

## APPENDIX G

### SAFETY

As manure decomposes, gases are released. The types of gases produced depend upon how the manure is stored. Under aerobic conditions (with oxygen present) the gases produced are not dangerous. However, when manure is stored anaerobically (no oxygen present), some of the gases produced are dangerous. When liquid manure is stored for a period of several weeks in an enclosed space, the dangerous gases can accumulate in the head space of the tank and in bubbles and dissolved gases within the manure itself. The greatest danger occurs when the manure is agitated; when this happens, the gases held in the manure are released and the concentrations can reach lethal levels within several minutes. Numerous deaths have occurred as a result of farm workers entering manure tanks and storages.

The gas that is most dangerous is hydrogen sulphide. Although it is readily detectable at low concentrations, at higher levels the gas paralyses the sense of smell, so it is possible to unknowingly encounter a dangerous situation. As the concentration increases, the hydrogen sulphide paralyses the nerves that control the diaphragm causing a person to stop breathing. When concentrations are high, a single breath of the gas can be fatal. The other gases considered to be dangerous are listed in the following table (Table G.1).

Good design and safe habits can prevent accidents from happening. Long-term storage should not be in the same air space as the animals or workers. The agitation required to remove the manure from the barn can increase gas concentrations to lethal levels very rapidly. Connections between the barn and long term storage must be separated by a gas trap to prevent the gases from returning to the barn. Design the facility so that all servicing can be performed without entering the storage.

When agitating manure in an in-barn storage, be certain to provide maximum ventilation. All personnel should work in pairs. All people should be evacuated from the air space above the storage, animals should be evacuated if possible. Begin by pumping without agitation to create several feet of head space for the gases. Agitate below the surface and do no more agitation than is necessary.

Never enter a manure tank without proper respiratory equipment that is designed for the purpose. A purpose-built breathing apparatus with full face mask and remote air tank and hose are required-**SCUBA equipment is not adequate**. Always work in pairs. If an accident does occur, apply cardio-pulmonary resuscitation (CPR) if necessary.

**TABLE H.1****Characteristics of the Most Dangerous Manure Gases**

Gas	Symbol	Density	Odour	Concentration (ppm) <sup>1</sup>	
				TLV-TWA <sup>2</sup>	Effects on Humans
Hydrogen Sulphide	H <sub>2</sub> S	1.19	Rotten Eggs, Nauseating	10	5 - Offensive odour 150 - Olfactory paralysis, death in 30 minutes. 700 - Rapidly fatal (fatal levels commonly observed)
Carbon Dioxide	CO <sub>2</sub>	1.53	None	5,000	30,000 - Increased breathing rate 40,000 - Drowsiness, headache 300,000 - May be fatal in 30 min. (fatal levels seldom observed)
Ammonia	NH <sub>3</sub>	0.60	Sharp, Pungent	25	100-150 - Irrigation of eyes, nose and throat in 30 min. 5,000 - Respiratory spasm, may be fatal (fatal levels rarely observed)
Methane	CH <sub>4</sub>	0.55	None		500,000 - Could asphyxiate (fatal levels rarely observed)

1. Ppm (parts per million) of a gas in atmospheric air; to convert to percentage by volume, divide ppm by 10,000.
2. TLV-TWA (Threshold Limit Value, Time-weighted Average), the concentration under which nearly all workers may be repeatedly exposed for an 8 h work-day and 40 hr work week without apparent adverse effects. Established by the American Conference of Government Industrial Hygienists, P. O. Box 1937, Cincinnati, OH 45201, U.S.

Source: Canada Plan Service Plan M-8710 "Manure Gas".