

COMPARISON BETWEEN PHOSPHINE AND METHYL BROMIDE GAS

1. General Properties of Phosphine and Methyl bromide

| Parameters | Phosphine | Methyl bromide |
|--|--|---|
| State: | It is available in solid form and emits phosphine gas. | Colourless liquid <i>(The fumigant is liquid under pressure. When in contact with air, there is immediate vaporization. The fumigant is stored in steel cylinders or tin cans)</i> |
| Odour: | Pure Phosphine is odourless, however due to impurities it has Garlic-like, decomposing fish and stale urine odour. | Odourless <i>(It is for this reason, 2% chloropicrin (tear gas) is added as warning agent)</i> |
| Common Name: | Phosphine gas | Methyl bromide |
| Chemical Name: | Hydrogen phosphide | Monobromomethane |
| Chemical formula: | PH ₃ | CH ₃ Br |
| Boiling Point: | -87.7°C | 3.6°C |
| Freezing Point : | -138.5°C | -93°C |
| Molecular Weight: | 34.04 | 94.94 |
| Density : | 1.45 Kg/m ³ at 15°C | 4.064 Kg/m ³ at 15°C |
| Flammability: | Explosive at 1.79% by volume in air. Auto-ignites at 38°C. | Non flammable |
| Solubility in water: | Very slightly soluble; reacts. 26 cc/100 cc at 17°C | Slightly soluble |
| Specific gravity at gaseous stage : | 1.214 | i) At gaseous stage: 3.27 at 0°C ii) At liquid stage : 1.732 at 0°C |
| Threshold Limit value (TLV): | 0.3 ppm or 0.4 mg/ m ³ | 5 ppm Or 19.4 mg/ m ³ |
| Relation between dosages and concentration of Gas in air: | | |
| 1 g/m ³ = | 718 ppm | 257 ppm |
| 16g/m ³ or 1 lb/1000 c.ft. = | 11493 ppm | 4121 ppm |
| Toxicity: | LD ₅₀ = 11.5 mg/kg It is toxic to Human beings and animals. | Oral LD ₅₀ = 214 mg/Kg It is toxic to Human beings and animals. |
| Natural Vapour pressure at various temperatures <i>(More the vapour pressure, better is the penetrating capability of the gas)</i> | 40 mm Hg @ -129.4 C 16416 mm Hg at 0°C (32°F); 25992 mm Hg at 20°C (68°F) 39444 mm Hg at 40°C (104°F) | 690 mm Hg at 0°C ; 1006 mm Hg at 10°C; 1390 mm Hg at 20°C; 1610 mm Hg at 25°C. |

2. Fumigation properties of phosphine and methyl bromide

The properties of phosphine and methyl bromide relevant to their use as fumigants are tabulated below:

| Phosphine | Methyl bromide |
|--|---|
| Self-ignition can occur at concentrations over 17,900 ppm (1.8%, 24.9 g/m ³) | Flammability classification - non-flammable gas |
| Penetration - excellent | Penetration - very good |
| Aeration - very good | Aeration - good |
| Sorption - slight | Sorption - is a problem with some Materials |
| Skin absorption - negligible | Skin absorption - slight |
| Chronic poison - no | Chronic poison - yes |
| Reaction: <ul style="list-style-type: none"> • as a gas - reacts with copper, gold, silver, brass, 3M copy paper | Reaction: <ul style="list-style-type: none"> • as a gas - reacts with sulfur compounds • as a liquid - reacts with aluminium and magnesium |

3. Advantages and disadvantages of phosphine and methyl bromide

Phosphine and methyl bromide each have specific advantages and disadvantages, as tabulated below and on the next page. Contracts or regulations may require that a specific fumigant must be used. Where this is not the case, it is always advisable to choose the better fumigant for the job.

| Phosphine | | Methyl bromide | |
|---|--|--|---|
| Advantages | Disadvantages | Advantages | Disadvantages |
| | Long exposure and airing period required - up to 8 days or more | Rapid kill with 24-hour exposure Broad spectrum | Cumulative poison in humans |
| | Less effective for use at temperatures below 15°C | | Less effective for use at temperatures below 10°C |
| Not an ozone depleting substance (environmentally safe) | Long-term availability for use threatened by the development of resistance | | A strong ozone depleting substance. Use will be limited to certain critical uses including quarantine and pre-shipment treatments and will be phased-out by: 2005 in industrialized countries; 2015 in developing Countries |

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|---|--|--|--|
| When properly used, leaves residues of no commercial significance | Repeated application of tablets or pellets into grain may leave residues above the maximum residue limit (MRL) | | Leaves residues of commercial importance |
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FUMIGATION UNDER GAS-PROOF SHEETS

| Phosphine | | Methyl bromide | |
|---|---|---|--|
| Advantages | Disadvantages | Advantages | Disadvantages |
| Simple application Procedure. Existing expertise and training and manuals | Ease of application and misunderstanding of gas loss have led to misuse and overreliance on a single method | Existing expertise and training and manuals | Application fairly complex. Requires electricity |
| Disperses rapidly inside the enclosure. No fans required | | | Must be vaporized and delivered as a hot gas. Requires fans (and electricity) for effective dispersion inside the enclosure. |
| Airs off easily after treatment | | | Airs off slowly and requires fans (and electricity) |
| Relatively easy and safe to transport when in original packaging | | | Supplied in cylinders that are heavy and relatively difficult to Transport; however, now they are also supplied in Cans. |
| Cheap | | | Becoming more Expensive because of the international phase-out process |
| Not known to affect germination | | | Germination can be affected – varies with seed and moisture content |