Petroleum: Human health tier II assessment

25 November 2016

CAS Number: 8002-05-9

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

Chemical Identity

Synonyms	Crude oil
Structural Formula	No Structural Diagram Available
Molecular Formula	Unspecified
Molecular Weight (g/mol)	Unspecified
Appearance and Odour (where available)	Crude oils range from light coloured to thick black oils.
SMILES	C(C)CCCCCCCCCCCCCCCCCCC

Import, Manufacture and Use

Australian

Crude oil (petroleum) production in 2015-16 was 11,582 megalitres (ML) with a significant proportion exported. The importation of crude oil and other refinery feedstocks was 19,742 ML (Australian Government Department of Industry, Innovation and Science 2016).

International

Crude oil is extracted and then shipped to refineries where it is

processed to produce a variety of petroleum streams including:

- petroleum gases
- fuel oils
- gas oils
- base oils
- gasolines
- kerosines
- solvents
- waxes.

NICNAS has assessed these petroleum streams as part of IMAP Stage One.

The United States (US) Personal Care Products Council International Nomenclature of Cosmetic Ingredients (INCI) dictionary lists CAS number 8002-05-9 as petroleum distillates.

Petroleum distillates is a fractional distillation of crude petroleum, followed by treatment to complete saturation and remove impurities (CIR 1986, CIR 2008). This is toxicologically very different to crude oil. It should be noted that this use of the CAS number is not consistent with the CAS number descriptor (refer **Health Hazard Information**).

There are many distillates of petroleum with unique CAS numbers. It is not considered appropriate to use 8002-05-9 for petroleum distillates. As such an assessment of petroleum distillates is not included in this assessment.

Restrictions

Australian

Major hazard facilities (MHFs) are locations such as oil refineries, chemical plants and large fuel and chemical storage sites where large quantities of hazardous materials are stored, handled or processed.

'Operators of determined MHFs have obligations to:

- Identify all major incidents and major incident hazards for the facility;
- Conduct and document a safety assessment in relation to the operation of the facility that involves a comprehensive and systematic investigation and analysis of all aspects of risks to health and safety that could occur in the operation of the MHF;
- Implement control measures that eliminate or minimise the risk of a major incident occurring at the MHF;
- Prepare an emergency plan;
- Establish a Safety Management System (SMS) for the operation of the MHF;
- Prepare a Safety Case for the MHF that demonstrates that the MHF's SMS will control risks arising from major incidents and major incident hazards and demonstrates the adequacy of the measures to be implemented by the operator to control risks associated with the occurrence of major incidents' (Safe Work Australia 2012).

In addition, activities carried out at these facilities are covered by a number of state and territory legislation and licensing requirements and reporting requirements under the National Environment Protection (National Pollutant Inventory) Measure, where reporting thresholds are met.

International

The chemical is listed on the following (Galleria Chemica):

- EU Cosmetics Regulation 1223/2009 Annex II—List of substances prohibited in cosmetic products;
- New Zealand Cosmetic Products Group Standard—Schedule 4: Components cosmetic products must not contain; and
- The Association of Southeast Asian Nations (ASEAN) Cosmetic Directive Annex II Part 1: List of substances which must not form part of the composition of cosmetic products.

Existing Work Health and Safety Controls

Hazard Classification

The chemical is classified as hazardous, with the following risk phrases for human health in the Hazardous Substances Information System (HSIS) (Safe Work Australia):

- R45 Carc. Cat 2 (carcinogenicity)

The classification is subject to note H.

'Note H: The classification and label shown for this substance applies to the dangerous property(ies) indicated by the Risk Phrase(s) in combination with the category(ies) of danger shown. The manufacturers, distributors and importers of this substance shall be obliged to carry out an investigation to make themselves aware of the relevant and accessible data which exists for all other properties to classify and label the substance' (Safe Work Australia).

Exposure Standards

Australian

No specific exposure standard is available for the chemical. Some exposure limits apply for the volatile constituents found in crude oil (API Petroleum HPV Testing Group 2011a) including:

- C4–C6 alkanes
- C6–C8 aromatics
- inorganic gases such as hydrogen sulfide (Safe Work Australia).

International

No specific exposure standard is available for the chemical. Some exposure limits apply for the volatile constituents found in crude oil (API Petroleum HPV Testing Group 2011a).

Health Hazard Information

The CAS number descriptor is “A complex combination of hydrocarbons. It consists predominantly of aliphatic, alicyclic and aromatic hydrocarbons. It may also contain small amounts of nitrogen, oxygen and sulfur compounds. This category encompasses light, medium, and heavy petroleums, as well as the oils extracted from tar sands. Hydrocarbonaceous materials requiring major chemical changes for their recovery or conversion to petroleum refinery feedstocks such as crude shale oils, upgraded shale oils and liquid coal fuels are not included in this definition" (NCI).

It is a UVCB—a substance that is of unknown or variable composition, a complex reaction product or biological material. Crude oil is predominantly made up of parraffinic, naphthenic and aromatic hydrocarbons (C4–>C60). Crude oils from different sources are compositionally distinct.

Data are available for several crude oils. The toxicity of a specific crude will depend on their chemical composition.

The most common constituents in crude oil which present human health hazards are:

- hydrogen sulfide
- polycyclic aromatic compounds (PAC)
- volatile organic compounds (VOCs) including those found in gasoline. Of these, benzene (CAS No. 71-43-2) has the highest toxicity (NICNASa).

Data for these constituents has been included in this assessment. Data for three petroleum streams covering C4-C60 hydrocarbons has also been included. These are gasolines, gas oils derived by secondary processing and selected unrefined or mildly refined base oils.

Hazardous diolefins such as 1,3-butadiene are not present in crude oil above trace amounts.

Acute Toxicity

Oral

Chemicals under this CAS description are expected to have low acute toxicity based on results from animal tests for several light and heavy crude oils following oral exposure. The median lethal dose (LD50) values in rats were >5000 mg/kg bw (API HPV Testing Group 2011a; US EPA 2011).

The chemical could have the potential to cause chemical pneumonitis if aspirated (refer **Observation in humans** section). The viscosity depends on the carbon number range (API HPV Testing Group 2011a) with heavier crude oils having higher viscosity. Crude oil, particularly light crude oils (Al-Besharah 1987), could meet the classification criteria for aspiration toxicity (Safe Work Australia, 2004; GHS, 2009). The threshold viscosity value for classification as an aspiration hazard is 20.5 mm^2/s at 40 °C.

Dermal

Chemicals under this CAS description are expected to have low acute toxicity based on results from animal tests for several light and heavy crude oils following dermal exposure. The median lethal dose (LD50) values in rats were >2000 mg/kg bw (API HPV Testing Group 2011a; US EPA 2011).

Inhalation

Based on the limited data available, chemicals under this CAS description are expected to have low to moderate acute toxicity. Sufficient data to determine an overaching classification are not available.

Acute inhalation could occur from either inhaling volatile constituents or aerosols of crude oil.

Volatile constituents

The acute inhalation hazard is primarily from hydrogen sulfide. Hydrogen sulfide is very toxic by inhalation (Safe Work Australia). Hydrogen sulfide is present in higher concentrations in sour crude oils compared to sweet crude oils. The refined component, gasoline, has low acute inhalation toxicity based on animal test and human observation data (NICNASa). However, exposure to high concentrations of volatile hydrocarbons has been associated with worker fatalities (refer **Observation in humans** section).

Aerosols

No deaths occurred in a whole body acute inhalation study in rats, with a crude oil derived from oil sands. Sprague-Dawley (SD) rats (5/sex) were exposed to aerosol concentrations of 4.0 mg/L for 6 hours. In a similar study in mice, five of the 10 mice died within the 14-day observation period (API HPV Testing Group 2011a; US EPA 2011).

Many petroleum stream chemicals with C>9 have low to moderate inhalation toxicity (NICNASb, NICNASc). Differences in toxicity could occur due to variations in aerosol particle size and deposition in the lungs.

Observation in humans

Three fatalities have been reported following oil aspiration by workers in petrol tankers (HSDB).

Several worker deaths have been associated with working close to open hatches of crude oil production tanks. Exposures to hydrocarbon gases and vapours and/or oxygen-deficient atmospheres are the likely primary or contributory factors to these workers'deaths (OSHA, 2016).

Corrosion / Irritation

Skin Irritation

Based on the available data, chemicals under this CAS description are expected to be slightly to moderately irritating to the skin. Chemicals under this CAS description caused drying of the skin following repeated exposure (refer **Repeated dose toxicity** section). While sufficient data to warrant classification for skin irritation are not available, the chemical should be classified for repeated exposure causing skin dryness or cracking.

In separate rabbit skin irritation studies with one heavy and two light crude oils, slight irritant effects were observed following four hour exposure. The mean scores (average of scores at 24, 48 and 72 hours) for erythema and oedema were <2 (API HPV Testing Group 2011a; HPV Testing Group 2011b; US EPA 2011)

Petroleum streams derived from the chemical produced slight to moderate skin irritation reactions in animal studies (NICNASa, NICNASb, NICNASc).

Eye Irritation

Based on the available data, chemicals under this CAS description are expected to be, at most, slightly irritating to the eye. Sufficient data to warrant classification are not available.

Results from rabbit eye irritation studies were available for five samples of crude oil (4 light and one heavy). No corneal or iris effects were observed in any of these studies. The mean scores (average of scores at 24, 48 and 72 hours) for conjunctivae were <2 for four of the studies. A mean score of 2.7 was reported for one light crude oil (API HPV Testing Group 2011a; HPV Testing Group 2011b; US EPA 2011)

Petroleum streams derived from the chemical produced slight eye irritation reactions in animal studies (NICNASa, NICNASb, NICNASc).

Sensitisation

Skin Sensitisation

Based on the available data, chemicals under this CAS description are not expected to be skin sensitisers.

Both a light and heavy crude oil did not cause dermal sensitisation in guinea pig Buehler tests (API HPV Testing Group 2011a; US EPA 2011). Petroleum streams derived from the chemical were not considered to be skin sensitisers (NICNASa, NICNASb, NICNASc).

Repeated Dose Toxicity

Oral

No data are available. The component chemical, benzene (CAS No. 71-43-2), is classified as hazardous with the risk phrase 'Toxic: Danger of serious damage to health by prolonged exposure by inhalation, in contact with skin and if swallowed' (R48/23/24/25) (Safe Work Australia). Levels of benzene in crude oil are generally <1 % (API HPV Testing Group 2011a), although can be up to 15 % in some condensates (IARC 1989).

Dermal

The potential for chemicals under this CAS description to cause damage to health by repeated dermal exposure will be dependent on the composition.

The systemic toxicity of high boiling petroleum substances (HBPS) could correlate with concentrations of PACs, particularly those composed of 3, 4, 5, 6 and/or 7 fused aromatic rings. However, other compositional characteristics could also influence toxicity (TERA, 2008: McKee 2014).

The component chemical, benzene (CAS No. 71-43-2), is classified as hazardous with the risk phrase 'Toxic: Danger of serious damage to health by prolonged exposure by inhalation, in contact with skin and if swallowed' (R48/23/24/25) (Safe Work Australia). Levels of benzene in crude oil are generally <1 % (API HPV Testing Group 2011a), although can be up to 15 % in some condensates (IARC 1989).

Two thirteen week dermal studies (in SD rats) were available for one light and one heavy crude oil (API HPV Testing Group 2011a; US EPA 2011). Dose levels were 0, 30, 125, and 500 mg/kg bw/day, 5 days/week. The samples had dimethylsulfoxide (DMSO)-extractable aromatic content with three or more rings of approximately 15 (light) and 21 % (heavy). This appears higher than the aromatic content measured for 46 crude oils samples (Mckee 2014, API HPV Testing Group 2011a). These had a total aromatic content of <9 %. A direct comparison of the sampling methodology is not possible.

Minimal skin irritation (flaking) occurred. Microscopically, hyperplasia of treated skin was observed at all doses for both crude oils. Effects were slightly more severe with the light crude oil. In general, lower viscosity petroleum-related materials have greater potential to cause drying of the skin.

Like other HBPS systemic effects observed included:

- reduced body weight (heavy only)
- increased liver weights
- reduced thymus weights
- changes in serum chemistry and haematological parameters.

Histopathological changes included the liver (hepatocellular vacuolation and mononuclear cell infiltration) and atrophy of the thymus. Effects were largely limited to rats dosed at 500 mg/kg bw/day. Hypertrophy and hyperplasia of the thyroid was observed at lower doses particularly in the males. Effects were more pronounced for the heavy crude oil. Increased cellularity in the bone marrow was also observed at lower doses in the study with heavy crude oil. The lowest observed adverse effect level (LOAEL) for both crude oils was 30 mg/kg bw/day (API HPV Testing Group 2011a; US EPA 2011).

Inhalation

The potential for chemicals under this CAS description to cause damage to health by repeated inhalation exposure will be dependent on the composition.

No data are available for the chemical.

The VOCs from crude oil are similar to those from gasoline. In general, minimal systemic effects have been observed in repeated dose inhalation studies with gasoline (NICNASa). The component chemical, benzene (CAS No. 71-43-2), is classified as hazardous with the risk phrase 'Toxic: Danger of serious damage to health by prolonged exposure by inhalation, in contact with skin and if swallowed' (R48/23/24/25) (Safe Work Australia). Levels of benzene in crude oil are generally <1 % (API HPV Testing Group 2011a), although can be up to 15 % in some condensates (IARC 1989).

Hydrogen sulfide is not classified for repeat dose inhalation toxicity (Safe Work Australia). The toxicity, including nasal and pulmonary effects, has been characterised in a 90 day study in rats and mice (whole-body exposure to 0, 10, 30, or 80 ppm for 6 h/day). There were no changes in toxicologically relevant alterations in haematological indices, serum chemistries, or gross pathology. Histologic evaluation showed exposure-related increased incidences of olfactory neuronal loss (rats and mice) and rhinitis (mice) and bronchiolar epithelial hypertrophy and hyperplasia (rats). The no observed adverse effect concentration (NOAEC) was 10 ppm (API HPV Testing Group 2011a).

Genotoxicity

Based on the data available, the chemicals in this group have demonstrated potential for inducing gene mutations in vitro. Limited in vivo data are available. In general, the level of mutagenic activity is related to the PAC and benzene content of the sample. In the absence of reliable data on a

specific chemical under this CAS description, classification is recommended, where this is consistent with the cut-off concentration limits for benzene (IPICEA, 2010).

In an optimised Ames assay, DMSO-extracted oil samples of three light and one heavy crude oil were positive in *Salmonella typhimurium* strain TA 98 in the presence of metabolic activation. One light crude oil was negative. Two samples of crude oils did not induce cytotoxicity or chromosome damage in Chinese hamster ovary cells. One crude oil sample did not show evidence of sister chromatid exchange in human lymphocytes (API HPV Testing Group 2011a; US EPA 2011).

Two samples of crude oil (one light and one heavy) did not induce an increase in the formation of micronuclei in bone marrow erythrocytes. Sprague Dawley rats were treated dermally for 13-weeks at doses of 0, 30, 125 or 500 mg/kg. A single intraperitoneal (i.p.) injection of a heavy crude oil at a dose of 6.1 g/kg to ICR mice did not induce an increase in micronuclei in the bone marrow.

In a sister chromatid exchange assay, Sch:ICR mice (3 males/group) were administered a heavy crude oil via i.p. injection at doses of 1800, 3600 or 7200 mg/kg. A slight, but significant increase in sister chromatid exchange was observed at the highest dose of crude oil tested.

The component chemical, benzene, is classified as hazardous—Category 2 mutagenic substance—with the risk phrase 'May cause heritable genetic damage' (T; R46) in the HSIS (Safe Work Australia). Reported concentrations of benzene in petroleum are > 0.1% (API HPV Testing Group 2011a), which is the cut-off concentration for classification for this endpoint.

Carcinogenicity

The chemical is classified as hazardous—Category 2 carcinogenic substance—with the risk phrase 'May cause cancer' (T; R45) in HSIS (Safe Work Australia). The available data support this classification.

Four crude oil samples, representing a range of compositions, have been investigated in mouse skin-painting studies of 104–110 week duration. All four crude oils produced skin tumours in mice with latency periods of 40-76 weeks (API HPV Testing Group 2011a; US EPA 2011). One sample of crude oil produced skin papilomas in rabbits in one experiment (IARC 1989).

Petroleum substances containing <3 % w/w dimethylsulfoxide (DMSO) extractables (as measured by the IP346 assay), or which are negative in the modified Ames test (mutagenicity index <1) are not carcinogenic to skin (IPIECA, 2010). The DMSO extractable aromatic content has been reported to be 1.85-5.82 % for a range of crude oils. Mutagenicity index predictions for 46 samples of crude oil were predominantly >1 (API HPV Testing Group 2011a).

In a retrospective cohort mortality study of a large group of male employees in petroleum producing and pipeline operations, mortality from all types of cancer was low, except from thyroid cancer. There was a significant deficit of lung cancer and no death from testicular cancer. Several case control studies did not provided consistent results or had several limitations. The International Agency for Research on Cancer (IARC) has classified crude oil as 'not classifiable as to its carcinogenicity to humans (Group 3), based on limited evidence for carcinogenicity in experimental animals and inadequate evidence in humans (IARC 1989).

Reproductive and Developmental Toxicity

Certain petroleum stream chemicals have been shown to be developmentally toxic by dermal exposure. Effects include increased incidence of early and total resorptions, and decreased foetal body weight (IPIECA, 2010; McKee, 2013). Similar embryotoxic effects have been described in laboratory animals exposed to PACs such as benz[a]anthracene, benzo[a]pyrene, and naphthalene (IPCS, 1998).

Similar effects have been observed in developmental toxicity studies with four samples of crude oil. Some additional effects such as delayed ossification and effects on viability were also observed (API HPV Testing Group 2011a; US EPA 2011).

Based on the weight of evidence, the data support classification for developmental effects (see ***Recommendation*** section). Whilst a predictive test for the developmental effects of HBPS has not been developed (IPIECA 2010), the associated developmental effects (increased incidence of resorptions and decrease in foetal body weight) have been shown to be significantly correlated with the mutagenicity index (Feuston et al. 1994).

A heavy and light crude oil were tested in similar studies investigating pre- and post-natal development (Feuston et al.1997). Pregnant rats were exposed dermally on gestation days 0-19. Prenatal rats were sacrificed on gestation day 20. One group of rats (post-natal) delivered naturally and remained with their litters until sacrifice at 3–4 weeks postpartum. Doses administered were:

- heavy crude oil 0, 30, 125, and 500 mg/kg/day (pre-natal and post-natal); and
- light crude oil: 0, 125, 500, and 2000 mg/kg/day (pre-natal) and 0 and 0, 125, 500, 1000 mg/kg bw/day (post natal).

Reductions in maternal body weight and food consumption and an increase in relative liver weight were observed in dams treated with 500 mg/kg bw/day (both crude oils). An increase in the number of resorptions and reduced foetal body weight were observed in the highest dose group (both crude oils). Incomplete ossification of the nasal bones and caudal centra occurred 125 mg/kg bw/day (light crude oil) and 500 mg/kg bw/day (heavy crude oil). In the post-natal treatment group, a number of effects were reported, including:

- reduced survival during first four days post-partum (heavy only—all doses);
- reduced bodyweight for live pups (light only—high dose); and

- a longer gestation length (heavy only—high dose).

The NOAEL for maternal toxicity was 125 mg/kg bw/day (both crude oils). A NOAEL for developmental toxicity could not be established for the both crude oils.

Whilst limited data are available for reproductive toxicity, reproductive effects are considered to be a less sensitive endpoint than developmental toxicity for other HBPS. Significant effects in the reproductive organs were not observed in the dermal repeated dose toxicity studies.

Risk Characterisation

Critical Health Effects

The critical health effects for risk characterisation for chemicals under this CAS description will depend on the composition. The principal systemic long-term effects (carcinogenicity, mutagenicity, developmental toxicity) are associated with exposure to benzene and dermal exposure to polycyclic aromatic compounds. The chemical can also cause harmful effects following repeated exposure.

Acute toxicological hazards are those associated with exposure by inhalation to volatile hydrocarbon constituents and hydrogen sulfide or aspiration effects.

The chemical can also cause skin irritation, particularly following prolonged exposure.

Public Risk Characterisation

Given the uses identified for the chemical, it is unlikely that the public will be exposed. Hence, the public risk from this chemical is not considered to be unreasonable.

Occupational Risk Characterisation

Exposure is possible in all operations involving crude oil, including drilling, pumping and treating steps; transport by pipeline, ships or rail cars; storage and refinery processing. Exposure through skin contact will be limited by use of closed systems. Inhalation exposure to significant levels of hydrogen sulfide (particularly with sour crude oils) and/or volatile organic compounds (VOCs) could occur in some situations i.e. enclosed spaces or tasks associated with working close to open hatches of crude oil production tanks.

Given the critical systemic long-term and systemic acute health effects, the chemical could pose an unreasonable risk to workers unless adequate control measures to minimise dermal and inhalation exposure are implemented. The chemical 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 the appropriate controls.

The data available support an amendment to the hazard classification in the HSIS (Safe Work Australia) (refer to **Recommendation** section).

NICNAS Recommendation

Assessment of the chemical is considered to be sufficient, provided that the recommended amendment to the classification is 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

Work Health and Safety

The chemical is recommended for classification and labelling under the current approved criteria and adopted GHS as below. This assessment does not consider classification of physical and environmental hazards.

The current HSIS classification for carcinogenicity of the chemicals indicated Note H. Note H is no longer considered relevant for these chemicals as the acute, systemic and local effects of the chemicals have been evaluated.

Acute toxicity: Classification of the chemical as an aspiration hazard should only be applied if the kinematic viscosity criteria for classification are met.

Genotoxicity: In the absence of specific test data, the classification should be applied unless it is known that the level of benzene is < 0.1 %.

Hazard	Approved Criteria (HSIS)[a]	GHS Classification (HCIS)[b]
Acute Toxicity	Harmful: may cause lung damage if swallowed (Xn; R65)	May be fatal if swallowed and enters airways - Aspi. Cat. 1 (H304)
Irritation / Corrosivity	Repeated exposure may cause skin dryness or cracking (R66)	Repeated exposure may cause skin dryness and cracking (AUH066)
Genotoxicity	Muta. Cat 2 - May cause heritable genetic damage (T; R46)	May cause genetic defects - Cat. 1B (H340)
Carcinogenicity	Carc. Cat 2 - May cause cancer (T; R45)*	May cause cancer - Cat. 1B (H350)
Reproductive and Developmental Toxicity	Repro. Cat 3 - Possible risk of harm to the unborn child (Xn; R63)	Suspected of damaging the unborn child - Cat. 2 (H361d)

[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 industry

Control measures

Control measures to minimise the risk from dermal and inhalation exposure to the chemical 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 chemical is used. Examples of control measures that could minimise the risk include, but are not limited to:

- using closed systems or isolating operations:
- using local exhaust ventilation (or working upwind in outdoor spaces) to prevent the chemical from entering the breathing zone of any worker;
- minimising manual processes and work tasks through automating processes i.e. using remote or automatic gauging and sampling;
- 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 chemical.

It is important to minimise inhalation exposure to hydrogen sulfide and VOCs when working with sour crude oil or in enclosed spaces or close to open hatches of crude oil production tanks.

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 chemical 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 the chemical has not been undertaken as part of this assessment.

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