

Inorganic Arsenic

Incident management

Key Points

Fire

- Non combustible under normal conditions
- Emits toxic arsenic fumes and gaseous arsine upon decomposition
- In the event of a fire involving arsenic, use fine water spray and liquid-tight chemical protective suits with breathing apparatus

Health


- Toxic by ingestion, inhalation and skin absorption
- Corrosive
- Secondary contamination may occur
- Inhalation may cause irritation of the upper respiratory tract and cause cough, sore throat, breathlessness, wheeze, pulmonary oedema and respiratory failure
- Ingestion causes abdominal pain, vomiting, diarrhoea, hypovolaemic shock and cardiovascular collapse
- Arsenic is highly irritant and corrosive to the eye causing pain, lacrimation, conjunctivitis, photophobia and corneal damage


Environment

- Dangerous for the environment
- Inform Environment Agency of substantial release incidents

Hazard Identification

Standard (UK) Dangerous Goods Emergency Action Codes^(a)

| | | | | |
|----------------|------------------|-------------|---|---|
| UN | | 1556 | Arsenic compound, liquid, n.o.s., inorganic, including: arsenates, n.o.s., arsenites, n.o.s., arsenic sulphides | |
| EAC | | 2X | Use fine water spray. Wear liquid-tight chemical protective clothing in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses. | |
| APP | | B | Gas-tight chemical protective suit with breathing apparatus**. | |
| Hazards | Class | 6.1 | Toxic substance |  |
| | Sub risks | - | | |
| HIN | | 66 | Highly toxic substance | |

| | | | | |
|----------------|------------------|-------------|---|---|
| UN | | 1556 | Arsenic compound, liquid, n.o.s., inorganic, including: arsenates, n.o.s., arsenites, n.o.s., arsenic sulphides | |
| EAC | | 2X | Use fine water spray. Wear liquid-tight chemical protective clothing in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses. | |
| APP | | - | | |
| Hazards | Class | 6.1 | Toxic substance |  |
| | Sub risks | - | | |
| HIN | | 60 | Toxic or slightly toxic substance | |

UN – United Nations number; EAC – Emergency Action Code; APP – Additional Personal Protection; HIN - Hazard Identification Number


* Liquid-tight chemical protective clothing (BS 8428) in combination with self-contained open circuit positive pressure compressed air breathing apparatus (BS EN 137).


** Gas-tight chemical protective clothing conforming to BS EN 943 part 2 in combination with self-contained open circuit positive pressure compressed air breathing apparatus to BS EN 137.

^a Dangerous Goods Emergency Action Code List, HM Fire Service Inspectorate, Publications Section, The Stationery Office, 2004.

INORGANIC ARSENIC – INCIDENT MANAGEMENT

Standard (UK) Dangerous Goods Emergency Action Codes^(a)

| | | | | |
|----------------|------------------|--------------|---|---|
| UN | | 1557 | Arsenic compound, liquid, n.o.s., inorganic, including: arsenates, n.o.s., arsenites, n.o.s., arsenic sulphides | |
| EAC | | 2X | Use fine water spray. Wear liquid-tight chemical protective clothing in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses. | |
| APP | | - | | |
| Hazards | Class | 6.1 | Toxic substance |  |
| | Sub risks | - | | |
| HIN | | 66/60 | Highly toxic/toxic or slightly toxic substance | |

| | | | | |
|----------------|------------------|-------------|---|---|
| UN | | 1558 | Arsenic | |
| EAC | | 2Z | Use fine water spray. Wear normal fire kit in combination with breathing apparatus*. Spillages and decontamination run-off should be prevented from entering drains and watercourses. | |
| APP | | - | | |
| Hazards | Class | 6.1 | Toxic substance |  |
| | Sub risks | - | | |
| HIN | | 60 | Toxic or slightly toxic substance | |



UN – United Nations number; EAC – Emergency Action Code; APP – Additional Personal Protection; HIN - Hazard Identification Number

* Normal fire fighting clothing i.e. fire kit (BS EN 469), gloves (BS EN 659) and boots (HO specification A29 and A30) in combination with self-contained open circuit positive pressure compressed air breathing apparatus (BS EN 137).

^a Dangerous Goods Emergency Action Code List, HM Fire Service Inspectorate, Publications Section, The Stationery Office, 2004.

Chemical Hazard Information and Packaging for Supply Classification^(a)



Arsenic

| | | | |
|-----------------------|---------------|---|---|
| Classification | T+ | Very toxic |  |
| | N | Dangerous for the environment |  |
| Risk phrases | R23/25 | Toxic by inhalation and if swallowed | |
| | R50/53 | Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment | |
| Safety phrases | S1/2 | Keep locked up and out of reach of children | |
| | S20/21 | When using do not eat, drink or smoke | |
| | S28 | After contact with skin, wash immediately with plenty of ... (see manufacturers advice) | |
| | S45 | In case of accident or if you feel unwell seek medical advice immediately (show the label where possible) | |
| | S60 | This material and its container must be disposed of as hazardous waste | |
| | S61 | Avoid release into the environment. Refer to special instructions/safety. | |

^a European Chemicals Bureau, Classification and Labelling, Annex I of Directive 67/548/EEC; <http://ecb.jrc.it/classification-labelling/> (accessed 2/2007).

Chemical Hazard Information and Packaging for Supply Classification^(a)

 Arsenic compounds^(b)

| | | | |
|-----------------------|---------------|---|---|
| Classification | T+ | Very toxic |  |
| | N | Dangerous for the environment |  |
| Risk phrases | R23/25 | Toxic by inhalation and if swallowed | |
| | R50/53 | Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment | |
| Safety phrases | S1/2 | Keep locked up and out of reach of children | |
| | S20/21 | When using do not eat, drink or smoke | |
| | S28 | After contact with skin, wash immediately with plenty of ... (see manufacturers advice) | |
| | S45 | In case of accident or if you feel unwell seek medical advice immediately (show the label where possible) | |
| | S60 | This material and its container must be disposed of as hazardous waste | |
| | S61 | Avoid release into the environment. Refer to special instructions/safety. | |

Specific concentration limits

| Concentration | Classification |
|---------------------------|--------------------|
| $C \geq 25 \%$ | T, N; R23/25-50/53 |
| $2.5 \% \leq C < 25 \%$ | T, N; R23/25-51/53 |
| $0.25 \% \leq C < 2.5 \%$ | T; R23/25-52/53 |
| $0.2 \% \leq C < 0.25 \%$ | T; R23/25 |
| $0.1 \% \leq C < 0.2 \%$ | Xn; R20/22 |

^a European Chemicals Bureau, Classification and Labelling, Annex I of Directive 67/548/EEC; <http://ecb.jrc.it/classification-labelling/> (accessed 2/2007).

^b Arsenic compounds with the exception of diarsenic trioxide, arsenic trioxide diarsenic pentoxide, arsenic pentoxide and arsenic oxide.

Physicochemical Properties

| | |
|---|---|
| CAS number | 7440-38-2 |
| Atomic weight | 75 |
| Chemical symbol | As |
| Common synonyms | Grey arsenic; metallic arsenic |
| State at room temperature | Solid |
| Volatility | Non-volatile at 20 °C |
| Specific gravity | 5.7 at 14 °C (water = 1) |
| Flammability | Non-combustible, substance itself does not burn |
| Lower explosive limit | Data not available |
| Upper explosive limit | Data not available |
| Water solubility | Sparingly and extremely slowly soluble in cold water |
| Reactivity | Forms volatile, highly toxic arsine gas when reduced in acid solution |
| Reaction or degradation products | Emits toxic arsenic fumes and gaseous arsine upon decomposition |
| Odour | Odourless |

References^(a,b,c)

^a Arsenic (HAZARDTEXT® Hazard Management). In: Klasco RK (Ed): TOMES® System. Thomson Micromedex, Greenwood Village, Colorado (accessed 02/2007).

^b The Merck Index (14th Edition). Entry 794; Arsenic, 2006.

^c The Dictionary of Substances and their Effects. Ed. S Gangolli. Second Edition, Volume 1, 1999.

Threshold Toxicity Values

Arsenic trioxide

| EXPOSURE VIA INGESTION | |
|------------------------|----------------------|
| mg | SIGNS AND SYMPTOMS |
| 20 | Life threatening |
| 100 - 300 | Estimated fatal dose |

References^(a)

TOXBASE - <http://www.toxbase.org>

^a TOXBASE: Arsenic and arsenic compounds, 2003.

Published Emergency Response Guidelines

Emergency Response Planning Guideline (ERPG) Values

| | Listed value (ppm) | Calculated value (mg m ⁻³) |
|-----------|-----------------------|---|
| ERPG-1* | Data not available | |
| ERPG-2** | | |
| ERPG-3*** | | |

* Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing other than mild transient adverse health effects or perceiving a clearly defined, objectionable odour.

** Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action.

*** Maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hr without experiencing or developing life-threatening health effects.

Acute Exposure Guideline Levels (AEGLs)^(a)

| | mg m ⁻³ | | | | |
|-----------------------|--------------------|--------|--------|------|------|
| | 10 min | 30 min | 60 min | 4 hr | 8 hr |
| AEGL-1 [†] | - | - | - | - | - |
| AEGL-2 ^{††} | 3.7 | 3.7 | 3.0 | 1.9 | 1.2 |
| AEGL-3 ^{†††} | 11 | 11 | 9.1 | 5.7 | 3.7 |

[†] The level of the chemical in air at or above which the general population could experience notable discomfort.

^{††} The level of the chemical in air at or above which there may be irreversible or other serious long-lasting effects or impaired ability to escape.

^{†††} The level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

^a U.S. Environmental Protection Agency. Acute Exposure Guideline Levels, <http://www.epa.gov/oppt/aegl/pubs/chemlist.htm> (accessed 02/2007)

Exposure Standards, Guidelines or Regulations

Occupational standards

| | |
|---------------------------|--|
| WEL ^(a) | LTEL(8 hour reference period): 0.03 ppm (0.1 mg m ⁻³) |
| | STEL (15 min reference period): No guideline value specified |

Public health guidelines

| | |
|---|---|
| DRINKING WATER QUALITY GUIDELINE ^(b) | 10 µg L ⁻¹ as As (provisional value) |
| AIR QUALITY GUIDELINE ^(c) | 1 µg m ⁻³ equates to an estimate of lifetime risk 1.5 × 10 ⁻³ |
| SOIL GUIDELINE VALUE AND HEALTH CRITERIA VALUES ^(d,e) | Residential with plant uptake: 20 mg kg ⁻¹ dry weight soil |
| | Residential without plant uptake: 20 mg kg ⁻¹ dry weight soil |
| | Allotments: 20 mg kg ⁻¹ dry weight soil |
| | Commercial/industrial: 500 mg kg ⁻¹ dry weight soil |
| | Index dose _{oral} 0.3 µg kg ⁻¹ bw day ⁻¹ |
| | Index dose _{inhalation} 0.002 µg kg ⁻¹ bw day ⁻¹ |

WEL – Workplace exposure limit; LTEL - Long-term exposure limit; STEL – Short-term exposure limit

^a Health & Safety Executive. EH40/2005 Workplace Exposure Limits 2005. The Stationery Office, London, 2005

^b Interim Guidance on the Water Supply (Water Quality) Regulations 2000 (England) and the Water Supply (Water Quality) Regulations 2001 (Wales). Drinking Water Inspectorate, September 2003.

^c Air Quality Guidelines for Europe. World Health Organization Regional Office for Europe, Copenhagen WHO Regional Publications, European Series, No. 91, Second Edition, 2000.

^d Department for Environment Food and Rural Affairs (DEFRA). Soil Guideline Values for Arsenic Contamination, 2002.

^e Department for Environment Food and Rural Affairs (DEFRA). Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans. Arsenic. 2002.

Health Effects

Major routes of exposure^(a)

- Toxic by ingestion, inhalation and dermal absorption.

Immediate signs or symptoms of acute exposure^(b-e)

- Ingestion may cause abdominal pain, vomiting, and diarrhoea leading to hypovolaemic shock, myocardial depression and cardiovascular collapse. Trivalent arsenic is corrosive to the mouth and mucous membranes causing oral burns, dysphagia and haemorrhagic gastroenteritis. These symptoms usually appear within 30 minutes to 2 hours of ingestion.
- Other features of ingestion that may occur include ECG changes, CNS depression, convulsions, encephalopathy and coma, pulmonary oedema, adult respiratory distress syndrome and acute respiratory failure.
- Inhalation causes irritation to the upper airways which can lead to symptoms such as a cough, sore throat, breathlessness, wheeze, pulmonary oedema and respiratory failure. Features of systemic toxicity may also occur.
- Dermal exposure can lead to features of systemic toxicity. Arsenic compounds are irritant and corrosive; trivalent arsenic compounds are well absorbed through the skin.
- Ocular exposure may cause pain, lacrimation, blepharospasm, conjunctivitis, photophobia, visual disturbance and corneal damage. Arsenic is highly irritant and is corrosive to the eye.

TOXBASE - <http://www.toxbase.org>

^a TOXBASE: Arsenic and arsenic compounds, 2003.

^b TOXBASE: Arsenic – features and management, 2003.

^c TOXBASE: Arsenic – inhalation, 2003.

^d TOXBASE: Arsenic – skin contact, 2003.

^e TOXBASE: Arsenic – eye contact, 2003.

Decontamination and First Aid

Important Notes^(a)

- Ambulance staff, paramedics and emergency department staff treating chemically-contaminated casualties should be equipped with Department of Health approved, gas-tight (Respirex) decontamination suits based on EN466:1995, EN12941:1998 and prEN943-1:2001, where appropriate.
- Decontamination should be performed using local protocols in designated areas such as a decontamination cubicle with adequate ventilation.
- Secondary contamination may occur.

Dermal exposure^(b)

- Remove patient from exposure.
- The patient should remove all clothing and personal effects.
- Double-bag soiled clothing and place in a sealed container clearly labelled as a biohazard.
- Brush away any adherent solid particles from the patient.
- Wash hair and all contaminated skin with copious amounts of water (preferably warm) and soap for at least 10-15 minutes. Decontaminate open wounds first and avoid contamination of unexposed skin.
- Pay special attention to skin folds, axillae, ears, fingernails, genital areas and feet.
- Cover affected area with a clean non-adherent dressing.

Ocular exposure^(c)

- Remove patient from exposure.
- Remove contact lenses if necessary and immediately irrigate the affected eye thoroughly with water or 0.9% saline for at least 10-15 minutes.
- Patients with corneal damage and those whose symptoms do not resolve rapidly should be referred for urgent ophthalmological assessment.

Inhalation^(d)

- Remove patient from exposure.
- Maintain a clear airway and adequate ventilation.
- Give oxygen to symptomatic patients.
- Apply other measures as indicated by the patient's clinical condition.

Ingestion^(e)

- Ensure clear airway and adequate ventilation.
- Give oxygen to symptomatic patients.

TOXBASE - <http://www.toxbase.org>

^a TOXBASE: Arsenic and arsenic compounds, 2003.

^b TOXBASE: Arsenic – skin contact, 2003.

^c TOXBASE: Arsenic – eye contact, 2003.

^d TOXBASE: Arsenic - inhalation, 2003.

^e TOXBASE: Arsenic – features and management, 2003.

- Do not attempt gastric lavage or give neutralising chemicals as heat produced during neutralization reactions may increase injury.
- Apply other measures as indicated by the patient's clinical condition.

This document will be reviewed not later than 3 years or sooner if substantive evidence becomes available.