More than 160 volatile compounds have been identified as contributing to the odor from confinement facilities.

Manure and Air Quality Concerns

Air quality issues associated with livestock systems are the focus of Lessons 40 through 44. Primary sources of odorous gases and other contaminants, measurement of odor, and technology- and management-based control measures will be discussed in detail in those lessons. A brief introduction to air quality concerns follows.

Table 1-4. Common odorous compounds associated with livestock manure.

Volatile fatty acids	Ammonia and amines	Phenolics/N heterocyles	Sulfur compounds
Acetic	Ammonia	Phenol	Hydrogen sulfide
Proprionic	Methylamine	P-cresol	Dimethyl sulfide
Butyric	Ethylamine	Indole	Methyl mercaptan
Isobutyric		Skatole	Ethyl mercaptan
Isovaleric			Diethyl sulfide

Common compounds

Manure handling and storage associated with confinement livestock and poultry systems result in a wide range of air emissions. More than 160 volatile compounds have been identified as contributing to the odor from confinement facilities.

Many of these volatile compounds contribute to observed odors. The primary groupings of odorous compounds are listed in Table 1-4. Because of the vast number of compounds contributing to an odor observation and the variation in the relative importance of individual gases for individual situations, attempts to identify a single indicator gas have not generally proven successful. In addition, other emissions are associated with livestock production. Dust emission from animal housing is gaining greater attention due to its possible health impact upon neighbors and its ability to serve as a carrier of odor compounds. Finally, the production of non-odorous gases including methane and carbon dioxide is gaining some attention as a potential contributor to global warming.

Anaerobic degradation of manure is an additional significant contributor of most compounds.

These compounds originate from a variety of sources. Metabolic processes within the gastrointestinal tract of livestock contribute some of these compounds. Anaerobic degradation of manure is an additional significant contributor of most compounds.

Anaerobic degradation involves the reduction of complex organic compounds to a variety of odorous volatile fatty acids (VFAs) by acid-forming bacteria. Methane-forming bacteria convert VFAs to odorless methane and carbon dioxide. If these anaerobic processes are in balance, most odorous compounds are eliminated. However, under certain conditions in manure storage or overloaded anaerobic treatment lagoons, acid-forming and methane-forming processes are not in balance, resulting in an accumulation of VFAs. In addition, sulfate-reducing bacteria found in anaerobic environments convert sulfate to hydrogen sulfide and other sulfur-containing compounds. Anaerobic degradation by sulfate-reducing bacteria and an imbalance of acid- and methane-forming bacteria are significant sources of odorous compounds.

Environmental Impacts

Odorous volatile compounds are commonly considered to be an unpleasant or nuisance experience by many neighbors. Neighbors' determination of odor nuisance is often related to a number of physical factors (frequency, duration, and intensity of odor experience) and social factors (neighbor's past experience with agriculture, neighbor's relationship with producer, and appearance of livestock or poultry operation). Neighbors' odor nuisance issues must be taken seriously. These experiences are commonly a critical driving force to discontent within a community, opposition to new or expanding facilities, and additional scrutiny of potential other environmental issues.

Recent research suggests that neighbors have strong emotional reactions and possible health-related responses to livestock-related odors. These concerns are summarized in Lesson 40, Emissions from Animal Production Systems. These reactions can impact psychological health and possibly physiological health.

Some community concerns and regulatory efforts have focused on individual gases as opposed to the general issue of odor. Hydrogen sulfide is one such gas. In general, the relationship between livestock odors and hydrogen sulfide is very weak. Hydrogen sulfide alone is not considered to be an acceptable indicator of odor. However, health-related concerns are a more common justification of standards or regulations for hydrogen sulfide. Exposure to concentrations of 2,000 ppm for a few minutes can be fatal. Long exposures at 300 ppm have also caused deaths. To avoid these concerns, worker health organizations have established average workplace concentration limits of 10 ppm. Some states have established levels as low as 0.03 ppm to 0.1 ppm for community exposure limits, assuming that a greater range of susceptibility to hydrogen sulfide exposure would be found within the general population than within a healthy workplace population.

Hydrogen sulfide alone is not considered to be an acceptable indicator of odor.

Livestock production is a source of greenhouse gases (methane and carbon dioxide). These gases are primary end products of anaerobic and aerobic (carbon dioxide only) decomposition of manure and other byproducts. It has been estimated that carbon dioxide and methane account for, respectively, 66% and 18% of the greenhouse gas effect. However, the carbon released from manure originated from plants that removed carbon dioxide as part of the photosynthetic process. Agriculture recycles greenhouse gases as opposed to contributing additional greenhouse gases, which occurs with the combustion of fossil fuels. In addition, regular land application of manure to cropland increases the organic matter (carbon content) of those soils, which may be an important sink for reducing greenhouse gases.

Ammonia is released in large quantities by livestock production. Anaerobic lagoons may lose more than two-thirds of the N in manure as ammonia. Open lots for livestock production will volatilize roughly half of the N, primarily as ammonia. As described previously in the water quality section, the primary problems associated with ammonia relate to its deposition on land or water.