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UNIVERSITY OF SASKATCHEWAN

Fact Sheet
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GASES AND MISTS

When inhaled, gases and mists can immediately irritate the lining of the respiratory system. From our lungs, these substances reach the bloodstream and are circulated throughout the body. Poisonings can result along with other long term health effects.

This fact sheet discusses chemicals, animal confinement gases, silo gases, carbon monoxide and disinfectants.

1. Chemicals: Pest Control and Fertilizers

There is a growing concern over the use of farm chemicals because of the hazards that they create for the public, environment, wildlife and chemical handler. Handlers need to be knowledgeable about the proper application and handling to prevent health effects from occurring.

The Risk:

Some of the most dangerous chemicals to the respiratory system are fumigants, anhydrous ammonia, and paraquat. Insecticides such as organophosphates and carbamates are highly toxic. The highest risk activity is tank mixing.

Fumigants:

- This group includes methyl bromide (Eg. Gardex® chemicals), calcium cyanide, aluminum phosphide (Eg. Gastoxin®, Phostoxin®) and others.
- Some cause respiratory tract irritation, suffocation from swelling of the vocal cords and narrowing of the air passages.
- Some chemicals do not have warning properties (such as smell, taste or irritation).
- There may be a delay in the onset of symptoms.
- Fumigants may penetrate rubber and plastics therefore respirators may not provide adequate protection.

Anhydrous Ammonia:

- A highly concentrated form of nitrogen used as fertilizer.
- Easily recognized by its odor.
- Highly water soluble, and binds with moist surfaces such as the respiratory tract and eyes to form a corrosive alkaline solution.
- Irritating to the nose, throat and eyes, making workers aware of its presence. Higher concentrations produce 'stuffiness,' then skin irritation followed by immediate coughing.

Paraquat:

- Paraquat (Eg. Gramozone®) and Diquat (Eg. Reglone®) are contact weed killers.
- Irritates the nose and throat.
- If ingested Paraquat is actively taken up by the lungs which fill with fluid and the person dies.

Organophosphate and Carbamate Insecticides:

- These insecticides (Eg. Lorsban®, Furadan®, Lannate®, Counter®) act upon the nervous system by inhibiting cholinesterase, an enzyme responsible for transmitting messages between nerves. Pyrethroids (Eg. Decis®) are also cholinesterase-inhibiting.

- Cholinesterase levels may drop slowly or rapidly.
- Symptoms of poisoning:
  - Mild - headache, fatigue, loss of appetite, nausea, dizziness, weakness, sweating, thirst, restlessness, skin and eye irritation, diarrhea, difficulty sleeping, sore nose and throat, mood changes.
  - Moderate - trembling, muscle incoordination and twitching, excessive salivation, blurred vision, tight throat and chest, flushed or yellow skin, abdominal cramps, confusion, excessive sweating, rapid pulse, cough, difficulty breathing.
  - Severe - fever, loss of reflexes, uncontrollable muscle twitching, severe secretions from respiratory tract, increased rate of breathing, small pupils, unconsciousness, inability to breathe.

Other chemicals, fertilizers applied in the granular form, and a variety of fuels, oils, lubricants, and degreasers may also be harmful to the lungs.

Elimination:

- Those interested in organic farming can attend a one day seminar entitled "Introduction to Certified Organic Farming," provided by the Saskatchewan Institute for Applied Science and Technology (SIAST).

Substitution:

- Use a less toxic chemical that is effective.
- Biological pest control may be an option in the future.

Engineering:

- Since ruptured/leaking valves, cross-threading hose connectors, damaged hoses, and hoses that become disconnnected are the main sources of accidental releases of ammonia, regular maintenance is crucial to preventing accidents.
- Spray booms in the back of a vehicle as compared to the front reduces the worker's exposure to chemical.

Safe Work Practices:

Remember, your risk is a combination of your exposure (length of time exposed to a substance and how it is absorbed into the body) and the level of toxicity of the chemical.

- Contact SIAST for information on pesticide applicator courses.
- **Always read label instructions**. Know the hazard symbols to determine what respirator and other equipment to wear.
- Store chemicals in original containers with legible labels.
- Use the correct strength and calibrate the sprayer tank.
- Use the least amount of chemical that is still effective.
- Never mix concentrated chemicals indoors.
- Fit and maintain a carbon filter to your tractor cab.
- A supply of fresh water should be available within reach of the spraying tank in order to immediately dilute any spills on skin or clothing.
- Care should be taken to avoid spills and splashing.
- Do not fill the tank next to the house water source.
- Use the lowest recommended spray pressure.

Observe 're-entry' periods for applicated areas.

<u>Integrated Pest Management (IPM)</u>

Fewer applications are needed if they are carefully timed in relation to pest monitoring, crop growth, irrigation, and rainfall. Integrated pest management uses:

- Economic thresholds: refers to the pest population level that would produce damage equal to the cost of the pesticide application.
- Scouting: counting the pests to monitor them.
- Biological pesticides, natural predators and practices including breeding plants for pesticide and disease resistance.
- Targeting the pesticide application to infested areas.

- Other information to determine the proper time for pesticide applications.

Integrated Pest Management may involve changing tillage practices, harvest dates, crop rotation and sanitation (removal of crop residue) practices.

Cholinesterase testing

This is recommended for users of organophosphates and carbamates which may interfere with proper nerve functioning.

- Before the spraying season, chemical handlers should get a baseline cholinesterase blood test which can be ordered by a doctor.
- During the spraying season, blood testing is recommended monthly to see if there is a drop in the cholinesterase enzyme. If there is a significant drop in the cholinesterose level, the worker should limit or stop using organophosphates or carbamate pesticides until the cholinesterose level returns to normal.

Important phone numbers:

Agriculture Canada Pesticide Information Line: 1-800-267-6315

- Information is available on registered uses as well as public concern issues, and general information

Spill Report Centre: 1-800-667-7525

Regina Poison Control Centre: 1-800-667-4545

Saskatoon Poison Control Centre: 1-800-363-7474

In an emergency:

- Get the victim away from the contamination source (if it's safe) and move them closer to fresh air.
- Loosen tight clothing
- Monitor breathing. Give Artificial Respiration if necessary and get medical attention.

2. Animal Confinement Gases: Ammonia (NH_3) and Hydrogen Sulfide (H_2S)

Agricultural confinement operations involve mainly poultry, cattle, and hogs. Animal confinement operators house their animals in controlled environments which include waste and feed handling systems. Ventilation rates and management practices must control the dust and gas concentrations to reduce worker health effects.

The gases of major concern are ammonia, especially for poultry workers and hydrogen sulfide for swine confinement workers. Other gases produced in hog confinement include methane (CH_4), carbon dioxide (CO_2) and carbon monoxide (CO). Methane usually is not a problem in ventilated facilities. Explosions may occur in buildings where the ventilation rate is low. Carbon dioxide does not reach high enough levels to impose risk but its measurement is an indication of air flow and air quality related to the other gas levels in the facility.

When agitated, the gases in below ground manure storage pits and truck holding tanks increase. **In Saskatchewan in 1998, three workers died after being overcome by gases in a truck manure holding tank**.

The Risk:

Ammonia

- Produced by decomposition of manure; has a sharp, pungent odor.
- Membranes in the eyes and nose may become irritated.
- May stick to dust particles to enter the lungs. Long term exposure may damage hair-like structures that sweep mucus out of the airways.

Ammonia levels:

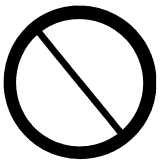
- Highest in poultry operations especially in areas rototilled to loosen litter.
- Highest in the winter due to low ventilation rates but warm weather increases the risk of gas accumulation.
- Higher ammonia levels are present in barns with solid floors, heated floors, or where scrapers are used.

Hydrogen Sulfide:

- Colorless gas that is heavier than air.
- Most dangerous gas produced by manure; is a concern in the hog industry, but not in poultry operations.

Hydrogen Sulfide levels:

- May not be detectable on a day-to-day basis.
- **Greatest risk is during manure agitation which causes a rapid increase in gas levels. Do not enter storage pits or tanks during agitation**.



- Odour is easy to detect at low levels because of its characteristic "rotten egg" smell. At high levels, hydrogen sulfide overcomes the sense of smell, the central nervous system is paralysed, and unconsciousness and death result.
- In low concentrations symptoms are: eye and nose irritation, sore throats and cough.
- With increased exposure: nausea, vomiting, diarrhea, abdominal cramps, shortness of breath, choking, chest pain, headache, insomnia, and loss of appetite. With repeated exposure, asthma and chronic obstructive pulmonary disease (COPD) may also occur.

Substitution:

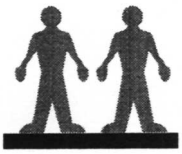
- Some research has shown that ammonia concentrations in poultry barns are reduced by the use of peat for litter.
- Generally liquid manure systems produce less ammonia than solid manure systems.

Engineering:

- Improved building design is the key to prevention.
- Manure pits should be constructed:
  - to minimize the need for entry
  - so that lids cannot fall into them
  - outside the confinement building.
  - with guard rails to prevent falls
- The lowest ammonia levels have been found in systems using conveyers for manure removal and in particular where manure is dried on conveyors.
- Wire, mesh or narrow slats help keep wastes from accumulating therefore, less ammonia is produced.
- Ammonia levels increase with an increase in the moisture level of bedding. To keep bedding dry, use improved water nipples to lower spillage of water into litter.
- To reduce ammonia levels in livestock buildings, prevent air leakage through manure channels. Exhaust as much air as possible through the manure channels. Air leakages may be eliminated by using tight fitting hatches, a water trap or evacuation fans in the channels.
- To decrease hydrogen sulfide leaks, there should be a gas trap between the confinement building and outside storage.
- Airflow through a slatted floor creates a suction to act as an air duct.
- Ventilation inlets should be adjusted so that the speed of incoming air is 600-800 fpm (feet per minute). Airflow should be directed toward the floor to keep dusts and gases from entering the breathing zone of the worker.
- Fans operating on a timer can provide the most consistent air exchange.

Safe Work Practices:

- Increased general ventilation will reduce gas levels but is limited in reducing dust levels, therefore, vegetable oil dust control may be considered. Sprinkling of crude canola oil has been shown to reduce hydrogen sulfide and ammonia concentrations in hog barns.
- Work with more than one person. Ensure everyone is trained regarding emergency rescue procedures (use of harness and ropes).



Safe Work Practices....manure handling:

- Feed additives (sarsaponin) have been shown to reduce ammonia released from manure.
- If manure is beneath a slatted floor, plenty of water should be used to keep manure solids submerged and the gases in solution.
- In shallow pits with scrapers or pull plugs, adding a thin layer of water back after scraping or draining will help keep ammonia in a solution rather than a gas. Frequent flushing of gutter systems with water will have the same effect.
- Minimize the storage time of manure inside buildings.

- To remove manure, the pH should be around 7-8 and if it is below 7, slaked (hydrated) lime (not field lime) can be added to control hydrogen sulfide release, one lb. of slaked lime per 5.5 cu. ft. of manure can raise the pH from 6 to 7.
- Agitation:
  - better on cool, windy days
  - when no animals/humans are in the barn
  - open windows and doors and turn fans on high
  - agitate very slowly at first
  - do not enter until building is aired out for 30 min. after agitation ceases.
- Put up warning signs near manure pits.

If H_2S or NH_3 levels are dangerous, trained workers with air supplied respirators should be assigned to the task.

3. Silo Gases: Nitrogen oxides

The nitrogen oxides found in silos are nitric oxide (NO), nitrogen dioxide ($N0_2$) and nitrogen tetroxide (N_20_4). These silo gases along with carbon dioxide are by-products of the fermentation process. Sulfur dioxide may also be present.

Oxygen limiting silos are sealed. Fermentation of the forage takes place while using up oxygen and holding carbon dioxide inside the building. Oxygen levels below 6% are immediately hazardous to life and in these silos it is near 0%. Conventional silos are more common. They are not sealed and the primary respiratory hazard is nitrogen dioxide poisoning (Silo Filler's Disease). Silo gases may form in ground silage methods but they usually do not collect because of the dispersion in open air.

The Risk:

In oxygen limiting silos, there is a risk of suffocation due to the low levels of oxygen. Silo gas forms on the surface of silage. Since this gas is heavier than air, it may travel down the silo chute and be present in holding areas, reaching its highest concentration 48 to 60 hours after the materials have been placed in the silo. The gas may be trapped in pockets below the surface and be present for up to two weeks.

Silo gas is yellow to reddish brown in color and smells either sweet or like household bleach. If inhaled, it combines with respiratory tract moisture and converts to nitric acid. This is known as Silo's Filler's Disease and may cause damage to any part of the respiratory tract. Because it is only mildly irritating, workers may continue to work in harmful atmospheres, inhaling fumes without detecting the danger.

- Symptoms of Silo Filler's Disease may include:
  - cough
  - shortness of breath
  - weakness, dizziness, or sleepiness
  - nausea or vomiting
  - fluid in the lungs

Death may result. Symptoms usually begin to occur 3 to 30 hours after being exposed. Delayed symptoms may also occur, taking as long as six weeks to appear.

Also associated with silos, are the allergic or toxic reactions that can occur from exposure to spores (mold). These reactions are known as "Organic Dust Toxic Syndrome" or ODTS.

Substitution:

Some plants (Eg. weeds, oats, barley) produce more silo gas than others and heavily fertilized crops, cloudy conditions, and rain increase the risk.

Engineering:

- Loading and distributing the silage should be done by mechanical means if possible
- If entry is necessary, silos should be fitted with blowers.

Safe Work Practices:

Do not enter a silo until 2 weeks after filling.

- Post warning signs.
- Run the blowers for at least 30 minutes before entering a filled silo.
- Workers entering a silo should wear an air supplied full face respirator. A second worker should be outside the silo.

Even 2 to 3 weeks after a silo has been filled, blowers won't do anything to eliminate the silo gas that may be disturbed by walking in the silo or moving the silage.

4. Carbon Monoxide (CO)

The Risk:

Carbon Monoxide (CO) is a colorless, odorless, and tasteless gas produced when fossil fuel burns. Some sources of carbon monoxide include heaters, gas

powered pressure washers, and vehicles or machinery. If carbon monoxide is inhaled, it attaches to hemoglobin in our blood more readily than oxygen. With little or no oxygen, our cells become starved for oxygen and will be damaged or die.

- Persons at risk of poisoning:
  - Those working in high CO concentrations.
  - Workers exposed to low concentrations for long periods of time.
  - Smokers (have higher levels of carbon monoxide in their body)
- Common symptoms of CO poisoning:
  - headache - dizziness - weakness
  - nausea and vomiting

Other symptoms include visual disturbances, confusion, dry mouth and diarrhea.

Long term exposure to low levels of CO may lead to slow poisoning.

- Chronic symptoms of poisoning:
  - headache - irritability
  - difficulty digesting food

In swine confinement buildings, CO overexposure may contribute to aborted litters and stillbirths.

Substitution:

- Diesel tractors may be associated with a smaller risk for CO poisoning than gasoline models.

Safe Work Practices:

- Opened windows, doors, or a fan may not provide sufficient ventilation to operate small, gas-powered engines in buildings or in semi-enclosed spaces.
- Ensure that equipment is functioning properly.
- Emission is greatest when an engine is cold and overloaded.
- If a vehicle is caught in a snowdrift, make sure that the tailpipe is free of snow.

5. Disinfectants: Chlorine, acid gases

These are used in dairy barns to clean equipment and in hog and poultry barns to add to water for pressure washing.

Most commonly used disinfectants contain quaternary ammonium compounds with or without aldehydes (glutaraldehyde, gloxal®, formaldehyde) or chloroamine-T®. Detergent and sanitizing agents may also produce harmful vapours.

The Risk:

Little research has been done in this area specific to housing animals. There is some association between the use of disinfectants related to allergic reactions and occupational asthma. The duration of the disinfection procedure and pressure used at disinfection are associated with chronic respiratory symptoms.

Safe Work Practices:

- **Mix chemicals as directed** as improper mixing may result in dangerous gases and vapors.
- Wear proper personal protection as directed (Eg. Gloves, boots, respirator...)

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