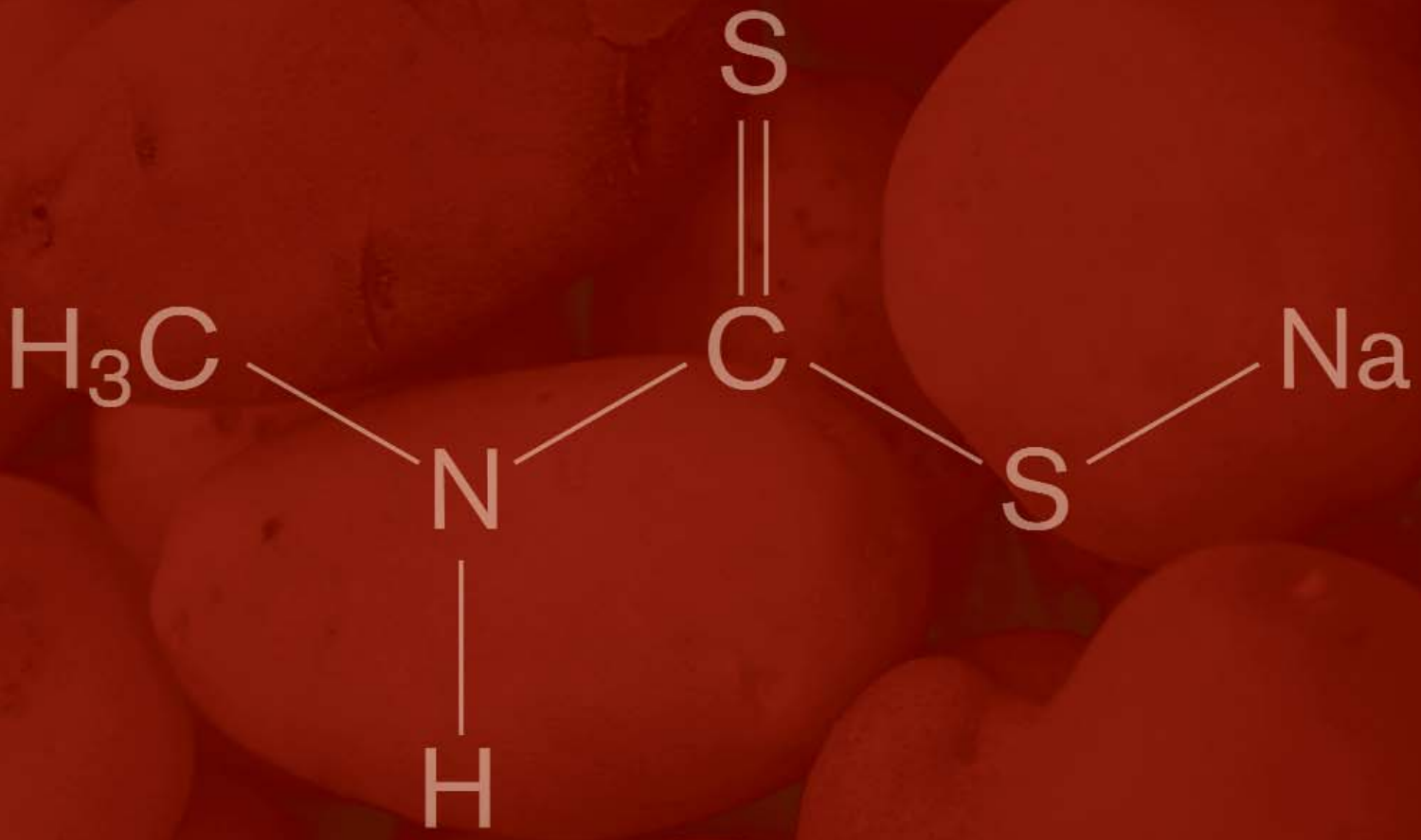
VAPAM® HL

A Soil Fumigant Solution for all Crops



metam sodium

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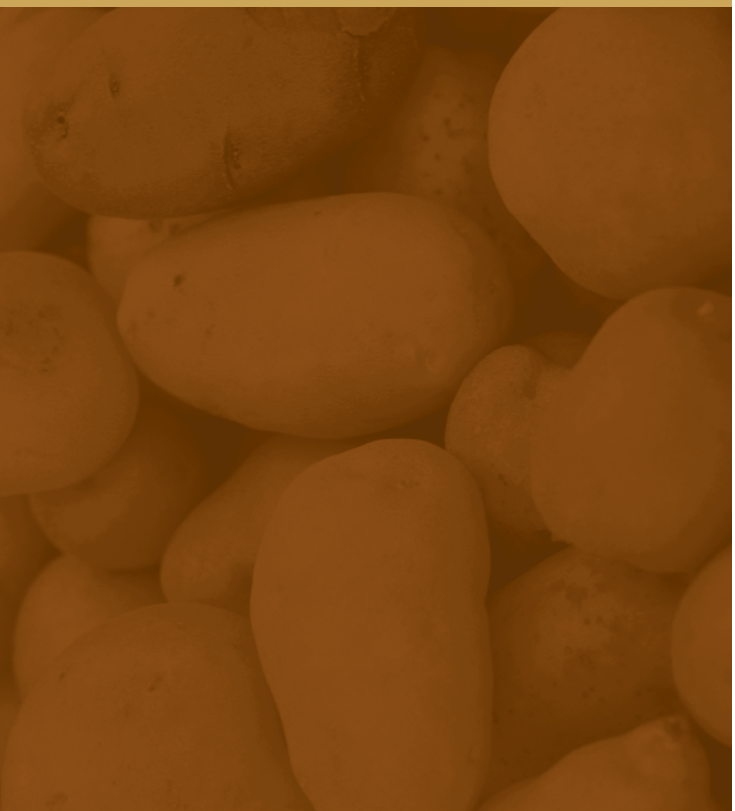
Vapam HL has been applied successfully using solid set sprinklers, linear movable sprinklers, drip irrigation, soil drench, spray blades, shank injection and power tillers.

Vapam HL in combination with Telone® and/or chloropicrin has been successfully applied commercially in various fruit and nut tree crops, vegetables and ornamental plant production. Vapam HL, in combination with Telone and chloropicrin, is a viable alternative to methyl bromide. Properly applied and incorporated, these combinations successfully control most soil pests. Proper application is the key to success.

Vapam HL is a registered soil fumigant for all crops.



PESTS CONTROLLED AND/OR SUPPRESSED WITH VAPAM HL

Nematodes

All species are susceptible when proper contact is achieved.

Diseases

Rhizoctonia, Pythium, Phytophtora, Verticillium, Sclerotinia, Oak Root Fungus, Fusarium. Active forms of the above listed pathogens are more susceptible. Resting forms are more difficult to control.

Weeds

Weed seeds must be respiring in order to be controlled. Germination is not required for control to be effective. Some seed coats are difficult to penetrate and may result in poor control unless the seeds are actively growing and good contact is achieved. Contact with the foliage and roots usually controls emerged, actively growing plants.

GENERAL INSTRUCTIONS

Soil Conditions

Before applying Vapam HL, always thoroughly cultivate the area to be treated, breaking up clods and loosening the soil to facilitate the uniform distribution of Vapam HL.

Proper moisture in the field is essential for optimum activity of Vapam HL. Soil moisture should be 50 to 80% of field capacity.

Field conditions such as soil type, soil temperature, soil structure, organic matter content and mineral makeup of soil directly impact the mobility and conversion reaction of metam sodium to MITC and the performance of the product.

Field Monitoring

For all applications, the applicator (Grower or Pest Control Operator (PCO)) should monitor the application site for the following conditions.

1. Wind Conditions
2. Air Temperature
3. Soil Temperature
4. Presence or absence of odors downwind of the application site.

Monitoring of the field should be conducted prior to, during and at the completion of all Vapam HL applications and for several hours thereafter. Always observe best management procedures to minimize off-site movement of odors when applying Vapam HL. Always consult local agricultural regulations for requirements.

Methods of Application

Vapam HL can be applied by various methods of application and through various types of application equipment. A chemigation application through the irrigation system can utilize sprinkler, flood and drip application equipment. Sprinkler and flood applications provide broadcast coverage. The depth and extent of Vapam HL movement into the soil is dependent upon soil type, duration of application time and amount of water used for the application.

Drip applications can use existing drip lines, or in some situations may require an additional drip line to ensure proper coverage. This form of application places the Vapam HL in the crop row seedbed. It can provide excellent protection in the root growing area of the soil. The depth and area of coverage depends on the amount of water applied and the duration of the application.

Injection by blade or shanks can place the Vapam HL in a band or in several bands vertically and horizontally in the soil. This method provides exact placement and generally targets specific pests.

Power incorporated applications place the Vapam HL in the upper levels of the soil profile distributing the Vapam HL throughout the incorporated zone. The placement of the Vapam HL is dependent on the depth of incorporation.

VAPAM HL CHEMIGATION GUIDE

1. Pre-application soil moisture should be 50 to 80% of field capacity in the top 4 to 6 inches at the time of application. (Refer to “Hands-On” chart below.)
2. The soil should be in seedbed condition, free of large clods.
3. For optimum results, beds should be listed, shaped and ready for planting.
4. Before working on, repairing, adjusting or calibrating injection equipment, personal protective equipment must be worn by all workers.
5. Make sure all hose connections are secure, sealed and tightened.
6. Inspect check valves, back-flow preventers, vacuum relief valves and low-pressure drains. Do not allow any chemical to flow into the water supply.
7. Determine that interlocking controls are installed and functioning.
8. Check the irrigation system for leaks.
9. Monitor the field application.
10. Flush irrigation system at the conclusion of the application.
11. Monitor the field to assure that no odors are released.

Contact your AMVAC representative for the complete Chemigation Guide at **1-888 GO AMVAC (462-6822)** or visit www.amvac-chemical.com.

“HANDS-ON” SOIL MOISTURE IDENTIFICATION

% MOISTURE	SAND	SANDY LOAM	CLAY LOAM	CLAY
Close to 0%	Dry, loose, single-grained, flows through fingers	Dry, loose, flows through fingers	Dry clods, breaks down into powdery condition	Hard, baked, cracked surface, loose crumbs on surface
50% or less	Appears dry, will not form a ball	Appears dry, will not form a ball	Crumbly, holds together, with pressure	Pliable, will form a ball under pressure
50% – 75%	Appears dry, will not form a ball	Will form a ball, will not hold together	Forms a ball slight slick with pressure	Forms a ball, ribbons between fingers
75% to field capacity	Sticks together, forms a weak ball	Forms a weak ball, will not become slick	Forms a ball, very pliable, readily forms a slick	Easily ribbons between fingers
Field Capacity	Under pressure moisture appears	Under pressure moisture appears	Under pressure moisture appears	Under pressure moisture appears

“Hands-On” gives in-field guidelines for identifying field moisture. This is an estimate only. Adapted from R. H. Coppock (Eds.), *Saving Water in Landscape Irrigation*, University of California, division of Ag. Science Leaflet 2976 (1978).

VAPAM HL DRIP FUMIGATION GUIDE

System Considerations

Emitters along the drip tape should be placed no more than 12 inches apart. The position of the drip tape is an important factor in the effective distribution of Vapam HL in the plant bed. Best results are obtained when the tape is positioned on the bed surface under the tarp (plastic). The system should be divided into quadrants sized to provide uniform distribution of the water and the Vapam HL.

Soil Preparation

The soil should be prepared and tilled properly. Pre-irrigate to initiate weed seed germination and activation of soil borne pests. The beds should be free of clods and firmly packed. The plastic tarp used over the shaped bed should not have holes or tears. Poor water distribution will result in poor fumigation and therefore poor results.

Amount of Water

To ensure optimal control of pests, fumigation must be done with an appropriate amount of water. In loamy soils, an application of 1.75 inches of water will wet more than 20 inches deep. Although Vapam HL will volatilize and may move beyond the wetted zone, the best treatment occurs within the wetted area. Application of Vapam HL in less than 1.5 inches of water often results in poor fumigant distribution and high volatilization losses, which diminishes the ability to control soil borne pathogens and other pests. Drip fumigation with a larger amount of irrigation water will result in better fumigant distribution in soil and will reduce fumigant volatilization losses. In sandy and loamy sand soils, limited lateral water movement may limit fumigation distribution.

VAPAM HL GROUND APPLICATION GUIDE

Vapam HL Application and Field Conditions

1. Moisture in the field is essential for optimum activity of Vapam HL. Soil moisture should be 50 to 80% of field capacity.
2. Pre-irrigation to thoroughly wet the treatment zone is recommended 7 to 10 days prior to application.
3. If drying conditions occur prior to application, a second irrigation should be made to ensure proper soil moisture during application.
4. Field should be in seed bed condition and free of clods.
5. The application should be properly calibrated with the correct rate for the targeted pest.
6. Proper placement of product in the soil is critical for optimum activity.

Follow the Vapam HL label directions for Worker Protection Standard. The MSDS also provides additional information about the safe handling of Vapam HL.

Spray Blade Application (for a weed control band)

1. Apply only on pre-formed and ready-to-plant beds. This will ensure accurate placement of product and assist in decapping.
2. Product should be applied at a depth of 3 to 4 inches from the top of the pre-formed bed.
3. The soil cap should be 5 to 9 inches and cover more than the width of the blade application.
4. The soil cap should not be cloddy, nor a mud slab with excessive moisture. The capping soil should be in good tilth to prevent volatilization of MITC.
5. The nozzle should have a spray width adequate to cover the width of the spray blade.
6. Decapping should not be deeper than the bed top.

Shank Injection Application

This method of application must be tailored to the pest. Weeds and disease applications require different methods of placement than for nematodes. Contact your retailer or local Amvac representative for specific recommendations.

Rotary Tiller or Power Mulcher Application

1. Tines should be “L” or “C” shaped. Straight tines should not be used.
2. When using shanks to apply the product ahead of the power tiller, the shanks should be 4 to 5 inches apart. The application and incorporation should be done in front of soil covering equipment such as bed shaper, and/or a roller/packer to smooth, compact and seal the soil surface.

3. When spraying Vapam HL immediately ahead of the power tiller, the tiller should be set to cut at a depth of 5 to 6 inches followed immediately with a roller/packer to smooth and seal the soil surface.

Choose the application method that best suits the target pest so the method of application will place the highest concentration of Vapam HL in the proper section of the soil profile. Vapam HL should be placed at or slightly below the target pest. Regardless of the method of application, certain conditions must be met to ensure Vapam HL's effectiveness (see below). Consult the label for additional information.

Key Aspects of Vapam HL for Optimum Pest Control

- A lethal concentration of MITC must be present while the target species is actively respiring.
- Re-infestation of the treated zone must be avoided after the application.
- Avoid trashy soil where the pest can be protected or prevent the soil from being properly sealed.
- Pre-irrigation is essential to enhance pest activation and optimum release of MITC (see Mode of Action section).
- The fields to be treated should be in seedbed condition to ensure optimum pest control (i.e., loosen soil deeply and thoroughly).
- Soil temperature should be optimum (50°F – 90°F) for the pest development, (40°F – 90°F in the PNW and Mid-West).
- Prevent the loss of MITC from the soil (i.e., by tarp, using a water or soil cap).
- Eliminate or minimize soil movement (tillage) after a Vapam HL application.

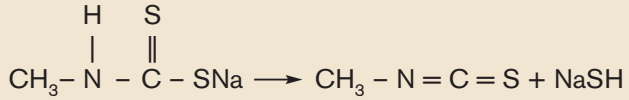
Testing of Treated Soils Before Planting

The information below describes a simple test to assay for harmful residual soil fumigants before planting.

Lettuce Seed Test

1. With a trowel, dig into the treated soil to or just below the depth of application. Remove 2 to 4 small (1 to 2 oz) soil samples, mix lightly and immediately place a portion in an air-tight jar so that fumes will not escape. Use mason, wheat germ or similar jars with gas-tight lids.
2. Sprinkle lettuce seeds on the moistened surface of the soil and recap immediately. Prepare a similar jar with untreated soil (untreated check) for comparison.
3. Keep the jars at 65°F to 85°F; do not place in direct sunlight. Direct sunlight may kill the seeds by overheating. Lettuce seeds will not germinate in the dark.

DECOMPOSITION



Metam Sodium — Methyl Isothiocyanate (MITC) — Sodium Hydrosulfide

MITC is the primary biologically active ingredient.

IN SUMMARY

Metam Sodium → MITC → Hydrogen (H), Sulfur (S), Nitrogen (N)

4. Inspect the jars for germination in 1 to 3 days.
5. The soil is safe for planting if seeds in the treated jar germinate the same as seeds in the untreated jar.

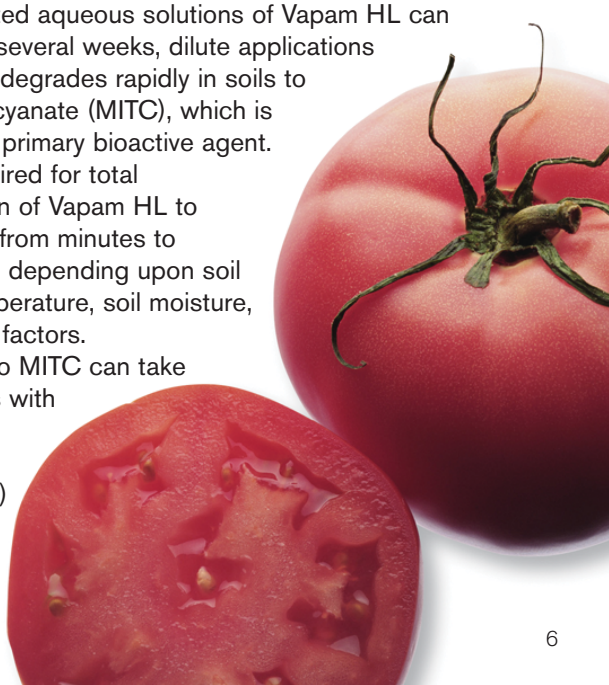
IMPORTANT: Be sure (1) to sample the field properly in several areas, particularly low, wet areas; (2) that the lids are air tight and have no grit under the seal; and (3) that the jars are placed in indirect sunlight.

MODE-OF-ACTION AND BEHAVIOR IN THE SOIL

Once Vapam HL is in moist soil it becomes a powerful biocide that can significantly reduce nematode populations, suppress fungi and bacteria and effectively reduce weed seed germination in the treated zone. Within approximately 14 to 21 days following application, Vapam HL breaks down into naturally occurring components containing carbon, hydrogen, sulfur and nitrogen.

Degradation

Although diluted aqueous solutions of Vapam HL can be stable for several weeks, dilute applications of Vapam HL degrades rapidly in soils to methylisothiocyanate (MITC), which is the product's primary bioactive agent. The time required for total decomposition of Vapam HL to MITC ranges from minutes to several hours, depending upon soil type, soil temperature, soil moisture, pH and other factors. (Conversion to MITC can take longer in soils with low pH and at cold soil temperatures.)



APPROXIMATE RATES OF METAM SODIUM CONVERSION TO MITC IN VARIOUS CALIFORNIA SOILS

SOIL COMPOSITION			% METAM SODIUM DECOMPOSITION	
	% Clay	% Organic Matter	1 min.	60 mins.
Egbert Peat	–	34	94	100
Bowers Clay	48	5	70	100
Sacramento Clay Loam	32	4.3	70	100
Yolo Clay Loam	33	2.1	64	100
Sorrento Loam	18	1.8	70	94
Salinas Silty Clay Loam	19	1.9	54	93
Holtville Silty Clay	39	1.4	46	92
Chualar Coarse Sandy Loam	9	0.6	36	74
Santa Cruz Loamy Sand	5	3.6	39	74
Greenfield Sandy Loam	7	2.8	36	71
Hesperia Sandy Loam	5	0.4	17	43
Hanford Sandy Loam	–	–	0	28
Builders Sand	–	<0.2	0	10

The biological activity of MITC is believed to be the result of the chemical inactivation of bio-chemically important thiol groups within cells. The thiocyanate portion of the MITC reacts with enzymes in the pests that contain free sulfhydryl groups.

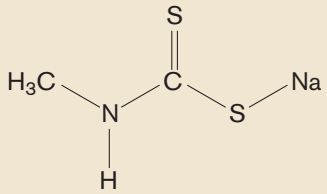
Soils with high clay contents exhibit higher rates of degradation of Vapam HL. Soils high in organic matter and clay absorb more MITC than soils with little or no clay and organic matter.

The rate of Vapam HL degradation is also strongly dependent upon the moisture content of the soil and the concentration of Vapam HL in the aqueous phase. Under conditions prevailing in soils during and after irrigation, the breakdown of Vapam HL is rapid enough that the main component in the percolating water will be MITC.

MITC breakdown in course-textured soils (<20% clay) is slow enough that the MITC concentration remains in the soil long enough to be effective. In fine-textured soils, absorption of MITC might cause a significant delay in MITC advancement through the soil, necessitating a higher application rate of Vapam HL, particularly when applied through irrigation systems.

The rate of breakdown of Vapam HL is also increased by high temperature, low moisture and high pH. The degradation of Vapam HL is not correlated with the presence of organisms and it is more rapid in soil than in aqueous solutions.

CHEMICAL AND PHYSICAL PROPERTIES

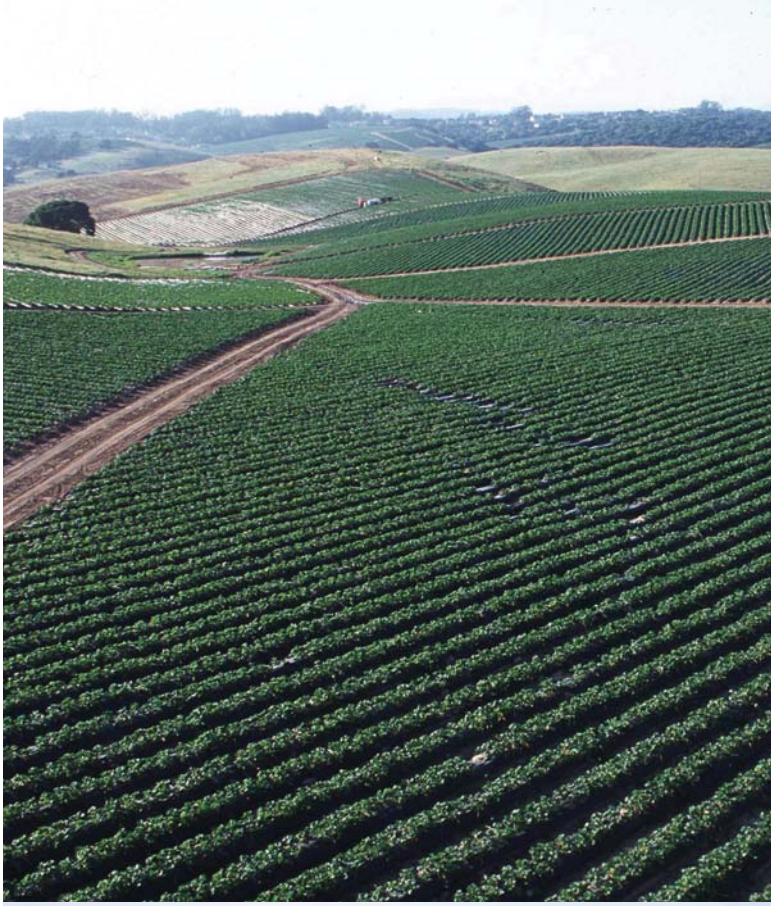
Chemical Family	Dithiocarbamate
Chemical Name	Sodium N-methyldithiocarbamate
	
Molecular Wt.	129.17
Color & Form	Crystalline sodium methyldithiocarbamate is an unstable white solid. Formulation can be colorless or a light green to light yellow liquid.
Boiling Point	112°C/234°F
Crystallization Point	0°C (32°F)
Specific Gravity	1.208 g/ml @ 20°C/4°C(68°F/39°F)
Density	10.06 lb/gal
Vapor Pressure (mm/Hg)	24 mm Hg @ 250C
Solubility in Water	Miscible

Upon application, dilute Vapam HL moves through the soil passages, with high concentrations moving toward areas with lower concentrations. Under normal soil conditions, Vapam HL reacts with soil constituents to produce MITC. Although there are several pathways of degradation for Vapam HL, under most soil conditions MITC further breaks down into hydrogen sulfide (which can also exhibit biocide activity), and finally to molecules containing hydrogen, sulfur and nitrogen. Allow 14 to 21 days after an application to pass before planting. If an application is under tarp it may take 30 days before it is safe to plant.

Movement in the Soil

The vertical and horizontal movement of Vapam HL in the soil is primarily dependent on water movement which is dependent on many factors. The most important of which are soil type (hydraulic conductivity and water holding capacity), initial soil moisture conditions, soil compaction, presence of shallow subsurface impermeable layers, water table and rate/volume of water delivery. Additional factors, which affect water infiltration and radial movement, will also affect the movement of Vapam HL through the soil profile, both horizontally and vertically.

Vapam HL is extremely soluble and moves with the waterfront. Osmosis is the “driving force” for moving Vapam HL throughout the soil profile. Vapam HL will move from areas of high concentration to areas where there is little or no concentration (i.e., concentration gradient). Vapam HL fumigation activity will not move vertically or horizontally past the point moved by the water front.



STABILITY AND REACTIVITY

Chemical Stability (Conditions to avoid)

This product is unstable as a dilute water (aqueous) solution, decomposing to methylisothiocyanate (MITC), and will also slowly degrade in the presence of air. As originally packaged, it is stable under normal storage conditions for up at least 2 years or more.

Incompatibility

This product is incompatible with strong aqueous acids. In addition, it is corrosive to copper, brass and zinc, and may soften and/or discolor iron. Tank mixing Vapam HL with fertilizer is not recommended.

Hazardous Decomposition Products

When mixed with water or heated to decomposition, this product will give off toxic fumes of methlisothiocyanate (MITC), hydrogen sulfide and nitrogen oxides. Do not mix Vapam HL with acid based fertilizers or adjuvants.

Hazardous Polymerization

This product will not polymerize.

Carcinogenicity

Laboratory studies have shown some developmental and carcinogenic effects in laboratory animals. Exposure monitoring studies conducted during agricultural applications of metam sodium have shown that human exposure is extremely low, therefore, any potential risk to humans from metam sodium exposure is considered minimal. Care should be exercised and all label instructions should be followed in the handling of Vapam HL soil fumigant.

ECOLOGICAL INFORMATION

This product is toxic to fish. Do not apply directly to areas where surface water is present or to inter tidal areas below the mean high water mark. Do not contaminate water when disposing of equipment wash water.

DISPOSAL CONSIDERATIONS

This product is not a Resource Conservation and Recovery Act (RCRA) hazardous waste. Disposal must be at an approved waste facility for chemical wastes. The empty container must be triple rinsed prior to disposal.

Consult the label and with Federal, State or local disposal authorities for the actual method(s) to be followed.

U.S. FEDERAL REGULATIONS

This product is registered under EPA/FIFRA Regulations. It is a violation of Federal Law to use this product in any manner inconsistent with its labeling. Read and follow all label directions. This product is excluded from listing requirements under Environmental Protection Agency and the Toxic Substances Control Act (EPA/TSCA).

SARA Title III Data, Section 311 & 312 Hazard Categories

Immediate Health Hazard	Yes
Delayed Health Hazard	Yes
Fire Hazard	No
Reactive Hazard	No
Sudden Pressure Release Hazard	No

Consult the VAPAM HL MSDS for additional information on hazards, handling, toxicology, shipping, storage, and Personal Protective Equipment for handling.

TOXICOLOGICAL INFORMATION

Ingestion	Oral LD50 (rat)	812 mg/kg
Inhalation	Inhalation LC50 (rat)	2.28 mg/L
Dermal	Skin LD50 (rabbit)	>2020 mg/kg
Eye Irritation	–	Irritant
Skin Irritation	–	Irritant
Other	Skin sensitization (guinea pig)	Sensitizer

For more information about VAPAM® HL contact your local agricultural chemical retailer, call **1-888 GO AMVAC (462-6822)** or visit www.amvac-chemical.com.

Photos courtesy of Scott Bauer, USDA, James Luzader, USDA NRCS, Gene Alexander, USDA NRCS, Joe Larsen, USDA NRCS, Lynn Betts, USDA NRCS, Jeff Vanuga, USDA NRCS

Always read and follow all label directions and use precautions. Always pre-test for phytotoxicity prior to large-scale use.

AMVA-001