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Phytosanitary treatments
Traitments phytosanitaires

Phosphine fumigation of empty storage areas to control stored product insects in general

Specific scope

This Standard describes the phosphine fumigation of empty premises, warehouses, structures and containers to control stored product insects in general.

Specific approval and amendment

First approved in 2012–09.

Introduction

After the storage of commodities infested by stored-product pests, some of these pests may remain in empty premises, warehouses, structures and containers. Disinfestation should be conducted in the empty storage areas before new consignments arrive to avoid further contamination of consignments stored in the facilities Experience from across the world has shown that using phosphine to disinfest facilities is effective.

Commodities/regulated articles

Empty storage areas including premises warehouses, structures, silos, ship holds and containers.

Pests

Stored product pests in general (see Table 1).

It should be noted that *Trogoderma granarium* is excluded because of the high level of resistance of diapausing larvae of this pest. Treatment to control this pest will require a longer exposure time (Shamilov & Mordkovich, 2012).

Treatment schedule

Treatment name: phosphine fumigation.
Treatment type: chemical.
Formulation: fumigant, packed as a bag, plate or pellets.
Active substance: aluminium phosphine 56% or magnesium phosphine 56%.

Table 1 Important stored product pests that can be controlled with phosphine

Coleoptera	*Acanthoscelides obtectus*	ACANOB
	Anthrenus museorum	ANTRMU
	Araecerus fasciculatus	ARAEFA
	Attagenus pellio	ATTGPE
	Callosobruchus chinensis	CALSCH
	Caryedon serratus	CARESE
	Cryptolestes ferrugineus	CRYLFE
	Dermestes lardarius	DERMLA
	Gnathocerus cornutus	GNATCO
	Lasioderma serricorne	LASDSE
	Necrobia rufipes	NECRRU
	Niptus hololeucus	NIPTHO
	Oryzaephilus surinamensis	ORYZSU
	Prostephanus truncatus	PROETR
	Ptinus fur	PTINFU
	Ptinus tectus	PTINTE
	Rhizopertha dominica	RHITDO
	Sitophilus granarius	CALAGR
	Sitophilus oryzae	CALAOR
	Sitophilus zeamais	CALAZM
	Stegobium paniceum	STEGPA
	Tenebrio molitor	TENBMO
	Tenebroides mauritanicus	TEBRMA
	Tribolium castaneum	TRIBCA
	Tribolium confusum	TRIBCO
Lepidoptera	*Corcyra cephalonica*	CORRCE
	Ephestia cautella	EPHECA
	Ephestia elutella	EPHEEL
	Ephestia kuehniella	EPHEKU
	Nemapogon granella	TINEGR
	Plodia interpunctella	PLODIN
	Sitotroga cerealella	SITTCE

Treatment conditions

Mode of action: fumigation at atmospheric pressure.
Number of applications: before storage of commodities.

Waiting period

The storage areas can be used only when monitoring instruments show that gas concentrations have fallen to, or are below, the toxic level value (TLV) set for phosphine.

Efficacy of treatment

Fumigation with phosphine is carried out as a disinfestation or quarantine measure against stored product pests in structures such as flour mills or food factories, or in empty freight containers and other transport, including aircraft (Hole *et al.*, 1976; Bell, 2000).

Phosphine fumigation has been found to be effective in many countries in the EPPO region and worldwide. The schedules described in Table 2 are the result of many years' experience and have been tested at the All-Russian Plant Quarantine Centre. The results show that these schedules are acceptable (100% mortality of the pests in Table 1 was achieved).

Fumigation conditions are important, consequently the dose to be used depends on the conditions, particularly relative temperature and humidity (Wainman *et al.*, 1975). When these conditions are not acceptable during fumigation, it is important to use a longer exposure time. Most data for the fumigation with phosphine was obtained at 60% humidity and 20°C. Fumigation should not be performed below 10°C (Zakladnoi & Ratanova, 1973). The exposure times recommended in the schedule are minimum times.

The longer the fumigation time, the more effective the fumigation. Exposure time should be lengthened to allow for penetration of gas in all parts of storage areas. This is particularly important in the fumigation of large storage areas. It should be noted that there is little to be gained by extending the exposure period if the structure to be fumigated has not been carefully sealed, or if distribution of gas is poor and insects are not subjected to lethal concentration of phosphine (Mordkovich & Vashakmadze, 2001).

Table 2 Application rate per treatment (gas dose) in empty premises, warehouses, structures, containers, silos and ship holds

Implementation	Active substance	Dose (g PH_3 m^{-3})*	Minimum exposure time (days)	Minimum temperature (°C)
Empty premises, warehouses, structures	Aluminium phosphine	2	7	10
			6	20
	Magnesium phosphine	2	6	10
			5	20
Empty containers, silos and ship holds	Aluminium phosphine	1	5	10
			4	20
	Magnesium phosphine	1	4	10
			3	20

*The table gives minimum exposure periods in days for a dosage of 1 and 2 g PH_3 m^{-3}; 1 day should be added to the exposure times to allow for development and distribution of the fumigant. The dose may need to be increased by 1 g PH_3 m^{-3} if fumigation conditions are poor (e.g. not very gas tight conditions or low relative humidity), or if resistant species are found or believed to be present. However, it is good practice to perform phosphine fumigation only in gas-tight conditions.

Notes

- To prevent the development of resistance, it is essential to avoid applications with sublethal doses (Maslov *et al.*, 2007). Depending on fumigation circumstances, particularly low temperature and poor gas-tightness of the building/container, it is important to use longer exposure to achieve pest mortality in all parts of the storage areas (Mordkovich, 2003).
- The most important drawbacks of phosphine are its slow activity (3–15 days); the rapid increase in insect resistance to this compound worldwide; the flammability above concentrations of 1.8% by volume; and the corrosion of copper (Mordkovich, 2003). Phosphine corrodes copper and its alloys, therefore electrical items need protection from exposure to the fumigant. Phosphine also reacts to certain metallic salts, which are contained in sensitive items such as photographic film and some inorganic pigments (Navarro, 2006).

Enquiries

Further information may be obtained from the national authorities responsible for the registration of this fumigant.

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