



Farm Safety Association

MANURE GAS -- HYDROGEN SULPHIDE

GENERAL

Liquid manure storage systems have come into prominent use in recent years. Many dairy, beef and hog operations (and to a limited extent poultry operations) now use liquid manure systems as a fast and economical method of handling animal wastes. These systems, particularly if they are incorporated into the barn construction, may pose a serious hazard because of gases produced. Decomposing animal manure gives off a variety of gases including hydrogen sulphide, carbon dioxide and methane. Of all these gases, hydrogen sulphide or more commonly called manure gas, is the most dangerous. Hydrogen Sulphide (H_2S) has been responsible for many animal deaths as well as occasional human deaths.

HOW HYDROGEN SULPHIDE IS FORMED

Hydrogen Sulphide is formed as a result of decomposing animal manure. The decomposition process begins as soon as it is excreted by the animals. Micro-organisms utilize the manure to synthesize new cellular material and to furnish energy for synthesis. This process takes place with or without oxygen. However, the type of microbes, and the type of gases that are produced, are dependent on the type of environment in which degradation takes place. In anaerobic conditions (without oxygen), typical of most liquid manure systems, hydrogen sulphide will be given off.

Hydrogen sulphide is produced continuously in all un-aerated manure storage systems, including shallow barn gutters, underground storage tanks or outside manure holding ponds or lagoons. Depending on temperatures and other factors, the

rate of release of the gas is slow in undisturbed storage.

PROPERTIES OF HYDROGEN SULPHIDE

Hydrogen sulphide is a clear, colourless gas that can be identified in relatively low concentrations, by a characteristic "rotten-egg" odour. Hydrogen sulphide is approximately 20 percent heavier than air, with a specific gravity of 1.19. Hydrogen sulphide odours can be recognized in concentrations of less than 1 mg/kg (air). The odour of hydrogen sulphide will increase as the gas becomes more concentrated. However, in concentrations of 150 or greater mg/kg (air), a person's ability to detect the gas is affected by temporary paralysis of the olfactory nerves in the nose. Owing to this unique property of Hydrogen sulphide, relying totally on the sense of smell to warn against the gas, can be extremely dangerous. In high concentrations, the ability to smell the gas is lost instantaneously, the disappearance of the odour could mean that the gas concentrations have increased.

PHYSIOLOGICAL EFFECTS OF HYDROGEN SULPHIDE

Hydrogen sulphide is classified as a toxic chemical, in high concentrations it will lead to almost instantaneous poisoning and death. High concentrations will result in the complete arrest of respiration. A person overcome by this gas should promptly be removed from the contaminated area and given immediate artificial respiration.

Exposure to lesser concentrations may result in nausea, stomach distress, belching and coughing. Moderate concentrations may result in eye

irritation.

THE DANGER PERIODS

Because hydrogen sulphide is heavier than air, the gas has a tendency to accumulate on the surface of the manure. Over a period of time, the undisturbed accumulation of the gas, along with a rising level of liquid manure in the storage system, may force the gas above floor level. When this happens animals are usually doomed. Above ground air currents may also result in localized concentrations of the gas, this usually explains why livestock losses occur in certain areas of a particular barn.

The greatest danger of exposure to hydrogen sulphide exists during agitation and pumping. Clean out during the fall months after several months of warm temperature storage accelerates gas production, or clean out after a prolonged period of time increases the potential danger. During agitation, hydrogen sulphide is released from the manure in the same manner as carbon dioxide is liberated after shaking a carbonated soft drink.

SAFE MANAGEMENT OF A LIQUID MANURE SYSTEM

The following precautions are essential to the safe management of a liquid manure system located in a livestock building:

1. Under no circumstances should anyone enter a liquid manure pit without wearing a self-contained breathing apparatus, even if the pit is empty. Use a life line that is connected to someone outside the danger area.
2. Never allow the manure pit to fill completely. Allow 1 to 2 feet of air space to accommodate concentrations of gas.
3. If possible, lower the level of liquid manure in the storage facility before commencing agitation. This will further reduce the possibility of gas being forced above floor level.
4. Keep the agitator below the liquid surface. Gas will be released in greater volumes if vigorous surface agitation occurs.
5. Provide strong ventilation during pumping

and agitation. The building interior should be off limits to people, and if possible, animals should be evacuated.

6. Because of the dangers presented by the agitation and pumping operations, these procedures should involve two people, connected by a life line, with one person always outside of the danger area.
7. Consult with your physician if you have been exposed to hydrogen sulphide in concentrations severe enough to cause irritation to the respiratory tract.

SPREADER TANKS

The danger of hydrogen sulphide in spreader tanks is as great, or greater than that of a liquid manure pit. Under no circumstances should a spreader tank be entered without using a self contained breathing apparatus and a life line attached to someone outside of the danger area.

PROPERTIES OF HYDROGEN SULPHIDE *

Chemical Formula	H ₂ S
Odour	Rotten Egg
Boiling Point	60° C
Odour Threshold	0.13 mg/kg (Oxygen)
Specific Gravity	1.19

* American Industrial Hygiene Association, 1962.

DESIGN AND CONSTRUCTION OF NEW FACILITIES

The following factors should be taken into consideration if you are considering incorporating a liquid manure system into a new building:

1. All manure pit pump-out openings should be located outside the building, thereby eliminating the danger of working in a confined area.
2. Liquid manure storage should be separated from the livestock buildings. Connecting drains, gutters and channels should be fitted with gas traps, or some other means, to

prevent gases from re-entering the building.

3. In-barn liquid manure collection pits should

be kept to a minimum volume and divided into small compartments to eliminate the need for agitation.

PHYSIOLOGICAL RESPONSE OF ADULT HUMANS TO HYDROGEN SULPHIDE

Effect	Concentration Mg (H ₂ S)/1 Kg (Air)
Least Detectable Odour	0.01-0.7
Offensive Odour	3-5
Eye Irritation	10
Irritation Mucous Membranes and Lungs	20
Irritation of Respiratory Tract	50-100
Olfactory Nerve Paralysis	150
Headache, Dizziness	200
Nausea, Excitement, Unconsciousness	500-600
Rapidly Fatal	700-2000

** Source Nordstron, G.A.: J.B. McQuilty: "Manure Gases in the Animal Environment." University of Alberta - 1976.

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