metal is then atmospherically oxidised into cadmium oxide (Zinc REACH Consortia, 2014; ChemIDPlus; US EPAa; US EPAb); and

- **Cadmium sponge** (also known as lead smelter sponge cadmium precipitate) is a purified precipitate obtained by treatment of slurried dusts from lead manufacturing with zinc. This chemical is produced by injecting gas or mixing a foaming agent into molten metal which creates a froth that is stabilised by a high-temperature foaming agent. The unpurified cadmium precipitate is filtered and forms a cake containing cadmium (approximately 12 %), zinc (25 %), and small amounts of other impurities such as copper (in insoluble form). The cake is then purified into pure cadmium metal and is further manufactured (oxidised in a controlled atmosphere) into cadmium oxide (available in powder form) (Hewitt and Wall, 2000; American Elements, 2014; USGS, 2014; ChemIDPlus).

Both the chemicals are grouped together due to the expected similarity in their physico-chemical properties, leading to the compounds within this group having related end uses. The toxicity of these cadmium compounds is considered to result entirely from the presence of the cadmium component, as cadmium oxide and cadmium metal (OECDa; OECDb). The remaining components (impurities) in the UVCB composition, particularly zinc and zinc dust (as zinc oxide) in cadmium sponge are not expected to contribute to the toxicity of the chemical compounds (NICNAS, 2012; NICNASd; NICNASe; NICNASf) in comparison to cadmium due to the small concentrations of impurities.

Import, Manufacture and Use

Australian

No specific Australian use, import, or manufacturing information has been identified.

International

The following international use has been identified through the European Union (EU) Registration, Evaluation and Authorisation of Chemicals (REACH) dossiers and several other sources (Zinc REACH Consortia, 2014; US EPAa; US EPAb):

The chemicals have reported site-limited use as intermediates in the manufacture of cadmium and cadmium compounds.

Metallic foams such as cadmium sponges have reported applications in heat exchangers, energy absorption, flow diffusion and lightweight optics (American Elements, 2014). However, it is unclear whether these are direct uses or uses from the manufactured cadmium compounds.

Restrictions

Australian

Cadmium and cadmium compounds are listed in the *Poisons Standard* (the Standard for the Uniform Scheduling of Medicines and Poisons—SUSMP) (SUSMP, 2014) under the following Schedules:

Appendix I, The uniform paint standard

The following applies to paints containing cadmium or cadmium compounds at >0.1 % (the proportion of a substance for the purposes of this Schedule is calculated as a percentage of the element present in the non-volatile content of the paint).

'A person must not manufacture, sell, supply or use a paint containing >0.1% of cadmium or cadmium compounds for application to:

- a roof or any surface to be used for the collection or storage of potable water; or
- furniture; or
- any fence, wall, post, gate or building (interior or exterior) other than a building which is used exclusively for industrial purposes or mining or any oil terminal; or
- any premises used for the manufacture, processing, preparation, packing or serving of products intended for human or animal consumption' (SUSMP, 2014).

Additionally, 'a person must not manufacture, sell, supply or use a paint for application to toys unless the paint complies with the specification for coating materials contained in Australian/New Zealand Standard AS/NZS ISO 8124.3:2012 entitled *Safety of toys Part 3: Migration of certain elements* (ISO 8124-03:2010, MOD)' (SUSMP, 2014).

'Schedule 6 except when:

(a) included in Schedule 4; or

(b) in paints or tinters containing 0.1 per cent or less of cadmium calculated on the non-volatile content of the paint or tinter' (SUSMP, 2014).

Schedule 6 substances are considered to have 'moderate potential for causing harm, the extent of which can be reduced through the use of distinctive packaging with strong warnings and safety directions on the label' (SUSMP, 2014).

Cadmium and its compounds are also listed as restricted hazardous chemicals in the Australian Work Health and Safety Regulations 2011 for 'use in abrasive blasting at a concentration of greater than 0.1% as cadmium' (Safe Work Australia).

International

Cadmium and cadmium compounds are listed on the following (Galleria Chemica):

- European Union (EU) Cosmetic Directive 76/768/EEC Annex II: List of substances which must not form part of the composition of cosmetic products;
- New Zealand Cosmetic Products Group Standard—Schedule 4: Components cosmetic products must not contain; and
- Health Canada List of prohibited and restricted cosmetic ingredients (The "Hotlist").

Cadmium and its compounds are also restricted in the EU under Annex XVII of the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulation. Cadmium compounds (as Cd) cannot be used in substances and preparations placed on the market for sale at the following concentrations in:

- plastic materials ≥0.01% by weight of the plastic material;
- paints with a zinc content of >10% by weight of the paint, ≥0.1% by weight;
- metal plating; and
- brazing (soldering/welding) fillers ≥0.01% by weight.

Existing Worker Health and Safety Controls

Hazard Classification

Cadmium oxide and cadmium metal are classified as hazardous with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia):

T+; R26 (Very toxic by inhalation)

T; R48/23/25 (Danger of serious damage to health by prolonged exposure through inhalation and if swallowed)

Carc. Cat. 2; R45 (May cause cancer)

Muta. Cat. 3; R68 (Possible risk or irreversible effects)

Repr. Cat. 3; R62-63 (Possible risk of impaired fertility and of harm to the unborn child)

Exposure Standards

Australian

Cadmium and cadmium compounds have an exposure standard of 0.01 mg/m^3 time weighted average (TWA).

International

For cadmium and cadmium compounds the following exposure limits were identified (Galleria Chemica).

An exposure limit (TWA) of 0.01–0.2 mg/m^3 in different countries such as Canada, USA, Latvia and Switzerland.

Health Hazard Information

Cadmium dross and cadmium sponge are industrial use by-products, which consist largely of cadmium metal and cadmium oxide (see **Grouping rationale** section). Both of these constituents are relatively insoluble in water and soluble at gastric pH (NICNASa; NICNASb; C&L Inventory; REACH).

Data sources for determining the hazard of the cadmium cation include animal studies on well characterised cadmium compounds such as cadmium oxide, soluble cadmium salts (cadmium chloride and cadmium sulfate) and a large amount of literature on observations of cadmium exposure in humans. The toxicity data for soluble cadmium salts (cadmium chloride and cadmium sulfate) by the oral route are considered relevant to the chronic systemic oral toxicity of the chemical as the oral bioavailability is expected to be similar. Cadmium oxide is considered relevant to the acute and chronic effects of the chemical by all routes of exposure (NICNASa; NICNASb; NICNASc).

Toxicokinetics

There is a large amount of information on the toxicokinetics of the cadmium ion in humans. This information is mostly related to general cadmium exposure in workers, and is not specific to particular cadmium compounds.

The available human data on cadmium indicate that gastro-intestinal absorption rates are low (5–10 %), and vary depending on the source of the cadmium, the presence of zinc in the diet, the body's iron stores (deficiencies linked with increased cadmium absorption) and the person's age and physiological condition (young or pregnant or lactating animals have been shown to absorb more cadmium than non-pregnant adult animals) (OECD, 2004; EU RAR, 2007).

Following long-term low-level exposure, cadmium is reported to be widely distributed in the body and has a biological half-life of 10–20 years. The greatest accumulation occurs in the kidneys and liver, with only 0.005–0.02 % reported to be excreted in urine and faeces each day. Cadmium is also detectable in the placenta, and can cross the placental barrier, although foetal concentrations are lower than placental concentrations. Concentrations of cadmium in newborn blood were 40–50 % lower than the levels in maternal blood (EU RAR, 2007). Cadmium is reported to be found in human breast milk at <1 µg/L (OECD, 2004). In tissue, cadmium is bound to metallothionein, a low molecular weight metal-binding protein that may play a key role in the metabolism and detoxification of cadmium (EU RAR, 2007).

It should be noted that higher levels of cadmium (particularly in the kidneys) are detected in smokers compared with non-smokers, as cadmium has been shown to accumulate in tobacco plant leaves (WHO, 2010).

Cadmium oxide (similarly to cadmium metal) is reported to be relatively water-insoluble but can dissolve at gastric pH. Thus the chemicals could have similar absorption and toxic effects to soluble cadmium salts. In vitro studies have demonstrated the solubility of the cadmium oxide to be 94 % in artificial gastric juice and 0.15 % in artificial intestinal juice (EU RAR, 2007). It was also reported that some water-insoluble compounds, including cadmium oxide and cadmium carbonate, can be changed to water-soluble cadmium salts by interaction with acids, or light and oxygen (ATDSR; NICNASa).

Animal studies have demonstrated that absorption of cadmium oxide following inhalation exposure ranges from 30 % (dusts, size-dependent) to 50 % (fumes). In humans, inhalation absorption of 10–30 % (dusts, size-dependent) has been reported (OECD, 2004; NICNASa).

In rodent dietary exposure studies using cadmium oxide, significant accumulation of cadmium was detected in the liver, kidneys, lungs and spleen. Levels in the liver and kidneys were reported to be dose-dependent. However, no significant increase in blood or urine levels of cadmium was detected. Absorption rates following oral exposure to low doses of cadmium oxide were reported to be much greater than those determined for exposure to higher doses (EU RAR, 2007; NICNASa).

Dermal absorption of cadmium in rabbits following exposure to a cadmium chloride solution was considered to be substantial, resulting in an accumulation of up to 0.8 % of the administered dose in the kidneys and liver (EU RAR, 2007; NICNASc).

Acute Toxicity

Oral

Based on available data, cadmium oxide is reported to be toxic if swallowed. Cadmium metal was reported to be acutely harmful but no further data are available to support a classification (NICNASb).

The NICNAS assessments of cadmium metal and cadmium oxide recommended classifications based on their oral bioavailability.

Dermal

Cadmium oxide and cadmium metal are not classified for acute dermal toxicity.

Dermal absorption of the chemicals is expected to be low due to the ionic nature of cadmium oxide and cadmium metal (see **Toxicokinetics** section) (NICNASa; NICNASb).

Inhalation

Based on available data and observations in humans (see **Acute toxicity: Observation in humans** section), cadmium oxide is reported to be very toxic following inhalation in rats exposed to cadmium fumes (NICNASa; NICNASb).

Cadmium oxide and cadmium metal are classified as hazardous with the risk phrase ‘Very toxic by inhalation’ (T+; R26) in HSIS (Safe Work Australia).

Observation in humans

Several cases of cadmium poisoning (compound not specified) as a result of ingesting contaminated food or drinks have been documented. Signs and symptoms of toxicity reported included nausea, vomiting, diarrhoea and abdominal cramps.

An eight-hour inhalation exposure to cadmium levels of 5 mg/m^3 is reported to be potentially lethal, while 1 mg/m^3 is considered to be immediately dangerous to life (EU RAR, 2008).

In addition, there are many case studies of acute poisoning following inhalation of cadmium oxide fumes, or fumes produced by heating cadmium-containing materials to high temperatures. Documented signs of toxicity include nausea, fever, difficulties in respiration and severe respiratory irritation. Pulmonary oedema, resulting in mortality, was commonly reported following acute exposure (EU RAR, 2007).

Corrosion / Irritation

Respiratory Irritation

While no specific data are available for cadmium oxide and cadmium metal, based on sublethal symptoms observed in inhalation studies in animals (see **Acute toxicity: Inhalation** and **Repeat dose toxicity: Inhalation** sections) and observations in humans exposed to cadmium and cadmium compounds (see **Acute toxicity: Observation in humans** and **Repeat dose toxicity: Observation in humans** sections), the chemicals are expected to irritate the respiratory tract (NICNASa; NICNASb).

Skin Irritation

No data are available.

Eye Irritation

No data are available.

Sensitisation

Skin Sensitisation

No data are available.

Repeated Dose Toxicity

Oral

Based on available data from animal studies and observations in humans (see **Repeat dose toxicity: Observation in humans** section) from repeat oral exposure to soluble cadmium salts (cadmium chloride and cadmium sulfate), cadmium oxide and cadmium metal are considered to have chronic oral toxicity resulting in bone deformities in male Wistar rats (NICNASa; NICNASb; NICNASc).

Cadmium oxide and cadmium metal are classified as hazardous with the risk phrase 'Toxic: Danger of serious damage to health by prolonged exposure if swallowed' (T; R48/25) in HSIS (Safe Work Australia).

Dermal

No data are available.

Inhalation

Based on the limited data available for cadmium metal, adverse effects in animals exposed by repeat inhalation to cadmium oxide and observations in humans (see **Repeat dose toxicity: Observation in humans** section), cadmium oxide and cadmium metal are reported to have chronic inhalation toxicity resulting in treatment-related lesions in the lungs, including inflammation and fibrosis, rales (abnormal respiratory sounds), laboured breathing and pneumonia in rats (NICNASa; NICNASb).

Cadmium oxide and cadmium metal are classified as hazardous with the risk phrase 'Toxic: Danger of serious damage to health by prolonged exposure if inhaled' (T; R48/23) in HSIS (Safe Work Australia).

Observation in humans

Exposure to low levels of cadmium over a long period of time has been linked to chronic cadmium poisoning. The effects of cadmium on specific target organs following exposure in humans are summarised and provided below.

Respiratory effects

There are a number of documented case studies of workers chronically exposed to cadmium oxide fumes (EU RAR, 2007). Effects reported include fatigue, respiratory irritation, shortness of breath, decreased lung function and recurrent bronchitis (NICNASa).

It is suggested that an increase in residual levels of cadmium oxide in the lungs may lead to chronic obstructive airway disease and (in some cases) mortality, all of which have been documented following repeated inhalation exposure to cadmium oxide (EU RAR, 2007). A lowest observed adverse effect concentration (LOAEC) of 0.0031 mg/L, based on lung effects (increased residual levels of the chemical), was derived from a study on workers exposed to cadmium oxide fumes at <0.5 mg/m^3 over several years (NICNASa).

Renal effects

The kidneys are considered to be the main target organ for cadmium toxicity following repeated oral and inhalation exposure (EU RAR, 2007; ATSDR, 2012). Initial signs of kidney effects following cadmium exposure include tubular dysfunction, a decreased glomerular filtration rate, and increased proteinuria and enzymuria. Renal dysfunction is considered to occur when renal cortex cadmium concentrations reach 200 ppm (equivalent to 5–10 µg/g creatinine) (EU RAR, 2007).

Increased frequency of kidney stones has also been reported in workers exposed to cadmium (18 %), compared with unexposed workers (3 %) (EU RAR, 2007).

Skeletal effects

Oral cadmium exposure is reported to cause bone disease in humans (EU RAR, 2008). While the underlying mechanism is not clearly understood, it is thought that cadmium-induced kidney damage and the resulting hypercalcinuria (elevated levels of calcium in the urine) may promote osteoporotic effects in bone (EU RAR, 2007).

In a case study in Japan, a high incidence of Itai-Itai disease was diagnosed in patients from specific geographical locations. It was found that farms in these areas were irrigated by a river being polluted by cadmium sludge from an upstream mine, and the patients may have been exposed to cadmium over a 30-year period. Samples of rice taken from those areas were reported to contain cadmium at 0.68 mg/kg, compared with 0.066 mg/kg in other areas (EU RAR, 2007). Itai-Itai disease is characterised by osteomalacia (softening of the bones), osteoporosis, severe renal tubular disease, and is associated with severe pain (WHO, 2011). A limited number of case reports have also documented clinical bone disease in workers exposed to cadmium compounds (EU RAR, 2007).

Genotoxicity

Based on available data for soluble cadmium salts (cadmium chloride and cadmium sulfate) and observations in humans (see **Genotoxicity: Observation in humans** section), cadmium oxide, cadmium metal and results for other cadmium compounds indicate that absorbed cadmium is mutagenic in several in vitro and in vivo studies (NICNASa; NICNASb; NICNASc).

Observation in humans

Chromosomal aberrations, increased frequency of micronuclei, and sister chromatid exchanges have been detected in humans environmentally exposed to cadmium (EU RAR, 2007). However, the specific cadmium compounds involved were not identified.

Cadmium oxide and cadmium metal are classified as hazardous (Category 3 mutagenic substance) with the risk phrase ‘Possible risk of irreversible effects’ (Xn; R68) in HSIS (Safe Work Australia).

Carcinogenicity

Based on the limited data available for cadmium metal, data from animal studies and observations in humans exposed (see **Carcinogenicity: Observation in humans** section) to cadmium oxide and soluble cadmium salts (cadmium chloride and cadmium sulfate) indicate that the chemicals are carcinogens. Treatment-related effects include increased incidence of large granular lymphocytes, leukaemia, prostate tumours, and testicular tumours in rats (NICNASa; NICNASb; NICNASc).

Observation in humans

There are many case studies that explore the link between exposure to cadmium compounds (not specified) and increased incidences of cancer in workers (NTP, 2011; IARC, 2012).

Significantly increased mortalities due to lung cancer were reported in workers in cadmium-processing plants, cadmium recovery plants and those who worked in the nickel-cadmium battery production industry (IARC, 2012). An increased risk of lung cancer was identified in workers with long-term employment in high cadmium-exposure jobs.

A few cases of cancer of the prostate, pancreas and kidney have also been reported following exposure to cadmium (either from occupational exposure or by contamination).

In some of these cases, workers may have been exposed to other chemicals, including arsenic and nickel. Both the International Agency for Research on Cancer (IARC) and the US National Toxicology Program (NTP) concluded that the increase in lung cancers could not be solely due to co-exposure to other chemicals (NTP, 2011; IARC, 2012). However, the Agency for Toxic Substances and Disease Registry (ATSDR) disputed that the interpretation of these observations in humans is complicated by co-exposure with other metals, and that there is a 'lack of significant relationship between cadmium exposure and duration' (ASTDR, 2012). These data suggest that there may be limited evidence of cancer of the prostate, pancreas and kidney occurring from exposure to cadmium compounds in these studies.

The International Agency for Research on Cancer (IARC) has classified cadmium and cadmium compounds as ‘Carcinogenic to humans (Group 1)’ based on sufficient evidence in humans and experimental animals (IARC, 2012). Additionally, the US National Toxicology Program (NTP) has also classified cadmium and cadmium compounds as ‘Known to be human carcinogens’ (NTP, 2011).

Cadmium oxide and cadmium metal are classified as hazardous (Category 2 carcinogenic substance), with the risk phrase ‘May cause cancer’ (T; R45) in HSIS (Safe Work Australia).

Reproductive and Developmental Toxicity

Based on the limited data available for cadmium metal, adverse effects from animals exposed by inhalation to cadmium oxide and by oral exposure to cadmium chloride indicate that the chemicals are potentially toxic for reproduction and development. It was reported that specific reproductive effects (fertility and developmental effects) were detected at dose levels that also caused general toxicity and maternal toxicity (NICNASa; NICNASb; NICNASc).

Observations in humans

Human epidemiological studies on toxicity to reproduction and fertility associated with occupational cadmium exposure reported no significant reduction in fertility in workers (NICNASb; REACH).

Cadmium oxide and cadmium metal are classified as hazardous (Category 3 substance toxic to reproduction) with the risk phrases ‘Possible risk of impaired fertility’ (Xn; R62) and ‘Possible risk of harm to the unborn child’ (Xn; R63) in HSIS (Safe Work Australia).

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation include systemic long-term effects (general toxicity in a number of organs, carcinogenicity, mutagenicity, reproductive toxicity and developmental toxicity resulting from repeated exposure following ingestion or inhalation. The chemicals are also expected to cause systemic acute effects (acute toxicity by oral and inhalation routes of exposure) and potential local effects (respiratory irritation).

Public Risk Characterisation

Uses for the chemicals were not identified in Australia. Furthermore, based on the use pattern of the chemicals overseas, it is unlikely that the public will be exposed to this chemicals. Hence, the public risk from these chemicals is not considered to be unreasonable.

Occupational Risk Characterisation

Uses for these chemicals were not identified in Australia. However, given the reported critical health effects for cadmium and cadmium compounds and the use of these chemicals overseas, the chemicals may pose an unreasonable risk to workers unless adequate control measures to minimise exposure to the chemicals are implemented, especially through the inhalation route (fumes). The chemicals should be appropriately classified and labelled to ensure that a person conducting a business or undertaking (PCBU) at a workplace (such as an employer) has adequate information to determine appropriate controls.

The data available support an amendment to the hazard classification in the Hazardous Substances Information System (HSIS) (Safe Work Australia) (see **Recommendation** section).

NICNAS Recommendation

The assessment of these chemicals is considered to be sufficient, provided that the recommended amendments to the classification are adopted, and labelling and all other requirements are met under workplace health and safety and poisons legislation as adopted by the relevant state or territory.

Regulatory Control

Public Health

Products containing the chemicals should be labelled in accordance with state and territory legislation (SUSMP, 2014).

Work Health and Safety

The chemicals are recommended for classification and labelling under the current Approved Criteria and adopted GHS as below. This assessment does not consider classification of physical hazards and environmental hazards.

The classification proposed below is based on read across principles (see **Health hazard information**) and the existing classifications for cadmium compounds. If empirical data become available for the chemicals indicating that a lower (or higher) classification is appropriate for the chemicals, these may be used to amend the recommended classification for the chemicals.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Acute Toxicity	Toxic if swallowed (T; R25) Very toxic by inhalation (T+; R26)	Toxic if swallowed - Cat. 3 (H301) Fatal if inhaled - Cat. 2 (H330)
Repeat Dose Toxicity	Toxic: danger of serious damage to health by prolonged exposure through inhalation (T; R48/23) Toxic: Danger of serious damage to health by prolonged exposure if swallowed (T; R48/25)	Causes damage to organs through prolonged or repeated exposure through inhalation - Cat. 1 (H372) Causes damage to organs through prolonged or repeated exposure if swallowed - Cat. 1 (H372)
Genotoxicity	Muta. Cat 3 - Possible risk of irreversible effects (Xn; R68)	Suspected of causing genetic defects - Cat. 2 (H341)
Carcinogenicity	Carc. Cat 2 - May cause cancer (T; R45)	May cause cancer - Cat. 1B (H350)

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Reproductive and Developmental Toxicity	Repro. Cat 3 - Possible risk of impaired fertility (Xn; R62) Repro. Cat 3 - Possible risk of harm to the unborn child (Xn; R63)	Suspected of damaging fertility or the unborn child - Cat. 2 (H361fd)

[a] Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(2004)].

[b] Globally Harmonized System of Classification and Labelling of Chemicals (GHS) United Nations, 2009. Third Edition.

[*] Existing Hazard Classification. No change recommended to this classification

Advice for consumers

Products containing the chemicals should be used according to the instructions on the label.

Advice for industry

Control measures

Control measures to minimise the risk from oral, dermal and inhalation exposure to the chemicals should be implemented in accordance with the hierarchy of controls. Approaches to minimise risk include substitution, isolation and engineering controls. Measures required to eliminate, or minimise risk arising from storing, handling and using a hazardous chemical depend on the physical form and the manner in which the chemicals are used. Examples of control measures which could minimise the risk include, but are not limited to:

- using closed systems or isolating operations;
- using local exhaust ventilation to prevent the chemicals from entering the breathing zone of any worker;
- health monitoring for any worker who is at risk of exposure to the chemical, if valid techniques are available to monitor the effect on the worker's health;
- air monitoring to ensure control measures in place are working effectively and continue to do so;
- minimising manual processes and work tasks through automating processes;
- work procedures that minimise splashes and spills;
- regularly cleaning equipment and work areas; and
- using protective equipment that is designed, constructed, and operated to ensure that the worker does not come into contact with the chemicals.

Guidance on managing risks from hazardous chemicals are provided in the *Managing risks of hazardous chemicals in the workplace—Code of practice* available on the Safe Work Australia website.

Personal protective equipment should not solely be relied upon to control risk and should only be used when all other reasonably practicable control measures do not eliminate or sufficiently minimise risk. Guidance in selecting personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

Obligations under workplace health and safety legislation

Information in this report should be taken into account to help meet obligations under workplace health and safety legislation as adopted by the relevant state or territory. This includes, but is not limited to:

- ensuring that hazardous chemicals are correctly classified and labelled;
- ensuring that (material) safety data sheets ((M)SDS) containing accurate information about the hazards (relating to both health hazards and physicochemical (physical) hazards) of the chemicals are prepared; and
- managing risks arising from storing, handling and using a hazardous chemical.

Your work health and safety regulator should be contacted for information on the work health and safety laws in your jurisdiction.

Information on how to prepare an (M)SDS and how to label containers of hazardous chemicals are provided in relevant codes of practice such as the *Preparation of safety data sheets for hazardous chemicals—Code of practice* and *Labelling of workplace hazardous chemicals—Code of practice*, respectively. These codes of practice are available from the Safe Work Australia website.

A review of the physical hazards of these chemicals has not been undertaken as part of this assessment.

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Chemical Identities

Chemical Name in the Inventory and Synonyms	**Cadmium, dross** Cadmium oxide residues Lead smelter cadmium slag Cadmium dross
CAS Number	69011-69-4
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

Chemical Name in the Inventory and Synonyms	**Cadmium, sponge** Lead smelter sponge cadmium precipitate Cadmium, sponge
CAS Number	69011-70-7
Structural Formula	

	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight	Unspecified

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