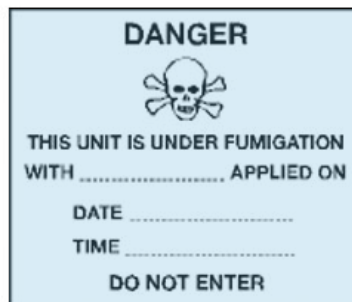


Dangers to crew during in-transit fumigation of cargo

Background

A fumigant is a chemical which under certain conditions will enter a gaseous state and in sufficient concentrations will be lethal to pest organisms. Fumigants are commonly used for killing insects in bulk cargoes like grain and other cereal products but are also used for cargoes like cocoa in bags, timber and for plants and foodstuff inside containers. In the old days fumigation would take place with the vessel in port and with the crew staying ashore, but today in-transit fumigation is the most common practice. In-transit fumigation is very convenient for the shippers but poses a certain risk to the crew members onboard, as the gases can also be deadly to humans, even in very low concentrations.



Over the years Gard has seen many cases where crew members have been exposed to dangerous concentrations of fumigant gases, some ending in fatalities and others endangering the entire crew. The purpose of this circular is therefore to alert Members and Clients to the risks involved, and their responsibility for the safety of their crew, when carrying out in-transit fumigation of cargo holds.

Fumigation in general

Hydrogen phosphide (PH₃), commonly called "phosphine", is now the most common fumigant in use for disinfestation of dry plant products loaded in bulk. Phosphine is relatively easy to handle as it is manufactured in a solid formulation of either magnesium or aluminium phosphide, often in the shape of tablets. These tablets are spread, using various methods, within the cargo or on top of it and will react when in contact with moisture. The hydrogen phosphide gases released are heavier than air and are efficient in killing insects within, for instance, a bulk cargo of grain. The most favourable conditions for the complete release of phosphine from the tablets are in tropical and subtropical climates, where four to five days are sufficient. In colder climates or in very dry atmospheres, more time is needed, in some cases more than a month.

Fumigation must be carried out by a professional fumigator whose job starts by inspecting the vessel, together with trained representatives of the Master, to decide whether the vessel is suitable for fumigation. It must be possible to make cargo holds sufficiently gastight to prevent leakage of the fumigant to the vessel's accommodation area, engine rooms and other working spaces. Very small corroded holes may act as sources of leaks of fumigant gases and can cause gas to seep into spaces occupied by the crew. In older vessels it is therefore imperative that all boundaries between cargo holds and living quarters and enclosed work spaces are thoroughly examined. Ventilators, conduct pipes for electrical cables, rubber seals and other deck and bulkhead penetrations should be given particular attention. Engine room ventilation systems may have sufficient exchange of air to prevent any build-up of dangerous concentrations of gases, but people within the accommodation areas can be more exposed, especially if extraction fans from bathrooms and toilets are in use creating a slight under-pressure.

Fumigation in transit should be carried out in accordance with strict procedures and only at the discretion of the Master. The IMO has issued recommendations on how to carry out fumigations, "*Recommendations on the safe use of pesticides in ships*", and we refer to MSC.1 Circ.1358 for general recommendations and to MSC.1 Circ.1264 and MSC.1 Circ.1361 for safety recommendations related to fumigation of cargo holds and cargo transport units, respectively. The fumigator, the vessel's management and the Master and staff onboard must be fully familiar with the IMO recommendations when establishing a procedure for how the fumigation is to be carried out and the procedure should be followed to the letter.

[→ more](#)

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Safety equipment and safety checks

The vessel must be equipped with adequate respiratory protective equipment and gas detection equipment; however, it is important to be aware of the equipment's shortcomings. Respiratory protection equipment normally consists of gas masks with a supply of filters, but gas masks may leak and filters need to be of the right type and be replaced on a regular basis. Individuals who understand the dangers of phosphine gas are likely to prefer breathing apparatus with air bottles if they have to enter a space containing gas, as the overpressure in the air supply will prevent gas leaking through the mask. It is important to emphasize, however, that entry into a space under fumigation should never take place except in the event of an extreme emergency.

With respect to detection equipment made available onboard, it is important that the crew has sufficient knowledge of how to use the equipment. Gas concentration safety checks should be carried out at regular intervals throughout the voyage and as a minimum every 8 hour as required by the IMO at all appropriate locations (accommodation area, engine rooms and other working spaces). Readings should be recorded in the ship's logbook. A permanently installed gas detector with an alarm in the accommodation area would lower the risks the crew members are exposed to, but such installations are not common onboard ships. Warning signs should be prominently displayed in relevant areas onboard.

Potential consequences for the crew

The IMO documents mentioned above list the symptoms of inhalation of phosphine gases as "nausea, vomiting, headache, weakness, fainting, chest pain, cough, chest tightness and difficulty breathing". If someone onboard a vessel carrying cargo under fumigation becomes ill, it is important to consider that the person may suffer from poisoning by the toxic fumigant gas. There are cases of crew members thought to have been suffering from seasickness or food poisoning and told to go to bed, never to wake up again. If there is a gas leak into the accommodation area, the worst place to stay could be the cabins. There is no antidote to phosphine poisoning. Treatment consists of support of respiratory and cardiovascular functions. In an emergency onboard a ship it is important to get the victims into fresh air.

Summary and recommendations

Fumigation of cargo for killing insects is normally carried out with the use of gases that are toxic and deadly to humans. As in-transit fumigation is the most common practice today, Members and Clients should be aware of the risks involved and carefully plan the operation to prevent crew being exposed to the toxic gases.

- Fumigation must only be carried out by a professional fumigator. Specific procedures for the fumigation operation must be established and must be approved by the Master. IMO's "*Recommendations on the safe use of pesticides in ships*" must be adhered to, including a formal written handover of the responsibility for maintaining safe conditions onboard from the fumigator to the Master.
- The ship should be inspected prior to the fumigation to determine whether it is suitable for fumigation. All boundaries between the vessel's cargo holds and accommodation areas, engine rooms and other working spaces must be inspected to ensure that there are no openings that can act as sources of leaks of fumigant gases and cause gas to seep into spaces occupied by the crew.
- Adequate respiratory protective equipment and gas detection equipment must be available onboard and the crew should be well trained in how to use the specific equipment. Warning signs should be displayed in relevant areas and gas concentration safety checks performed at regular intervals during the voyage.
- In case of illness among crew members during fumigation operations one must never exclude the possibility that the individuals may be suffering from poisoning by the toxic fumigant gas.

More information on the risks involved in fumigation on board ships can be found in Gard News [no. 204](#) and [no. 173](#). For the problem of toxic gases in containers, we recommend the handbook on toxic gases and vapours in cargo "*Don't get caught by surprise*" by Donald Suidman (editor), Feico Houweling and Jacques Bonewit, which can be found on web page www.tgav.info.

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