



Friday 28th March 2014

Bulletin 957 - 03/14 - Disposal of Aluminium Phosphide residues following fumigation of cargoes in transit - Worldwide

The UK P&I Club has received reports of a number of accidents and injuries to crew members resulting from the inadvertent release of highly toxic phosphine gas or the effects of fires and explosions, both caused by the unsafe disposal of residues of aluminium phosphide following the fumigation of cargoes in transit.

International guidance and recommendations on fumigation on board ships is contained in MSC Circulars 1264¹ and 1396² and the IMSBC Code³. These stress that:

- Fumigation in transit should only be carried out at the discretion of the Master
- The Master should be aware of the regulations of the Flag State of Administration having regard to fumigation in transit,
- When phosphine generating formulations (of the type with which this bulletin is concerned) are used, any collected residues may ignite.

The Ship Manager's ISM Code should include a section dealing with fumigation.

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Fumigant formulations

Phosphine is a well established insecticide suitable for the fumigation of bulk cargoes such as grain. Phosphine is also poisonous to humans at relatively low concentrations and can form flammable gas:air mixtures. Phosphine can be conveniently generated on and in cargo in the holds by the reaction of atmospheric moisture with aluminium or magnesium phosphide formulations placed in the holds by specialist fumigation contractors. Aluminium and magnesium phosphide are manufactured in several different formulations for a variety of

¹ MSC.1/Circ. 1264 Recommendations of the safe use of pesticide in ships applicable to the fumigation of cargo holds. International Maritime Organisation, 27 May 2010.

² MSC.1/Circ. 1396. Amendment to the recommendations of the safe use of pesticide in ships applicable to the fumigation of cargo holds (MSC.1/Circ. 1264). International Maritime Organisation, 27 May 2011.

³ IMSBC Code, 2013 Edition, Section 3.6

fumigation applications and aluminium phosphide is the more common of the two. The powdered formulation is usually compressed into hard round or flat tablets. Aluminium phosphide powder is also prepared in permeable bags or sachets.

How the formulation is supplied and applied



The fumigation products are supplied in hermetically sealed tubes, cans or flasks to prevent contact with moisture from the atmosphere, an example of which is illustrated in the adjacent photograph. For ease of application and safety, pellets or sachets are sometimes supplied in predetermined quantities in the form of ropes, belts, prepacs or blankets for specific applications. 'Fumisleeves', which are rather like long woven socks knotted at the bottom, are used to facilitate the introduction of tablets at various depths in a bulk cargo, and the subsequent removal of reacted material at the discharge port. If correct application procedures are followed the fumigation in transit should proceed without incident

Possible problems with aluminium phosphide fumigant - use and disposal

Examples of a failure to follow correct application procedures are:

- Too many pellets or sachets clustered together as illustrated in the below photograph,
- Belts, blankets, blister packs and ropes left folded or coiled up.



This presents a fire hazard, and possibly an explosion hazard because the higher concentration of fumigant product can react to generate phosphine at a much higher rate and cause locally higher temperatures. This condition worsens if moisture that condenses on the upper parts of the cargo space (sweating) drips onto the fumigant product. Under these circumstances a flammable phosphine:air mixture is more likely to form, and if such a mixture accumulates within an enclosed space such as a cargo hold or a drum fitted with a lid into which only partially reacted fumigant residue is placed, it may ignite spontaneously and cause a fire. An explosion over-pressure may also occur, as illustrated in the below photograph, which could cause damage to the boundaries of the enclosure such as the displacement of hatch covers, or the lid of a closed drum into which partially reacted residues have been

placed, and serious injury.

Condition of the residue after fumigation

The rate of decomposition of a correctly applied fumigant preparation will vary depending on the temperature and moisture conditions to which it is exposed. When the moisture and temperature of the fumigated commodity are high, decomposition of the preparation may be complete after about three days. Loosely applied pellets or tablets leave a greyish-

white non-hazardous powder similar to that illustrated in the below photograph, containing a small amount of un-reacted aluminium phosphide which should not present a hazard.



Factors that are likely to increase the amount of un-reacted aluminium phosphide in the formulation and therefore cause it to remain hazardous are:

- Too many pellets or sachets clustered together, or belts, blankets, prepacs and ropes left folded or coiled up, which restricts the penetration of moisture to the centre of the fumigant preparation.
- Low ambient temperatures and/or humidity or moisture conditions.
- Short voyages.



Disposal of fumigant residues

Crew members and other personnel must strictly follow the requirements of the MSC Circular 1264 having regard to the testing and opening of cargo spaces that have been fumigated and personal protection equipment that should be worn.

MSC Circular 1264 requires that *“all waste and residues are disposed of in an appropriate manner, either by incineration or by disposal on shore, as recommended by the manufacturer. **Clear written instructions must be given to the master of the ship, to the receiver of the cargo and to the authorities at the discharging port as to how any residues are to be disposed of.**”* Wherever possible, the collection and disposal of fumigation waste should be carried out by properly trained contractors.

If residues are to be disposed of by the crew, then note:

- Dispose of waste in accordance with manufacturer’s instructions, or instructions provided by the fumigation contractors at the load port.
- Fully reacted residue is safe for disposal at a suitably approved site.
- Waste containing un-reacted material is classed as a hazardous waste and will require special care, and deactivation before disposal.
- Unless crew members have expertise in determining whether the residue contains un-reacted material, it would be prudent to treat it as though it requires deactivation before disposal, and the manufacturer’s instructions for this procedure should be carefully followed. If the instructions are not understood, guidance should be sought from the manufacturers or the UK P&I Club. One manufacturer’s instructions for deactivation on board ship involves mixing the material with water and low-foam detergent in an open-topped drum in the open air. Sufficient water must be used for the quantity of material involved, and the Manufacturer’s instructions in this regard must be followed in full, paying particular attention to selecting an area that can be taped off from general access and the use of suitable respiratory equipment by those involved with the procedure.

AVOIDING ACCIDENTS

- **DO NOT** pile residues onto an open deck exposed to damp or wet conditions as this may cause a fire and toxic gas hazard.
- **DO NOT** under any circumstances store residues in a closed drum or other sealed container as this may result in an explosion if a flammable phosphine: gas:air mixture ignites spontaneously, accompanied by the continuing escape of toxic phosphine gas.
- **DO NOT** store residues in an open drum exposed to damp or wet conditions.
- **DO NOT** place an open drum of waste in a compartment or locker, such as a fore-castle store, because of the risk of build-up of phosphine in the space.

To summarise, phosphide fumigants can be hazardous, but by carefully following the guidance and warnings in MSC Circulars 1264 and 1396, and the IMSBC Code and the manufacturer's instructions for the disposal of spent or partially spent material, accidents and injury can be avoided.

Source of information

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UK P&I Club – Carefully to Carry Committee Member

<http://www.ukpandi.com/loss-prevention/cargo-stowage-advice/carefully-to-carry/>

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