File No: LTD/1594

May 2012

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME (NICNAS)

PUBLIC REPORT

Calcium Dichromate

This Assessment has been compiled in accordance with the provisions of the *Industrial Chemicals (Notification and Assessment) Act 1989* (Cwlth) (the Act) and Regulations. This legislation is an Act of the Commonwealth of Australia. The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) is administered by the Department of Health and Ageing, and conducts the risk assessment for public health and occupational health and safety. The assessment of environmental risk is conducted by the Department of Sustainability, Environment, Water, Population and Communities.

For the purposes of subsection 78(1) of the Act, this Public Report may be inspected at our NICNAS office by appointment only at Level 7, 260 Elizabeth Street, Surry Hills NSW 2010.

This Public Report is also available for viewing and downloading from the NICNAS website or available on request, free of charge, by contacting NICNAS. For requests and enquiries please contact the NICNAS Administration Coordinator at:

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Director
NICNAS

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SUMMARY

The following details will be published in the NICNAS *Chemical Gazette:*

ASSESSMENT REFERENCE	APPLICANT(S)	CHEMICAL OR TRADE NAME	HAZARDOUS SUBSTANCE	INTRODUCTION VOLUME	USE
LTD/1594	PPG Industries Australia Pty Ltd	Calcium Dichromate	Yes	< 1 tonnes per annum	Component of two part sealant for aeroplanes

CONCLUSIONS AND REGULATORY OBLIGATIONS

Hazard classification
Based on the read across and literature data, the notified chemical should be considered as though it is classified as hazardous according to the Approved Criteria for Classifying Hazardous Substances (NOHSC, 2004) with the following risk phrases:

T+; R26 Very toxic by inhalation
T; R25 Toxic if swallowed
Xn; R21 Harmful in contact with skin
C; R34 Causes burns
Xn; R42 May cause sensitisation by inhalation
Xi; R43 May cause sensitisation by skin contact
T; R48/23 Danger of serious damage to health by prolonged exposure through inhalation
T; R46 May cause heritable genetic damage (category 2)
T; R45 May cause cancer (category 2)
T; R60 May impair fertility (category 2)
T; R61 May cause harm to the unborn child (category 2)

and

The classification of the notified chemical using the Globally Harmonised System for the Classification and Labelling of Chemicals (GHS) (United Nations, 2009) is presented below. The environmental classification under this system is not mandated in Australia and carries no legal status but is presented for information purposes.

	Hazard category	*Hazard statement*
Inhalation	2	Fatal if inhaled
Oral	3	Toxic if swallowed
Dermal	4	Harmful in contact with skin
Corrosion	1B	Causes severe skin burns and eye damage
Respiratory sensitisation	1	May cause allergy or asthma symptoms or breathing difficulties if inhaled
Skin sensitisation	1	May cause an allergic skin reaction
Repeated exposure	1	Causes damage to organs through prolonged or repeated exposure
Germ cell mutagenicity	1B	May cause genetic defects
Carcinogenicity	1B	May cause cancer
Reproductive toxicity	1B	May damage fertility or the unborn child
Environment	Acute 1	Very toxic to aquatic life

Environment	Chronic 1	Very toxic to aquatic life with long lasting effects

Human health risk assessment
The notified chemical is not considered to pose an unreasonable risk to the health of workers provided that it is only used under controlled conditions by trained workers wearing adequate PPE.

When used in the proposed manner, the notified chemical is not considered to pose an unreasonable risk to public health.

Environmental risk assessment
On the basis of the reported use pattern, the notified chemical is not considered to pose an unreasonable risk to the environment.

Recommendations

REGULATORY CONTROLS
Hazard Classification and Labelling

- Safe Work Australia, should consider the following health hazard classifications for the notified chemical:
  - Conc ≥ 25%: T+; R45; R46; R60; R61; R26; R25; R48/23; R34; R21; R42/43
  - ≥ 10% Conc < 25%: T+; R45; R46; R60; R61; R26; R48/23; R34; R22; R42/43
  - ≥ 7% Conc < 10%: T+; R45; R46; R60; R61; R26; R22; R48/20; R36/37/38; R42/43
  - ≥ 5% Conc < 7%: T; R45; R46; R60; R61; R23; R22; R48/20; R36/37/38; R42/43
  - ≥ 3% Conc < 5%: T; R45; R46; R60; R61; R23; R22; R48/20; R42/43
  - ≥ 1% Conc < 3%: T; R45; R46; R60; R61; R23; R48/20; R42/43
  - ≥ 0.5% Conc < 1%: T; R45; R46; R60; R61; R20; R42/43
  - ≥ 0.2% Conc < 0.5%: T; R45; R46; R20; R42/43
  - ≥ 0.1% Conc < 0.2%: T; R45; R46; R20

- Based on the information provided, the notifier should consider their obligations under the Australian Dangerous Goods Code.

Exposure Standard

- The following Safe Work Australia exposure standard for water soluble chromium (VI) compounds (as chromium) should also be applied to the notified chemical: 0.05 mg/m^3 time weighted average (8 hours).

Health Surveillance

- As the notified chemical is an inorganic chromium compound, health surveillance for workers is required under Schedule 3 of the National Model Regulations for Control of Workplace Hazardous Substances and Schedule 14 of Model Work Health and Safety Regulations 2011 of Safe Work Australia.

Material Safety Data Sheet

- The MSDS provided by the notifier should be amended as follows:
  - Update the hazard classifications for the product to be in line with the classification cut-offs recommended above.

Implementation of workplace controls

- State and Territory OHS authorities should consider the use of the notified chemical in their jurisdictions

CONTROL MEASURES

Occupational Health and Safety

- Employers should implement the following safe work practices to minimise occupational exposure during handling of products containing the notified chemical:
  - Prepackaging in Semkits wherever possible
  - Training of workers who will use the notified chemical
  - Avoid contact with skin and eyes
  - Good hygiene practices to avoid contamination of surfaces or clothing
  - Where inhalation may occur, the Safe Work Australia exposure standard for water soluble chromium (VI) compounds (as chromium) should also be applied to the notified chemical: 0.05 mg/m^3 time weighted average (8 hours).

- Employers should implement health surveillance (health monitoring) as required by Safe Work Australia and the OHS jurisdictions.

- Employers should ensure that the following personal protective equipment is used by workers to minimise occupational exposure to the notified chemical within sealant products:
  - Safety glasses
  - Coveralls
  - Impervious gloves
  - Respiratory protection if inhalation may occur.

  Guidance in selection of personal protective equipment can be obtained from Australian, Australian/New Zealand or other approved standards.

- A copy of the MSDS should be provided to employees.

- If products and mixtures containing the notified chemical are classified as hazardous to health in accordance with the *Approved Criteria for Classifying Hazardous Substances* [NOHSC:1008(2004)] workplace practices and control procedures consistent with provisions of State and Territory hazardous substances legislation must be in operation.

Environment

- The following control measures should be implemented by the user to minimise environmental exposure during repackaging and use of products containing the notified chemical:
  - Not to be released to sewer or surface waters

Disposal

- The notified chemical should be disposed of to landfill.

Storage

- The following precautions should be taken by store managers regarding storage of products containing the notified chemical:
  - Segregate from combustible materials
  - The handling and storage of the notified chemical should be in accordance with the NOHSC National Code of Practice for the Storage and Handling of Workplace Dangerous Goods [NOHSC:2017(2001)] or relevant State or Territory regulations.

Emergency procedures

- Spills or accidental release of the notified chemical should be handled by physical containment, collection and subsequent safe disposal.

Transport and Packaging

- The transportation of the notified chemical should be in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG code) (NTC, 2007).

Regulatory Obligations

Secondary Notification
This risk assessment is based on the information available at the time of notification. The Director may call for the reassessment of the chemical under secondary notification provisions based on changes in certain circumstances. Under Section 64 of the *Industrial Chemicals (Notification and Assessment) Act (1989)* the notifier, as well as any other importer or manufacturer of the notified chemical, have post-assessment regulatory obligations to notify NICNAS when any of these circumstances change. These obligations apply even when the notified chemical is listed on the Australian Inventory of Chemical Substances (AICS).

Therefore, the Director of NICNAS must be notified in writing within 28 days by the notifier, other importer or manufacturer:

(1) Under Section 64(1) of the Act; if
- the importation volume exceeds one tonne per annum notified chemical;
- there is release of the notified chemical to surface waters or the sewer;
- the use of the notified chemical within Australia changes in any way that could potentially increase the inhalation exposure of workers.
- the use of the notified chemical within Australia changes in any way that could potentially increase public exposure.

or

(2) Under Section 64(2) of the Act; if
- the function or use of the chemical has changed from a component of sealant for aeroplanes, or is likely to change significantly;
- the amount of chemical being introduced has increased from one tonne per annum, or is likely to increase, significantly;
- the chemical has begun to be manufactured in Australia;
- additional information has become available to the person as to an adverse effect of the chemical on occupational health and safety, public health, or the environment.

The Director will then decide whether a reassessment (i.e. a secondary notification and assessment) is required.

Material Safety Data Sheet
The MSDS of a product containing the notified chemical provided by the notifier was reviewed by NICNAS. The accuracy of the information on the MSDS remains the responsibility of the applicant.

ASSESSMENT DETAILS

1. APPLICANT AND NOTIFICATION DETAILS

APPLICANT(S)
PPG Industries Australia Pty Ltd (ABN 82 055 500 939)
McNaughton Road
CLAYTON VIC 3168

NOTIFICATION CATEGORY
Limited-small volume: Chemical other than polymer (1 tonne or less per year).

EXEMPT INFORMATION (SECTION 75 OF THE ACT)
Data items and details claimed exempt from publication: chemical name, CAS number, molecular and structural formulae, molecular weight, analytical data, degree of purity, impurities and identity of manufacturer.

VARIATION OF DATA REQUIREMENTS (SECTION 24 OF THE ACT)
Variation to the schedule of data requirements is claimed as follows: Melting Point/Freezing Point, Boiling Point, Vapour Pressure, Hydrolysis as a Function of pH, Partition Coefficient, Adsorption/Desorption, Dissociation Constant, Particle Size, Autoignition Temperature and Explosive Properties.

PREVIOUS NOTIFICATION IN AUSTRALIA BY APPLICANT(S)
None

NOTIFICATION IN OTHER COUNTRIES
None

2. IDENTITY OF CHEMICAL

MARKETING NAME(S)
Calcium Dichromate
PR-1422 A-2 Part A (product containing 10 – 30% notified chemical)

MOLECULAR WEIGHT
< 500 Da

ANALYTICAL DATA
Reference IR spectra were provided.

3. COMPOSITION

DEGREE OF PURITY > 90%

4. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE AT 20 °C AND 101.3 kPa: orange-red solid

Property	Value	Data Source/Justification
Melting Point/Freezing Point	100°C	Haynes (2011)
Boiling Point	Not determined	Expected to decompose at high temperature.
Density	2,370 kg/m^3	Haynes (2011)
Vapour Pressure	Not determined	Expected to be very low as it is an inorganic salt.
Water Solubility	Not determined	Expected to be soluble in water based on the solubility of chromates and dichromates. $CaCrO_4.2H_2O$ = 17 g/L (Aylward and Findlay, 1998). $Na_2Cr_2O_7$ ~ 2,355 g/L (ECB, 2005) $K_2Cr_2O_7$ ~ 115 g/L (ECB, 2005) $NH_4Cr_2O_7$ ~ 360 g/L (ECB, 2005)
Hydrolysis as a Function of pH	Not determined	Expected to dissociate in water to form an equilibrium between chromate and dichromate
Partition Coefficient (n-octanol/water)	Not determined	Not applicable for metal salts
Adsorption/Desorption	Not determined	Expected to be highly mobile in soils and sediments based on the behaviour of analogues (ECB, 2005)
Dissociation Constant	Not determined	The notified chemical is a salt and is expected to readily dissociate in aqueous environments
Particle Size	Not determined	Imported in solution
Flash Point	Not determined	The chemical does not sustain

		combustion (MSDS).
Flammability	Not determined	Not expected to be flammable as it is an inorganic ionic solid.
Autoignition Temperature	Not determined	The notified chemical is not expected to autoignite under normal conditions of use.
Explosive Properties	Not expected to be explosive	The structural formula contains no explosophores.
Oxidising Properties	Expected to be oxidising	Dichromate anions are strong oxidising agents (Cotton et al., 1999).

DISCUSSION OF PROPERTIES

Reactivity
The notified chemical is expected to be a strong oxidiser based on the presence of the dichromate anion. The chemical sodium dichromate (CAS number 10588-01-9), potassium dichromate (CAS number 7778-50-9) and ammonium dichromate (CAS number 7789-09-5) are classified as O; R8 - contact with combustible material may cause fire.

The standard redox potential for the reduction of the dichromate anion to chromium (III) is as follows (Cotton et al., 1999):

$Cr_2O_7^{2-} + 14H^+ + 6e = 2Cr^{3+} + 7H_2O \qquad E^o = 1.33v.$

Due to the large difference in the electric potential between the chromium (VI) and chromium (III) states the reduction of chromium (VI) to chromium (III) when present in soluble species is expected to occur rapidly within biological systems however the reverse oxidation reaction is not observed (IPCS, 1998).

Dangerous Goods classification
Based on the submitted physical-chemical data the notified chemical cannot be classified according to the Australian Dangerous Goods Code (NTC, 2007). However, based on the classification of the analogous dichromate chemicals sodium dichromate, potassium dichromate and ammonium dichromate the notified chemical should be treated as if it was classified under the Australian Dangerous Goods Code (NTC, 2007) as:

Class 5 Oxidizing substances and organic peroxides
Division 5.1 Oxidizing substances

Due to the limited information the packing group for division 5.1 could not be assigned for the notified chemical.

The data above do not address all Dangerous Goods endpoints. Therefore, consideration of all endpoints should be undertaken before a final decision on the Dangerous Goods classification is made by the introducer of the chemical.

5. INTRODUCTION AND USE INFORMATION

MODE OF INTRODUCTION OF NOTIFIED CHEMICAL (100%) OVER NEXT 5 YEARS
The notified chemical will not be manufactured or reformulated in Australia. The notified chemical is imported as a component of a two-pack sealant system in sealed 200 kg drums.

MAXIMUM INTRODUCTION VOLUME OF NOTIFIED CHEMICAL (100%) OVER NEXT 5 YEARS

Year	*1*	*2*	*3*	*4*	*5*
Tonnes	< 1	< 1	< 1	< 1	< 1

PORT OF ENTRY
Melbourne, Sydney and Brisbane.

IDENTITY OF RECIPIENTS
PPG Industries Australia Pty Ltd

TRANSPORTATION AND PACKAGING
The product containing the notified chemical will be transported by road or rail to the notifier's warehouse in sealed 200 kg drums. It may be transported to end-use sites in 200 kg drums or in Semkit packaging.

USE
The notified chemical will be used as a component (10 – 30%) of Part A of a two part sealant for aeroplanes.

OPERATION DESCRIPTION
The notified chemical will not be manufactured in Australia.

At the notifier's site, the imported product containing the notified chemical (10 – 30%) may be repackaged into Semkits, which allow controlled mixing of the two parts of the sealant during end-use. Repackaging will occur in an automated and enclosed process.

At the end-use sites, the mixing process will vary, depending on whether repackaging has occurred. Where the product has been repackaged into Semkits, mixing with Part B of the sealant will occur within the Semkit. Where the imported product has not been repackaged, it will be decanted from the drum and mixed with Part B manually before application.

The resulting mixture will be applied to the substrate using conventional pumping equipment (i.e. caulking type guns). On occasions the operator may manually reshape the applied sealant to achieve the desired profile.

The polymer material reacts with atmospheric moisture at the time of application to form an inert solid matrix. Any excess adhesive will be cleaned using a specially formulated cleaning product and a cloth.

6. HUMAN HEALTH IMPLICATIONS

6.1. Exposure Assessment

6.1.1. Occupational Exposure

CATEGORY OF WORKERS

Category of Worker	*Exposure Duration (hours/day)*	*Exposure Frequency (days/year)*
Transport	2-3	10-15
Mixing and application	8	260

EXPOSURE DETAILS
Transport
Transport and storage workers are not expected to be exposed to the notified chemical except in the unlikely event of an accident.

Repackaging
Where the product containing the notified chemical is repackaged into Semkits, dermal and ocular exposure may occur during connection of the drum to the packaging equipment, and from any splashes or spills. Similar exposure may occur during cleaning of the equipment. Exposure during this process would be reduced by the enclosed nature of the repackaging equipment.

Mixing and application
It is expected that end-use of the sealant containing the notified chemical will occur at varied sites for aircraft maintenance throughout Australia. Dermal, ocular and inhalation exposure to the notified chemical may occur during the mixing of the two components and the manual addition of the sealant to the application equipment. Dermal exposure may also occur during the application and reshaping of the applied product and during the cleaning of the application equipment.

To minimise exposure to the notified chemical, the end users will wear eye protection, coveralls, gloves and respiratory protection. It is expected that the potential for exposure will be lessened by pre-packaging into Semkits, when this occurs. There is a greater potential for exposure when manual weighing and mixing of the

two components of the sealant occurs at end-use sites.

Workers may make dermal contact with the notified chemical during application, before the sealant formulation is dried to the substrate, however once dried the sealant will form a film that will contain and immobilise the notified chemical.

6.1.2. Public Exposure

The notified chemical is present in formulations which are for industrial use only. In the unlikely event that the general public come in contact with the cured sealant containing the notified chemical, the chemical will be fully reacted into the matrix and will not be bioavailable.

6.2. Human Health Effects Assessment

No toxicity data on the notified chemical has been submitted. The human health hazard for the notified chemical will be based on available literature information on the notified chemical as well as the analogous chemicals sodium dichromate, potassium dichromate and ammonium dichromate.

Selection of analogues

The analogues were chosen based on the fact that the notified chemical is expected to have a high water solubility (see section 4) which for chromium (VI) compounds is stated as having a major significance on the toxicity and carcinogenicity (Langård et al., 2012). The analogues also have identical dichromate anions to the notified chemical and it is the dichromate anion that is the source of the toxicity seen in these analogues.

Toxicokinetics, metabolism and distribution.

The notified chemical is of low molecular weight (<500) and hence dermal absorption may occur. The irritating nature of the notified chemical may increase dermal adsorption (ECHA, 2008).

In animal studies 20 – 30% of chromium (VI) compounds administered through inhalation exposure were rapidly absorbed via the respiratory tract (ECB, 2005). The remaining inhaled chromium in the lung was cleared much more slowly, with significant amounts remaining in the lung for several weeks although some was removed from the lung into the gastrointestinal tract by mucociliary clearance (ECB, 2005). Absorption of water soluble chromium (VI) compounds through the gastrointestinal tract was between 2 and 9% in human studies although it can increase to up to 4 times this amount in diabetic individuals (ECB, 2005). The reduction of chromium (VI) to chromium (III) in the stomach reduces absorption through the gastrointestinal tract (ATSDR, 2008). Only limited (1 – 4%) dermal absorption was seen in guinea pigs treated with an aqueous solution of chromium (VI) compounds (ECB, 2005).

Once absorbed into the body, chromium (VI) is distributed rapidly throughout the body with a substantial proportion initially taken up by erythrocytes and can cross the placenta into embryos (ECB, 2005). Within the erythrocytes, and also within the plasma, chromium (VI) is rapidly reduced to chromium (III) (ECB, 2005). During the reduction of chromium (VI) to chromium (III) reactive intermediates such as chromium adducts with proteins and DNA, and secondary free radicals can be generated (ATSDR, 2008; IARC, 2012). Water soluble chromium (VI) compounds are readily taken into cells through the sulphate channels, however if reduction of chromium (VI) occurs extracellularly the chromium (III) species produced are unlikely to enter the cells (IARC, 2012). The majority of absorbed chromium is excreted from the body within one week although it can persist within the erythrocytes for several weeks (ECB, 2005). Chromium (VI) compounds deposited in the bronchial tree is reduced locally prior to absorption into the body except when the dose is high enough to overwhelm the reductive capacity of the bronchial lining fluids, macrophages, and epithelial cells in the lung (Langård et al., 2012).

Acute toxicity.

There is no acute toxicity data available on the notified chemical. Water soluble chromium (VI) compounds have been shown in animal studies to be very toxic by inhalation, toxic by ingestion and harmful in contact with the skin (ECB, 2005; Ullmann's, 2009). The analogous chemicals sodium dichromate, potassium dichromate and ammonium dichromate are all classified as follows according to the Safe Work Australia Hazardous Substances Information System adopted from the EU classification of these analogues:

T+; R26 Very toxic by inhalation
T; R25 Toxic if swallowed
Xn; R21 Harmful in contact with skin

Based on the read across and literature data the notified chemical is expected to be very toxic by inhalation, toxic if swallowed and harmful in contact with skin.

Irritation and Sensitisation.
Water soluble chromium (VI) compounds have been shown to be irritating to the skin in animals studies (ECB, 2005). In humans water soluble chromium (VI) compounds have also been shown to be irritating to the skin, with effects seen at concentrations down to 0.5% (ECB, 2005). Ulceration of the skin of workers who have had contact with high concentrations of water soluble chromium (VI) compounds has been observed (IPCS, 1998).

Water soluble chromium (VI) compounds have been shown to cause severe eye irritation in animal studies and eye damage has been reported during accidental exposure in human workers (ECB, 2005).

There is no reliable information available on respiratory irritation from studies in animals using chromium (VI) compounds. Workers exposed to aqueous chromium (VI) trioxide mist during chrome plating have reported irritation (ECB, 2005).

Sodium and potassium dichromate were found to be skin sensitisers in guinea pig maximisation tests and the sensitisation potential of potassium dichromate was reinforced in a local lymph node assay in mice (ECB, 2005). Amongst workers skin sensitisation by chromium (VI) compounds has been demonstrated in patch testing studies of contact dermatitis patients with potassium dichromate solution (ECB, 2005). Skin sensitisation to potassium dichromate has also been shown to occur within the general population (Rui et al., 2010).

A case study in the aircraft industry looked at the product PR1422, containing the notified chemical at a concentration of 20% w/w and also magnesium dichromate at a concentration of 5% w/w. PR1422 is the product proposed for use in Australia. Four fitters who reported allergic contact dermatitis all showed a positive allergic response in patch tests to the product diluted to concentrations of 1 and 5%. They also showed a positive allergic response in patch tests to potassium dichromate at a concentration of 0.5%. All four of the workers were involved in manually applying the product to aircraft and either wore inadequate gloves or none at all when handling the product and in all cases dermatitis was predominantly confined to the hands and forearms (Handley et al., 1994).

The analogous chemicals sodium dichromate, potassium dichromate and ammonium dichromate are all classified as follows according to the Safe Work Australia Hazardous Substances Information System adopted from the EU classification of these analogues:
C; R34 Causes burns
Xn; R42 May cause sensitisation by inhalation
Xi; R43 May cause sensitisation by skin contact

Based on the read across and literature data the notified chemical is expected to be corrosive and a skin and respiratory sensitiser.

Repeated Dose Toxicity.
There is no information on repeated dose toxicity available on the notified chemical. In studies where workers had been exposed to water soluble chromium (VI) species effects seen included irritation and corrosion from both dermal and inhalation exposure and evidence of kidney and liver damage has been reported in chromium plating workers (ECB, 2005; Langård et al., 2012; Ullmann's, 2009). Effects in animals treated with water soluble chromium (VI) compounds were consistent with those seen in humans (ECB, 2005).

The analogous chemicals sodium dichromate, potassium dichromate and ammonium dichromate are all classified as follows according to the Safe Work Australia Hazardous Substances Information System adopted from the EU classification of these analogues:
T; R48/23 Danger of serious damage to health by prolonged exposure through inhalation.

Based on the read across and literature data, repeated exposure to the notified chemical is expected to lead to serious damage to health, particularly through inhalation exposure.

Mutagenicity.
There is no available information on mutagenicity for the notified chemical. Mutagenic activity has been demonstrated in *in vitro* and *in vivo* studies with water soluble chromium (VI) compounds (Ullmann's, 2009;

ECB, 20005). In the limited human data available there was sporadic evidence of mutagenic effects (ECB, 2005; Langård et al., 2012).

The analogous chemicals sodium dichromate, potassium dichromate and ammonium dichromate are all classified as follows according to the Safe Work Australia Hazardous Substances Information System adopted from the EU classification of these analogues:
T; R46 May cause heritable genetic damage (category 2)

Based on the read across and literature data exposure to the notified chemical is expected to be genotoxic.

Carcinogenicity.
Workers exposed to chromium (VI) compounds by inhalation in a variety of industries have been associated with increased risk of respiratory system cancers (ATSDR, 2008; IARC, 2012; Langård et al., 2012). In humans there are a number of studies investigating environmental exposure to chromium (VI) compounds, predominantly through drinking water, and increased cancer mortality; in all but one of the studies the conclusion does not support a significant positive link (ATSDR, 2008; IARC, 2012). There is no data available regarding the carcinogenic effects of chromium compounds in humans following dermal exposure (ATSDR, 2008). In the case of oral exposure to chromium (VI) compounds in humans, absorption is expected to be limited by the reduction to chromium (III) within the gastrointestinal tract, hence also reducing the systemic carcinogenic potential (ECB, 2005). However, cancer at the site of contact following oral exposure still remains a concern due to the reactive intermediates formed during the reduction of chromium (VI) to chromium (III) (Langård et al., 2012).

Exposure to chromium (VI) compounds via inhalation and intratracheal or intrabronchial implantation has been demonstrated to cause cancer in animals (ECB, 2005; IARC, 2012). In addition subcutaneous and intramuscular injection of chromium (VI) compounds caused malignant tumours at the site of injection in animals (IARC, 2012). Sodium dichromate in drinking given to rats and mice for 2 years was also shown to cause cancer of the oral cavity and small intestine (NTP, 2011). Oral administration of potassium chromate (although not given alone) enhanced UV-induced skin carcinogenesis, indicating tumour systemic effects.

The analogous chemicals sodium dichromate, potassium dichromate and ammonium dichromate are all classified as follows according to the Safe Work Australia Hazardous Substances Information System adopted from the EU classification of these analogues:
T; R45 May cause cancer (category 2)

Based on the read across and literature data exposure to the notified chemical is expected to be carcinogenic, particularly if inhaled, although based on data from animal studies cancer via other routes of exposure cannot be ruled out.

Toxicity for reproduction.
There is no available information on the reproductive toxicity of the notified chemical. Studies on the effects of chromium (VI) on reproduction in humans are inconclusive (ECB, 2005). Water soluble chromium (VI) compounds have been shown to be developmental toxicants in animals via the oral route (ECB, 2005; Langård et al., 2012). No information on the reproductive toxicity of chromium (VI) compounds from dermal or inhalation exposure is available (ECB, 2005).

The analogous chemicals sodium dichromate, potassium dichromate and ammonium dichromate are all classified as follows according to the Safe Work Australia Hazardous Substances Information System adopted from the EU classification of these analogues:
T; R60 May impair fertility (category 2)
T; R61 May cause harm to the unborn child (category 2)

Based on the read across and literature data exposure to the notified chemical may impair fertility and cause harm to the unborn child.

Health hazard classification
Based on the read across and literature data, the notified polymer should be considered as though it is classified as hazardous according to the *Approved Criteria for Classifying Hazardous Substances* (NOHSC, 2004) with the following risk phrases:

T+; R26 Very toxic by inhalation
T; R25 Toxic if swallowed
Xn; R21 Harmful in contact with skin
C; R34 Causes burns
Xn; R42 May cause sensitisation by inhalation
Xi; R43 May cause sensitisation by skin contact
T; R48/23 Danger of serious damage to health by prolonged exposure through inhalation
T; R46 May cause heritable genetic damage (category 2)
T; R45 May cause cancer (category 2)
T; R60 May impair fertility (category 2)
T; R61 May cause harm to the unborn child (category 2)

6.3. Human Health Risk Characterisation

6.3.1. Occupational Health and Safety

The notified chemical is expected to be carcinogenic, mutagenic and a reproductive toxin. The notified chemical is also expected to be a respiratory and skin sensitiser, corrosive, toxic through repeated exposure through inhalation, very toxic by inhalation, toxic if swallowed and harmful in contact with the skin. The evidence for carcinogenicity of the notified chemical is predominantly established in relation to inhalation exposure. Positive animal studies also demonstrate that the notified chemical is potentially carcinogenic through the oral route. Carcinogenicity through dermal exposure has not been studied in detail, however very limited available data suggests that such effects cannot be ruled out.

The notified chemical will be imported into Australia at concentrations up to 30% for use as a component of a two part sealant for aeroplanes. It is expected that a proportion of the chemical will be repackaged at one site and that end-use of the sealant will occur at varied sites throughout Australia. Exposure to the notified chemical is possible during connection of the drum to the packaging equipment when the notified chemical is being repackaged into Semkits, mixed and added to the application equipment at the end use site or during application and reshaping of the applied product. Exposure in such circumstances is expected to predominantly be dermal. Exposure is potentially greater when mixing of the sealant components occurs at end-use sites rather than through the prepackaged Semkits. Products containing the notified chemical used in the same manner as a sealant for aircraft were presumed to have been the main cause of allergic contact dermatitis in four workers (Handley et al., 1994). However, all four workers were using either inadequate PPE or no PPE at all to prevent dermal exposure to their hands where the dermatitis was predominantly located. Therefore, the use of adequate PPE and in particular gloves which are impervious to the notified chemical during all processes is essential in reducing the risk of dermal exposure. Oral exposure to the notified chemical is expected to be limited to accidental ingestion of the chemical. Training of workers, good hygiene practices and the removal and cleaning prior to reuse of any contaminated clothing is expected to reduce the risk of oral and to a lesser extent dermal exposure to the notified chemical.

Inhalation exposure is expected to be limited due the very low predicted vapour pressure of the notified chemical and the fact that products containing the notified chemical are not expected to be used in a manner that could generate aerosols. Nonetheless, due to the highly hazardous nature of the notified chemical if inhaled, the following exposure standard by Safe Work Australia for water soluble chromium (VI) compounds (as chromium) should be applied: 0.05 mg/m^3 time weighted average (8 hours) if inhalation may occur. If it is expected that this exposure limit could be exceeded then an appropriate air purifying or air fed respirator along with engineering controls such as local exhaust ventilation must be used by workers to prevent inhalation exposure.

Once the sealant is mixed and cured the notified chemical will be incorporated into an inert matrix and will not be bioavailable.

Health effects of the notified chemical include sensitisation, corrosion and carcinogenicity. In the context of the proposed use sensitisation and corrosion through skin contact are the most relevant risks. Based on these health effects, provided that control measures are in place and are strictly adhered to, the risk to the health of workers from the proposed use of the notified chemical is not considered to be unreasonable.

6.3.2. Public Health

The sealant containing the notified chemical will not be sold to the public. In the unlikely event that the general public come in contact with the cured sealant containing the notified chemical, the chemical will be

fully reacted into the matrix and will not be bioavailable. Therefore the risk to the public from the notified chemical is not considered to be unreasonable.

7. ENVIRONMENTAL IMPLICATIONS

7.1. Environmental Exposure & Fate Assessment

7.1.1. Environmental Exposure

RELEASE OF CHEMICAL AT SITE

The notified chemical is imported into Australia for repackaging into two part sealant formulations. Accidental spills and leaks during transport and residues from repackaging are expected to be physically contained and disposed of to landfill via a licensed waste contractor.

RELEASE OF CHEMICAL FROM USE

After mixing two parts of the sealant, the majority of the notified chemical is expected to form an inert matrix upon reaction with atmospheric moisture. Releases of the notified chemical to the environment are expected in the form of extruded product containing the notified chemical (< 10% of total import volume) that is left over after application of the sealant product, spills (< 1 %) and residues in empty containers (< 1 %). These releases are expected to be collected and disposed of to landfill via a licensed waste contractor.

RELEASE OF CHEMICAL FROM DISPOSAL

Spent cartridges are expected to be sent to licensed waste contractors for disposal. The sealant will remain within jointed surfaces until the articles to which it is bound are disposed of to landfill or thermally decomposed when metal articles are recycled. In both cases the residual notified chemical is expected to have fully cured prior to disposal.

7.1.2. Environmental Fate

No environmental fate data were submitted. Aquatic exposure of the notified chemical is not expected when it is used as proposed in sealant products. Components containing the notified chemical are expected to be disposed of to landfill or processed by metal recyclers. In landfill, the notified chemical is expected to remain incorporated in an inert matrix. During metals recycling, inorganic wastes containing the notified chemical are expected to be collected and disposed of according to State/Territory regulations.

7.1.3. Predicted Environmental Concentration (PEC)

A predicted environmental concentration (PEC) was not determined because the notified chemical is not expected to be released to the aquatic compartment when used as proposed in sealant products.

7.2. Environmental Effects Assessment

No ecotoxicity data were submitted. However, comprehensive ecotoxicological information is available for a number of close analogues of the notified chemical (sodium chromate, sodium dichromate, ammonium dichromate, potassium dichromate) in a reliable, internationally peer reviewed report (ECB 2005). These analogues would be expected to have very similar properties to the notified chemical as they have identical anions and the cations are expected to have negligible ecotoxicity compared with the dichromate anions. Furthermore it was found that the ecotoxicity between the analogues was similar when expressed in terms of total chromium.

Minimum and maximum acute and chronic endpoint results from ecotoxicological studies of the analogues on several species of freshwater fish, aquatic invertebrates, algae and one bacterial study are summarised below. The endpoints from studies with the two highest validity ratings, as judged by the report authors, were utilised for the hazard characterisation. These studies were conducted to methods that were the same, or very similar to, current OECD test guidelines.

The GHS guidance (UN, 2009b) stipulates that hazard classification should be made according to the concentration of the soluble ion. Therefore the endpoints presented in the table below have been converted on a per dichromate basis. This is justified considering the analogues were found to have similar ecotoxicity when endpoints were expressed on an equivalent mg Cr/L basis. Hence, the lowest acute endpoint (aquatic invertebrates) is EC50 = 0.07 mg $Cr_2O_7^{2-}$/L and the lowest chronic endpoint (aquatic invertebrates) is NOEC = 1.04 µg $Cr_2O_7^{2-}$/L.

Endpoint	*Result as Cr concentration*	*Lowest endpoint expressed as $Cr_2O_7^{2-}$ concentration*	*Assessment Conclusion for $Cr_2O_7^{2-}$*
Acute Endpoints			
Fish Toxicity (96 h)	LC50 = 13[a] – 120[b] mg/L	27.08 mg/L	Harmful
Aquatic Invertebrate Toxicity (48 h)	L(E)C50 = 0.035[c] – 34.8[c] mg/L	0.07 mg/L	Very Toxic
Algal Toxicity (72 and 96 h)	E_rC50 = 0.233[c] – 4.6[c] mg/L	0.49 mg/L	Very Toxic
Inhibition of Bacterial Respiration	3 h IC50 = 30[d] mg/L	62.5 mg/L	Potentially inhibitory to bacterial respiration at > 62.5 mg/L
Chronic Endpoints			
Fish Toxicity (28 or 30 days mortality and growth)	NOEC = 0.05[d] – 3.5[c] mg/L	0.10 mg/L	Very toxic with long lasting effects
Aquatic Invertebrate Toxicity (14 day reproduction and 40 day mortality, respectively)	NOEC = 0.0005[d] – 3.5[c] mg/L	1.04 µg/L	Very toxic with long lasting effects
Algal Toxicity (96 h)	NOEC = 0.11[c] – 0.35[c] mg/L	0.23 mg/L	Toxic with long lasting effects

[a]sodium chromate [b]potassium chromate [c]potassium dichromate [d]sodium dichromate.

Specific guidance is provided for the hazard classification of metals under the Globally Harmonised System of Classification and Labelling of Chemicals (GHS; United Nations, 2009b). The notified chemical contains chromium in the VI oxidation state. In the environment, an equilibrium is expected between the notified chemical at oxidation state Cr(VI) and its reduced form Cr(III), however the Cr(VI) is the more toxic form and hence the GHS is conservatively based on the Cr(VI) data above. Furthermore, since chromium metal is not expected to leach from the notified chemical the ecotoxicity endpoints for the analogues of notified chemical above are therefore suitable to use for classification under the GHS without the inclusion of effects due to dissolved metal ions released from the notified chemical.

Under the GHS the notified chemical is considered to be acutely harmful to fish, and very toxic to aquatic invertebrates and algae. It is chronically very toxic to fish and aquatic invertebrates, and toxic to algae. Based on the acute toxicity to aquatic invertebrates the notified chemical is formally classified under the GHS as "Acute category 1; Very toxic to aquatic life". Based on the chronic toxicity to aquatic invertebrates it is formally classified as "Chronic category 1; Very toxic to aquatic life with long lasting effect" under the GHS.

7.2.1. Predicted No-Effect Concentration

A predicted no-effect concentration (PNEC) has not been calculated for the notified chemical as no aquatic exposure is expected based on its reported use pattern.

7.3. Environmental Risk Assessment

The notified chemical is expected to have high acute and chronic toxicity to aquatic organisms. However the majority of the notified chemical is expected to be incorporated into an inert matrix upon reaction with atmospheric moisture and is therefore not bioavailable. Notified chemical may be sent to landfill as wastes during use or as a component of articles. The notified chemical may also be separated from recycled metal components and disposed of according to State/Territory regulations. Since there is expected to be no exposure to aquatic organisms, the notified chemical is not expected to pose an unreasonable risk to the aquatic environment based on its proposed use pattern.

BIBLIOGRAPHY

ATSDR (2008) Toxicological Profile for Chromium. Agency for Toxic Substances and Disease Registry, U.S. Department of Health and Human Services < http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=62&tid=17 >. Accessed 25 April 2012.

Aylward G & Findlay T (1998) SI Chemical Data 4th Edition. Singapore, Jacaranda Wiley.

Cotton FA, Wilkinson G, Murillo CA, & Bochmann M (1999) Advanced Inorganic Chemistry, Sixth Edition. New York, John Wiley & Sons, Inc., 736-756.

ECB (2005) European Commission – Joint Research Centre Institute for Health and Consumer Protection, European Chemicals Bureau (ECB). European Union Risk Assessment Report. Chromium trioxide, sodium chromate, sodium dichromate, ammonium dichromate and potassium dichromate. Series: 3rd Priority List Volume: 53.

ECHA (2008) Guidance on information requirements and chemical safety assessment Chapter R.7c: Endpoint specific guidance, May 2008. European Chemicals Agency <http://guidance.echa.europa.eu/docs/guidance_document/information_requirements_r7c_en.pdf?vers=20_08_08>. Accessed 17 April 2012.

Handley J & Burrows (1994) Dermatitis from hexavalent chromate in the accelerator of an epoxy sealant (PR1422) used in the aircraft industry. Contact Dermatitis, **30**:193-196.

Haynes W. M. (ed.), 92nd edition, 2011-2012, CRC Press, Taylor and Francis Group, Boca Raton, FL, 2011, 2656 p.

IARC (2012) IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Volume 101C: A Review of Human Carcinogens: Arsenic, Metals, Fibres, and Dusts. Lyon, France, World Health Organisation, International Agency for Research on Cancer, pp 147-164.

IPCS (1998) International Program on Chemical Safety. Environmental Health Criteria 61, Chromium. <http://www.inchem.org/documents/ehc/ehc/ehc61.htm>. Accessed 26 April 2012.

Langård S, Lison D & Søstrand P (2012) Chromium, Molybdenum, and Tungsten. In: Bingham E & Cohrssen ed. Patty's Toxicology, Sixth Edition. John Wiley & Sons, Inc., Volume 1, Chapter 16, pp 565-576.

NOHSC (1994) National Code of Practice for the Labelling of Workplace Substances [NOHSC:2012(1994)]. National Occupational Health and Safety Commission, Canberra, Australian Government Publishing Service.

NOHSC (2001) National Code of Practice for the Storage and Handling of Workplace Dangerous Goods [NOHSC:2017(2001)]. National Occupational Health and Safety Commission, Canberra, Australian Government Publishing Service.

NOHSC (2003) National Code of Practice for the Preparation of Material Safety Data Sheets, 2nd edition [NOHSC:2011(2003)]. National Occupational Health and Safety Commission, Canberra, Australian Government Publishing Service.

NOHSC (2004) Approved Criteria for Classifying Hazardous Substances, 3rd edition [NOHSC:1008(2004)]. National Occupational Health and Safety Commission, Canberra, AusInfo.

NTC (National Transport Commission) 2007 Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG code), 7th Edition, Commonwealth of Australia.

NTP (2011) Report on Carcinogens, Twelfth Edition. U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program. <http://ntp.niehs.nih.gov/ntp/roc/twelfth/roc12.pdf>. Accessed 26 April 2012.

Rui F, Bovenzi M, Prodi A, Fortina AB, Romano I, Peserico A, Corradin MT, Carrabba E & Filon FL (2010) Nickel, cobalt and chromate sensitization and occupation. Contact Dermatitis, **62**:225-231.

Ullmann's Encyclopedia of Industrial Chemistry (2009), John Wiley & Sons, Inc. Chromium Compounds. Anger G, Halstenberg J, Hochgeschwender K, Scherhag C, Korallus U, Knopf H, Schmidt P & Ohlinger M. Accessed online 26 April 2012.

United Nations (2009a) Globally Harmonised System of Classification and Labelling of Chemicals (GHS), 3rd revised edition. United Nations Economic Commission for Europe (UN/ECE), <http://www.unece.org/trans/danger/publi/ghs/ghs_rev03/03files_e.html >.

United Nations (2009b) Globally Harmonized System of Classification and Labelling of Chemicals (GHS), third revised edition. Annex 9 Guidance on hazards to the aquatic environment. United Nations Economic Commission for Europe, United Nations, pp 463–545. <http://www.unece.org/trans/danger/publi/ghs/ghs_rev03/03files_e.html>, Accessed 2012, Apr 24.