Material Safety Data Sheet

Metiram
sc-250404

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
Metiram

STATEMENT OF HAZARDOUS NATURE

NFPA

SUPPLIER
Santa Cruz Biotechnology, Inc.
2145 Delaware Avenue
Santa Cruz, California 95060
800.457.3801 or 831.457.3800

EMERGENCY
ChemWatch
Within the US & Canada: 877-715-9305
Outside the US & Canada: +800 2436 2255
(1-800-CHEMCALL) or call +613 9573 3112

SYNONYMS
"zinc ammoniate ethylenebis(dithiocarbamate)-poly(ethylene thiuram disulfide)", tris(amine(ethylenebis(dithiocarbamate)zinc(2+)), "(tetrahydro-1, 2, 4, 7-dithiadiazine-3, 8-dithione) polymer", polyram, carbate, "NIA 9102", "RCRA U114"

Section 2 - HAZARDS IDENTIFICATION

CHEMWATCH HAZARD RATINGS

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flammability</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Toxicity</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Body Contact</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Reactivity</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Chronic</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

CANADIAN WHMIS SYMBOLS

1 of 12
EMERGENCY OVERVIEW

RISK
Harmful if swallowed.
Very toxic to aquatic organisms.

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED
- Accidental ingestion of the material may be harmful; animal experiments indicate that ingestion of less than 150 gram may be fatal or may produce serious damage to the health of the individual.
- Lethal doses of some thiocarbamates have produced muscle weakness and ascending paralysis progressing to respiratory paralysis and death in animals. Exposure to small quantities of thiocarbamates and intake of small quantities of ethanol may produce flushing, breathing difficulties, nausea and vomiting and lowered blood pressure. Sensitization to alcohol may last as long as 6-14 days following exposure.
- The acute toxicity of thiocarbamates is generally low, because of their rapid metabolism. Exposure to high doses may produce signs such as loss of appetite, squinting, excessive production of saliva, watery eyes, hair standing on end, laboured breathing, reduced body temperature, incoordination, depression and rapid muscle twitching.

EYE
- Although the material is not thought to be an irritant (as classified by EC Directives), direct contact with the eye may cause transient discomfort characterised by tearing or conjunctival redness (as with windburn). Slight abrasive damage may also result. The material may produce foreign body irritation in certain individuals.

SKIN
- Skin contact is not thought to produce harmful health effects (as classified under EC Directives using animal models). Systemic harm, however, has been identified following exposure of animals by at least one other route and the material may still produce health damage following entry through wounds, lesions or abrasions. Good hygiene practice requires that exposure be kept to a minimum and that suitable gloves be used in an occupational setting.
- Open cuts, abraded or irritated skin should not be exposed to this material.
- Entry into the blood-stream, through, for example, cuts, abrasions or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.

INHALED
- The material is not thought to produce either adverse health effects or irritation of the respiratory tract following inhalation (as classified by EC Directives using animal models). Nevertheless, adverse systemic effects have been produced following exposure of animals by at least one other route and good hygiene practice requires that exposure be kept to a minimum and that suitable control measures be used in an occupational setting.
- Persons with impaired respiratory function, airway diseases and conditions such as emphysema or chronic bronchitis, may incur further disability if excessive concentrations of particulate are inhaled.

CHRONIC HEALTH EFFECTS
- Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.

Based on experience with similar materials, there is a possibility that exposure to the material may reduce fertility in humans at levels which do not cause other toxic effects.

Long term exposure to high dust concentrations may cause changes in lung function i.e. pneumoconiosis; caused by particles less than 0.5 micron penetrating and remaining in the lung. Prime symptom is breathlessness; lung shadows show on X-ray.

Some dithiocarbamates may cause birth defects and cancer and may affect male reproductive capacity. They may also cause goitre (overactivity of the thyroid gland) and nerve disorders.

Thiocarbamates have been show to alter sperm form and therefore reproduction.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>NAME</th>
<th>CAS RN</th>
<th>%</th>
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<tbody>
<tr>
<td>metiram</td>
<td>9006-42-2</td>
<td>&gt;98</td>
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</tbody>
</table>
Section 4 - FIRST AID MEASURES

SWALLOWED

- IF SWALLOWED, REFER FOR MEDICAL ATTENTION, WHERE POSSIBLE, WITHOUT DELAY.
- For advice, contact a Poisons Information Centre or a doctor.
- Urgent hospital treatment is likely to be needed.
- In the mean time, qualified first-aid personnel should treat the patient following observation and employing supportive measures as indicated by the patient's condition.
- If the services of a medical officer or medical doctor are readily available, the patient should be placed in his/her care and a copy of the MSDS should be provided. Further action will be the responsibility of the medical specialist.
- If medical attention is not available on the worksite or surroundings send the patient to a hospital together with a copy of the MSDS. Where medical attention is not immediately available or where the patient is more than 15 minutes from a hospital or unless instructed otherwise
- INDUCE vomiting with fingers down the back of the throat, ONLY IF CONSCIOUS. Lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration.
  NOTE Wear a protective glove when inducing vomiting by mechanical means.

EYE

If this product comes in contact with the eyes
- Wash out immediately with fresh running water.
- Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids.
- Seek medical attention without delay; if pain persists or recurs seek medical attention.
- Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.

SKIN

- If skin or hair contact occurs
  - Flush skin and hair with running water (and soap if available).
  - Seek medical attention in event of irritation.

INHALED

- If dust is inhaled, remove from contaminated area.
- Encourage patient to blow nose to ensure clear passage of breathing.
- If irritation or discomfort persists seek medical attention.

NOTES TO PHYSICIAN

- Medical literature on human exposure to thio Carbamate derivatives is scarce.
- Animal studies suggest that contact dermatitis and thyroid hyperplasia may occur following exposure.
- These compounds do not have the cholinergic properties of structurally related carbamate insecticides.
- The usual measures for gut and skin contamination are recommended for large doses.
- Some thio Carbamates are structurally similar to disulfiram and may cause the characteristically unpleasant alcohol type reactions lasting for several hours; they may respond to fluids, oxygen and analgesics. Dysrhythmias may occur and patients with serious reactions should have cardiac monitoring.
- Precautions should be taken to prohibit intake of alcohol for 10 days.
- Fats, oils and lipid solvents must not be consumed as they may enhance absorption.

As a general rule thio Carbamates can be absorbed by the skin, mucous membranes and respiratory and gastrointestinal tract. They are eliminated quickly via expired air and urine. Two major pathways exist for the metabolism of thio Carbamates in mammals. One is via sulfoxidation and conjugation with glutathione. The conjugation product is cleaved to the cysteine derivative which is further metabolised to a mercapturic acid compound. The second route involves oxidation of the sulfur to a sulfoxide which is oxidised to a sulfone, or hydroxylation to compounds which enter the carbon metabolic pool.

Section 5 - FIRE FIGHTING MEASURES

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
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<tr>
<td>Vapor Pressure (mmHG)</td>
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<tr>
<td>Upper Explosive Limit (%)</td>
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<tr>
<td>Specific Gravity (water=1)</td>
<td>Not available</td>
</tr>
<tr>
<td>Lower Explosive Limit (%)</td>
<td>Not available.</td>
</tr>
</tbody>
</table>

EXTINGUISHING MEDIA

- Alcohol stable foam.
- Foam.
- Dry chemical powder.
- BCF (where regulations permit).
- Carbon dioxide.
- Water spray or fog - Large fires only.

FIRE FIGHTING

- Alert Fire Brigade and tell them location and nature of hazard.
- Wear breathing apparatus plus protective gloves.
- Prevent, by any means available, spillage from entering drains or water courses.
- Use water delivered as a fine spray to control fire and cool adjacent area.
- DO NOT approach containers suspected to be hot.
- Cool fire exposed containers with water spray from a protected location.
- If safe to do so, remove containers from path of fire.
- Equipment should be thoroughly decontaminated after use.

When any large container (including road and rail tankers) is involved in a fire, consider evacuation by 100 metres in all directions.

Section 6 - ACCIDENTAL RELEASE MEASURES

MINOR SPILLS
- Remove all ignition sources.
- Clean up all spills immediately.
- Avoid contact with skin and eyes.
- Control personal contact by using protective equipment.
- Use dry clean up procedures and avoid generating dust.
- Place in a suitable, labelled container for waste disposal.

Environmental hazard - contain spillage.

MAJOR SPILLS
Environmental hazard - contain spillage.
Moderate hazard.
- CAUTION Advise personnel in area.
- Alert Emergency Services and tell them location and nature of hazard.
- Control personal contact by wearing protective clothing.
- Prevent, by any means available, spillage from entering drains or water courses.
- Recover product wherever possible.
- IF DRY Use dry clean up procedures and avoid generating dust. Collect residues and place in sealed plastic bags or other containers for disposal. IF WET Vacuum/shovel up and place in labelled containers for disposal.
- ALWAYS Wash area down with large amounts of water and prevent runoff into drains.
If contamination of drains or waterways occurs, advise Emergency Services.

**Section 7 - HANDLING AND STORAGE**

**PROCEDURE FOR HANDLING**
- Avoid all personal contact, including inhalation.
- Wear protective clothing when risk of exposure occurs.
- Use in a well-ventilated area.
- Prevent concentration in hollows and sumps.
- DO NOT enter confined spaces until atmosphere has been checked.
- DO NOT allow material to contact humans, exposed food or food utensils.
- Avoid contact with incompatible materials.
- When handling, DO NOT eat, drink or smoke.
- Keep containers securely sealed when not in use.
- Avoid physical damage to containers.
- Always wash hands with soap and water after handling.
- Work clothes should be laundered separately. Launder contaminated clothing before re-use.
- Use good occupational work practice.
- Observe manufacturer's storing and handling recommendations.
- Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions are maintained.
- Empty containers may contain residual dust which has the potential to accumulate following settling. Such dusts may explode in the presence of an appropriate ignition source.
- Do NOT cut, drill, grind or weld such containers.
- In addition ensure such activity is not performed near full, partially empty or empty containers without appropriate workplace safety authorization or permit.

**RECOMMENDED STORAGE METHODS**
- Glass container is suitable for laboratory quantities
- Polyethylene or polypropylene container.
- Check all containers are clearly labelled and free from leaks.

**STORAGE REQUIREMENTS**
- Store in original containers.
- Store at room temperature.
- Keep containers securely sealed.
- Store in a cool, dry area protected from environmental extremes.
- Store away from incompatible materials and foodstuff containers.
- Protect containers against physical damage and check regularly for leaks.
- Observe manufacturer's storing and handling recommendations

For major quantities
- Consider storage in bunded areas - ensure storage areas are isolated from sources of community water (including stormwater, ground water, lakes and streams).
- Ensure that accidental discharge to air or water is the subject of a contingency disaster management plan; this may require consultation with local authorities.

**Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION**

<table>
<thead>
<tr>
<th>Source</th>
<th>Material</th>
<th>TWA ppm</th>
<th>TWA mg/m³</th>
<th>STEL ppm</th>
<th>STEL mg/m³</th>
<th>Peak ppm</th>
<th>Peak mg/m³</th>
<th>TWA F/CC</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Canada - Ontario Occupational Exposure Limits</td>
<td>metiram (Particles Insoluble or Poorly Soluble) Not Otherwise</td>
<td>10 (I)</td>
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<td>Canada - British Columbia Occupational Exposure Limits</td>
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<tr>
<td>Location</td>
<td>Classification</td>
<td>Substance Description</td>
<td>Limit</td>
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<tr>
<td>Canada - Ontario</td>
<td>Occupational Exposure Limits</td>
<td>metiram (Specified (PNOS) / Particules (insolubles ou peu solubles) non précisées par ailleurs)</td>
<td>3 (R)</td>
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<td>US - Tennessee</td>
<td>Occupational Exposure Limits - Limits For Air Contaminants</td>
<td>metiram (Particulates not otherwise regulated Respirable fraction)</td>
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<td>US - California</td>
<td>Permissible Exposure Limits for Chemical Contaminants</td>
<td>metiram (Particulates not otherwise regulated Respirable fraction)</td>
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<td>US - Oregon</td>
<td>Permissible Exposure Limits (Z-1)</td>
<td>metiram (Particulates not otherwise regulated (PNOR) (f) Total Dust)</td>
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<td></td>
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<tr>
<td>US - Oregon</td>
<td>Permissible Exposure Limits (Z-1)</td>
<td>metiram (Particulates not otherwise regulated (PNOR) (f) Respirable Fraction)</td>
<td>5</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>US - Wyoming</td>
<td>Toxic and Hazardous Substances Table Z1 Limits for Air Contaminants</td>
<td>metiram (Particulates not otherwise regulated (PNOR)(f) Respirable fraction)</td>
<td>5</td>
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<td></td>
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</tbody>
</table>

**PERSONAL PROTECTION**
RESPIRATOR
- Particulate. (AS/NZS 1716 & 1715, EN 1432000 & 1492001, ANSI Z88 or national equivalent)

EYE
- Safety glasses with side shields
- Chemical goggles.
- Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lens or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59], [AS/NZS 1336 or national equivalent]

HANDS/FEET
- Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include:
  - frequency and duration of contact,
  - chemical resistance of glove material,
  - glove thickness and dexterity
- Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739, AS/NZS 2161.1 or national equivalent).
- When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended.
- When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater than 60 minutes according to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended.
- Contaminated gloves should be replaced.
- Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.
- Experience indicates that the following polymers are suitable as glove materials for protection against undissolved, dry solids, where abrasive particles are not present.
  - polychloroprene
  - nitrile rubber
  - butyl rubber
  - fluorocautchouc
  - polyvinyl chloride
- Gloves should be examined for wear and/or degradation constantly.

OTHER
- Overalls.
- P.V.C. apron.
- Barrier cream.
- Skin cleansing cream.
- Eye wash unit.

ENGINEERING CONTROLS
- Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection.
- The basic types of engineering controls are:
  - Process controls which involve changing the way a job activity or process is done to reduce the risk.
  - Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment. Ventilation can remove or dilute an air contaminant if designed properly.
  - The design of a ventilation system must match the particular process and chemical or contaminant in use.
- Employers may need to use multiple types of controls to prevent employee overexposure.
- Local exhaust ventilation is required where solids are handled as powders or crystals; even when particulates are relatively large, a certain proportion will be powered by mutual friction.
- Exhaust ventilation should be designed to prevent accumulation and recirculation of particulates in the workplace.
- If in spite of local exhaust an adverse concentration of the substance in air could occur, respiratory protection should be considered. Such protection might consist of:
  - (a) particle dust respirators, if necessary, combined with an absorption cartridge;
  - (b) filter respirators with absorption cartridge or canister of the right type;
(c) fresh-air hoods or masks

- Build-up of electrostatic charge on the dust particle, may be prevented by bonding and grounding.
- Powder handling equipment such as dust collectors, dryers and mills may require additional protection measures such as explosion venting.

Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to efficiently remove the contaminant.

<table>
<thead>
<tr>
<th>Type of Contaminant</th>
<th>Air Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>direct spray, spray painting in shallow booths, drum filling, conveyor loading,</td>
<td>1-2.5 m/s (200-500 f/min.)</td>
</tr>
<tr>
<td>crusher dusts, gas discharge (active generation into zone of rapid air motion)</td>
<td></td>
</tr>
<tr>
<td>grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released</td>
<td>2.5-10 m/s (500-2000 f/min.)</td>
</tr>
<tr>
<td>at high initial velocity into zone of very high rapid air motion)</td>
<td></td>
</tr>
</tbody>
</table>

Within each range the appropriate value depends on

<table>
<thead>
<tr>
<th>Lower end of the range</th>
<th>Upper end of the range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room air currents minimal or favourable to capture</td>
<td>1 Disturbing room air currents</td>
</tr>
<tr>
<td>2 Contaminants of low toxicity or of nuisance value only</td>
<td>2 Contaminants of high toxicity</td>
</tr>
<tr>
<td>3 Intermittent, low production.</td>
<td>3 High production, heavy use</td>
</tr>
<tr>
<td>4 Large hood or large air mass in motion</td>
<td>4 Small hood-local control only</td>
</tr>
</tbody>
</table>

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 4-10 m/s (800-2000 f/min) for extraction of crusher dusts generated 2 metres distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

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### Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

**PHYSICAL PROPERTIES**

Solid.
Does not mix with water.

<table>
<thead>
<tr>
<th>State</th>
<th>Melting Range (°F)</th>
<th>Boiling Range (°F)</th>
<th>Flash Point (°F)</th>
<th>Decomposition Temp (°F)</th>
<th>Autoignition Temp (°F)</th>
<th>Upper Explosive Limit (%)</th>
<th>Lower Explosive Limit (%)</th>
<th>Volatile Component (%vol)</th>
<th>APPEARANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not Available</td>
<td>284</td>
<td>Not available</td>
<td>Not available</td>
<td>Not available</td>
<td>Negligible</td>
<td>Powder with typical dithiocarbamate odor; does not mix with water. Soluble with decomposition in pyridine. Slowly decomposed by light. The product appears to be a mixture rather than a complex.</td>
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### Section 10 - CHEMICAL STABILITY

**CONDITIONS CONTRIBUTING TO INSTABILITY**

- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerization will not occur.

**STORAGE INCOMPATIBILITY**

- Thiocarbamates and dithiocarbamates are incompatible with acids, peroxides, and acid halides.
- Flammable gases are generated by the combination of thiocarbamates and dithiocarbamates with aldehydes, nitrides, and hydrides.
- Avoid oxidising agents, acids, acid chlorides, acid anhydrides, chloroformates.
- Avoid strong bases.

For incompatible materials - refer to Section 7 - Handling and Storage.

### Section 11 - TOXICOLOGICAL INFORMATION

#### metiram

**TOXICITY AND IRRITATION**

**METIRAM**

- unless otherwise specified data extracted from RTECS - Register of Toxic Effects of Chemical Substances.

<table>
<thead>
<tr>
<th>TOXICITY</th>
<th>IRRITATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral (rat) LD50 2850 mg/kg</td>
<td>Nil Reported</td>
</tr>
<tr>
<td>Oral (mouse) LD50 2630 mg/kg</td>
<td></td>
</tr>
<tr>
<td>Oral (rabbit) LD50 620 mg/kg</td>
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</tr>
</tbody>
</table>

**For metiram**

**Toxicological Effects**

Acute toxicity Metiram is practically nontoxic when ingested, with reported oral LD50 values of greater than 6180 mg/kg to greater than 10,000 mg/kg in rats, greater than 5400 mg/kg in dogs, and 2400 to 4800 mg/kg in guinea pigs. The dermal LD50 is greater than 2000 mg/kg in rats, indicating slight toxicity. It is reported to be a mild skin and eye irritant. Via the inhalation route, it is slightly toxic with a reported 4-hour inhalation LC50 of greater than 5.7 mg/L. Metiram is a cholinesterase inhibitor. Early symptoms of cholinesterase inhibition are blurred vision, fatigue, headache, vertigo, nausea, pupil contraction, abdominal cramps, and diarrhea. Severe inhibition of cholinesterase may cause excessive sweating, tearing, slowed heartbeat, giddiness, slurred speech, confusion, excessive fluid in the lungs, convulsions, and coma.

Chronic toxicity When rats were fed metiram at dietary doses of 50 mg/kg/day 5 days a week for 2 weeks, no symptoms of illness were produced. Adverse effects did occur at 500 mg/kg/day. No ill-effect was observed in dogs that received 45 mg/kg/day of the fungicide for 90 days, or 7.5 mg/kg/day for almost 2 years. When metiram was fed to rats at dietary doses of 0.25, 1, 4, or 16 mg/kg/day, the only effect observed was muscle atrophy in rats receiving 16 mg/kg/day. The major toxicological concern in situations of chronic exposure to metiram, however, is ethylenethiourea (ETU), a contaminant and a breakdown product of metiram that has been shown to cause birth defects and cancer in experimental animals.

Reproductive effects Pregnant rats fed 80 and 160 mg/kg/day exhibited reduced rates of body weight gain. Litter size was reduced for rats fed 0.25, 2 or 16 mg/kg/day metiram. Rats receiving the 16 mg/kg/day dose also exhibited decreases in parental body weight and in food consumption. The evidence suggests that reproductive effects are unlikely in humans under normal circumstances.

Teratogenic effects No teratogenic effects were found in female rats fed 40, 80 and 160 mg/kg/day of metiram.

Mutagenic effects The majority of mutagenicity studies on metiram have been negative. Out of six tests performed, only one highly sensitive test indicated that metiram may be mutagenic. These data indicate that metiram is either nonmutagenic or weakly mutagenic.

Carcinogenic effects All of the EBDC pesticides can be degraded or metabolized into ethylenethiourea (ETU), which has been shown to produce cancer in mice and rats. However, other EBDCs do not appear to be carcinogenic. These were no data available regarding the carcinogenic properties of metiram itself.

Organ toxicity No data were available regarding the target organs of metiram. It is likely that its target organs will be similar to those affected by closely related compounds such as maneb and mancozeb. Those compounds exert their principal effects on the thyroid.

Fate in humans and animals Metiram is not well absorbed through the skin; less than 1% of a 240 mg/kg dose, applied topically, was absorbed through the skin of rats after 8 hours. Metabolic fate studies in rats indicate that ingested metiram is readily absorbed by the body and eliminated through the urine and feces. Residues remaining in the body were highest in the kidneys, thyroid, and gastrointestinal tract and were higher in females than in males. In mammalian tissues the ethylene(bis)dithiocarbamates break down into ETU.

**For ethylenebis(dithiocarbamates) (EBDCs)**

Acute toxicity In spray or dust forms, the EBDCs are moderately irritating to the skin and to respiratory mucous membranes, poisoning from this class of chemicals include itching, scratchy throat, sneezing, coughing, inflammation of the nose or throat and bronchitis. Early symptoms from exposure of humans to inhalation of zineb include tiredness, dizziness and weakness. More severe symptoms include headache, nausea, fatigue, slurred speech, convulsions and unconsciousness. There is no evidence of “neurotoxicity”, that is nerve tissue destruction or behavioral change, from the EBDCs. However, EBDCs are partially chemically broken down, or metabolised, to carbon disulfide, a neurotoxin capable of damaging nerve tissue. EBDC residues in or on foods convert readily to ETU during commercial processing or home cooking.

EBDCs are generally considered to have low short-term mammalian toxicity. A major toxicological concern, however, is ethylenethiourea (ETU), an industrial contaminant and a breakdown product of EBDC pesticides. In addition to having the potential to cause goiter, a condition in which the thyroid gland is enlarged, this metabolite has produced birth defects and cancer in experimental animals. ETU has been classified as a probable human carcinogen by the EPA. ETU can be produced when EBDCs are used on stored produce, and also when fruit or vegetables with residues of these fungicides are cooked.

Conversion of EBDCs into ETU can occur inside of spray tanks, during cooking of produce or processing of crops bearing EBDC residues, or as EBDCs are metabolised within the body. Residues of the EBDCs and of ETU can readily be removed from produce by washing or peeling.

Disulfiram is an EBDC which is used in the treatment of alcoholics to produce an intolerance to alcohol. Ingestion of disulfiram and alcohol together causes symptoms of nausea, vomiting, headache, excessive sweating and chills. Other EBDC compounds may cause similar symptoms when combined with alcohol.
Teratogenic effects ETU, the primary metabolite of zineb and other EBDC pesticides, has been shown to be teratogenic in hamsters, but not in mice.

Mutagenic Effects ETU, is known to cause mutations.

Carcinogenic Effects All of the EBDC pesticides can be degraded or metabolised into ethylene thiourea (ETU), which has been classified as a probable human carcinogen by the EPA. Liver and thyroid cancer can be produced by ETU. Marked increases in the incidence of liver tumors were observed in mice fed 32.3 mg/kg of ETU daily for 80 weeks. Rats fed 8.75 or 17.5 mg/kg daily for 18 months developed malignant thyroid tumors. In rats fed ETU at doses of 0.1, 1.25, 6.25, 12.5 or 25 mg/kg/day ppm for nearly 2 years, a dose related increase in thyroid tumors was observed at the 12.5 and 25 mg/kg doses. Female mice fed doses of 16.7 or 50 mg/kg/day ETU for up to 2 years exhibited 58 and 96% incidence of malignant liver tumors, respectively. In this same study, there was also a significant increase in the incidence of thyroid tumors at the 50 mg/kg dose level.

Several studies of the effects of EBDCs on test animals have shown rapid reduction in the uptake of iodine and swelling of the thyroid (i.e. goiter). In one study, a marked reduction of iodine uptake was measured 24-hours after administration of a large dose of maneb, an EBDC fungicide. A 90-day study of the effects of the metabolite, ETU, revealed a NOEL of 5 ppm (0.25 mg/kg/day).

Organ toxicity In general, the EBDC compounds are so rapidly metabolised and excreted from the body, that blood detection is difficult.

ADI 0.02 mg/kg/day
NOEL 5 mg/kg/day

**CARCINOGEN**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>US Environmental Defense Scorecard Recognized Carcinogens</th>
<th>Reference(s)</th>
<th>P65</th>
</tr>
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<tr>
<td>METIRAM</td>
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<table>
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<tr>
<th>Ingredient</th>
<th>US Environmental Defense Scorecard Suspected Carcinogens</th>
<th>Reference(s)</th>
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</table>

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>US - Maine Chemicals of High Concern List</th>
<th>Carcinogen</th>
<th>CA Prop 65</th>
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</table>

**REPROTOXIN**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>US - California Proposition 65 - Reproductive Toxicity</th>
<th>NSRL or MADL (µg/day)</th>
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</thead>
<tbody>
<tr>
<td>metiram</td>
<td></td>
<td></td>
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</tbody>
</table>

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**Section 12 - ECOLOGICAL INFORMATION**

Very toxic to aquatic organisms.
This material and its container must be disposed of as hazardous waste. 
Avoid release to the environment. 
Refer to special instructions/ safety data sheets.

**Ecotoxicity**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Persistence: Water/Soil</th>
<th>Persistence: Air</th>
<th>Bioaccumulation</th>
<th>Mobility</th>
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<tbody>
<tr>
<td>metiram</td>
<td>No Data Available</td>
<td>No Data Available</td>
<td>LOW</td>
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---

**Section 13 - DISPOSAL CONSIDERATIONS**

**Disposal Instructions**
All waste must be handled in accordance with local, state and federal regulations.
- Containers may still present a chemical hazard/ danger when empty.
- Return to supplier for reuse/ recycling if possible.
Otherwise:
- If container cannot be cleaned sufficiently well to ensure that residuals do not remain or if the container cannot be used to store the same product, then puncture containers, to prevent re-use, and bury at an authorized landfill.
- Where possible retain label warnings and MSDS and observe all notices pertaining to the product.
Legislation addressing waste disposal requirements may differ by country, state and/ or territory. Each user must refer to laws operating in their area. In some areas, certain wastes must be tracked.
A Hierarchy of Controls seems to be common - the user should investigate:
- Reduction
- Reuse
- Recycling
- Disposal (if all else fails)
This material may be recycled if unused, or if it has not been contaminated so as to make it unsuitable for its intended use. Shelf life considerations should also be applied in making decisions of this type. Note that properties of a material may change in use, and recycling or reuse may not always be appropriate. In most instances the supplier of the material should be consulted.
- DO NOT allow wash water from cleaning or process equipment to enter drains.
- It may be necessary to collect all wash water for treatment before disposal.
- In all cases disposal to sewer may be subject to local laws and regulations and these should be considered first.
- Where in doubt contact the responsible authority.
- Recycle wherever possible.
Consult manufacturer for recycling options or consult local or regional waste management authority for disposal if no suitable treatment or disposal facility can be identified.

Dispose of by: burial in a land-fill specifically licenced to accept chemical and / or pharmaceutical wastes or Incineration in a licenced apparatus (after admixture with suitable combustible material)

Decontaminate empty containers. Observe all label safeguards until containers are cleaned and destroyed.

**Section 14 - TRANSPORTATION INFORMATION**

**DOT:**

<table>
<thead>
<tr>
<th>Symbols</th>
<th>Hazard class or Division</th>
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</thead>
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<tr>
<td>G</td>
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<table>
<thead>
<tr>
<th>Identification Numbers</th>
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<table>
<thead>
<tr>
<th>Label Codes</th>
<th>Special provisions:</th>
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<tr>
<td>9</td>
<td>8, 146, 335, B54, IB8, IP3, N20, T1, TP33</td>
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<tr>
<th>Packaging: Exceptions</th>
<th>Packaging: Non-bulk</th>
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<tbody>
<tr>
<td>155</td>
<td>213</td>
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<table>
<thead>
<tr>
<th>Packaging: Exceptions</th>
<th>Quantity limitations:</th>
</tr>
</thead>
<tbody>
<tr>
<td>155</td>
<td>Passenger aircraft/rail: No limit</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Quantity Limitations: Cargo only</th>
<th>Vessel stowage: Location</th>
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<tr>
<td>No limit</td>
<td>A</td>
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</table>

| Vessel stowage: Other | None |

Hazardous materials descriptions and proper shipping names:

**Environmentally hazardous substance, solid, n.o.s**

**Air Transport IATA:**

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<thead>
<tr>
<th>ICAO/IATA Class</th>
<th>ICAO/IATA Subrisk</th>
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<table>
<thead>
<tr>
<th>UN/ID Number</th>
<th>Packing Group</th>
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<tr>
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<table>
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<tr>
<th>Special provisions</th>
<th>Cargo Only</th>
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<td>A97</td>
<td>Maximum Qty/Pack: 400 kg</td>
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<tr>
<th>Passenger and Cargo</th>
<th>Maximum Qty/Pack: 400 kg</th>
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<table>
<thead>
<tr>
<th>Passenger and Cargo Limited Quantity</th>
<th>Packing Instructions:</th>
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<td>Y956</td>
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<table>
<thead>
<tr>
<th>Packing Instructions: Maximum Qty/Pack: 30 kg G</th>
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Shipping name:ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.(contains metiram)

**Maritime Transport IMDG:**

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<table>
<thead>
<tr>
<th>UN Number</th>
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<table>
<thead>
<tr>
<th>EMS Number</th>
<th>Special provisions</th>
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<tr>
<td>F-A,S-F</td>
<td>274 335</td>
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<table>
<thead>
<tr>
<th>Limited Quantities</th>
<th>Marine Pollutant</th>
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<td>5 kg</td>
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Shipping name:ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.(contains metiram)

**Section 15 - REGULATORY INFORMATION**

metiram (CAS: 9006-42-2) is found on the following regulatory lists;

*US - California Air Toxics "Hot Spots" List (Assembly Bill 2586) Substances for Which Production, Use, or Other Presence Must be
Section 16 - OTHER INFORMATION

LIMITED EVIDENCE

■ Cumulative effects may result following exposure*.
■ May possibly affect fertility*.
* (limited evidence).

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references. A list of reference resources used to assist the committee may be found at: www.chemwatch.net/references.

■ The (M)SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

■ For detailed advice on Personal Protective Equipment, refer to the following U.S. Regulations and Standards:
OSHA Standards - 29 CFR:
1910.132 - Personal Protective Equipment - General requirements
1910.133 - Eye and face protection
1910.134 - Respiratory Protection
1910.136 - Occupational foot protection
1910.138 - Hand Protection
Eye and face protection - ANSI Z87.1
Foot protection - ANSI Z41
Respirators must be NIOSH approved.

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www.Chemwatch.net

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