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Managing Odor Nuisance and Dust from Cattle Feedlots

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Operators and owners of cattle feedlot production systems face environmental challenges associated with manure accumulation, storage and disposal. As residences and acreage owners encroach on agricultural areas, people living near feedlots voice their concerns about odor and dust from these operations.

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A typical feedlot includes multiple pens equipped with watering and feeding facilities. As a result, moisture content varies considerably throughout the pen surface, although the most moisture predominantly occurs on the pen surface near feed and water source locations.

Feedlot pens contain a variable number of animals based on pen size. The cattle are in the pens for as little as a few months or up to a year. The pens normally are cleaned twice, once in the spring and again in the fall. The scraped solid manure either is stored or applied directly to fields following collection.

Odor and dust emissions can be a nuisance and a potential health concern in the community if the feedlot has a persistent objectionable smell. Recent studies suggest that if management practices are not followed properly, livestock facilities may have a negative impact on the quality of life for the neighboring communities, as well as health and welfare of workers.

Feedlot Odor

Livestock manure contains many nutrients, such as starch, proteins and lipids, and these can be utilized by bacteria. Odors from animal feeding operations (AFOs) are produced primarily due to incomplete fermentation of livestock manure by bacteria under anaerobic (oxygen-free) conditions. Volatile fatty acids (VFA) are the predominant odor-causing compounds produced during fermentation.

Therefore, feedlot management and feeding practices that influence the use and/or excretion of nutrients, such as starch, protein and lipids, by cattle may affect the production of odor from these systems significantly.

Emission of odorous gases and other compounds from cattle feedlots is closely associated with rainfall events and warm temperatures. Standing water or excessive moisture in feedlot pens following rainfall events create anaerobic conditions on the uncompacted manure layer, resulting in the generation of odors.

Feedlot Dust

On the other hand, excessively dry (less than 25 percent moisture), uncompacted or loose manure and soil on the corral surface contribute to greater dust (particulate matter) emission from feedlots. Loose manure and soil suspend in the air due to the hoof action of cattle.

Typically, the peak concentration of dust is observed in the evening when cattle activity spikes. Also, drier manure pack and relatively stable atmospheric conditions after sunset promote nuisance dust events downwind of the feedlot. Such events may last for several hours and clouds of dust may cause limited visibility on public roadways, a major source of nuisance, especially on the prevailing windward side of high-traffic roadways.

In addition, substantial amounts of odorous compounds can be absorbed and transported by particulate matter from the feedlot to surrounding areas.

Excessive odor and dust emissions are an increasingly difficult and pressing problem for the livestock facilities. If such emissions are left uncontrolled, establishment of a new or expansion of an existing feedlot operation will be difficult due to public complaints and opposition. Therefore, current feedlot waste management practices need to be enhanced to control odor and dust. A combination of the following practices will aid in controlling excessive odor and dust emissions from feedlots.

Feedlot Design Consideration

A feedlot design (slope, length, mound, feed bunk and watering systems) that facilitates separation of liquid (rain, snowmelt and process water) from manure and other organic material such as waste feed through good drainage of corrals results in reduced odor generation.

More odor is generated from wet and warm corral surfaces due to greater microbial activity at higher temperatures. As a result, in warm conditions, the strongest odor will occur two to three days after the surface becomes wet and anaerobic conditions persist. Odor emissions will continue until the corral surface dries out or a thick crust of manure forms. Therefore, rapid drying of the corral surface is a key management strategy to minimize odor from feedlots. A properly drained corral with compacted subsoil and a thinner (1 to 2 inches) manure layer help improve the situation.

In contrast, poorly drained pens with standing water remaining for several days after rainfall events will result in greater odor levels (Fig. 1a). Well-managed moisture content in a feedlot will control odors, but not dust (Fig. 1b).

A slope of 4 percent to 6 percent will facilitate better drainage than a flat corral, reducing the likelihood of standing water and an odor-generating source. A slope greater than 8 percent can contribute to soil erosion. Therefore, pen design is very critical to minimize some of these environmental issues.

(a) **(b)**

Fig. 1. Examples of a poorly designed and managed (a) and a well-designed (b) feedlot.

Feedlot Pen Surface Management Practices

Pen surface manure accumulation and removal markedly influence odor and dust emissions. Frequent removal of manure from pens will give much better odor control than infrequent or no cleaning of pen manure.

In a feedlot pen, manure is compacted by machinery or hoof action of cattle. However, if it is not properly compacted, hoof action of cattle will promote dust emissions during the daytime when unstable air conditions prevail. Dust and odor potential are closely related to the pen surface moisture content. By maintaining pen surface moisture content between 25 percent and 40 percent, feedlot dust can be controlled.

Frequent pen scraping (once every three to four months) also can help remove loose manure that contributes to dust production and carries odorous gases. Therefore, considerable effort is needed to maintain pen moisture content and reduce excess manure accumulation to control odor and dust from cattle feedlots.

Feeding Practices

Modifying cattle feeding sources and schedules also can minimize odor and dust from feedlots. Decreasing crude protein (CP) in beef cattle diets can decrease odor by reducing nutrients, such as fecal starch, protein and lipids, in excreted manure. Incomplete fermentation of this fecal starch in livestock manure is the driving force of malodors. However, formulating feed rations that reduce malodor production without compromising cattle performance can be challenging. In spite of these challenges, reducing CP in beef cattle diet provides the most practical means to reduce odor and other gases, such as ammonia, from feedlots.

Another important factor is the feeding schedule. By feeding cattle at sunrise, noon and sunset, feedlot dust can be controlled. This feeding practice will replace the active evening period with a period of eating and ruminating thus reducing cattle activity and excessive dust generation. Recall that any reduction of dust generation also will help reduce odorants carried by dust particles.

Stocking Density

Increased stocking density (for example, 120 to 150 ft^2/animal) also may control dust production and emissions. Increasing stocking density in feedlot pens results in reduced space and reduced cattle activities, leading to decreased dust concentrations and odor carried with dust downwind of the feedlot.

If increased stocking density is used to manage dust emissions, increasing pen surface scraping frequency also is important to decrease the amount of manure buildup in pens.

However, reduced pen space for the cattle may affect cattle performance and needs to be taken into consideration (for example, the typical stocking density is 300 to 400 ft^2/animal in North Dakota in an unpaved feedlot).

Additives

Most amendments/additives investigated in the past were used in poultry manure and pig slurry. Recently, different amendments (for example, alum, commercial products, calcium chloride, brown humate, black humate) have been tested on beef cattle feedlots under laboratory settings and their effectiveness to control odors varied widely depending on amendment types. These additives may be applied to control odor from the feedlot, but the effectiveness of these additives to control odors from feedlots is not very well documented.

The pH (alkalinity or acidity) of feedlot manure plays an important role in releasing offensive odors. Odors are released when the pH drops to a point that allows microorganisms to grow and break down compounds in manure and generate offensive odors. Additives can be used to maintain pH to control odor. Studies show that most malodors are generated during the first two days after a heavy rainfall on a feedlot. Short-term use of additives to modify the microbial process during this time period after rain may be appropriate to control odors.

Conclusion

Simultaneous suppression of nuisance feedlot odor and dust is a challenge for AFO operators. Good feedlot design (4 percent to 6 percent slope to promote drainage), optimum pen surface moisture content (25 percent to 40 percent), frequent pen scraping (once every three to four months) to reduce excessive manure accumulation and maintain a less than 2-inch depth of loose manure, creating a compacted manure and subsurface layer and good management to reduce spikes in cattle activity are the keys to controlling odor and dust potential from cattle feedlots.

In the meantime, the scientific community continues to carry out research on cattle feed amendments and corral surface additives to effectively address dust and odor issues.

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