



Ship Type: Bulk Carrier

Trade Area: Worldwide

Bulletin 289 - 02/03 - Fumigation (Phosphine) Explosions

We have been informed of an explosion that occurred recently on a ship while at sea and under fumigation with phosphine gas. Whilst no crewmember was injured as a result of the explosion, a pair of hatchcover panels were blown upwards, coming to rest against the accommodation block. The cause of the explosion was attributed to the ongoing fumigation of the cargo grain that was being treated with phosphine gas generated from aluminium phosphide tablets.

We understand that whilst not a regular occurrence, this is not the first time this has occurred.

Phosphine gas has long been recognized as highly toxic. However, it is not widely known that it is, potentially, an inflammable gas, with a low flammability level of 1.8% by volume in air. In the event that a mixture of air/phosphine - in which the phosphine concentration exceeds its inflammable limit - is ignited in a confined space, it is highly probable that an explosion will occur.

Phosphine gas is generated from aluminium phosphide tablets by reaction of the aluminium phosphide with moisture in the air. This process, in addition to liberating phosphine, also produces aluminium oxide as a by-product. Additionally, small quantities of another gas known as diphosphine is also sometimes produced during this reaction. Unlike phosphine, diphosphine is spontaneously inflammable, reacting instantly with oxygen in the air. Production of diphosphine occurs in a similar way to that generating phosphine ie. by reaction between aluminium phosphide and moisture, but in this case the aluminium phosphide tablets contain an imbalance between the aluminium and phosphorous, with an excess of phosphorous compared to aluminium. Such a situation may arise during production of the tablets if an excess of phosphorous is inadvertently used during preparation.

Although not proven definitively, we have been advised that it is likely that potentially explosive mixtures of air and phosphine are frequently encountered during the first 12 to 24 hours of phosphine fumigations when the phosphine concentration in the upper reaches of the hold reaches a peak concentration. The resulting high concentrations of phosphine then disperse by diffusion, with the gas diffusing into the less accessible lower portions of the cargo. In this recent case, the explosion occurred some 12 hours or more after the fumigation had been started and the hatch covers had been closed. Although no source of ignition was identified conclusively, it is suspected that defective aluminium phosphide tablet(s), containing localised excesses of phosphorous were the cause. Such tablets could be envisaged as producing localised high concentrations of diphosphine leading to a very rapid reaction with oxygen and to ignition.

Aluminium phosphide tablets are routinely used in fumigation and a very large number of shipments are fumigated annually without any problems. Incidences of explosions are therefore very rare and as far as we have been advised, fumigant explosions have only been encountered when companies have used cheaper brands of aluminium phosphide tablets produced in developing countries.

We would advise Members that when cargoes are fumigated in ports in the developing world that the presence of crewmembers on deck adjacent to or in the vicinity of the holds and hatch covers under fumigation is kept to a minimum during the first 24 to 48 hours after the fumigation has been set.

Source of information: Loss Prevention Department