Australian Government

Australian Pesticides and Veterinary Medicines Authority

Public Release Summary

on the evaluation of the new active constituent hydrogen cyanide in the products Bluefume Fumigant and Bluefume-D Fumigant

APVMA product numbers 90646 and 90643

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This publication is available from the APVMA website.

Contents

List of tables

Preface

The Australian Pesticides and Veterinary Medicines Authority (APVMA) is the Australian Government regulator responsible for assessing and approving agricultural and veterinary chemical products prior to their sale and use in Australia. Before approving an active constituent and/or registering a product, the APVMA must be satisfied that the statutory criteria, including the safety, efficacy, trade, and labelling criteria, have been met. The information and technical data required by the APVMA to assess the statutory criteria of new chemical products, and the methods of assessment, must be consistent with accepted scientific principles and processes. Details are outlined on the APVMA website.

The APVMA has a policy of encouraging transparency in its activities and seeking community involvement in decision making. Part of that process is the publication of Public Release Summaries for products containing new active constituents. This Public Release Summary is intended as a brief overview of the assessment that has been conducted by the APVMA and of the specialist advice received from advisory agencies, including other Australian Government agencies and State departments of primary industries. It has been deliberately presented in a manner that is likely to be informative to the widest possible audience to encourage public comment.

About this document

This Public Release Summary indicates that the APVMA is considering an application for registration of an agricultural or veterinary chemical. It provides a summary of the APVMA's assessment, which may include details of:

- the toxicology of both the active constituent and product
- the residues and trade assessment
- occupational exposure aspects
- environmental fate, toxicity, potential exposure and hazard
- efficacy and target crop or animal safety.

Comment is sought from interested stakeholders on the information contained within this document.

Making a submission

In accordance with sections 12 and 13 of the Agvet Code, the APVMA invites any person to submit a relevant written submission as to whether the application for registration of Bluefume Fumigant and Bluefume-D Fumigant should be granted. Submissions should relate only to matters that the APVMA is required, by legislation, to take into account in deciding whether to grant the application. These matters include aspects of public health, occupational health and safety, chemistry and manufacture, residues in food, environmental safety, trade, and efficacy and target crop or animal safety. Submissions should state the grounds on which they are based. Comments received that address issues outside the relevant matters cannot be considered by the APVMA.

Submissions must be received by the APVMA by close of business on 14 February 2023 and be directed to the contact listed below. All submissions to the APVMA will be acknowledged in writing via email or by post.

Relevant comments will be taken into account by the APVMA in deciding whether the product should be registered and in determining appropriate conditions of registration and product labelling.

When making a submission please include:

- a contact name
- the company or organisation name (if relevant)
- an email or postal address (if available)
- the date you made the submission.

Please note: submissions will be published on the APVMA website unless you have asked for the submission to remain confidential, or if the APVMA chooses at its discretion not to publish any submissions received (refer to the public consultation coversheet).

Please lodge your submission using the public consultation coversheet, which provides options for how your submission will be published.

Note that all APVMA documents are subject to the access provisions of the *Freedom of Information Act 1982* and may be required to be released under that Act should a request for access be made.

Unless you request for your submission to remain confidential, the APVMA may release your submission to the applicant for comment.

Written submissions should be addressed to:

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Further information

Further information can be obtained via the contact details provided above.

Copies of technical evaluation reports covering chemistry, efficacy and safety, toxicology, occupational health and safety aspects, residues in food and environmental aspects are available from the APVMA on request.

Further information on Public Release Summaries can be found on the APVMA website.

Introduction

This publication provides a summary of the data reviewed and an outline of the regulatory considerations for the proposed registration of Bluefume Fumigant and Bluefume-D Fumigant, and approval of the new active constituent, hydrogen cyanide.

Applicant

Draslovka Services Pty Ltd.

Purpose of application

Draslovka Services Pty Ltd has applied to the APVMA for registration of the new products Bluefume Fumigant and Bluefume-D Fumigant, each containing 976 g/kg, as liquid vapouriser (LV) formulations, of the new active constituent, hydrogen cyanide.

This publication provides a summary of the data reviewed and an outline of the regulatory considerations for the proposed registration of the products Bluefume Fumigant and Bluefume-D Fumigant, and approval of the new active constituent hydrogen cyanide.

Proposed claims and use pattern

The proposed products, Bluefume Fumigant and Bluefume-D Fumigant are intended for use as indoor fumigants for empty structures against beetles, weevils, borers, moths, mites, cockroaches, and rodents. Use of both products will be restricted to licensed fumigators who have also completed a mandatory product stewardship training program.

Bluefume Fumigant is a liquid vaporizer which is supplied in pressurised stainless steel cylinders and is applied from outside the structure by a certified fumigator via a distribution system using only approved equipment.

Bluefume-D Fumigant is a liquid vaporizer consisting of wood pulp discs (discoids) impregnated with hydrogen cyanide (HCN) and distributed manually in empty structures by a certified fumigator. The discs are supplied in gas-tight lacquered and tinplated steel cans, which are opened inside the structure to be treated. Once the can is opened with a Draslovka-approved can opener, volatile HCN is slowly released from the discs as a function of the ambient temperature.

Mode of action

Hydrogen cyanide acts by inhibition of mitochondrial respiration by blocking electron transfer at the cytochrome c oxidase and the terminal oxidase enzymes, thereby reducing the availability of oxygen and causing hypoxia and cellular destruction. Hydrogen cyanide is a member of the cyanide group of compounds which are designated Group 24B insecticides by the Insecticide Resistance Action Committee (IRAC 2022).

Overseas registrations

Bluefume is currently registered in the United Kingdom, Malaysia, Morocco and the EU (Austria, Belgium, Croatia, Czech Republic, France, Germany, Italy, Netherlands, Portugal, Romania, Slovakia and Spain) as Bluefume Fumigant or Uragan D2 and is supplied in either cylinders or cans[1]. Bluefume-D Fumigant is currently also registered in New Zealand as Bluefume-D[2].

[1] European Chemicals Agency, *Information on biocides*, ECHA website, 2021, accessed 11 October 2022.

[2] New Zealand Environmental Protection Authority, *Decision on application for approval to import Bluefume for release (APP203876)*, New Zealand Environmental Protection Authority website, 28 April 2021, accessed 11 October 2022.

Chemistry and manufacture

Active constituent

The active constituent, hydrogen cyanide, is manufactured overseas. Details of the chemical name, structure, and physicochemical properties of hydrogen cyanide are listed below in tables 1–2.

The active ingredient is a clear colourless liquid with a boiling point of 26.1°C. At room temperature (25°C), the active constituent is present in gas form. Hydrogen cyanide is weakly acidic with a pKa of 9.2, and partially ionises in water to form the cyanide anion (CN^-). It is highly miscible in both water and most common organic solvents.

The vapour pressure (82.8 kPa at 20°C) and the Henry's law constant (5.1×10^{-2} atm-m^3/mol at 25°C) indicate that volatilisation is a major route of dissipation for hydrogen cyanide. It is highly flammable in liquid form and expected to form a potentially explosive mixture with air but does not undergo self-ignition or oxidation.

Hydrogen cyanide is expected to be stable for at least 2 years when stored under normal conditions.

Table 1: Nomenclature and structural formula of the active constituent hydrogen cyanide

Common name (ISO):	Hydrogen cyanide
IUPAC name:	Hydrogen cyanide
CAS registry number:	74-90-8
Molecular formula:	HCN
Molecular weight:	27.02 g/mol
Structural formula:	H-C≡N

Table 2: Key physicochemical properties of the active constituent hydrogen cyanide

Physical form:	Liquid
Colour:	Clear colourless
Odour:	Faint bitter almond odour
Melting point:	–15.3°C
Boiling point:	26.1°C
Relative density	0.69 g/cm^3 at 20°C
Stability:	At ambient temperature, hydrogen cyanide was shown to be stable during storage for at least one year. At elevated temperatures, no changes in the active were observed after two weeks storage at 54ºC. No signs of corrosion or polymerisation of the packaging material were observed following 5 years storage at ambient conditions. Technical hydrogen cyanide is therefore expected to be stable in storage for at least 2 years, under normal conditions.
Safety properties:	Highly flammable and explosive when mixed with air. Does not self-ignite. Hydrogen cyanide technical does not show any chemical incompatibility with oxidising and reducing agents.
Solubility in water:	Completely miscible with water at 22.2°C
Organic solvent solubility:	Methanol: >250 g/L Ethyl acetate: >250 g/L Toluene: >250 g/L Dichloromethane: >250 g/L n-heptane: 20 to 22 g/L
Dissociation constant (PK_a):	pKa= 9.21 at 20°C
PH:	pH 2.79 at a 0.1 g/L aqueous solution
Octanol/water partition coefficient (Log K_{ow}/K_{OW}):	log P_{ow}= -0.69 at 20°C
Vapour pressure:	82.8 kPa at 20°C 99.8 kPa at 25°C 233 kPa at 50°C
Henry's law constant:	5.2 kPa-m^3/mol 25°C 5.1×10^{-2} atm-m^3/mol at 25°C
UV/VIS absorption spectra:	No absorption maxima in the range of 190 nm to 800 nm in neutral and basic solution
Hydrolysis in water:	Highly volatile in water at pH 4.0, pH 7.0 and pH 9.0.

Formulated product – Bluefume Fumigant

The product Bluefume Fumigant will be manufactured overseas. Tables 3 and 4 outline some key aspects of the formulation and physicochemical properties of the product.

Bluefume Fumigant will be available in 250 g to 30 kg of stabilised hydrogen cyanide, packed into 500 mL to 50 L cylinders, made from 316L grade stainless steel. The cylinders are equipped with stainless steel 316 L grade dual-port valves with dip tubes for the liquid HCN outlet, and gas-ports for nitrogen pressuring. Elastomeric sealing utilises polychlorotrifluoroethane (PCTEF).

Table 3: Key aspects of the formulation of the product Bluefume Fumigant

Distinguishing name:	Bluefume Fumigant
Formulation type:	Liquid vapouriser (LV)
Active constituent concentration/s:	976 g/kg hydrogen cyanide

Table 4: Physicochemical properties of the product Bluefume Fumigant

Physical form:	Volatile clear colourless liquid
Corrosion of metal:	No corrosion on stainless steel or iron containers
Safety properties:	Classified as a highly volatile compound and may explode when mixed with air. Hydrogen cyanide is applied as a liquid by spraying nozzles and evaporates (does not condense). The active ingredient is gas only.
Storage stability:	There were sufficient data to conclude that the product is expected to remain within specifications for at least 2 years when stored under normal conditions.

Formulated product – Bluefume-D Fumigant

The product Bluefume-D Fumigant will be manufactured overseas. Tables 5 and 6 outline some key aspects of the formulation and physicochemical properties of the product.

Bluefume-D Fumigant will be available in lacquered and tinplated steel cans containing 1,500 g of stabilised hydrogen cyanide, absorbed in porous wood pulp discoids (35 to 40 pieces, enough to fill the can and adsorb 1,500 g of stabilised hydrogen cyanide), packed in wooden crates containing 12 cylindrical cans.

Table 5: Key aspects of the formulation of the product Bluefume-D Fumigant

Distinguishing name:	Bluefume-D Fumigant
Formulation type:	Liquid vapouriser (LV)
Active constituent concentration/s:	976 g/kg hydrogen cyanide

Table 6: Physicochemical properties of the product Bluefume-D Fumigant

Physical form:	Clear colourless liquid
Corrosion of metal:	No corrosion observed for the cans
Safety properties:	Classified as a highly volatile compound, explosive when mixed with air. The stabilised hydrogen cyanide is absorbed in porous wood pulp discoids and packed in cylindrical lacquered and tinplated steel cans which in turn are packed in wooden crates.
Storage stability:	There were sufficient data to conclude that the product is expected to remain within specifications for at least 2 years when stored under normal conditions.

Recommendations

The APVMA Chemistry section has evaluated the chemistry of the active constituent hydrogen cyanide and associated products Bluefume Fumigant and Bluefume-D Fumigant, including the manufacturing process, quality control procedures, physicochemical properties, spectra, stability, packaging, batch analysis results and analytical methods, and found them to be acceptable. The available storage stability data indicate that the formulated products are expected to remain stable for at least 2 years when stored under normal conditions.

Based on a review of the chemistry and manufacturing details, the registration of Bluefume Fumigant and Bluefume-D Fumigant, and approval of the active constituent hydrogen cyanide, are supported from a chemistry perspective.

Toxicological assessment

The applicant submitted a complete data package, which was sufficient to assess the toxicity of hydrogen cyanide. A number of the studies related to hydrogen cyanide were carried out using either cyanide salts (e.g., KCN and NaCN), its precursor acetone cyanohydrin (ACH), or ethanedinitrile (cyanogen, C_2N_2).

Evaluation of toxicology

Chemical class

Cyanides and nitriles are related compounds that belong to several classes, including hydrogen cyanide (hydrocyanic acid, prussic acid, HCN); cyanogen (CN_2); and the simple salts of HCN which dissociate to release CN^- ions (such as sodium, potassium, calcium, and ammonium cyanide).

Pharmacokinetics

The absorption and subsequent disposition of cyanide following exposure is principally influenced by its physicochemical properties (for example, aqueous solubility, boiling point and pKa) at physiological pH and temperature (for example, 7.4 and 37°C). HCN is a gas at 37°C. HCN and cyanates are readily absorbed from aqueous solutions, with complete absorption following oral exposure. Gaseous hydrogen cyanide may be absorbed by skin, or by inhalation, however the rate of skin absorption is very much reduced when compared to inhalation.

Free cyanide in water is generally considered to be the sum of cyanide present in the form of HCN and CN^-. HCN is a weak acid, which does not completely dissociate to its ionic form. Interconversion between HCN and CN^- occurs readily, however in the human body most will be present as HCN. Cyanide salts, such as potassium or sodium cyanide, that are readily converted in the acidic environment of the stomach to HCN, and this form predominates in the body fluid. Based on the rapid conversion of cyanide ions to HCN and the rapid absorption of HCN from the stomach, a bolus dose will generate an acute high blood concentration, whereas continuous uptake from inhalation exposures will produce a markedly different blood profile.

Cyanide given orally (such as in drinking water) is rapidly metabolised to produce thiocyanate. About 80% of cyanide is detoxified by this route and effectively distributed by blood into all tissues. The rate of spontaneous detoxification of cyanide in humans is about 1 µg/kg body weight per minute. Thiocyanate is primarily excreted via urine.

Acute toxicity (active constituent)

Hydrogen cyanide has high oral, dermal, and inhalational toxicity, and the potential to be a severe eye irritant. No skin irritation or sensitisation studies are available due to the technical difficulty of performing such studies; however, repeated exposure to low levels can result in a skin rash in humans (cyanide rash).

Acute toxicity (products)

No acute toxicity studies were submitted on the two products Bluefume Fumigant and Bluefume-D Fumigant. Based on the composition of the product, the acute toxicity is expected to be consistent with the toxicity of the active constituent.

The joint FAO/WHO expert committee of food additives (JECFA) has reviewed cyanide and cyanogenic glycosides (which may be found in cassava and other plant-based foods) and concluded that hydrocyanic acid present in cassava flour at up to 10 mg HCN/kg was not associated with acute toxicity[3].

Repeat-dose toxicity

A number of repeat-dose toxicity studies following oral or inhalation exposure have been performed in different laboratory animal species. Repeat-dose dermal studies were not available.

In a short-term (15-day) repeat dose toxicity study, rats were administered potassium cyanide (KCN) in drinking water at rates equivalent to 0, 0.12, 0.36, 1.2 or 3.6 mg CN^-/kg bw/day. The highest dose group had a 70% lower weight gain in comparison to control group animals. Microscopic changes were seen in the kidney, liver, and thyroid, mainly consisting of cytoplasmic vacuolation in proximal tubular epithelial cells of the kidney at the two top doses, and in liver cells at the highest dose. No NOAEL was established.

In a short-term whole body inhalation toxicity study (28-day), rats were exposed to ACH vapours at 9.2, 29.9 or 59.6 ppm for 6 h/day. Irritation of the eyes and/or nose and breathing difficulties in the mid and high-exposure groups, and hypoactivity in the high-exposure group were observed during exposure. Signs associated with anoxia/hypoxia, such as respiratory distress, tremors and/or convulsions, foaming at the mouth and prostrate posture were observed following the first exposure in four high-exposure males. No NOAEL was established.

In a 14-week whole body inhalation toxicity study, rats were exposed at 0, 10.1, 28.6 or 57.7 ppm ACH in air for 6h/d. No clinical signs, changes in haematological parameters, or clinical chemistry were observed outside normal biological variability, with the exception of thiocyanate levels. Urine thiocyanate levels were elevated in all exposure groups, while serum thiocyanate levels were elevated in low- and mid-dose exposure groups. No change in body weights or gross or microscopic pathology were observed. The NOAEC was 57.7 ppm, the highest dose, based on elevated urine and serum thiocyanate (SCN^-) levels.

[3] JECFA (1993). Cyanogenic glycosides. Toxicological evaluation of certain food additives and naturally occurring toxicants. WHO Food Additives series 30. First draft prepared by Speijers G, National Institute of Public Health and Environmental Protection, Bilthoven, Netherlands. International Programme on Chemical Safety, World Health Organization, Geneva, Switzerland.

Chronic toxicity and carcinogenicity

Exposure of rats to a diet treated with hydrocyanic acid (containing HCN at 73 and 183 mg cyanide per kg of diet) did not affect growth, food consumption, or survival, and there were no effects on organ body weight or microscopic changes in the organs. Increased thiocyanate levels were seen at both doses. In other studies, effects of cyanide on thyroid functioning were investigated. The study found decreased thyroid gland activity in young rats, however after one year, the effects had diminished. Enlarged thyroids were observed on autopsy at the end of the study and may indicate a level of adaption.

Following inhalation exposure to acetonitrile (which is metabolised in the body to cyanide), there were no effects on survival, clinical signs, body weight, organ weights, or microscopic organ changes. There was no evidence of carcinogenicity at any dose.

Reproductive and developmental toxicity

No reproduction studies following inhalational exposure to cyanide could be located in the public domain or in the many available cyanide reviews. However, in a male and female fertility study, rats were exposed by inhalation to the cyanide precursor ACH. The NOAEC ranged from 61.9 to 63.4 mg CN^-/m^3. No effects on reproduction were observed.

The effects of feeding KCN to pregnant rats did not have effects on gestation and lactation but did reduce food consumption and daily growth of offspring when fed during the post-weaning period. Sodium thiocyanate was significantly increased, but there were no effects noted on pup survival or development.

In a 110-day reproduction study, gilts (young female swine/pigs) received a cassava root flour-based diet containing 0, 250, or 500 mg KCN/kg. Serum thiocyanate concentration was slightly, but not significantly, increased at the highest dose group both in adults and foetus, and serum protein bound iodine decreased during gestation in all groups. A small increase in maternal thyroid weight with increasing levels of cyanide was observed. Pathological studies showed proliferation of glomerular cells of the kidneys in gilts of all groups, and reduced activity of the thyroid gland in gilts fed 500 mg KCN/kg group. Cyanide fed during gestation did not affect performance during lactation. Milk thiocyanate and colostrum iodine concentrations were significantly higher in the group fed 500 mg KCN/kg feed. No effects of cyanide were reported on indices of reproduction performance.

No developmental toxicity studies on cyanide via the inhalation route were available. However, two studies which investigated developmental effects in rats following oral exposure to cyanide salts (KCN, ACH) were available. They reported an absence of any developmental effects in the absence of maternotoxicity.

Similarly, studies with cyanogenic glycosides reveal that developmental effects only occur at maternally toxic doses. Overall, the available data suggest that developmental toxicity is unlikely in exposure scenarios not associated with general systemic acute or chronic toxicity hazards.

Genotoxicity

There were no indications of any mutagenic or genotoxic activity of cyanide.

Neurotoxicity

The central nervous system is the primary target of cyanide toxicity in humans and animals regardless of the route of exposure. Following a single, short-term exposure at toxic levels, an initial brief period of stimulation including ataxia and tremors is followed by depression, loss of consciousness, convulsions, coma, and ultimately death. This is associated with relatively high cyanide concentration in the brain. The acute mode of action of cyanide has been extensively studied and is well understood.

Experimental studies in animals exposed to HCN or cyanide salts by inhalation, oral, or dermal routes have observed neurological effects. However, based on different enzyme availability, and different metabolism pathways in dogs and pigs from those in humans, the relevance of these is unclear.

Mode of action

In mammals, cyanide is rapidly absorbed in the form of non-ionised HCN following oral, dermal, or inhalation exposure. Cyanides are very toxic by all routes of exposure. The mechanism of cyanide toxicity, irrespective of its mode of administration, is due to its affinity and inhibition of cytochrome a3 oxidase activity in the mitochondrial respiratory pathway in various tissues. The most sensitive organs to cytochrome oxidase inhibition are those with the greatest oxygen demand, such as the brain and heart. The acute inhalational toxicity is a function of the vapour concentration and exposure duration.

Cyanide blocks aerobic metabolism by binding to the ferric ion of mitochondrial cytochrome c oxidase, which prevents the generation of ATP. Depletion of cellular energy reserves follows, causing tissue metabolism to utilise the anaerobic pathway, leading to acidosis due to increased levels of pyruvic and lactic acid. Organs with the highest aerobic energy demands are the most quickly affected, particularly the brain and heart.

Reports related to human toxicity

Obtaining an estimate of a lethal oral dose of cyanide in humans is difficult to determine because of the uncertainty in determining an exact dose that has been ingested following self-administration. An estimated fatal oral dose for HCN is 50 to 100 mg as total. The average non-lethal threshold dose after oral exposure is about 1.5 mg/kg bw.

Health-based guidance values and poisons scheduling

Poisons Standard

Hydrocyanic acid (or hydrogen cyanide) has a general entry in Schedule 7 and in Appendix J of the Poisons Standard. Hydrocyanic acid for therapeutic use is in Schedule 4 and in Appendix G.

Health-based guidance values

Acceptable daily intake and acute reference dose

The products Bluefume Fumigant and Bluefume-D Fumigant are not intended for uses leading to exposure in food, therefore health-based guidance values have not been calculated.

Worker exposure standards

In performing an occupational risk assessment for a pesticide application, the APVMA usually identifies a suitable NOAEL from a toxicological study that has an occupationally relevant duration. However, for commodity and industrial chemicals that have many different applications, occupational exposure limits are frequently determined by other agencies, e.g. Safe Work Australia, who are also responsible for risk minimisation. Such is the case for hydrogen cyanide.

A fumigation plan and an emergency management plan as per 'AS 2476:2008 General Fumigation' is required. Although the document 'AS 2476:2008 General Fumigation' was officially withdrawn by Standards Australia on 30 May 2018, the various states in Australia still require compliance with the relevant sections of 'AS2476:2008'.

Occupational exposure limit (OEL)

OEL values are established to protect workers from both the acute effects of short-term exposures of airborne concentrations and the chronic, cumulative effects of regular whole-shift daily exposure. Safe Work Australia have recently reviewed their limit values for hydrogen cyanide and concluded that the time-weighted average exposure over 8 hours should be reduced to 0.9 ppm (1 mg/m^3) to protect against chronic neurological symptoms and thyroid enlargement in exposed workers[4]. A peak (<15 min) limitation level of 4.7 ppm (5 mg/m^3) was also agreed upon to protect workers exposed at the workplace from immediate and severe health effects (death, coma, respiratory failure).

These OELs will be protective of bystanders who could incidentally be exposed to low levels of cyanide if they live, work, or pass by a building during the short period of post-fumigation venting where ground level cyanide concentrations may be measurable.

[4] Safe Work Australia, *Hazardous Chemicals Information System (HCIS), Exposure standard documentation, Hydrogen cyanide*, SafeWork Australia website, 2019 accessed 5 January 2023.

Recommendations

The APVMA has no objections on human health grounds to the approval of the active constituent, hydrogen cyanide.

The APVMA has no objections on health grounds to the registration of the products, Bluefume Fumigant and Bluefume-D Fumigant, when used in accordance with the label directions.

As Bluefume Fumigant and Bluefume-D Fumigant contain 97.6% hydrogen cyanide, they are included in Schedule 7, requiring a DANGEROUS POISON label signal heading.

Residues assessment

A residues assessment is not required because Bluefume Fumigant and Bluefume-D Fumigant are not intended to be used in buildings or structures containing stored food or agricultural food commodities. The following restraint appears on the label to mitigate risks in line with the AS-2476:2008 Standard:

- DO NOT use unless all commodities are removed from the fumigation site or hermetically sealed inside impervious bags or similar wrappings as per the Australian standard AS-2476:2008.

Furthermore, the below label statement was added to account for food commodities that may be stored in the treated structures or buildings at times other than during fumigation. This will ensure commodities are only introduced to the fumigated area after the full, required ventilation period. As such, HCN exposure to stored commodities is negligible, and no residues are expected to be present in these commodities.

- DO NOT introduce stored commodities to the fumigation enclosure or remove the hermetically sealed inside impervious bags or similar wrappings unless the ventilation process is complete, and the hydrogen cyanide concentration is less than 0.5 ppm (0.55 mg/m^3).

Assessment of overseas trade aspects of residues in food

The assessment of overseas trade aspects of residues in food is not required considering Bluefume Fumigant and Bluefume-D Fumigant are not to be used on any food commodities.

Work health and safety assessment

Health hazards

Acute toxicity studies indicate hydrogen cyanide has high oral, dermal, and inhalational toxicity. It is a severe eye irritant and has potential to be a skin irritant. There are no data on skin sensitisation. It is not genotoxic and is unlikely to be carcinogenic in humans; however, it is neurotoxic.

Occupational exposure and risk

APVMA concluded that adequate data were available to characterise the toxicological profile of hydrogen cyanide and to undertake occupational and bystander health risk assessments for the two products, Bluefume Fumigant and Bluefume-D Fumigant.

Safe Work Australia has established a peak limitation workplace exposure standard (WES) of 4.7 ppm (5 mg/m^3) for HCN to protect against immediate and severe health effects (death, coma, respiratory failure) among workers[5]. Safe Work Australia has also established a time-weighted average WES of 0.9 ppm (1 mg/m^3), to protect against chronic neurological symptoms and thyroid enlargement in exposed workers. Both the TWA and Peak values are consistent with those established by the Scientific Committee on Occupational Exposure Limits (SCOEL) in Europe (SCOEL 2010)[6].

Draslovka has developed a product stewardship training program which must be completed by each licensed fumigator before they are supplied with Bluefume or Bluefume-D Fumigants. Firstly, the fumigators must hold a license or accreditation in accordance with State or Territory requirements. Secondly, fumigators must pass a theoretical and practical training course specifically aimed at the safe handling, use, and disposal of Bluefume and Bluefume-D. Regular audits also form part of the Draslovka stewardship program to ensure the products are handled and applied safely.

In addition to the Draslovka product stewardship program, the supply and use of both products is also governed by state and territory regulations which are also designed to minimise the risks to fumigators, the public, and the environment.

[5] Safe Work Australia, *Workplace exposure standard – hydrogen cyanide*, Safe Work Australia website, 2019, accessed 5 January 2023.

[6] European Commission, *Scientific Committee on Occupational Exposure Limits, Recommendation from the Scientific Committee on Occupational Exposure Limits for Cyanide (HCN, KCN, NaCN) SCOEL Report No. SCOEL/SUM/115*, European Commission (SCOEL) website, May 2013.

SCOEL (2010) Recommendation from the Scientific Committee on Occupational Exposure Limits for Cyanide (HCN, KCN, NaCN). Scientific Committee on Occupational Exposure Limits (SCOEL) Report No. SCOEL/SUM/115.

Risk during use

Operator exposure during fumigation

During fumigation, personnel are required to use personal protective equipment including chemical resistant clothing fastened to the neck and wrist, elbow length chemical-resistant gloves, impervious non-sparking footwear, and a full facepiece respirator with a canister specified for hydrogen cyanide when levels are above 0.45 ppm.

When HCN levels are above 45 ppm, a supplied air respirator must be worn. Operational measures to ensure operators do not come into contact with high concentrations of HCN vapours include mandatory training for all licensed fumigators before they are supplied with the products and a requirement for fumigators to carry a portable monitoring device calibrated to detect HCN levels in the air with a minimum detectable level of 0.45 ppm throughout the entire fumigation procedure, including the ventilation and post ventilation phases.

Exposure of professionals during ventilation phase

During ventilation, an exclusion zone must be established to ensure the airborne HCN concentration at its border is no more than 3 mg/m^3. For example, an operator wearing prescribed PPE (i.e. where levels are above 0.45 ppm, a full facepiece respirator with canister specified for hydrogen cyanide or where levels are above 45 ppm, a supplied air respirator) will be responsible for shifting the border if required by a change in weather conditions.

Exposure of bystanders

To avoid unacceptable exposure of bystanders, an exclusion zone must be set around the fumigated structure, which can only be accessed by authorised persons from the beginning of the fumigation until the end of the ventilation period. A reasonable assumption is that bystanders will spend no more than 30 mins at the border of the exclusion zone. This corresponds to an exposure of 0.03 mg/kg bw for adults when applying an inhalation rate of 1.25 m^3/h, and body weight of 60 kg (0.5 h × 1.25 m^3 × 3 mg/m^3/60 kg), and to 0.15 mg/kg bw for infants when applying an inhalation rate of 1 m^3/h and body weight of 10 kg. Thus, the systemic dose due to exposure of an adult bystander corresponds to 6.3%, and that of an infant corresponds to 31% of the acute AEL (WES) value of 4.7 ppm (5 mg/m^3).

Risk during re-entry or re-handling

Re-entry to the building during fumigation where the HCN concentration is expected to be high is prohibited unless in extreme emergency. The worker must wear the PPE as stated on the label to prevent exposure as indicated below.

All ventilation windows and doors should be opened from the outside of the building. Fumigators must carry a gas detector at all times to monitor gas concentrations and must wear the label-required PPE.

The following statements apply:

- DO NOT re-enter the treatment site or rehandle treated material until the fumigation is cleared. The fumigation cannot be cleared until the ventilation phase ends. The ventilation phase ends when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations) below 0.9 ppm.
- DO NOT permit the re-occupancy of buildings and structures until the level of cyanide is below 0.45 ppm.

Public exposure

As the product will not be available to the general public and will not be stored in circumstances where contamination of public areas is likely to occur, accidental exposure is considered unlikely.

Recommendations

The APVMA has no objections on human health grounds to the registration of the two products, Bluefume Fumigant and Bluefume-D Fumigant.

Taking into consideration the potential toxicological hazard and use pattern of hydrogen cyanide, the following first aid instructions, safety directions, precautionary (warning) statements, restraints/restrictions and re-entry statements are recommended for the product label.

First aid instructions

If poisoning occurs, immediately contact a doctor or Poisons Information Centre. Phone Australia 13 11 26.

In the event of cyanide poisoning, time is of the essence. Immediately call triple zero (000) as you provide first aid assistance to the victim. Only give first aid if no suspected cyanide is present in the immediate environment. If the harmful chemical is suspected, do not enter the area unless wearing protective equipment. Once the area is safe, do the following steps.

- Remove the casualty from the area if cyanide exposure is continuous. When possible, arrange for another isolation area.
- Remove the contaminated clothing and clean the skin thoroughly with water.

- Ensure an open airway but avoid using mouth-to-mouth resuscitation techniques due to the risk of contamination. Administer medical oxygen at the maximum rate, preferably via a CPR resuscitation mask.
- Administering high flow oxygen can also be helpful, but this is normally only an option for trained medical professionals.

The above first aid steps apply to all cases of cyanide poisoning. Treat the victim depending on the mode of cyanide exposure – whether through inhalation, ingestion, and absorption through the skin.

In addition, the following precautions should apply:

- For eye contact, quickly rinse the eye with clean water for at least ten minutes, then treat it as above.
- For ingestion, treat the cyanide poisoning as above and avoid giving anything by mouth.
- Do not give direct mouth-to-mouth resuscitation if swallowed. To protect rescuer, use air-viva, oxy-viva, or one-way mask. Resuscitate in a well-ventilated area.

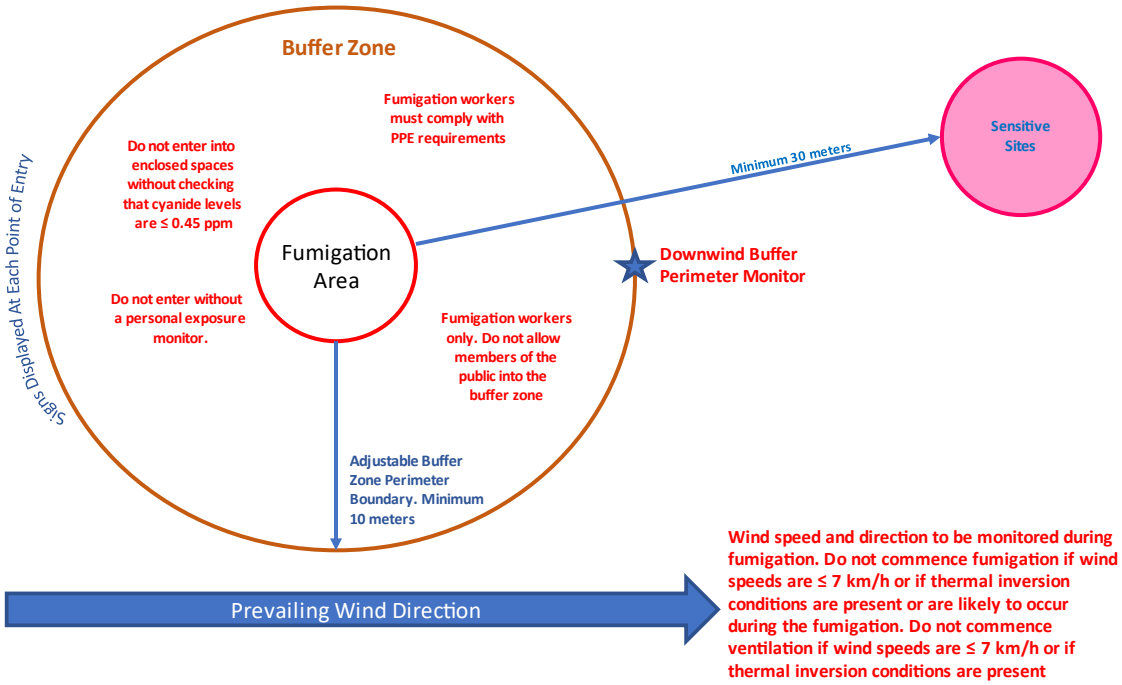
Safety directions

Very dangerous. Can kill if inhaled. Poisonous if swallowed or absorbed by skin. Will irritate the eyes, nose and throat and skin. Avoid contact with eyes and skin. Do not inhale vapour. When using the product and preparing the product for use and when uncovering the treated area/material, wear protective clothing (chemical resistant) fastened to the neck and wrist, elbow-length chemical resistant gloves, impervious footwear (non-sparking), and (or where levels are at or above 0.45 ppm) a full facepiece respirator with canister specified for hydrogen cyanide, and (or where levels are at or above 45 ppm) a supplied air respirator. Detailed instructions for safe use appear in state/territory regulation. Thoroughly ventilate treated areas before reoccupying. After each day’s use, wash gloves, respirator, and contaminated clothing.

Precautionary (warning) statements

May be fatal if inhaled, swallowed or absorbed through skin. May cause fire or explosions. Keep away from heat, sparks and naked flames.

Figure 1: Boundaries of the affected area and buffer zone



General instructions, safety precautions and restraints

A summary of the proposed new general instructions, precautions, and restraints for cyanide fumigation of empty structures are shown in Table 7 below. Additionally, the above graphic (or an equivalent facsimile) MUST be included in the *Precautions* section of the label.

Boundaries of the affected area and buffer zone are to be adjusted according to measurements taken at the perimeter in the downwind direction from the application site. However, the perimeters of the affected area and the buffer zone extend in all directions (not just downwind) to account for wind changes.

Table 7: Proposed general instructions, restrictions and restraints for Bluefume and Bluefume-D Fumigants

General instructions and important definitions	
The fumigation process consists of 3 phases: • The treatment phase • The ventilation phase • Clearing of the fumigation. The fumigation can only be declared to be cleared when the ventilation phase is complete. The fumigation treatment phase starts when the cyanide is first introduced into the fumigation area and ends when the ventilation phase is started. The ventilation phase starts when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations inside the treatment area) below 900 ppm. *For buildings and structures:* Cyanide is lighter than air, hence once the building is opened it tends to disperse up into the atmosphere. At the start of the ventilation period wear appropriate PPE and open the front door and windows and check the concentration of cyanide inside and around the building. Re-enter the building wearing appropriate PPE and gradually open other doors and windows. The ventilation phase ends when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations) below 0.9 ppm.	There are controls that apply to the overall fumigation process as well as specific controls that apply to the treatment phase and the ventilation phase. Clear definitions of what constitutes the fumigation process, the different fumigation process phases and the different zones are required so that relevant label requirements can be applied and adhered to.

General instructions and important definitions	
The fumigation site is divided into an outer buffer zone surrounded by a buffer zone perimeter and an inner fumigation area (see label graphic). Different precautions apply to each area.	
Use extreme caution when handling this product which is a flammable, colourless, highly toxic gas with an almond-like odour. Users should note that the odour cannot be detected by everybody, and the threshold varies widely between individuals, so it is not a reliable indicator of the presence of cyanide.	This is important basic information that should be readily available to users of this product.
Detailed instructions for safe use appear in state/territory regulations.	There are other legal requirements imposed by the states and territories
Proposed restrictions	**Justification**
Maximum treatment rate	
DO NOT exceed the maximum application rate of 10 g/m^3.	The APVMA's risk assessment is based on this parameter and accounts for the uncertainties associated with the underlying supportive data and modelling. Increasing the application rate may result in inadequate risk mitigation. The purpose of this control is to minimise the initial bolus of cyanide released at the start of treatment and any subsequent leakage of free cyanide into the surrounding environment during the treatment phase, to reduce the probability of unacceptable free cyanide levels occurring in the breathing zone atmosphere within the Buffer Zone, and

General instructions and important definitions	
	to reduce the probability of unacceptable free cyanide levels spreading beyond the Buffer Zone boundary.
Adequate sealing is required before fumigation starts	
DO NOT apply Bluefume-D™ Fumigant or Bluefume Fumigant into areas to be treated unless they are properly sealed as per the Australian standard AS2476:2008.	The fumigation treatment phase (particularly the start of the treatment phase) is when the highest level of free cyanide within the fumigated structure.
Risk mitigation controls must be in place before the fumigation starts and remain in place until fumigation ends	
DO NOT commence treatment before the buffer zone controls are in place and operational.	To be effective these risk mitigating controls must be in place and operational before fumigation starts and must remain in place until fumigation ends.
DO NOT commence treatment before exposure monitoring has started.	
DO NOT remove the Buffer zone controls until ventilation is completed and the fumigation has been cleared.	
DO NOT stop exposure monitoring until ventilation is completed and the fumigation is cleared.	
Risk mitigation controls for the protection of food	
DO NOT use for grain, food, or other food commodity fumigation.	The product is not approved for these uses.
Risk mitigation controls for the prevention of fire	
DO NOT smoke while preparing the product for use, using the product or while within the buffer zone and fumigation area	Cyanide gas is flammable and explosive.
DO NOT use near heat sources, spark sources and naked flames.	

General instructions and important definitions	
Take precautionary measures against static discharge.	
Risk mitigation controls for the protection of the public during fumigation	
Cyanide fumigation, including placarding and signage, MUST comply with Australian standard AS2476-2008 General Fumigation Procedures and with relevant state and territory regulations.	This is a legal requirement.
Exposure of the general population must be limited in accordance with relevant state and territory standards.	This is a legal requirement.
DO NOT allow the public past the buffer zone perimeter during fumigation. Relevant placarding and signage stating "DANGER KEEP OUT, AREA UNDER FUMIGATION, DO NOT ENTER WITHOUT PERMISSION, DO NOT ENTER WITHOUT APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT" are required at all entry points around the buffer zone perimeter. This signage should also carry a skull and crossbones pictogram with date and time of the fumigation commencement, date and time the restrictions expire, fumigant product name and contact details (telephone number) for the fumigator. If the area cannot be physically secured, a watchman must be stationed to prevent people entering the risk area.	Members of the public are not appropriately trained, lack appropriate personal protective equipment and exposure monitoring equipment. All entrances to the fumigation area must be clearly placarded in accordance with local state/territory WHS requirements and regulations.
DO NOT fumigate within 30 metres of sensitive sites (hospitals, childcare centres, aged care facilities, custodial facilities, schools, playgrounds, camping sites and residential/domestic areas).	Because people in sensitive sites have reduced awareness regarding exposure, reduced ability to voluntarily control exposure and reduced capacity to avoid or escape from exposure an additional uncertainty factor of 3 was applied to the minimum buffer zone perimeter of 10 metres i.e., 3 × 10= 30 metres.

General instructions and important definitions	
DO NOT commence fumigation treatment if wind speeds are ≤7 km/h or if thermal inversion conditions are present or are likely to occur during the fumigation treatment.	Under such meteorological conditions cyanide may not adequately disperse into the atmosphere resulting in localised hot spots with unacceptably high concentrations or other unanticipated behaviour may occur.
DO NOT commence fumigation treatment if temperature at the site of pest activity to be fumigated is below 12°C.	
Additional risk mitigation controls for transportation workers	
DO Not fumigate on ships while any crew member remains aboard.	Ship compartments are not necessarily gas tight and it is impractical to evaluate all ship compartments before fumigation. Enclosed spaces in ships reduce the speed of escape.
DO NOT fumigate at any time while a ship is at sea. Fumigation MUST only occur in securely moored ships in port.	Fumigation of this nature cannot be well controlled while ships are underway.
DO NOT use on any vehicles, aircraft, empty containers, railcars, or other transportation vehicles that are in transit or likely to be in transit during fumigation.	Fumigation of this nature cannot be well controlled during transport.
Risk mitigation requirements for fumigation workers	
DO NOT apply before reading the full label, SDS and the user manual Work Instruction and Product Guide.	Required to use the product safely.
DO NOT apply by yourself. Always work at least in a group of two.	Basic safety requirement when working with hazardous materials.
DO NOT use this product unless trained in the proper use of required respirator, detection devices, emergency procedures and safe use and handling of the fumigant.	Basic safety requirement when working with hazardous materials.
DO NOT come into direct contact with liquid cyanide.	Liquid cyanide is readily absorbed through the skin and ocular mucous membranes.

General instructions and important definitions	
DO NOT enter the fumigation area after the start of treatment and until the fumigation is cleared	The fumigation area has the highest levels of cyanide.
DO NOT enter the buffer zone and fumigation area unless all wounds and skin abrasions are covered with a waterproof dressing.	Required to minimise the risk of dermal absorption.
DO NOT exceed Acute Exposure Guideline Level 1 (AEGL-1) exposure levels. Any worker whose cyanide exposure level equals or exceeds the AEGL-1 values MUST immediately leave the fumigation site and must not be occupationally re-exposed to cyanides for at least 24 hours. A respiratory protection factor of 0.1 MUST be used in estimating exposure as per the following example: Example Exposure Calculation A worker's personal exposure monitor indicated an exposure of 25 ppm over 10 minutes. The worker always wore a full facepiece respirator for the entire 10 minutes. The inhaled exposure would be 0.1 × 25= 2.5 ppm over 10 minutes. This is equal to the 10-minute AEGL-1. This worker must leave the fumigation site immediately and not be occupationally re-exposed to cyanides for at least 24 hours.	AEGLs represent threshold exposure limits (exposure levels below which adverse health effects are not likely to occur). AEGL-1 values are the airborne concentration of cyanide above which disabling effects that reduce the capacity to escape or evade exposure and more adverse effects may occur. With increasing airborne concentrations above each AEGL, there is a progressive increase in the likelihood of occurrence and the severity of effects. Sufficient recovery time must be allowed if exposures equal to, or above, the AEGL-1 level occur. Exposure below the AEGL-1 is not innocuous. Airborne concentrations below AEGL-1 represent exposure levels that can produce mild and progressively increasing but transient and nondisabling odour, taste, and sensory irritation or certain asymptomatic non-sensory adverse effects.
DO NOT exceed the occupational 8-hour time weighted average (TWA) Tolerable Exposure Level (TEL) for cyanide of 0.9 ppm. Any worker exposure equals or exceeds the occupational 8-hour TWA TEL MUST immediately leave the fumigation site and must not be occupationally re-exposed to cyanides for at least 24 hours.	The APVMA occupational 8-hour TWA TEL for cyanide is 0.9 ppm. If worker exposure is equal to, or above the occupational 8-hour TWA TEL, sufficient time must be provided for recovery.

	10-minute exposure	30-minute exposure	1-hour exposure	4-hour exposure
AEGL-1 (non-disabling)	2.5 ppm (2.8 mg/m^3)	2.5 ppm (2.8 mg/m^3)	2.0 ppm (2.2 mg/m^3)	1.3 ppm (1.4 mg/m^3)

General instructions and important definitions	
A respiratory protection factor of 0.1 MUST be used in estimating exposure as per the following example: Example Exposure Calculation A worker's personal exposure monitor indicated an exposure of 8 ppm over an 8-hour day. The worker always wore a full facepiece respirator over an 8-hour workday. The inhaled exposure would be 0.1 × 8= 0.8 ppm over 8 hours. This is equal to the occupational 8-hour TWA TEL. This worker must leave the fumigation site immediately and not be occupationally re-exposed to cyanides for at least 24 hours.	
DO NOT allow direct of exposure of the skin and ocular mucous membranes to cyanide concentrations ≥4.7 ppm for more than 15 minutes.	The 15-minute dermal STEL for cyanide is 4.7 ppm.
Additional risk mitigation requirements for fumigation workers in the buffer zone during fumigation	
DO NOT fumigate unless a calibrated downwind buffer zone perimeter monitor is used. The buffer zone perimeter monitor MUST be capable of: • an audible alarm that must be set for cyanide levels at 0.45, 0.9, 4.7 and 45 ppm • short-term exposure level (STEL) measurements • measuring an 8-hour time weighted average (TWA) exposure level of 0.9 ppm	Continuous monitoring is required to set the flexible buffer zone perimeter radius. The downwind position is the point on the buffer zone perimeter where the highest cyanide levels are likely to occur. APVMA is proposing to set an occupational action level (OAL-1) of 0.45 ppm. When cyanide levels within the buffer zone are ≥ 0.45 ppm fumigation workers within the buffer zone must wear full PPE (wear protective clothing (chemical resistant) fastened to the neck, elbow length chemical resistant gloves, impervious footwear (non-sparking) and full facepiece respirator with canister specified for hydrogen cyanide (or where levels are above the OAL-2 of 45 ppm) a supplied air (air-hose, air-line or SCBA) respirator in positive pressor mode). The buffer zone perimeter monitor must be capable of measuring at ≤0.45 ppm to implement the OAL. The meter must be capable of measuring to at least 0.9 ppm since this is the occupational 8-hour TWA TEL for cyanide and controls are set around this value. The meter must also be capable of measuring to at least 45 ppm (the OAL-2) since workers must change over from a full-face respirator to an supplied air (air-hose, air-line or SCBA) respirator in positive pressure mode if cyanide levels equal or exceed 45 ppm; or if cyanide levels equal or exceed 45 ppm and a supplied air (air-hose, air-

General instructions and important definitions	
	line or SCBA) respirator capable of positive pressure mode is not available, workers must leave the buffer zone. 4.7 ppm is the 15-minute STEL for cyanide. Appropriate audible alarms must be available to alert workers when respiratory protection and other PPE is needed.
DO NOT fumigate without a minimum starting buffer zone perimeter radius of 10 metres from the application site. If cyanide levels at the downwind buffer zone perimeter monitor levels are greater than or equal to 0.9 ppm the buffer zone radius MUST increase at 1-metre intervals until the cyanide level is less than 0.9 ppm. There is no maximum buffer zone radius or size.	Based on evaluation of the submitted data and modelling and its associated uncertainty, a 10-metre starting buffer zone perimeter radius is protective of workers within the buffer zone perimeter and the public outside of the buffer zone. a buffer zone increment of 1 metre is considered practical given the likely use pattern.
DO NOT allow fumigation workers into the buffer zone without a calibrated personal exposure monitor that is always carried on their person. The personal exposure monitor must be capable of: • an audible alarm must be set for cyanide levels at 0.45, 0.9, 4.7 and 45 ppm • short-term exposure level (STEL) measurements • measuring an 8-hour time weighted average (TWA) exposure level of 0.9 ppm.	APVMA is proposing to set an occupational action level (OAL-1) of 0.45 ppm. When cyanide levels within the buffer zone are ≥0.45 ppm fumigation workers within the buffer zone must wear full PPE (wear protective clothing (chemical resistant) fastened to the neck, elbow length chemical resistant gloves, impervious footwear (non-sparking) and full facepiece respirator with canister specified for hydrogen cyanide (or where levels are above the OAL-2 of 45 ppm, a supplied air (air-hose, air-line or SCBA) respirator in positive pressure mode). The personal monitors must be capable of measuring at ≤0.45 ppm to implement the OAL. The personal monitors must be capable of measuring to at least 0.9 ppm since this is the occupational 8-hour TWA TEL for cyanide and controls are set around this value. The personal monitors must also be capable of measuring to at least 45 ppm (the OAL-2) since workers must change over from a full-face supplied air (air-hose, air-line or SCBA) respirator in positive pressure mode if cyanide levels equal or exceed 45 ppm; or if cyanide levels equal or exceed 45 ppm and a supplied air (air-hose, air-line or SCBA) respirator capable of positive pressure mode is not available, workers must leave the buffer zone. 4.7 ppm is the 15-minute STEL for cyanide.

General instructions and important definitions	
	Appropriate audible alarms must be available to alert workers when respiratory protection and other PPE is needed.
DO NOT allow fumigation workers into the buffer zone without a full-face respirator with canister specified for hydrogen cyanide that is always carried on their person. If cyanide levels within the buffer zone are greater than or equal to 0.45 ppm all workers MUST wear a full facepiece respirator with canister specified for hydrogen cyanide. If cyanide levels within the buffer zone are greater than or equal to 45 ppm all workers MUST wear a supplied air (air hose, air line or SCBA) respirator. If cyanide levels within the buffer zone are greater than or equal to 45 ppm all workers without access to a supplied air (air hose, air line or SCBA) respirator must leave the buffer zone as quickly as possible and must not re-enter the buffer zone without appropriate personal protective equipment.	These instructions are necessary to implement OAL-1 and OAL-2 values.
DO NOT enter enclosed spaces or low-lying areas within the buffer zone without checking that cyanide levels are less than 0.45 ppm, and a breathable atmosphere is present.	Unexpectedly high cyanide levels may be encountered within such spaces. Checking for a breathable atmosphere before entering enclosed spaces is a standard worker safety requirement.
Risk mitigation for ventilation phase and re-entry to treated sites	
DO NOT re-enter the treatment site or rehandle treated material until the fumigation is cleared. The fumigation cannot be cleared until the ventilation phase ends. The ventilation phase ends when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations) below 0.9 ppm.	The purpose of this instruction is to minimise exposure to cyanide.
DO NOT permit the re-occupancy of buildings and structures until the level of cyanide is below 0.45 ppm.	This assumes that the product will not be used in buildings, structures, and facilities where people reside (e.g., houses, nursing homes etc.) and is based on the OAL-1 value.

Environmental assessment

Fate and behaviour in the environment

Hydrogen cyanide is a ubiquitous substance in the environment as a result of natural biological and volcanic processes, and industrial activities. Following its proposed use as a fumigant in enclosed spaces, hydrogen cyanide will be released to the environment as a gas and is expected to remain in the air due to its physicochemical properties.

Although hydrogen cyanide has the potential to be transported long distances due to its long half-life in air (DT_{50} 1 to 3 years), its use as a fumigant is not expected to increase background concentrations resulting from natural processes or other anthropogenic sources.

Effects and associated risks to non-target species

Terrestrial species

Hydrogen cyanide is very toxic to mammals by inhalation exposure (5-min LC_{50} 493 mg ac/m^3, 30 min LC_{50} 173 mg ac/m^3, 60-min LC_{50} 158 mg ac/m^3, *Rattus norvegicus*). It is similarly expected to be toxic to other terrestrial vertebrates such as birds and reptiles. Therefore, a protection statement is advised to identify the hazard.

As the proposed uses are limited to well-sealed empty structures and transportation facilities, any possible exposure of terrestrial vertebrates to hydrogen cyanide is expected to be limited to release into the air during ventilation. The proposed label states that ventilation should not be started until the concentration of hydrogen cyanide inside the sealed fumigated structures has declined to 1 g/m^3. At this concentration, hydrogen cyanide can cause inhalational toxicity to terrestrial vertebrates if present in the immediate vicinity of the treated premises during ventilation, even for short periods. Therefore, it is advised that ventilation should not occur until any non-target animals are cleared from the immediate area.

Following ventilation, the concentration of hydrogen cyanide in the air for very large structures (100,000 m^3) was predicted to reach only 0.14 to 1.1 mg a.c./m^3, assuming a worst-case scenario and ventilation over 6 to 48 hours. As a result, it is expected that hydrogen cyanide released from fumigation uses would not reach levels in air that would be harmful to terrestrial vertebrates in the area surrounding the fumigated structures.

Based on rapid dissipation of hydrogen cyanide in the air with negligible deposition, exposure of other terrestrial species (bees, other non-target arthropods, soil organisms, terrestrial plants) following ventilation is considered to be negligible.

Aquatic species

Hydrogen cyanide has high toxicity to fish (lowest LC_{50} 0.042 mg a.c./L, *Oncorhynchus mykiss*), aquatic invertebrates (lowest EC_{50} 0.013 mg a.c./L, *Chironomus riparius*), and algae (ErC_{50} 0.12 mg a.c./L, *Scenedesmus subspicatus*). For most species of fish, juveniles are the most sensitive life stage. Based on

the high toxicity of hydrogen cyanide to aquatic species, a label protection statement is advised to identify the hazard.

Based on rapid dissipation of hydrogen cyanide in the air with negligible deposition, exposure of the aquatic compartment to hydrogen cyanide following ventilation is considered to be negligible.

Recommendations

In considering the environmental safety of the proposed uses of Bluefume Fumigant and Bluefume-D Fumigant, the APVMA had regard to the toxicity of the active constituent in relation to relevant organisms and ecosystems.

Based on the available information and the inclusion of the following protection and disposal statements on the product labels, the APVMA can be satisfied the proposed uses of the products are unlikely to have an unintended effect that is harmful to animals, plants or things, or to the environment.

Protection and disposal statements

Protection of wildlife, fish, crustaceans and environment – Bluefume and Bluefume-D fumigants

Very toxic to wildlife. DO NOT ventilate until any non-target animals are cleared from the immediate area.

Very toxic to aquatic life. DO NOT contaminate streams, rivers or watercourses with the chemical or used containers.

Disposal – Bluefume Fumigant

Empty contents fully into application equipment. When empty, close all valves and return to the point of supply for refill or storage.

Disposal – Bluefume-D Fumigant

Empty cans and swept up wood pulp discs shall be placed into a suitable waste container stored in a secure, well-ventilated place and disposed in landfill after confirming there is zero hydrogen cyanide concentration by an approved HCN detector.

Efficacy assessment

Proposed product use pattern – Bluefume Fumigant and Bluefume-D Fumigant

Bluefume Fumigant contains the active ingredient hydrogen cyanide at a concentration of 976 g/kg and is proposed to be applied as an indoor fumigant for use in empty, sealed structures such as warehouses, poultry facilities, quarantine and transportation facilities, silos and ship holds, for the control of stored product insect pests, mites, and rodents. Bluefume is a liquid vaporizer which is supplied in pressurised cylinders and is applied from outside the structure by a certified fumigator via a distribution system using only approved equipment.

Bluefume-D Fumigant also contains the active ingredient hydrogen cyanide at a concentration of 976 g/kg and is proposed to be applied as an indoor fumigant for use in empty, sealed structures such as warehouses, poultry facilities, quarantine and transportation facilities, silos and ship holds, for the control of stored product insect pests, mites, and rodents.

Bluefume-D Fumigant is a liquid vaporizer product consisting of wood pulp discs impregnated with HCN and distributed manually in empty structures by a certified fumigator only. The discs are supplied in gas-tight lacquered and tinplated steel cans, which are opened inside the structure to be treated. Once the can is opened with a Draslovka-approved can opener only, volatile HCN is slowly released from the discs as a function of the ambient temperature.

These products are intended to replace methyl bromide, which is subject to restrictions under the Montreal Protocol on substances that deplete the ozone layer.

Efficacy – Bluefume Fumigant and Bluefume-D Fumigant

Overseas field and laboratory trials were completed by a registered fumigation company to demonstrate efficacy of HCN on a range of stored product insect pests and rodents, and to establish exposure times. Trials comparing HCN release from substrates vs direct application at different ambient temperatures were also submitted to demonstrate that the release and dissipation of HCN from the wood pulp discs in the Bluefume-D Fumigant is equivalent to the release and dissipation of HCN from the Bluefume D Fumigant from pressurised steel cylinders. Therefore, the efficacy data presented in support of Bluefume Fumigant can also be relied on in support of the efficacy of Bluefume-D Fumigant.

The data provided were considered in conjunction with the proposed label to determine whether the use of Bluefume Fumigant as proposed controls stored product insect pests, mites, and rodents effectively. The proposed label states Bluefume should be applied at 10 g HCN/m^3 for 24 hours in empty structures, and at 2 to 4 g HCN/m^3 for 2 to 4 hrs in aircraft at temperatures 4°C or above in aircraft. For all proposed uses, ventilation should last 24 hours, or until HCN concentration reaches <1 mg/m^3 (0.9 ppm).

Insects

Laboratory and field trials were undertaken on ten species of insects: saw-toothed grain beetles *(Oryzaephilus surinamensis)*, German cockroaches *(Blattella germanica L.)*, Mediterranean flour moths

(Ephestia kuehniella), Indian meal moths *(Plodia interpunctella)*, red flour beetles *(Tribolium castaneum)*, confused flour beetles *(Tribolium confusum)*, flour mites *(Acarus siro)*, storage mites *(Lepidoglyphus destructor)*, cheese/mould mites *(Tyrophagus putrescentiae)* and poultry red mites *(Dermanyssus gallinae Deg.)*. Field trials in the house mouse *(Mus Musculus)* and the brown rat *(Rattus norvegicus)* were also completed. In the laboratory trials, HCN was applied at 1.1 g HCN/m^3 with temperatures ranging from 19 to 24°C and in the field trials, at 10 g HCN/m^3 with temperatures ranging from 14.8 to 24°C and relative humidity 48 to 91.3%.

In both the laboratory and field tests, there was 100% mortality of saw-toothed grain beetles at every developmental stage when exposed to HCN for up to 180 minutes in the laboratory trial, and for 24 hours in the field trial. In the field trial, there were zero hatched larvae from exposed eggs. Temperatures in the field trial were between 14.8 to 20.3°C with relative humidity between 48.0 to 89.1%.

For German cockroaches, there was 100% mortality of all tested developmental stages in both the laboratory and field trials when the insects were exposed to HCN for up to 75 minutes in the lab trial, and for 24 hours in the field trials. In the field trials, temperatures ranged from 14.8 to 20.3°C and relative humidity ranged from 48.0 to 89.1%.

In both the Mediterranean flour moth and Indian meal moth trials, there was 100% mortality at every developmental stage after 180 minutes of exposure in the lab trial, and after 24 hours exposure in the field trial. In the buildings fumigated in the field trials, temperatures ranged between 14.8 to 20.3°C with relative humidity ranging from 48.0 to 89.1%.

In the red flour beetle trial, there was also 100% mortality at all developmental stages after 300 minutes of exposure in the laboratory trial, and after 24 hours exposure in the field. There were zero hatched larvae from exposed eggs in both the laboratory and field trials. In the field, temperatures ranged from 14.8 to 20.3°C with relative humidity from 48.0 to 89.1% depending on the floor of the building.

In the confused flour beetle trial, there was 100% mortality at all developmental stages in both the laboratory (after 240 minutes exposure) and field trials (24 hours exposure) including zero hatched eggs in the field trial. In the field, temperatures varied between 14.8 to 20.3°C with relative humidity between 48.0 to 89.1%.

In the flour and storage mite trials, there was 100% mortality for all stages of development after 720 minutes exposure in the lab trials, and after 24-hour exposure in the field trials. Zero hatched eggs from both flour and storage mites were reported in the field. Temperatures and humidity in the buildings ranged from 18.1 to 19.4°C and 65.7 to 73.0%.

In the cheese/mould mite trials, there was 100 % mortality for all developmental stages, including zero hatched nymphs from exposed eggs in both laboratory and field trials. In the laboratory, insects were exposed to HCN for up to 720 minutes, and 24 hours in the field trial. In the field, temperatures ranged from 18.1 to 19.4°C with relative humidity from 65.7 to 73.0%.

Lastly, in the poultry red mite trials, there was 100% mortality in both laboratory (after 30 minutes exposure) and field (after 22 to 24 hours exposure) trials for all developmental stages. In the first field trial, temperatures ranged from 19.3 to 24°C with relative humidity between 72.2 to 91.3% whereas in the other trials, temperatures ranged from 6.2 to 21.8°C and relative humidity 48.9 to 98.2%. Other than the three poultry red mite trials, temperature conditions in the trials were as per label recommendations which states

not to apply Bluefume Fumigant or Bluefume-D Fumigant if temperature at the site of pest activity to be fumigated is below 12°C.

Bluefume Fumigant and Bluefume-D Fumigant are effective in controlling cockroaches, beetles, moths, and mites when applied at the proposed label rate and at the proposed exposure period. Considering clear efficacy of HCN was demonstrated against significant stored product pests – including three species of beetles, two species of moths, four species of mites, and German cockroaches – it is reasonable to expect Bluefume Fumigant and Bluefume-D Fumigant will be equally effective at controlling other stored product insect pests such as weevils and borers (as proposed on the product label).

Rodents

In support of the control claim for rodents, the applicant submitted trials targeting house mice and brown rats. In the house mice trial, efficacy was demonstrated in a 5032 m^3 poultry house with 81 mice found dead after treatment at 10 g/m^3 following a 24-hour exposure period at 8.1 to 16.5°C with relative humidity between 74.9 to 98.2%. No surviving mice were reported at the end of the treatment.

In the brown rat trial, a 12-storey building of area 7319 m^3 was treated at 10 g/m^3 following a 24-hour exposure period at 8.4 to 10.9°C with relative humidity from 66-100%. No surviving rats were reported at the end of the treatment.

The temperatures reported in these trials were below the minimum temperature stated on the label 12°C. However, fumigation at lower temperatures is generally regarded as a greater challenge to efficacy. Therefore, these trials can be considered supportive of efficacy when applied at 10 g/m^3 for 24 hours to well-sealed, empty structures, poultry sheds, pet food facilities, and transportation facilities including ship holds.

The product label also includes claims for control of rodents at 2 to 4 g/m^3 for 2 to 4 hrs in aircraft at temperatures 4°C or above. This fumigation rate is lower than that used in the submitted trials and equates to a Concentration over Time (CT) value of 4 to 16 gh/m^3.

The CT value of 4 gh/m3 is higher than rates known to achieve lethality in laboratory studies, which report:

Mortality in brown rats after inhalation exposure at 1.34 g/m^3 for 1 minute (CT= 0.022 gh/m^3); and

Mortality in mice after inhalation exposure at 0.166 g/m^3 for 5 minutes (CT= 0.027 gh/m^3).

In comparison, the CT value of the minimum proposed label rate for control of rodents in aircraft (CT= 4 gh/m^3), representing a CT value approximately 148 times higher than the concentration known to achieve lethality of rodents in the laboratory so it is reasonable to assume that the rate will be efficacious under the proposed directions for use.

Further support for this rate in aircraft can be found from the extensive history of use of HCN at this application rate (or lower), treatment time and temperature range since the early 1900s. This application rate is currently approved for control of rodents in more challenging fumigation situations, such as empty warehouses and ship holds where an airtight seal is not necessarily guaranteed, in other countries such as New Zealand and Malaysia. The Food and Agricultural Organisation (FAO) stipulates treatment at 2 to 4 g/m^3 for 2 hrs in ship holds at temperatures 4°C or above.

Efficacy against rodents at the proposed rates of 2 to 4 g/m^3 for 2 to 4 hrs in aircraft at temperatures 4°C or above is therefore supported on the basis of:

- trial data confirming lethality in rodents at 10 g/m^3 in larger structures without airtight seals for 24 hours
- laboratory data confirming lethality in rodents following direct inhalation exposure for shorter durations at far lower concentrations
- a successful history of use at the same rate in similar situations overseas.

Rate of increase in HCN concentration between different types of applications at different ambient temperatures

A laboratory trial compared the release of HCN from 6.8 and 6.7 g of impregnated cardboard reels at 12 and 15°C respectively. At both temperatures, HCN concentration of 10 g/m^3 was achieved within sixty minutes. Therefore, temperatures at the lower end of the temperature range proposed on the product label do not have a significant effect on the rate of dissipation of HCN released from cardboard.

At 19°C, when 12.22 g HCN was directly injected into a fumigation chamber, a concentration of 20 g/m^3 was reached after only ten minutes and vapour was evenly distributed throughout the chamber. The concentration remained consistent for 28 minutes. When glass wool blocks and hardboard discs were soaked in HCN and placed in the chamber, there was a delay before the concentration reached 20 g/m^3. With 12.20 g HCN-soaked glass wool blocks, concentration increased for 70 minutes before reaching 20 g/m^3, and this level was maintained for 30 minutes. When 12.25 g HCN soaked hardboard-discs were placed in the fumigation chamber, the 20 g/ m3 level was reached after 120 minutes but was maintained for 180 minutes.

At 25°C, when 12.25 g HCN (~ 20g/m^3) was applied to hardboard, HCN release was slow (20 g/m^3 after more than 180 minutes), but slightly faster than at 19 °C and HCN completely released after only 60 to 70 minutes. The results from these trial reports indicate that Hydrogen cyanide release from inert porous materials is slower than release in liquid form from a pressurised cylinder, with a consistent high concentration maintained for longer after complete release. The results of these trials demonstrate that the rates of HCN can reasonably be expected to reach the target application rates for HCN packaged in pressurised steel cylinders (Bluefume Fumigant) or in woodpulp discs within a can (Bluefume-D Fumigant).

Overall, the efficacy trials show HCN is distributed sufficiently throughout the fumigated structures proposed on the product label resulting in 100% control of all insects and rodents.

Resistance management

Hydrogen cyanide is a member of the mitochondrial complex IV electron transport inhibitors mode of action group (24B) of insecticides as designated by the Insecticide Resistance Action Committee (IRAC). The product label includes the following resistance management statement:

For insecticide resistance management Bluefume Fumigant and Bluefume-D Fumigant are a Group 24B insecticide.

Some naturally occurring insect biotypes resistant to Bluefume Fumigant, Bluefume-D Fumigant and other Group 24B insecticides may exist through normal genetic variability in any insect population. The resistant individuals can eventually dominate the insect population if Bluefume Fumigant and Bluefume-D Fumigant or other Group 24B insecticides are used repeatedly. The effectiveness of Bluefume Fumigant and Bluefume-D Fumigant on resistant individuals could be significantly reduced. Since occurrence of resistant individuals is difficult to detect prior to use, Draslovka Services Pty Ltd. Accepts no liability for any losses that may result from the failure of Bluefume Fumigant or Bluefume-D Fumigant to control resistant insects.

Bluefume Fumigant and Bluefume-D Fumigant may be subject to specific resistance management strategies. For further information contact your local supplier, Draslovka Services Pty Ltd representative or local agricultural department agronomist.

Recommendations – Bluefume Fumigant and Bluefume-D Fumigant

Based on the submitted trial data, Bluefume Fumigant and Bluefume-D Fumigant are expected to be effective when applied at 10 g HCN/m^3 in enclosed structures for the control of stored product insect pests, mites, and rodents for an exposure period of 24 hours and at 2 to 4 g HCN /m^3 for 2 to 4 hours at temperatures above 4°C for the control of rodents in aircrafts, if used according to label instructions.

Labelling requirements – Bluefume Fumigant

Company Name: Draslovka Services Pty Ltd

Product Name: Bluefume Fumigant

APVMA approval no: 90646/129668

Table 8: Labelling requirements – Bluefume Fumigant

Label name	Bluefume Fumigant
Signal headings	DANGEROUS POISON KEEP OUT OF REACH OF CHILOREN FIRE & EXPLOSION HAZARD READ SAFETY DIRECTIONS BEFORE OPENING OR USING
Constituent statements	976 g/kg hydrogen cyanide
Mode of action:	Group 24B Insecticide
Statement of claims	For use by professionally licensed and authorised fumigators as an indoor fumigant for empty structures against beetles, weevils, moths, mites, cockroaches and rodents.
Net contents	250 g to 30 kg
Other limitations	
Withholding periods	
Trade advice	
Resistance warning	For insecticide resistance management Bluefume™ Fumigant is a Group 24B insecticide. Some naturally occurring insect biotypes resistant to Bluefume™ Fumigant and other Group 24B insecticides may exist through normal genetic variability in any insect population. The resistant individuals can eventually dominate the insect population if Bluefume™ Fumigant or other Group 24B insecticides are used repeatedly. The effectiveness of Bluefume™ Fumigant on resistant individuals could be significantly reduced. Since occurrence of resistant individuals is difficult to detect prior to use, Draslovka Services Pty Ltd. accepts no liability for any losses that may result from the failure of Bluefume™ Fumigant to control resistant insects. Bluefume™ Fumigant may be subject to specific resistance management strategies. For further information contact your local supplier, Draslovka Services Pty Ltd representative or local agricultural department agronomist.
Precautions	Refer to *Restraints* and *General instructions* for further directions.
Protections	Protection of wildlife, fish, crustaceans and the environment:

	• Very toxic to wildlife. DO NOT ventilate until any non-target animals are cleared from the immediate area. • Very toxic to aquatic life. DO NOT contaminate streams, rivers or watercourses with the chemical or used containers • Avoid release to environment except for as required for ventilation of fumigation space.
Storage and disposal	Store cylinders upright in a locked room or place away from children, animals, food, feedstuffs, seeds and fertilisers. Store cylinders in the closed, original container in a cool, well-ventilated area. Do not store for prolonged periods in direct sunlight. Cylinders remain the property of The Draslovka Group. Empty contents fully into application equipment. When empty, close all valves and return to the point of supply for refill or storage.
Safety directions	Very dangerous. Can kill if inhaled. Poisonous if swallowed or absorbed by skin. Will irritate the eyes, nose and throat and skin. Avoid contact with eyes and skin. Do not inhale vapour. When using the product and preparing the product for use and when uncovering the treated area/material, wear protective clothing (chemical resistant) fastened to the neck and wrist, elbow-length chemical resistant gloves, impervious footwear (non-sparking), and (or where levels are at or above 0.45 ppm) a full facepiece respirator with canister specified for hydrogen cyanide, and (or where levels are at or above 45 ppm) a supplied air respirator. Detailed instructions for safe use appear in state/territory regulation. Thoroughly ventilate treated areas before reoccupying. After each day's use, wash gloves, respirator, and contaminated clothing.
First aid instructions	If poisoning occurs, immediately contact a doctor or Poisons Information Centre. Phone Australia 1311 26. In the event of cyanide poisoning, time is of the essence. Immediately call triple zero (000) as you provide first aid assistance to the victim. Only give first aid if no suspected cyanide is present in the immediate environment If the harmful chemical is suspected, do not enter the area unless wearing protective equipment Once the area is safe, do the following steps: • Remove the casualty from the area if cyanide exposure is continuous. When possible, arrange for another isolation area. • Remove the contaminated clothing and clean the skin thoroughly with water. • Ensure an open airway but avoid using mouth-to-mouth resuscitation techniques due to the risk of contamination. Administer medical oxygen at the maximum rate, preferably via a CPR resuscitation mask. • Administering high flow oxygen can also be helpful, but this is normally only an option for trained medical professional. The above first aid steps apply to all cases of cyanide poisoning. Treat the victim depending on the mode of cyanide exposure – whether through inhalation, ingestion, and absorption through the skin. In addition, the following precautions should apply: • For eye contact, quickly rinse the eye with clean water for at least ten minutes, then treat it as above. • For ingestion, treat the cyanide poisoning as above and avoid giving anything by mouth.

	• Do not give direct mouth-to-mouth resuscitation if swallowed. To protect rescuer, use air-viva, oxy-viva or one-way mask. Resuscitate in a well-ventilated area.
First aid warnings:	May be fatal if inhaled, swallowed or absorbed through skin. May cause fire or explosions. Keep away from heat, sparks and naked flames.

Restraints

Refer to *Precautions* and *General instructions* for further directions.

DO NOT apply Bluefume Fumigant unless with Draslovka Services Pty Ltd approved equipment.

DO NOT connect cylinders to introduction equipment until all fumigation warning signs have been posted and the space to be fumigated is cleared of people, non-target animals, and secured.

DO NOT leave structure unattended. If the area cannot be physically secured, a watchman must be stationed to prevent people entering the risk area.

DO NOT introduce stored commodities to the fumigation enclosure or remove the hermetically sealed inside impervious bags or similar wrappings unless the ventilation process is complete, and the hydrogen cyanide concentration is less than 0.45 ppm.

Maximum treatment rate

DO NOT exceed the maximum application rate of 10 g/m^3.

Adequate sealing is required before fumigation starts

DO NOT apply Bluefume™ Fumigant into areas to be treated unless they are properly sealed as per the Australian standard AS2476:2008.

Risk mitigation controls must be in place before the fumigation starts and remain in place until fumigation ends

DO NOT commence treatment before the buffer zone controls are in place and operational.

DO NOT commence treatment before exposure monitoring has started.

DO NOT remove the buffer zone controls until ventilation is completed and the fumigation has been cleared.

DO NOT stop exposure monitoring until ventilation completed and the fumigation is cleared.

Risk mitigation controls for the protection of food

DO NOT use for grain, food, or other food commodity fumigation.

DO NOT use unless all commodities are removed from the fumigation site or hermetically sealed inside impervious bags or similar wrappings as per the Australian standard AS2476:2008.

Risk mitigation controls for the prevention of fire

DO NOT smoke while preparing the product for use, using the product or while within the buffer zone and fumigation area.

DO NOT use near heat sources, spark sources and naked flames.

Take precautionary measures against static discharge.

Risk mitigation controls for the protections of the public during fumigation

Cyanide fumigation, including placarding and signage, MUST comply with Australian Standard AS2476-2008 General Fumigation Procedures and with relevant state and territory regulations.

Exposure of the general population must be limited in accordance with relevant state and territory standards.

DO NOT allow the public past the buffer zone perimeter during fumigation. Relevant placarding and signage stating:

'DANGER KEEP OUT, AREA UNDER FUMIGATION, DO NOT ENTER WITHOUT PERMISSION, DO NOT ENTER WITHOUT APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT" are required at all entry points around the buffer zone perimeter.

This signage should also carry a skull and crossbones pictogram with date and time of the fumigation commencement, date and time the restrictions expire, fumigant product name and contact details (telephone number) for the fumigator.

If the area cannot be physically secured, a watchman must be stationed to prevent people entering the risk area.

DO NOT fumigate within 30 metres of sensitive sites (hospitals, childcare centres, aged care facilities, custodial facilities, schools, playgrounds, camping sites and residential/domestic areas).

DO NOT commence fumigation treatment if wind speeds are ≤7 km/h or if thermal inversion conditions are present or are likely to occur during the fumigation treatment.

DO NOT commence fumigation treatment if temperature at the site of pest activity to be fumigated is below 12°C (except for aircraft in accordance with directions on the product label).

Additional risk mitigation controls for transportation workers

DO NOT fumigate on ships while any crew member remains aboard.

DO NOT fumigate at any time while a ship is at sea. Fumigation MUST only occur in securely moored ships in port.

DO NOT use on any vehicles, aircraft, empty containers, railcars, or other transportation vehicles that are in transit or likely to be in transit during fumigation or ventilation.

Risk mitigation requirements for fumigation workers

DO NOT apply before reading the full label, SDS and the user manual Work Instruction and Product Guide.

DO NOT apply by yourself. Always work at least in a group of two.

DO NOT use this product unless trained in the proper use of required respirator, detection devices, emergency procedures and safe use and handling of the fumigant.

DO NOT come into direct contact with liquid cyanide.

DO NOT enter the fumigation area after the start of treatment and until the fumigation is cleared.

DO NOT enter the buffer zone and fumigation area unless all wounds and skin abrasions are covered with a waterproof dressing.

DO NOT exceed Acute Exposure Guideline Level 1 (AEGL-1) exposure levels. Any worker whose cyanide exposure level equals or exceeds the AEGL-1 values MUST immediately leave the fumigation site and must not be occupationally re-exposed to cyanides for at least 24 hours.

	10-minute exposure	30-minute exposure	1-hour exposure	4-hour exposure
AEGL-1 (non-disabling)	2.5 ppm (2.8 mg/m^3)	2.5 ppm (2.8 mg/m^3)	2.0 ppm (2.2 mg/m^3)	1.3 ppm (1.4 mg/m^3)

A respiratory protection factor of 0.1 MUST be used in estimating exposure as per the following example:

Example exposure calculation 1

A worker's personal exposure monitor indicated an exposure of 25 ppm over 10 minutes. The worker always wore a full facepiece respirator for the entire 10 minutes. The inhaled exposure would be 0.1 × 25= 2.5 ppm over 10 minutes. This is equal to the 10-minute AEGL-1. This worker must leave the fumigation site immediately and not be occupationally re-exposed to cyanides for at least 24 hours.

DO NOT exceed the occupational 8-hour time weighted average (TWA) Tolerable Exposure Level (TEL) for cyanide of 0.9 ppm. Any worker exposure equals or exceeds the occupational 8-hour TWA TEL MUST immediately leave the fumigation site and must not be occupationally re-exposed to cyanides for at least 24 hours.

A respiratory protection factor of 0.1 MUST be used in estimating exposure as per the following example:

Example exposure calculation 2

A worker's personal exposure monitor indicated an exposure of 8 ppm over an 8-hour day. The worker always wore a lull facepiece respirator over an 8-hour workday. The inhaled exposure would be 0.1 × 8= 0.8 ppm over 8 hours. This is equal to the occupational 8-hour TWA TEL This worker must leave the fumigation site immediately and not be occupationally re-exposed to cyanides for at least 24 hours.

DO NOT allow direct of exposure of the skin and ocular mucous membranes to cyanide concentrations ≥4.7 ppm for more than 15 minutes.

Any worker exposure equals or exceeds the dermal 15-minute STEL of 4.7 ppm MUST immediately leave the fumigation site and must not be occupationally re-exposed to cyanides for at least 24 hours.

Additional risk mitigation requirements for fumigation workers in the buffer zone during fumigation

DO NOT fumigate unless a calibrated downwind buffer zone perimeter monitor is used.

The buffer zone perimeter monitor MUST be capable of:

- an audible alarm that must be set for cyanide levels at 0.45, 0.9, 4.7 and 45 ppm
- short-term exposure level (STEL) measurements
- measuring an 8-hour time weighted average (TWA) exposure level of 0.9 ppm.

DO NOT fumigate without a minimum starting buffer zone perimeter radius of 10 metres from the application site.

If cyanide levels at the downwind buffer zone perimeter monitor levels are greater than or equal to 0.9 ppm the buffer zone radius MUST increase at 1-metre intervals until the cyanide level is less than 0.9 ppm.

There is no maximum buffer zone radius or size.

DO NOT allow fumigation workers into the buffer zone without a calibrated personal exposure monitor that is always carried on their person.

The personal exposure monitor must be capable of:

- an audible alarm must be set for cyanide levels at 0.45, 0.9, 4.7 and 45 ppm,
- short term exposure level (STEL) measurements
- measuring an 8-hour time weighted average (TWA) exposure level of 0.9 ppm.

DO NOT allow fumigation workers into the buffer zone without a full-face respirator with canister specified for hydrogen cyanide that is always carried on their person.

If cyanide levels within the buffer zone are greater than or equal to 0.45 ppm all workers MUST wear a full facepiece respirator with canister specified for hydrogen cyanide.

If cyanide levels within the buffer zone are greater than or equal to 45 ppm all workers MUST wear a supplied air (air hose, air line or SCBA) respirator.

If cyanide levels within the buffer zone are greater than or equal to 45 ppm all workers without access to a supplied air (air hose, air line or SCBA) respirator must leave the buffer zone as quickly as possible and MUST not re-enter the buffer zone without appropriate personal protective equipment.

DO NOT enter enclosed spaces or low-lying areas within the buffer zone without checking that cyanide levels are less than 0.45 ppm and a breathable atmosphere is present

Risk mitigation for ventilation phase and re-entry to treated sites

DO NOT commence ventilation until the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations inside the treatment area) below 900 ppm.

DO NOT re-enter the treatment site or rehandle treated material until the fumigation is cleared. The fumigation cannot be cleared until the ventilation phase ends. The ventilation phase ends when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations) below 900 ppm.

DO NOT permit the re-occupancy of buildings and structures until the level of cyanide is below 0.45 ppm.

Directions for use

Table 9: Directions for use – Bluefume Fumigant

Situation	Pest	Application rate	Critical comments
Well-sealed empty structure such as fumigation structures, mills, silos, seed storage facilities and food factories Well-sealed empty warehouses, elevators, store structures, sheds and enclosures Well-sealed poultry sheds, pet food facilities Transportation facilities such as stationary railway trucks and buses, empty ship holds	Storage insect pests, mites and rodents	10 g hydrogen cyanide/m^3 for 24 hours	Fumigate using good fumigation practice in accordance with the Australian Fumigation Standard AS2476:2008 and state regulations. Fumigation may be performed only where there is no unacceptable risk to people, animals and the environment The BLUEFUME™ Fumigant Work Instruction and Product Guide contains important information for the safe and effective use of this product. This manual must be followed and must be in the user's possession during fumigation. Cylinder preparation: BLUEFUME Fumigant cylinders are connected with tubing to a cylinder containing an inert gas. That acts as a propellant for transmitting BLUEFUME Fumigant into the tubing or pipes distributing the fumigant into the structure. Fumigation time: 24 hrs minimum Ventilation: Ventilation must start only after the internal concentration of hydrogen cyanide reaches 1 g/m^3 (900 ppm) or less. Ventilation must be done slowly and gradually with careful monitoring of the hydrogen cyanide concentration within the buffer zone. Ventilation time is 24 hours or until the hydrogen cyanide level reaches less

Situation	Pest	Application rate	Critical comments
			than 1 mg/m^3 (0.9 ppm). The length of ventilation period may be significantly affected by weather conditions (temperature, wind speed end direction). presence of local exhaust ventilation (LEV).
Aircraft fumigation	Rodents	2 to 4 g hydrogen cyanide /m^3 tor 2 to 4 hours at 4°C or above	Ventilation time is 24 hours or until the HCN level reaches less than 1 mg/m^3 (0.9 ppm). The length of the ventilation period may be significantly affected by weather conditions (temperature, wind speed and direction), presence of local exhaust ventilation (LEV).

NOT TO BE USED FOR ANY PURPOSE OR IN ANY MANNER CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION

General instructions

Refer to Precautions and Restraints for further directions.

Adherence to the Australian Standard for general fumigation procedures (AS 2476-2008) must be followed.

BLUEFUME™ Fumigant is a rapid acting, flammable fumigant to control stored product pests in enclosed spaces.

The use of Bluefume™ Fumigant requires the use of certain specific application equipment. All application equipment used for Bluefume™ Fumigant application must be approved by Draslovka Services and also regularly maintained and tested as specified by its supplier, the recommended PPE as specified on the product label and the portable detector has to be specifically designed and approved for use with HCN. All licensed fumigators must attend a product training session (provided) by Draslovka Services Pty Ltd. Updates regarding approved equipment and training can be found at www.draslovka.com or by emailing agriculture@draslovka.com. No other equipment is approved for use with Bluefume™ Fumigant. To request approval and testing of alternative equipment, please contact Draslovka Services Pty Ltd via email at agriculture@draslovka.com.

The fumigation process consists of three phases:

- treatment phase
- ventilation phase

- clearing of the fumigation. The fumigation can only be declared to be cleared when the ventilation phase is complete.

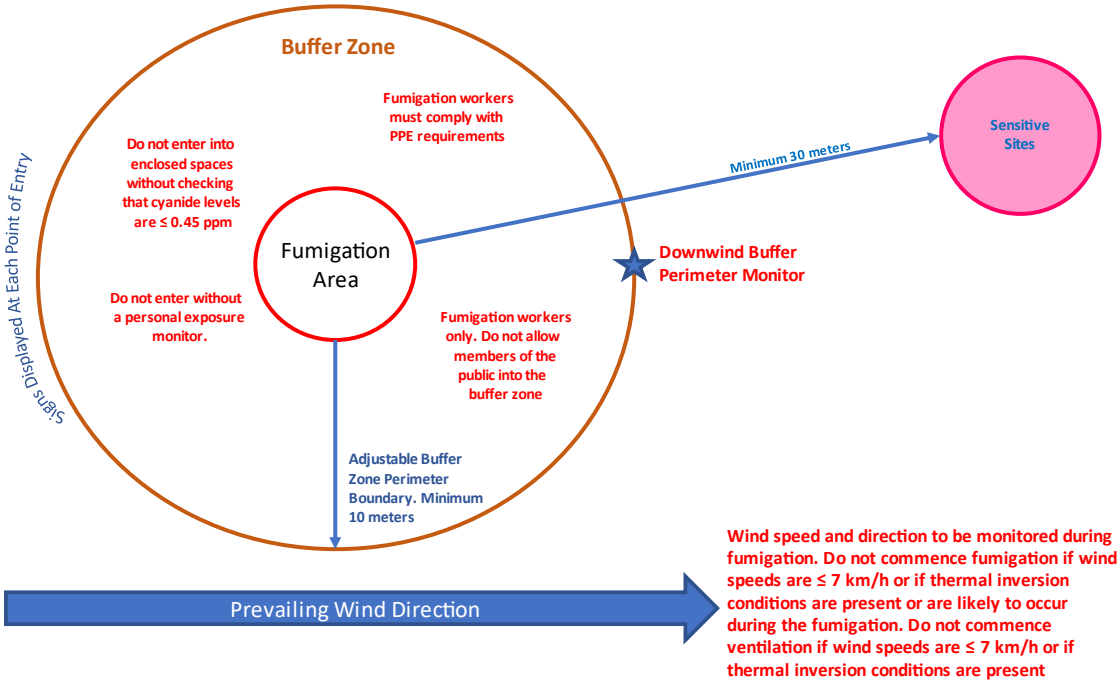
The fumigation treatment phase starts when the cyanide is first introduced into the fumigation area and ends when the ventilation phase is started.

The ventilation phase starts when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations inside the treatment area) below 900 ppm.

For buildings and structures: Cyanide is lighter than air, hence once the building is opened it tends to disperse up into the atmosphere. At the start of the ventilation period wear appropriate PPE and open the front door and windows and check the concentration of cyanide inside and around the building. Re-enter the building wearing appropriate PPE and gradually open other doors and windows. The ventilation phase ends when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations) below 0.9 ppm.

The fumigation area: The fumigation site is divided into an outer buffer zone surrounded by a buffer zone perimeter and an inner fumigation area (see label graphic). Different precautions apply to each area.

Figure 2: Boundaries of the affected area and buffer zone



Boundaries of the affected area and buffer zone are to be adjusted according to measurements taken at the perimeter in the downwind direction from the application site. However, the perimeters of the affected area and the buffer zone extend in all directions (not just downwind) in order to account for wind changes.

Use extreme caution when handling this product which is a flammable, colourless, highly toxic gas with an almond-like odour. Users should note that the odour cannot be detected by everybody, and the threshold varies widely between individuals, so it is not a reliable indicator of the presence of cyanide.

Detailed instructions for safe use appear in state and territory regulations.

Application

1. Before commencing the treatment, the fumigator must read the SDS. Work Instruction and Product Guide and label. If in any doubt, contact the supplier.
2. Thoroughly conduct an external and internal check of the building with the customer and make sure it is suitable and safe to conduct fumigation.
3. Bluefume™ Fumigant must never be applied by one fumigator alone. One or more assistants, all wearing suitable PPE should always accompany the fumigator.
4. All fumigation workers must carry a portable monitoring device, calibrated to detect HCN levels in the air with minimum detectable level of 0.45 ppm. The detection device must be within calibration date, and it is strongly recommended to conduct a bump test before each use.
5. Bluefume™ Fumigant can be applied either through temporary or permanent system which depends upon the volume of the treatment structure and treatment frequency. Measure the total volume of the structure (number of floors and rooms), calculate the amount of product and number and types of the nozzles required for even distribution of the fumigant.
6. Bluefume™ Fumigant is applied by using spraying nozzles. Consult with the supplier and Bluefume™ Fumigant distributor prior to the application.
7. The monitoring system must be installed prior to application. The number of monitoring systems depends upon the size and number of floors of the building. The monitoring system consists of a polyethylene tube that is installed at an appropriate location inside the treatment building and extended to the outside and connected to a hub that is attached with a monitoring device. Consult with the supplier for approved monitoring devices.
8. The building must be hermetically sealed for the treatment period mentioned on the label. For example, by taping over all closed windows and doors that are not gas-tight under normal circumstances, and other openings. To seal the openings, it is possible to use multiple means depending on the customs and practices in the area (tapes, paper strips with various types of glue, foil, etc.). Another option is to seal the entire building by wrapping it in a tarp.
9. Remove all food materials and other essential materials prior to treatment or ensure these are hermetically sealed inside impervious bags or similar wrappings as per the Australian standard AS-2476:2008.
10. Eliminate all potential ignition sources in and around the treated building/ structure before fumigation.
11. Prior to treatment, all insect hiding places should be opened and cleaned as far as possible to increase the penetration and efficacy of the gas.
12. Place the warning signs on access points and these should NOT be removed until the building has been declared safe to re-enter after treatment.

13. Do not fumigate any part of an enclosed space unless all persons and domestic animals have been removed from the entire structure.
14. Lock and seal exit door immediately from the outside before commencing the fumigation.
15. In case re-entry into the treated area is absolutely necessary during fumigation wear appropriate PPE recommended in the safety directions.
16. The structure can only be ventilated when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations inside the treatment area) below 900 ppm.

Labelling requirements – Bluefume-D Fumigant

Company Name: Draslovka Services Pty Ltd

Product Name: Bluefume-D Fumigant

elabel Application No: DC10-82129196E3

APVMA approval no: 90643/129661

Table 10: Labelling requirements – Bluefume-D Fumigant

Label name	Bluefume-D Fumigant
Signal headings	DANGEROUS POISON KEEP OUT OF REACH OF CHILOREN FIRE & EXPLOSION HAZARD READ SAFETY DIRECTIONS BEFORE OPENING OR USING
Constituent statements	976 g/kg hydrogen cyanide
Mode of action:	Group 24B Insecticide
Statement of claims	For use by professionally licensed and authorised fumigators as an indoor fumigant for empty structures against beetles, weevils, moths, mites, cockroaches and rodents.
Net contents	1.5 kg
Other limitations	
Withholding periods	
Trade advice	
Resistance warning	For insecticide resistance management Bluefume-D™ Fumigant is a Group 24B insecticide. Some naturally occurring insect biotypes resistant to Bluefume-D™ Fumigant and other Group 24B insecticides may exist through normal genetic variability in any insect population. The resistant individuals can eventually dominate the insect population if Bluefume-D™ Fumigant or other Group 24B insecticides are used repeatedly. The effectiveness of Bluefume-D™ Fumigant on resistant individuals could be significantly reduced. Since occurrence of resistant individuals is difficult to detect prior to use, Draslovka Services Pty Ltd. accepts no liability for any losses that may result from the failure of Bluefume-D™ Fumigant to control resistant insects. Bluefume-D™ Fumigant may be subject to specific resistance management strategies. For further information contact your local supplier, Draslovka Services Pty Ltd representative or local agricultural department agronomist.
Precautions	Refer to *Restraints* and *General instructions* for further directions.

Protections	Protection of wildlife, fish, crustaceans and the environment: • Very toxic to wildlife. DO NOT ventilate until any non-target animals are cleared from the immediate area. • Very toxic to aquatic life. DO NOT contaminate streams, rivers or watercourses with the chemical or used containers • Avoid release to environment except for as required for ventilation of fumigation space.
Storage and disposal	Store cans upright in a locked room or place away from children, animals, food, feedstuffs, seeds and fertilisers. Store cans in the closed, original container in a cool, well-ventilated area. Do not store for prolonged periods in direct sunlight. Empty cans and swept up cardboard reels shall be placed into a suitable waste container stored in a secure, well-ventilated, place and disposed in landfill after confirming there is zero hydrogen cyanide concentration by approved HCN detector.
Safety directions	Very dangerous. Can kill if inhaled. Poisonous if swallowed or absorbed by skin. Will irritate the eyes, nose and throat and skin. Avoid contact with eyes and skin. Do not inhale vapour. When using the product and preparing the product for use and when uncovering the treated area/material, wear protective clothing (chemical resistant) fastened to the neck and wrist, elbow-length chemical resistant gloves, impervious footwear (non-sparking), and (or where levels are at or above 0.45 ppm) a full facepiece respirator with canister specified for hydrogen cyanide, and (or where levels are at or above 45 ppm) a supplied air respirator. Detailed instructions for safe use appear in state/territory regulation. Thoroughly ventilate treated areas before reoccupying. After each day's use, wash gloves, respirator, and contaminated clothing.
First aid instructions	If poisoning occurs, immediately contact a doctor or Poisons Information Centre. Phone Australia 1311 26. In the event of cyanide poisoning, time is of the essence. Immediately call triple zero (000) as you provide first aid assistance to the victim. Only give first aid if no suspected cyanide is present in the immediate environment. If the harmful chemical is suspected, do not enter the area unless wearing protective equipment Once the area is safe, do the following steps: • Remove the casualty from the area if cyanide exposure is continuous. When possible, arrange for another isolation area. • Remove the contaminated clothing and clean the skin thoroughly with water. • Ensure an open airway but avoid using mouth-to-mouth resuscitation techniques due to the risk of contamination. Administer medical oxygen at the maximum rate, preferably via a CPR resuscitation mask. • Administering high flow oxygen can also be helpful, but this is normally only an option for trained medical professionals. The above first aid steps apply to all cases of cyanide poisoning. Treat the victim depending on the mode of cyanide exposure – whether through inhalation, ingestion, and absorption through the skin. In addition, the following precautions should apply: • For eye contact, quickly rinse the eye with clean water for at least ten minutes, then treat it as above.

	• For ingestion, treat the cyanide poisoning as above and avoid giving anything by mouth. Do not give direct mouth-to-mouth resuscitation if swallowed. To protect rescuer, use air-viva, oxy-viva or one-way mask. Resuscitate in a well-ventilated area.
First aid warnings:	May be fatal if inhaled, swallowed or absorbed through skin. May cause fire or explosions. Keep away from heat, sparks and naked flames.

Restraints

Refer to *Precautions* and *General instructions* for further directions.

DO NOT apply Bluefume-D™ Fumigant unless with Draslovka Services Pty Ltd approved equipment.

DO NOT place Bluefume-D™ cans inside the treated area unless all fumigation warning signs have been posted and the space to be fumigated is cleared of people, non-target animals, and secured.

DO NOT leave structure unattended. If the area cannot be physically secured, a watchman must be stationed to prevent people entering the risk area.

DO NOT Introduce stored commodities to the fumigation enclosure or remove the hermetically sealed inside impervious bags or similar wrappings unless the ventilation process is complete, and the hydrogen cyanide concentration is less than 0.45 ppm.

Maximum treatment rate

DO NOT exceed the maximum application rate of 10 gm^3.

Adequate sealing is required before fumigation starts

DO NOT apply Bluefume-D™ Fumigant into areas to be treated unless they are property sealed as per the Australian Standard AS2476:2008.

Risk mitigation controls must be in place before the fumigation starts and remain in place until fumigation ends

DO NOT commence treatment before the buffer zone controls are in place and operational.

DO NOT commence treatment before exposure monitoring has started.

DO NOT remove the buffer zone controls until ventilation is completed and the fumigation has been cleared.

DO NOT stop exposure monitoring until ventilation is completed and the fumigation is cleared.

Risk mitigation controls for the protection of food

DO NOT use for grain, food, or other food commodity fumigation.

DO NOT use unless all commodities are removed from the fumigation site or hermetically sealed inside impervious bags or similar wrappings as per the Australian Standard AS2476:2008.

Risk mitigation controls for the prevention of fire

DO NOT smoke while preparing the product for use, using the product or while within the buffer zone and fumigation area.

DO NOT use near heat sources, spark sources and naked flames.

Take precautionary measure against static discharge.

Risk mitigation controls for the protections of the public during fumigation

Cyanide fumigation, including placarding and signage, MUST comply with Australian Standard AS2476:2008 General Fumigation Procedures and with relevant state and territory regulations.

Exposure of the general population must be limited in accordance with relevant state and territory standards.

DO NOT allow the public past the butler zone perimeter during fumigation. Relevant placarding and signage stating:

“DANGER KEEP OUT, AREA UNDER FUMIGATION, DO NOT ENTER WITHOUT PERMISSION, DO NOT ENTER WITHOUT APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT”

are required at entry points around the buffer zone perimeter.

This signage should also carry a skull and crossbones pictogram with date and time of the fumigation commencement, date and time the restrictions expire, fumigant product name and contact details (telephone number) for the fumigator.

If the area cannot be physically secured, a watchman must be stationed to prevent people entering the risk area.

DO NOT fumigate within 30 metres of sensitive sites (hospitals, childcare centres, aged care facilities, custodial facilities, schools, playgrounds, camping sites and residential/domestic areas).

DO NOT commence fumigation treatment if wind speeds are ≤7 km/h or if thermal inversion conditions are present or are likely to occur during the fumigation treatment.

DO NOT commence fumigation treatment if the temperature at the site of pest activity to be fumigated is below 12°C (except for aircraft in accordance with directions on the product label).

Additional risk mitigation controls for transportation workers

DO NOT fumigate on ships while any crew member remains aboard.

DO NOT fumigate at any time while a ship is at sea. Fumigation MUST only occur in securely moored ships in port.

DO NOT use on any vehicles, aircraft, empty containers, railcars or other transportation vehicles that are in transit or likely to be in transit during fumigation or ventilation.

Risk mitigation requirements for fumigation workers

DO NOT apply before reading the full label, SDS and the user manual Work Instruction and Product Guide.

DO NOT apply by yourself. Always work at least in a group of 2.

DO NOT use this product unless trained in the proper use of required respirator, detection devices, emergency procedures and safe use and handling of the fumigant.

DO NOT come into direct contact with liquid cyanide.

DO NOT enter the fumigation area after the start of treatment and until the fumigation is cleared.

DO NOT enter the buffer zone and fumigation area unless all wounds and skin abrasions are covered with a waterproof dressing.

DO NOT exceed Acute Exposure Guideline Level 1 (AEGl-1) exposure levels. Any worker whose cyanide exposure level equals or exceeds the AEGL-1 values MUST immediately leave the fumigation site and must not be occupationally re-exposed to cyanides for at least 24 hours.

	10-minute exposure	30-minute exposure	1-hour exposure	4-hour exposure
AEGL-1 (non-disabling)	2.5 ppm (2.8 mg/m^3)	2.5 ppm (2.8 mg/m^3)	2.0 ppm (2.2 mg/m^3)	1.3 ppm (1.4 mg/m^3)

A respiratory protection factor of 0.1 MUST be used in estimating exposure as per the following example:

Example exposure calculation 3

A worker's personal exposure monitor indicated an exposure of 25 ppm over 10 minutes. The worker always wore a full facepiece respirator for the entire 10 minutes. The inhaled exposure would be 0.1 × 25= 2.5 ppm over 10 minutes. This is equal to the 10-minute AEGL-1. This worker must leave the fumigation site immediately and not be occupationally re-exposed to cyanides for at least 24 hours.

DO NOT exceed the occupational 8-hour time weighted average (TWA) tolerable exposure level (TEL) for cyanide of 0.9 ppm. Any worker exposure equals or exceeds the occupational 8-hour TWA TEL MUST immediately leave the fumigation site and must not be occupationally re-exposed to cyanides for at least 24 hours.

A respiratory protection factor of 0.1 MUST be used in estimating exposure as per the following example:

Example exposure calculation 4

A worker’s personal exposure monitor indicated an exposure of 8 ppm over an 8-hour day. The worker always wore a full facepiece respirator over an 8-hour workday. The inhaled exposure would be 0.1 × 8= 0.8 ppm over 8-hours. This is equal to the occupational 8-hour TWA TEL This worker must leave the fumigation Site immediately and not be occupationally re-exposed to cyanides for at least 24 hours.

DO NOT allow direct or exposure of the skin and ocular mucous membranes to cyanide concentrations ≥4.7 ppm for more than 15 minutes.

Any worker exposure equals or exceeds the dermal 15-minute STEL of 4.7 ppm MUST immediately leave the fumigation site and must not be occupationally re-exposed to cyanides lor at least 24 hours.

Additional risk mitigation requirements for fumigation workers in the buffer zone during fumigation

DO NOT fumigate unless a calibrated downwind buffer zone perimeter monitor is used.

The buffer zone perimeter monitor MUST be capable of:

- an audible alarm that must be set for cyanide levels at 0.45, 0.9, 4.7 and 45 ppm
- short-term exposure level (STEL) measurements
- measuring an 8-hour time weighted average (TWA) exposure level of 0.9 ppm.

DO NOT fumigate without a minimum starting buffer zone perimeter radius of 10-metres from the application site.

If cyanide levels at the downwind buffer zone perimeter monitor levels are greater than or equal to 0.9 ppm the buffer zone radius MUST increase at 1-metre intervals until the cyanide level is less than 0.9 ppm.

There is no maximum buffer zone radius or size.

DO NOT allow fumigation workers into the buffer zone without a calibrated personal exposure monitor that is always carried on their person.

The personal exposure monitor must be capable of:

- an audible alarm must be set lor cyanide levels at 0.45, 0.9. 4.7 and 45 ppm
- short-term exposure level (STEL) measurements
- measuring an 8-hour tine weighted average (TWA) exposure level of 0.9 ppm.

DO NOT allow fumigation workers into the buffer zone without a full-face respirator with canister specified for hydrogen cyanide that is always carried on their person.

If cyanide levels within the buffer zone are greater than or equal to 0.45 ppm all workers MUST wear a full facepiece respirator with canister specified for hydrogen cyanide.

If cyanide levels within the buffer zone are greater than or equal to 45 ppm all workers MUST wear a supplied air (air hose, air line or SCBA) respirator.

If cyanide levels within the buffer zone are greater than or equal to 45 ppm all workers without access to a supplied air (air hose. air line or SCBA) respirator must leave the buffer zone as quickly as possible and MUST not re-enter the buffer zone without appropriate personal protective equipment.

DO NOT enter enclosed spaces or low-lying areas within the buffer zone without checking that cyanide levels are less than 0.45 ppm, and a breathable atmosphere is present.

Risk mitigation for ventilation phase and re-entry to treated sites

DO NOT commence ventilation until the free cyanide concentration in the treated structure is consistently (a minimum or four separate measurements over 60 minutes at a minimum of four separate locations inside the treatment area) below 900 ppm.

DO NOT re-enter the treatment site or rehandle treated material until the fumigation is cleared. The fumigation cannot be cleared until the ventilation phase ends. The ventilation phase ends when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations) below 0.9 ppm.

DO NOT permit the re-occupancy of buildings and structures until the level of cyanide is below 0.45 ppm.

Directions for use

Table 11: Directions for use – Bluefume-D Fumigant

Situation	Pest	Application rate	Critical comments
Well-sealed empty structure such as fumigation structures, mills, silos, seed storage facilities and food factories Well-sealed empty warehouses, elevators, store structures, sheds and enclosures Well-sealed poultry shed, pet food facilities Well-sealed transportation facilities such as stationary railway trucks and buses Empty ship holds	Storage insect pests, mites and rodents	10 g hydrogen cyanide/m^3 for 24 hours	Fumigate using good fumigation practice in accordance with the Australian Fumigation Standard AS2476:2008 and state regulations. Fumigation may be performed only where there is no unacceptable risk to people, animals and the environment The BLUEFUME-D™ Fumigant Work Instruction and Product Guide contain important information for the safe and effective use of this product. They must be followed and must be in the user's possession during fumigation. Cans preparation: The calculated number of cans is placed according to a schedule, starting on the upper floor and moving downward. The cans must be distributed equally within the treated area to avoid any fluctuations of hydrogen cyanide concentration. Only Draslovka Services approved can openers must be used to open the can. Fumigation time: 24 hrs. The exact treatment time will be determined by the fumigator based on the real time monitoring of hydrogen cyanide concentration inside the treated area. Ventilation: Ventilation must start only after the internal concentration of hydrogen

			cyanide level reaches 1 g/m^3 (900 ppm) or less. Ventilation must be done slowly and gradually with careful monitoring of the hydrogen cyanide concentration within the buffer zone. Ventilation time is 24 hours or until the hydrogen cyanide level reaches less than 1 mg/m^3 (0.9 ppm). The length of ventilation period may be significantly affected by weather conditions (temperature, wind speed and direction), presence of local exhaust ventilation (LEV).
Aircraft fumigation	Rodents	2 to 4 g hydrogen cyanide/m^3 tor 2 to 4 hours at 4°C or above	The exact treatment time will be determined by the fumigator based on the real time monitoring of hydrogen cyanide concentration inside the treated area. Ventilation time is 24 hours or until the HCN level reaches less than 1 mg/m^3 (0.9 ppm). The length of the ventilation period may be significantly affected by weather conditions (temperature, wind speed and direction), presence of local exhaust ventilation (LEV).

NOT TO BE USED FOR ANY PURPOSE OR IN ANY MANNER CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION.

General instructions

Refer to *Precautions* and *Restraints* for further directions.

Adherence to the Australian Standard for general fumigation procedures (AS 2476-2008) must be followed.

BLUEFUME-D™ Fumigant is a rapid acting, flammable fumigant to control stored product pests in enclosed spaces.

The use or Bluefume-D™ Fumigant requires the use of certain specific application equipment. All application equipment used for Bluefume-D™ Fumigant application must be approved by Draslovka Services and also regularly maintained and tested as specified by its supplier, the recommended PPE as specified on the product label and the portable detector has to be specifically designed and approved for use with HCN. All licensed fumigators must attend a product training session (provided) by Draslovka Services Pty Ltd. Updates regarding approved equipment and training can be found at www.draslovka.com or by emailing agriculture@draslovka.com. No other equipment is approved for use with Bluefume-D TM Fumigant. To request approval and testing or alternative equipment. Please contact Draslovka Services Pty Ltd via email at agriculture@draslovka.com.

The fumigation process consists of three phases:

- The treatment phase
- The ventilation phase
- Clearing of the fumigation. The fumigation can only be declared to be cleared when the ventilation phase is complete.

The fumigation treatment phase starts when the cyanide is first introduced into the fumigation area and ends when the ventilation phase is started.

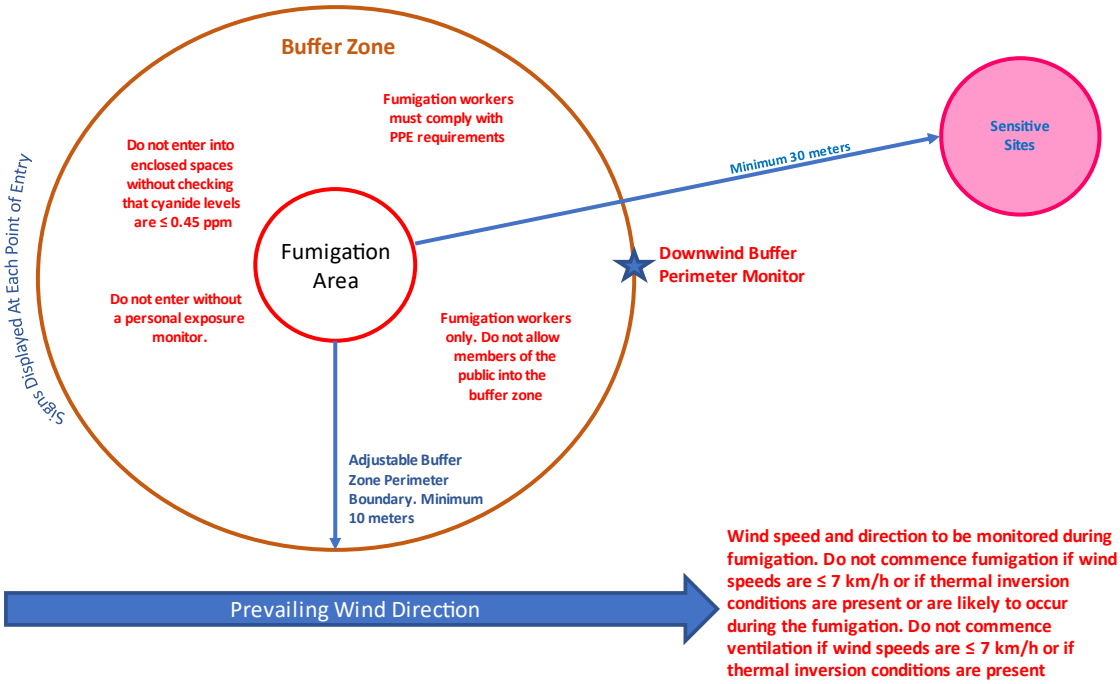
The ventilation phase starts when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations inside the treatment area) below 900 ppm.

For buildings and structures: Cyanide is lighter than air, hence once the building is opened it tends to disperse up into the atmosphere. At the start of the ventilation period wear appropriate PPE and open the front door and windows and check the concentration of cyanide inside and around the building. Re-enter the building wearing appropriate PPE and gradually open other doors and windows.

The ventilation phase ends when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations) below 0.9 ppm.

The fumigation area: The fumigation site is divided into an outer buffer zone surrounded by a buffer zone perimeter and an inner fumigation area (see label graphic). Different precautions apply to each area.

Figure 3: Boundaries of the affected area and buffer zone



Boundaries of the affected area and buffer zone are to be adjusted according to measurements taken at the perimeter in the downwind direction from the application site. However, the perimeters of the affected area and the buffer zone extend in all directions (not just downwind) in order to account for wind changes.

Use extreme caution when handling this product which is a flammable, colourless, highly toxic gas with an almond-like odour. Users should note that the odour cannot be detected by everybody, and the threshold varies widely between individuals, so it is not a reliable indicator of the presence of cyanide.

Detailed instructions for safe use appear in state/territory regulations.

Application

1. Before commencing the treatment, the fumigator must read the SDS, Work instruction and Product Guide and label. If in any doubt, contact the supplier.
2. Thoroughly conduct an external and internal check of the building with the customer and make sure it is suitable and safe to conduct fumigation.
3. Bluefume-D™ Fumigant must never be applied by one fumigator alone. One or more assistants, all wearing suitable PPE should always accompany the fumigator.
4. All fumigation workers must carry a portable monitoring device, calibrated to detect HCN levels in the air with minimum detectable level of 0.45 ppm. The detection device must be within calibration date, and it is strongly recommended to conduct a bump test before each use.

5. The required number of Bluefume-D™ Fumigant cans (unopened) should be distributed throughout the building at the places it is desired to apply the fumigant paper or other suitable protective material should be placed on the floor on which the Bluefume-D™ Fumigant can be placed.
6. The monitoring system must be installed prior to application. The number of monitoring systems depends upon the size and number of floors of the building. The monitoring system consists of a polyethylene tube that is installed at an appropriate location inside the treatment building and extended to the outside and connected to a hub that is attached with a monitoring device. Consult with the supplier for approved monitoring devices.
7. The building must be hermetically sealed for the treatment period mentioned on the label, for example by taping over all closed windows and doors that are not gas-tight under normal circumstances, and other openings. To seal the openings, it is possible to use multiple means depending on the customs and practices in the area (tapes, paper strips with various types or glue, foil, etc.). Another option is to seal the entire building by wrapping it in a tarp.
8. Remove all food materials and other essential materials prior to treatment or ensure these are hermetically sealed inside impervious bags or similar wrappings as per the Australian standard AS-2476:2008.
9. Eliminate any potential ignition sources in and around the treated building/structure before fumigation.
10. Prior to treatment, all insect hiding places should be opened and cleaned as far as possible to increase the penetration and efficacy of the gas.
11. Place the warning signs on access points and these should NOT be removed until the building has been declared safe to re-enter after treatment.
12. Do not fumigate any part of an enclosed space unless all persons and domestic animals have been removed from the entire structure.
13. Conduct application by opening cans with the Draslovka Services approved can opener only. Always start on the top floor further from the exit (stairway) and continue towards the lower floors (exit). If the fumigated building has a cellar, fumigate the cellar first and finish on the ground floor.
14. Lock and seal exit door immediately from the outside before commencing the fumigation.
15. In case re-entry into the treated area Is absolutely necessary during fumigation wear appropriate PPE recommended in the safety directions.
16. The structure can only be ventilated when the free cyanide concentration in the treated structure is consistently (a minimum of four separate measurements over 60 minutes at a minimum of four separate locations inside the treatment area) below 900 ppm.
17. The used cans and the remaining discoids must be examined for hydrogen cyanide traces before being collected by the fumigator.

Acronyms and abbreviations

Shortened term	Full term
ACCS/ACMS	Advisory Committee for Chemicals Scheduling/Advisory Committee for Medicines Scheduling
ac	active constituent
ADI	Acceptable Daily Intake (for humans)
AHMAC	Australian Health Ministers Advisory Council
ai	active ingredient
ARfD	Acute Reference Dose
AS2476 – 2008	Australian Standard – General Fumigation Procedures
BBA	Biologische Bundesanalstalt fur Land—und forstwirschaft
bw	Bodyweight
d	Day
DAT	Days After Treatment
DT_{50}	Time taken for 50% of the concentration to dissipate
EA	Environment Australia
E_bC_{50}	concentration at which the biomass of 50% of the test population is impacted
EC_{50}	concentration at which 50% of the test population are immobilised
EEC	Estimated Environmental Concentration
E_rC_{50}	concentration at which the rate of growth of 50% of the test population is impacted
EI	Export Interval
EGI	Export Grazing Interval
ESI	Export Slaughter Interval
EUP	End Use Product
F_0	original parent generation
g	Gram
GAP	Good Agricultural Practice
GCP	Good Clinical Practice

Shortened term	Full term
GLP	Good Laboratory Practice
GVP	Good Veterinary Practice
h	Hour
ha	Hectare
HCN	Hydrogen cyanide
Hct	Heamatocrit
Hb	Haemoglobin
HPLC	High Pressure Liquid Chromatography *or* High Performance Liquid Chromatography
id	Intradermal
im	Intramuscular
ip	Intraperitoneal
IPM	Integrated Pest Management
iv	Intravenous
in vitro	outside the living body and in an artificial environment
in vivo	inside the living body of a plant or animal
kg	Kilogram
K_{OC}	Organic carbon partitioning coefficient
L	Litre
LC_{50}	concentration that kills 50% of the test population of organisms
LD_{50}	dosage of chemical that kills 50% of the test population of organisms
LOD	Limit of Detection—level at which residues can be detected
Log K_{OW}	Log to base 10 of octanol water partitioning co-efficient, synonym P_{OW}
LOQ	Limit of Quantitation—level at which residues can be quantified
LV	Liquid vapouriser
mg	Milligram
mL	Millilitre
MRL	Maximum Residue Limit

Shortened term	Full term
MSDS	Material Safety Data Sheet
NEDI	National Estimated Daily Intake
NESTI	National Estimated Short Term Intake
ng	Nanogram
NHMRC	National Health and Medical Research Council
NOEC/NOEL	No Observable Effect Concentration Level
NOAEL	No Observed Adverse Effect Level
OC	Organic Carbon
OM	Organic Matter
PCTFE	Polychlorotrifluoroethylene
pKa	$-\log_{10}K_a$
po	Oral
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
Q-value	Quotient-value
RAL	Regulatory Acceptable Level
RBC	Red Blood Cell Count
REI	Re-Entry Interval
s	Second
sc	Subcutaneous
SC	Suspension Concentrate
SCOEL	Scientific Committee on Occupational Exposure Limits
SDMT	Spray Drift Management Tool
SDRAT	Spray Drift Risk Assessment Tool
SUSMP	Standard for the Uniform Scheduling of Medicines and Poisons
TGA	Therapeutic Goods Administration

Shortened term	Full term
TGAC	Technical grade active constituent
TWA	Time weighted average
µg	Microgram
vmd	volume median diameter
WG	Water Dispersible Granule
WHP	Withholding Period

Glossary

Term	Description
Active constituent	The substance that is primarily responsible for the effect produced by a chemical product
Acute	Having rapid onset and of short duration
Carcinogenicity	The ability to cause cancer
Chronic	Of long duration
Codex MRL	Internationally published standard maximum residue limit
Desorption	Removal of a material from or through a surface
Efficacy	Production of the desired effect
Formulation	A combination of both active and inactive constituents to form the end use product
Genotoxicity	The ability to damage genetic material
Hydrophobic	Repels water
Leaching	Removal of a compound by use of a solvent
Metabolism	The chemical processes that maintain living organisms
Photodegradation	Breakdown of chemicals due to the action of light
Photolysis	Breakdown of chemicals due to the action of light
Subcutaneous	Under the skin
Toxicokinetics	The study of the movement of toxins through the body
Toxicology	The study of the nature and effects of poisons

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