



UK Health
Security
Agency

Aluminium phosphide

Incident management

This document provides information needed for response to a chemical incident, such as physicochemical properties, health effects and decontamination advice.

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Main points

General

Aluminium phosphide is a crystalline solid at room temperature, presenting as various colours including green, brown, dark grey or dark yellow due to impurities. It is commonly encountered as pellets or tablets for pest control varying in colour from dark grey, through brown to a light tan or yellow.

It has a garlic odour due to impurities and the release of phosphine gas.

Aluminium phosphide is non-flammable. However, on contact with water, moist air and acids it decomposes to highly toxic and flammable phosphine gas.

Health

Highly toxic by ingestion (as phosphine is released in the stomach) or by inhalation of liberated phosphine gas - see compendium entry for phosphine for more information.

Onset of symptoms is usually very rapid; early symptoms include nausea, vomiting, retrosternal and epigastric pain, dyspnoea and haematemesis (due to corrosive lesions of the oesophagus and stomach).

Pulmonary oedema occurs frequently and usually 4 to 48 hours after ingestion, but it is not always clear whether it is cardiogenic or non-cardiogenic aetiology.

There is often the smell of garlic on the breath of exposed individuals due to the presence of impurities.

Casualty decontamination at the scene

Aluminium phosphide reacts with water or moisture to liberate phosphine gas. Following disrobe, improvised dry decontamination should be considered for an incident involving aluminium phosphide unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances.


Environment

Hazardous to the aquatic environment. Inform the [Environment Agency](#) of substantial incidents

Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters.

Hazard identification

Table 1a. Standard (UK) dangerous goods emergency action codes for aluminium phosphide pesticide

UN		3048	Aluminium phosphide pesticide	
EAC		4W	Use dry agent: water must not be allowed to come into contact with substance. Wear chemical protective clothing with liquid tight connections for whole body in combination with breathing apparatus [note 1]. Danger that the substance can be violently or explosively reactive. Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters.	
APP		-	-	
Hazards	Class	6.1	Toxic substances	
	Sub-risks	-	-	
HIN		642	Toxic solid, which reacts with water, emitting flammable gases	

Abbreviations

UN = United Nations number.

EAC = emergency action code.

APP = additional personal protection.

HIN = hazard identification number.



Note to Table 1a

Note 1: Chemical protective clothing with liquid tight connections for whole body (Type 3) conforming to the relevant standards such as BS 8428 or EN 14605 in combination with breathing apparatus conforming to BS EN 137.

References

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA '[Dangerous Goods Emergency Action Code List](#)'. The Stationery Office 2023

Table 1b. Standard (UK) dangerous goods emergency action codes for aluminium phosphide

UN		1397	Aluminium phosphide	
EAC		4WE [note 1]	Use dry agent – water must not be allowed to come into contact with substance. Wear chemical protective clothing with liquid tight connections for whole body in combination with breathing apparatus [note 2]. Danger that the substance can be violently or explosively reactive. Spillages, contaminated fire and decontamination run-off should be prevented from entering drains and surface and groundwaters. There may be a public safety hazard outside the immediate area of the incident [note 3].	
APP		-	-	
Hazards	Class	4.3	Substances which in contact with water emit flammable gases	
	Sub-risks	6.1	Toxic substances	
HIN		-	-	

Abbreviations

UN = United Nations number.

EAC = emergency action code.

APP = additional personal protection.

HIN = hazard identification number.

Note to Table 1b

Note 1: Not applicable to carriage of dangerous goods under Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID), and the Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR).

Note 2: Chemical protective clothing with liquid tight connections for whole body (Type 3) conforming to the relevant standards such as BS 8428 or EN 14605 in combination with breathing apparatus conforming to BS EN 137.






Note 3: People should be warned to stay indoors with all doors and windows closed, preferably in rooms upstairs and facing away from the incident. Ignition sources should be

eliminated and ventilation stopped. Effects may spread beyond the immediate vicinity. All non-essential personnel should be instructed to move at least 250 m away from the incident.

References

National Chemical Emergency Centre (NCEC), part of Ricardo-AEA. '[Dangerous Goods Emergency Action Code List](#)'. The Stationery Office 2023

Table 2. The GB classification, labelling and packaging (CLP) regulation for aluminium phosphide

Hazard class and category	Water-react. 1	Substances and mixtures, which in contact with water, emit flammable gases, category 1	
	Acute Tox. 2	Acute toxicity category 2 (oral)	
	Acute Tox. 3	Acute toxicity category 3 (dermal)	
	Acute Tox. 1	Acute toxicity category 1 (inhalation)	
	Aquatic Acute 1	Acute hazards to the aquatic environment, category 1	
Hazard statement	H260	In contact with water releases flammable gases which may ignite spontaneously	
	H300	Fatal if swallowed	
	H311	Toxic in contact with skin	
	H330	Fatal if inhaled	
	H400	Very toxic to aquatic life	
Supplemental hazard statement	EUH029	Contact with water liberates toxic gas	
	EUH032	Contact with acids liberates very toxic gas	
Signal words	DANGER		

References

The Health and Safety Executive (HSE). '[GB CLP Regulation](#)' (viewed September 2024)

Physicochemical properties

Table 3. Physicochemical properties

CAS number	20859-73-8
Molecular weight	58
Formula	Al-P
Common synonyms	Aluminum phosphide, AIP, Al-Phos, Aluminium monophosphide, Celphide, Celphine, Celphos, Delicia, Delicia gastoxin, Detia, Detia gas Ex-B, Fumitoxin, Gastion, Phostoxin, Phostoxin-A, Quickphos.
State at room temperature	Crystals (various colours including green, brown, dark grey or dark yellow). Commonly encountered as pellets or tablets for pest control varying in colour from dark grey, through brown to a light tan/yellow.
Volatility	No data available
Specific gravity	2.9 g/cm ³ (water = 1)
Flammability	Non-flammable, but forms extremely flammable gas on contact with water or damp air
Lower explosive limit	1.6% (phosphine gas)
Upper explosive limit	100% (estimated) (phosphine gas)
Water solubility	Reacts with water to form phosphine gas
Reactivity	Explosive reaction on contact with mineral acids. Decomposes on contact with water, moist air and acids producing highly flammable and toxic gases (phosphine)
Odour	Garlic odour (due to impurities and is associated with the generation of phosphine)
Structure	Al≡P

References

International Programme on Chemical Safety. '[International Chemical Safety Card entry for aluminium phosphide](#)'. ICSC 0472, 2018. World Health Organization (viewed September 2024)

International Programme on Chemical Safety. '[International Chemical Safety Card entry for phosphine](#)'. ICSC 0694, 2013. World Health Organization (viewed September 2024)

PubChem Bethesda (MD): National Library of Medicine (US), National Center for Biotechnology Information. '[PubChem Compound Summary for CID 30332, Aluminum phosphide](#)' 2004 (viewed September 2024)

Reported effect levels from authoritative sources

Table 4. Exposure by inhalation [note 1]

ppm	mg/m ³	Duration	Signs and symptoms	Reference
100-190	140-260	30-60 min	Serious effects	a, b
290-430	400-600	30-60 min	Dangerous to life	a
400-600	560-840	30-60 min	Potentially fatal	a, b
2000	2800	Acute	Rapidly fatal	a

Note 1: Values relate to phosphine gas which is liberated when aluminium phosphide with water or moisture in air.

These values give an indication of levels of exposure that can cause adverse effects. They are not health protective standards or guideline values.

References

- a. International Programme on Chemical Safety (IPCS). '[Phosphine and selected metal phosphides. Environmental Health Criteria 73](#)'. 1998: World Health Organization
- b. [TOXBASE](#): Phosphine. 2022 (viewed September 2024)

Published emergency response guidelines

Table 5. Acute exposure guideline levels (AEGLs) [note 1]

	Concentration (ppm)				
	10 minutes	30 minutes	60 minutes	4 hours	8 hours
AEGL-1 [note 2]	NR	NR	NR	NR	NR
AEGL-2 [note 3]	4.0	4.0	2.0	0.50	0.25
AEGL-3 [note 4]	7.2	7.2	3.6	0.90	0.45

Notes to Table 5

Note 1: These values relate to phosphine gas, which is liberated when aluminium phosphide reacts with water or moisture in air

Note 2: Level of the chemical in air at or above which the general population could experience notable discomfort.

Note 3: 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.

Note 4: Level of the chemical in air at or above which the general population could experience life-threatening health effects or death.

NR = Not reported due to insufficient data

Reference

US Environmental Protection Agency (EPA) '[Acute Exposure Guideline Levels](#)' (viewed September 2024)

Exposure standards, guidelines or regulations

Table 6. Occupational standards [note 1]

	LTEL (8-hour reference period)		STEL (15-min reference period)	
	ppm	mg/m ³	ppm	mg/m ³
WEL	0.1	0.14	0.2	0.28

Note 1: Values relate to phosphine gas, which is liberated when aluminium phosphide reacts with water or moisture in air

Abbreviations

WEL = workplace exposure limit.

LTEL = long-term exposure limit.

STEL = short-term exposure limit.

Reference

HSE. '[EH40/2005 Workplace Exposure Limits](#)'. Fourth Edition 2020

Table 7. Public health standards and guidelines

Drinking water standard	No guideline values specified
WHO guideline for drinking water quality	
UK indoor air quality guideline	
WHO indoor air quality guideline	
WHO air quality guideline	

Health effects

Aluminium phosphide reacts with water, acids and moisture in the air to liberate phosphine gas. Phosphine gas is highly toxic when inhaled - see [compendium entry for phosphine](#) for more information.

Table 9. Signs or symptoms of acute exposure

Route	Signs and symptoms
Ingestion	<p>The onset of symptoms is usually very rapid.</p> <p>Early symptoms include nausea, vomiting, retrosternal and epigastric pain and diarrhoea. Haematemesis due to corrosive lesions of the oesophagus and stomach may occur and lead to the development of oesophageal stricture.</p> <p>There is often a smell of garlic on the breath due to the presence of impurities.</p> <p>Headache, dizziness, drowsiness, fatigue and CNS depression leading to coma may ensue.</p> <p>Hypotensive shock and circulatory failure are important early signs of severe poisoning and are frequent causes of death. Symptoms including cough, tachypnoea, dyspnoea with crackles and wheeze on auscultation of the lung fields, occur frequently and usually 4 to 48 hours after ingestion. Palpitations, sinus tachycardia/bradycardia, conduction disturbances (including RBBB, Brugada syndrome and ST and T-wave changes) and ventricular arrhythmias have been observed, particularly in children.</p> <p>Complications include acute kidney injury and acute liver failure, with associated metabolic acidosis or mixed metabolic acidosis and respiratory alkalosis.</p> <p>Pulmonary oedema with tachypnoea, dyspnoea, crepitations and rhonchi occur frequently and usually 4 to 48 hours after ingestion.</p> <p>Hypokalaemia is common and probably secondary to vomiting. Hypocalcaemia has also been reported.</p> <p>Hypoglycaemia, which may be persistent and severe, is due to impaired gluconeogenesis and glycogenolysis. Hyperglycaemia may also rarely occur.</p>

Reference

[TOXBASE](#). Aluminium Phosphide, February 2022 (viewed September 2024)

Decontamination at the scene

Chemical specific advice

The approach used for decontamination at the scene will depend upon the incident, location of the casualties and the chemicals involved. Therefore, a risk assessment should be conducted to decide on the most appropriate method of decontamination.

Aluminium phosphide reacts with water or moisture to liberate phosphine gas. Following disrobe, improvised dry decontamination should be considered for an incident involving aluminium phosphide unless casualties are demonstrating signs or symptoms of exposure to caustic or corrosive substances.

People who are processed through improvised decontamination should subsequently be moved to a safe location, triaged and subject to health and scientific advice. Based on the outcome of the assessment, they may require further decontamination.

Emergency services and public health professionals can obtain further advice from the UK Health Security Agency (UKHSA) Radiation, Chemicals and Environment Directorate using the 24-hour chemical hotline number: 0344 892 0555.

Disrobe

The disrobe process is highly effective at reducing exposure to HAZMAT/CBRN material when performed within 15 minutes of exposure.

Therefore, disrobe must be considered the primary action following evacuation from a contaminated area.

Where possible, disrobing should be conducted at the scene and by the casualty themselves. Disrobing should be systematic to prevent transfer of contaminant from clothing to skin. Clothing should not be pulled over the head if possible.

Clothing stuck to the casualty by the contaminant should not be forcefully removed, as this risks causing further harm.

Consideration should be given to ensuring the welfare and dignity of casualties as far as possible. Immediately after decontamination the opportunity should be provided to dry and dress in clean robes or clothes.

Improvised decontamination

Improvised decontamination is an immediate method of decontamination prior to the use of specialised resources. This should be performed on all contaminated casualties unless medical advice is received to the contrary. Improvised dry decontamination should be considered for an incident involving chemicals unless the agent appears to be corrosive or caustic.

Unprotected first responders and members of the public should not approach casualties incapacitated by exposure to administer improvised decontamination, as they may be exposed to contaminants and become a casualty themselves.

Important note: Improvised decontamination should continue until more structured interventions such as Interim or Specialist Operational Response are present.

Improvised dry decontamination

Improvised dry decontamination should be considered for an incident involving aluminium phosphide unless casualties are demonstrating obvious signs of chemical burns or skin irritation.

Any available dry absorbent material can be used such as kitchen towel, paper tissues (for example blue roll) and clean cloth.

Exposed skin surfaces should be blotted first and then rubbed, starting with the face, head, and neck, and moving down and away from the body.

Blotting and rubbing should not be too aggressive, as it could drive contamination further into the skin.

Casualties should also blow their nose to remove contaminants from the nasal cavities.

All waste material arising from decontamination should be left in situ, and ideally bagged, for disposal at a later stage.

Improvised wet decontamination

Wet decontamination should be used if contamination with a caustic chemical substance is suspected.

Water should only be used for decontamination where casualty signs and symptoms are consistent with exposure to caustic or corrosive substances such as acids or alkalis.

Wet decontamination may be performed using copious amounts of water from any available source such as taps, showers, water bottles, fixed installation hose-reels and sprinklers to gently rinse the affected skin. Other natural sources of water may be considered unless this creates greater risks to the individuals affected. Wet wipes or baby wipes may be used as an effective alternative.

Improvised decontamination should not involve overly aggressive methods to remove contamination as this could further damage affected tissues and drive the contamination further into the skin.

Where appropriate, seek professional advice on how to dispose of contaminated water and prevent run-off going into the water system.

Additional notes

Following improvised decontamination, remain cautious and observe for signs and symptoms in the decontaminated person and in unprotected staff.

If water is used to decontaminate casualties this may be contaminated, and therefore hazardous, and a potential source of further contamination spread.

All materials (paper tissues and so on) used in this process may also be contaminated and, where possible, should not be used on new casualties.

The risk from hypothermia should be considered when disrobe and any form of wet decontamination is carried out.

People who are contaminated should not eat, drink or smoke before or during the decontamination process and should avoid touching their face.

When vulnerable people are affected by a hazardous substance, they may need additional support to remove themselves, their clothing or the substance.

Casualties should remain in the area and should not leave to seek care at a hospital, as this presents a contamination risk. Further care will be administered on site by the appropriate emergency services.

Interim wet decontamination

Interim decontamination is the use of standard Fire and Rescue Service equipment to provide a planned and structured decontamination process prior to the availability of purpose-designed decontamination equipment.

Decontamination at the scene references

Home Office. [‘Initial operational response to a CBRN incident’](#). Version 2.0 (July 2015)

NHS England. [‘Emergency Preparedness, Resilience and Response \(EPRR\): Guidance for the initial management of self-presenters from incidents involving hazardous materials’](#). (February 2019)

JESIP. [‘Initial Operational Response IOR to Incidents Suspected to Involve Hazardous Substances or CBRN Materials’](#). (June 2024)

Clinical decontamination and first aid

Clinical decontamination is the process where trained healthcare professionals, using purpose-designed decontamination equipment, treat contaminated persons individually.

[Detailed information on clinical management](#) can be found on TOXBASE.

Important notes

Aluminium phosphide reacts with water or moisture to liberate phosphine gas.

Once body surface contaminants have been removed or if your patient was exposed by ingestion or inhalation, the risk that secondary care givers may become contaminated is very low. Secondary carers should wear standard hospital PPE as a precaution against secondary contamination from vomit and body fluids.

If the patient has not been decontaminated following surface contamination, secondary carers must wear appropriate NHS PPE for chemical exposure to avoid contaminating themselves.

The area should be well ventilated.

For comprehensive clinical advice consult TOXBASE directly.

Clinical decontamination following surface contamination

Carry out decontamination after resuscitation.

This should be performed in a well-ventilated area, preferably with its own ventilation system.

The patient should remove soiled clothing themselves if possible and try to avoid any cross-contamination from clothing to unexposed skin. Patients should avoid touching their face as much as possible.

Contaminated clothing should be removed, double-bagged, sealed and stored safely.

Dry decontamination should be considered as aluminium phosphide reacts with water or moisture to liberate phosphine gas.

Decontaminate exposed skin by blotting and rubbing skin with any dry absorbent material (for example kitchen towel, paper tissue, clean cloth). Start with the face, head and neck moving

down and away from the body. **Do not** reuse contaminated material for decontamination of multiple patients.

Blotting the skin should be gentle rather than aggressive in order to prevent further contamination into the skin.

All waste material from dry decontamination should be left in situ and bagged for appropriate later disposal.

If it is essential to wash carry out in a well ventilated area and minimise the risk of inhalation of toxic phosphine fumes

Dermal exposure

Decontaminate (as above) the patient following surface contamination.

Other supportive measures as indicated by the patient's clinical condition.

Ocular exposure

Ensure that the area is well ventilated as aluminium phosphide will liberate Phosphine gas when in contact with water.

If symptomatic: immediately irrigate the affected eye thoroughly with 1000 mL 0.9% saline or equivalent crystalloid (for example via an infusion bag with a giving set) for a minimum of 10 to 15 minutes. A Morgan Lens may be used if anaesthetic has been given.

Amphoteric, hypertonic, chelating solutions may be used if available.

Refer for ophthalmological assessment if necessary.

Carry out other measures as indicated by the patient's clinical condition.

Patients should be advised on discharge to seek medical attention if symptoms subsequently develop.

Ingestion and Inhalation

Maintain a clear airway and ensure adequate ventilation.

Administer oxygen to achieve adequate oxygenation.

In the presence of methaemoglobinaemia pulse oximetry is unreliable

Monitor vital signs and cardiac rhythm. Check the capillary blood glucose.

Check and record pupil size.

Perform a 12-lead ECG in all patients who require assessment.

Other measures as indicated by the patient's clinical condition.

Clinical decontamination and first aid references

[TOXBASE](#) (viewed September 2024)

TOXBASE Aluminium phosphide (2022)

TOXBASE Phosphine (2020)

About the UK Health Security Agency

UKHSA is responsible for protecting every member of every community from the impact of infectious diseases, chemical, biological, radiological and nuclear incidents and other health threats. We provide intellectual, scientific and operational leadership at national and local level, as well as on the global stage, to make the nation health secure.

UKHSA is an executive agency, sponsored by the Department of Health and Social Care.

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