SRI LANKA STANDARD 973 : PART 2 : 1994

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CODE OF PRACTICE FOR FUMIGATION OF AGRICULTURAL PRODUCE
PART 2 : PHOSPHINE FUMIGATION

SRI LANKA STANDARDS INSTITUTION

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Gr. 5

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Sri Lanka.

Sri Lanka Standards are subject to periodical revision in order to accommodate the progress made by industry. Suggestions for improvement will be recorded and brought to the notice of the Committees to which the revisions are entrusted.

This standard does not purport to include all the necessary provisions of a contract.

SRI LANKA STANDARD
CODE OF PRACTICE FOR FUMIGATION OF AGRICULTURAL PRODUCE
PART 2 : PHOSPHINE FUMIGATION

FOREWORD

This Standard was finalized by the Sectoral Committee on Cereals, Pulses and their products and was authorized for adoption and publication as a Sri Lanka Standard by the Council of the Sri Lanka Standards Institution on 1994-03-31.

Fumigants are toxic and chemically reactive material. Therefore considerable care is required in handling and application of fumigants to assure the safety of personnel exposed to them. Thus, Part 1 of this standard covers general safety requirements in handling and application of fumigants. Other parts will cover the selection, safety and application techniques of commonly used fumigants.

Phosphides of aluminium and magnesium are the chemical precursors which evolve hydrogen phosphide gas or phosphine in the presence of the moisture in the atmosphere or in the produce. Once the volatile phosphine is given off the residue consists of hydroxides of aluminium or magnesium. As phosphine has a low inflammable temperature, it is necessary that the commercially available fumigant preparations of the precursors contain additives to delay emission of phosphine and to reduce explosion hazards. Phosphine is highly toxic to all forms of animal and human life and therefore persons supervising the fumigation must be professionally trained in the use of phosphine fumigants.

This standard should be used in conjunction with specific codes of instructions or regulations applicable to fumigation with phosphine gas.

In the preparation of this code, the valuable assistance derived from the following publications is gratefully acknowledged :

IS 7247 : 1974 Indian Standard Code of practice for fumigation of agricultural produce
Part 3 : Aluminium phosphide

MONRO, H.A.U, Manual of fumigation for insect control, 2nd ed., Published by FAO, Rome, 1969.

1 SCOPE

This standard prescribes the practices to be adopted in fumigation using aluminium phosphide and magnesium phosphide preparations. It includes general information on methods of fumigation and precautions to be observed in handling and use of phosphine fumigants.

2 REFERENCES

SLS 910 Limits for pesticide residues in food.
SLS 973 Fumigation of agricultural produce
Part 1 : General safety requirements.

3 GENERAL PROPERTIES

Chemical formula	PH_3
Molecular weight	34.04
Boiling point	-87.4 °C
Freezing point	-133.5°C
Specific gravity	
of liquid (water at 4°C = 1)	0.746
of gas (air = 1)	1.17
Latent heat of vaporization	102.6 cal/g
Lowest explosion point	1.79 per cent by volume in air
Odour	Carbide or garlic like
Solubility in water	26 ml/100 ml at 17 °C

4 AVAILABILITY

Formulations of 56 per cent to 57 per cent aluminium phosphide are locally available in three different presentations - pellets weighing 0.6 g and releasing 0.29 g phosphine packed in resealable flasks; round or flat tablets weighing 3 g and releasing 1 g phosphine contained in cylindrical aluminium tubes; and as 11cm^2 x 11cm^2 Tyvek bags weighing 34 g and liberating 11.3 g phosphine.

56 per cent to 66 per cent formulations of magnesium phosphide are available as 3 g tablets and 0.6 g pellets packed in cylindrical aluminium tubes and resealable flasks respectively ; and as 28 cm^2 x 17 cm^2 plates, where high purity magnesium phosphide has been incorporated into a plastic polyethylene matrix and pressed out in the form of a plate and packed in heat-sealed alufoil pouches. Each plate weighs 117 g and releases 33 g phosphine.

5 MATERIAL TO BE FUMIGATED

Phosphine can be used for fumigation of many dry food stuffs and fodder. The phosphides of aluminium and magnesium are employed with advantages for the fumigation of whole and milled grain commodities, processed food, and contaminated storage spaces. However, products with delicate aromas such as spices should be pretested to ascertain any impairment to quality. Living plants, fresh vegetables and fruits (with a few exceptions) should not be fumigated.

6 DOSAGE AND DURATION OF EXPOSURE

6.1 A successful fumigation depends primarily on the type of storage and efforts made to effectively seal the store. The dosage rates differ with type of presentation of fumigant product (tablets, bags, plates etc.), species of pests and their developmental stage. Therefore, dosages recommended in this section should be only a guidance. See product lables and manufacturer's brochures for details.

6.2 The recommended dosage of aluminium phosphide is two to three tablets per tonne of grain. For shed fumigation the recommended dosage is 42 g/m^3. Decomposition of a tablet takes three days when the temperature and moisture content of the commodity are high. When the temperature and moisture content of the commodity are lower than 15°C and 10 per cent respectively, complete decomposition may take five days. The recommended exposure period is seven days.

6.3 Recommended dosages for various types of fumigations :

	Dosage (PH_3)
Silo	2 to 5 g/ton
Flat storage	3 to 6 g/ton
Space stack container	1 to 2 g/m^3

6.4 Recommended minimum exposure periods :

Temperature	Tablets AlP* Mg_3P_2	Pellets AlP* Mg_3P_2	Bags AlP	Plates Mg_3P_2
16 °C to 25°C	4 days	3 days	4 days	3 days
more than 25°C	3 days	3 days	3 days	3 days

7 PRECAUTIONS

7.1 General safety requirements as prescribed in SLS 973 : Part 1 should be followed.

7.2 Phosphide precursors when exposed to atmosphere, start releasing the phosphine gas. The fumigation work should therefore be planned in such a manner that the operation of placement of precursors, covering with fumigation covers, closing the doors and the ventilators should be completed in about 30 minutes. To ensure uniform and rapid distribution, the points of application should be decided in advance. No person should be allowed in the premises within 30 minutes from the begining of the operation.

7.3 As pellets and tablets crumble with the evolution of phosphine, they should be placed on trays and inserted under the covers.

7.4 Phosphine reacts with all metals, specially with copper or copper-containing equipment; electrical apparatus may be severely damaged. Therefore, all copper-containing equipment and parts in the godowns or other structures should be protected before the treatment starts.

7.5 The daily exposure of an operator to the fumigant should not exceed 0.3 mg/kg or 0.4 mg/m^3 (TWA TLV - time weighted average for normal 8 hour working day or 40 hours work week).

7.6 The operator undertaking the fumigation should invariably wear a gas-mask with a canister containing specially activated charcoal for protection against gases.

7.7 The operator should also wear gloves when dispensing the precursors by hand.

7.8 Odour of the fumigant should not be relied upon as an indication of poisonous concentration of the fumigant.

7.9 Smoking or touching food at any time during the application of the fumigant should be strictly prohibited.

7.10 The permissible limit of phosphine in food grains should be 0.1 mg/kg and 0.01 mg/kg in processed food (Refer SLS 910).

7.11 On completion of aeration,the containers of precursors should be carefully collected and buried in the ground or disposed of in a rubbish dump under conditions where there is no possibility of future human contact.

8 FUMIGATION

8.1 Fumigation in stacks

The stacks should be made to uniform height. The required number of tablets, pellets or sachets, depending on the quantity of grain, should be placed at definite places fixed earlier. The stack(s) should be covered immediately with a fumigation cover and should be made airtight by pressing with sand snakes. The operation should be completed within 30 minutes of the placement or exposure of the precursor. After the exposure period of about seven days (see 6), the cover should be partially lifted and aeration should be allowed for atleast one hour. After an hour the cover should be removed completely. Aeration should be allowed for about 6 hours. Operators should wear gas-masks fitted with right type of canister of air-hose type mask.

8.2 Fumigation in godowns

The doors and ventilators of the godown should be closed and the structure should be made airtight by pasting them with kraft paper, cardboard etc. If necessary, polythene sheets cut to the sizes of doors and ventilators should be pasted on them. All the doors except the exit door should be locked from outside. The required number of tablets depending on the volume of the godown should be distributed at intervals throughout the building so as to effect an even dispersion of the required dose. If there are one or more storeys, operators should start at the top floor and proceed downward towards the final exit. The doors and ventilators should be opened after an exposure period of seven days (See 6). Aeration should be allowed for 6 hours to 8 hours.

8.3 Fumigation in bulk storage structures

To simplyfy the application,it is recommended to level the surface of grain before the fumigation is started.The bins or other bulk storage structures should be made completely airtight. The required number of tablets or sachets should be inserted at various depths into the agricultural produce to be fumigated by means of a suitable applicator or a special probe. It is recommended that a tarpaulin or polyethylene sheet be placed over the surface of the grain after the precursors are applied. After an exposure period of seven days (See 6) the structure should be opened and aeration should be allowed for about 6 hours.

In the case of fumigation in silos, the precursors may be inserted in the storage bins by placement at regular intervals, on conveyor belts conveying grain into bins.

9 SYMPTOMS OF POISONING

Symptoms may appear immediately or after more than 48 hours depending on the concentration of phosphine absorbed.

Symptoms include shortness of breath, dissiness, restlessness, vomiting, headache, stomachache, sensibility to cold, diarrhoea (like food poisoning), sweating, chest pain, transitory loss of consciousness, convulsions, disturbance of equilibrium, unconsciousness, respiratory and cardiac arrest.

10 FIRST-AID TREATMENT

10.1 The affected person should be removed out of the contaminated atmosphere into the open air. Make him sit or lie down. If patient is unconscious, place him in stable lateral reclining position.

10.2 Remove clothing (clothes often absorb a large quantity of gas) and take it outdoors.

10.3 If the patient had contact with the fumigant (powder etc.), clean off remaining powder by brushing and only then using water to clean.

10.4 In case of contact with the eyes, remove remainders of metal phosphide with cotton. Rinse with plenty of water only after ensuring that no more powder residues are visible; administer eye drops.

10.5 Giving oxygen with oxygen breathing equipment is recommended. Administer a cardiac tonic and a drug to stimulate blood circulation.

10.6 In case of pulmonary oedema, a hypertonic solution of glucose should be injected.

10.7 If poisoning is suspected resulting in pulmonary irritation, immediately administer 10 pumps of the dosing cortisone aerosol. Repeat with 5 pumps after 10 minutes, and again with 5 pumps after another 30 minutes.

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The Sri Lanka Standards Institution is the owner of the registered certification mark shown below. Beneath the mark, the number of the Sri Lanka Standard relevant to the product is indicated. This mark may be used only by those who have obtained permits under the SLS certification marks scheme. The presence of this mark on or in relation to a product conveys the assurance that they have been produced to comply with the requirements of the relevant Sri Lanka Standard under a well designed system of quality control inspection and testing operated by the manufacturer and supervised by the SLSI *which includes surveillance inspection of the factory, testing of both factory and market samples.*

Further particulars of the terms and conditions of the permit may be obtained from the Sri *Lanka Standards Institution, 17, Victoria Place, Elvitigala Mawatha, Colombo 08.*

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SRI LANKA STANDARDS INSTITUTION

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The principal objects of the Institution as set out in the Act are to prepare standards and promote their adoption, to provide facilities for examination and testing of products, to operate a Certification Marks Scheme, to certify the quality of products meant for local consumption or exports and to promote standardization and quality control by educational, consultancy and research activity.

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