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RECOMMENDED STRATEGIES FOR ODOR CONTROL IN CONFINEMENT BEEF CATTLE OPERATIONS

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Odors coming off a beef feeding operation are generated from three different sources: the feedlot facility, waste storage, and the land where the manure is applied. In some operations, the feedlot facility may also serve as the primary waste storage area. To reduce the total amount of odor generated from a beef feeding operation, odor generation and emission by each of these three sources needs to be reduced.

Several options for odor reduction are available in each area. Only practices that are proven to be effective and that can be immediately implemented in new and existing facilities are listed in Table 1. Other options are currently being developed or tested; continued research will reveal whether they can be successfully implemented in the future.

The table is organized in four sections covering practices to reduce odor generation, reduce odor emission from facilities and storage units, increase odor dispersion, and reduce odor emission from manure application. For each practice, advantages and disadvantages are listed. The effectiveness and the cost of implementing each practice are indicated using odor generation from a standard beef feeding operation as a base line. The base line operation is assumed to be dirt-lot with no slope, no additional manure storage structure, and no dietary modifications to reduce odor generation.

The effectiveness of each practice is indicated as "low," "moderate," or "high." A low effectiveness is assumed to reduce odor generation by less than 20%; moderate, 20 to 50%; and high, more than 50% relative to the base line operation. These values relate only to the specific area in which the practices are used.

Some practices in the table are listed as best management practices (BMP). These are practices with a well-documented beneficial effect on the sustainability of a production system. Their implementation should be encouraged even without considering their potential for reduction of odor emission.

The cost of each practice is indicated. A "low" cost is assumed to be less than $0.50 per head marketed (steer or heifer), "moderate" adds $0.50-$1.50 per head, and "high" adds more than $1.50 per head to total production costs as compared to the base line unit.

Final Recommendations

The most common beef cattle feeding facilities in South Dakota are dirt lots. Simply modifying management practices, such as balancing diets properly, keeping the lots dry by providing adequate slope and manure removal, and incorporating manure as quickly as possible following application, can reduce odors emissions from these types of facilities. Other practices listed also should be considered for greater levels of odor control.

For cattle confined in a building, a biofilter may be considered. This is an inexpensive, environmentally friendly system producers can construct. It is made from a compost-woodchip mixture that, when moistened, captures and contains many common odors. It is attached to an exhaust fan, and when air is directed through the compost mixture, it traps up to 96% odor-free air.

Research in the area of odor reduction is ongoing and many new technologies are being developed. As independent research using these technologies become available, some of them may prove to be even more effective than the once listed above.

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Table 1. Odor reduction practices for beef feedlots

Practice	Description	Advantages	Disadvantages	Effectiveness	Cost	Comments
Generation						
a. Diet manipulation	Feeding closer to protein requirements (phase feeding).	Decreased N excretion with diets balanced for requirements.	None	Low to moderate	Low	Returns in production offset costs. Should be considered a BMP.
	Balance diets for protein degradability rather than total crude protein.	Overfeeding crude protein (CP) avoided. Efficient nutrient use.	Possibly more labor	Low to moderate	Low	Returns in production offset costs. Should be considered a BMP.
	Avoid overfeeding sulfur	Sulfur excretion prevented, reduced production of hydrogen sulfide and other aromatic compounds	If requirements are underfed, microbial protein may be depressed	Low	Low	
b. Feed preservation	Avoid ensiling forages with excess moisture. Adjust feed-out face to minimize aerobic exposure.	Reduced spoilage. Increased efficiency of feed utilization.	Dependent on weather and timely availability of harvesting equipment.	Low	Low	Improved efficiency of nutrient utilization offsets costs. Should be considered a BMP.

Table 1. Odor reduction practices for beef feedlots (cont.)

Practice	Description	Advantages	Disadvantages	Effectiveness	Cost	Comments
Emission						
a. Animal housing						
1. Earthen lots (with or without sheds)	a. Adequate slope	Keeps lots dry to reduce microbial activity	Need collection for runoff	Moderate	Low	Waste management issues may need to be addressed
	b. Oil treatment	Prevents dust and may prevent respiratory irritations in cattle	Increased cost of product and application	Low	Low to moderate	Some of the cost may be offset by improved performance
2. Concrete lots with sheds	a. Scrape manure often	Reduces volatilization	Increases labor	Moderate	Low	Should be considered a BMP
	b. Bedding	May reduce volatilization of nitrogen and sulfur	Increased cost of bedding, manure handling and labor	Low to moderate	Low	
3. Solid floor building	a. Deep pack	May reduce volatilization of nitrogen and sulfur	Increased cost of bedding, manure handling and labor	Low to moderate	Moderate	More research with these building types need to be conducted
4. Slatted floor building	a. Biofilters. Air is exhausted through a biofilter. Materials: Mixtures with 30% to 50% of compost (by weight) and 70% to 50% of wood chips	Very effective	Cost and building design may prevent use	Moderate	Moderate	Lameness and reduced performance may be a problem with long days on feed
b. Manure storage						
1. Earthen basins (single or double cell)	Covers: Natural crust Bio-covers (straw) Inorganic (geo-textile, clay balls, plastic cover)	High nutrient retention	Difficult to cover evenly. Care must be taken during agitation and pumping (particularly with inorganic covers). With plastic covers air can exhaust through a bio-filter	Natural crust: High Bio-covers: High Inorganic covers: High	Low Low Moderate to high	Odor potential if slurry is not injected. Local ordinances may limit design options. Effectiveness highly dependent on proper management
2. Steel or concrete tanks above or below ground:	Covers: a. Impermeable (PVC, wood, concrete) b. Permeable (straw)	Duration (10-15 years) Cost	Cost Duration. Sometimes difficult to maintain afloat	a. Impermeable: High b. Permeable: High	Moderate to high Moderate	Impermeable cover: A bio-filter needs to be added at the end of the vents to treat exhaust gases
3. Solids separation	Solids separated from liquids through sedimentation basins or mechanical separators	May reduce odor/ammonia. Easier agitation and pumping.	Capital/operational costs; reliability	Moderate	Moderate	Adds another "waste" source to be managed by the producer
4. Aeration	Air is forced into the manure storage system. Aerobic bacteria oxidize odorous compounds to carbon dioxide and water	Reduces methane, hydrogen sulfide, ammonia and volatile fatty acids.	Added utility costs. Requires power to aerate the materials	Moderate	Moderate	
5. Methane digesters	Treats waste with 3-10% solids. Biogas methane produced to maintain digester temperature	Generation of electricity.	Currently suitable for dairies with 1,000 animal units or more. Likely requires slatted floor building	High	High	Limited data

Table 1. Odor reduction practices for beef feedlots (cont.)

Practice	Description	Advantages	Disadvantages	Effectiveness	Cost	Comments
Siting/Dispersion						
a. Shelterbelts	Creates barrier of vegetation for dust and odor compounds.	Help disperse and dilute odors. Cost. Environment. Aesthetics	Planning and time required for effective barrier to grow	Low	Low	The most cost effective odor dispersion method.
b. Windbreak walls	Solid or porous wall 10 to 15 feet from the exhaust fans causes dust to settle.	Rapid implementation. Help disperse and dilute odors. Trap dust particles	Cost. Aesthetics. Need for periodic cleaning of dust from porous walls	Low	Low to moderate.	Recent and on-going research but needs more
c. Setback distances	Optimize distance between odor emission sources and urban areas	Complaints less likely	Not applicable for dairies currently in operation	High	Variable.	Recent and on-going research but needs more
Land Application						
a. Manure incorporation	Manure is rapidly incorporated in the soil after spreading with plowing	Reduces odor and ammonia emissions	Requires some degree of management by the producer	Moderate	Moderate	Most research has been done in Europe. More research on odor emission needed
b. Manure injection	Manure is injected into the soil (shallow and deep)	Reduces odor and ammonia emissions	Cost	High	Low	Most research has been done in Europe. More research on odor emission needed
c. Band spreading	Manure is discharged at ground level through a series of trailing pipes	Reduces odor and ammonia emissions	Manure must be rapidly incorporated	Low	Low	Most research has been done in Europe. More research on odor emission needed