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# RECOMMENDED STRATEGIES FOR ODOR CONTROL IN DAIRY OPERATIONS

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**Summary**

Odor emission from dairy farms is of growing concern, particularly in areas where residential sprawl has brought the farm and the general public closer together.

Although setback distances are considered among the most effective means of decreasing odor perception, dairies already in operation need other alternatives to deal with the problem. The following steps may be helpful in developing an odor control plan:

1. create a list of potential odor sources on the farm,
2. determine the sources most likely to bring complaints, and
3. list control strategies for each odor source.

Odor source, frequency, and intensity of episodes vary between farms. Manure storage, animal housing, and manure application to land are among the most significant contributors. Other potential odor-emitting areas on the farm are carcass disposal sites, silage piles, and feed centers.

Odor control practices can aim at reduced generation, decreased emission, and/or increased dispersion. Only practices that are proven effective and can be immediately implemented are listed in the accompanying table. Other alternatives are being developed or tested; research will determine whether they will be successful.

The table covers practices to reduce odor generation by dietary and feed manipulation, 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.

For comparison, it has been assumed that the base line dairy uses current standard management recommendations and facilities (curtain-sided free stall with open ridge roof) and that manure is scraped and stored in a single- or double-cell earthen basin.

The odor reduction effectiveness of each practice is indicated as “low,” “moderate,” or “high.” A low effectiveness assumes a reduction in odor generation of less than 20%; moderate, between 20 and 50%; and high, greater than 50% relative to the base line unit.

These values relate only to specific areas. To obtain an overall reduction in odor emitted from the farm, reductions need to be made in odor generated from the building, the storage facility, and from land application.

Best management practices (BMP) are listed in the table. 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.

An approximate cost for each practice is indicated. Low cost implies that the practice may not significantly add to the daily cost of production per hundredweight of milk. Some of these low-cost practices will actually result in improved milk production, milk quality, and/or cow longevity, resulting in a source of additional net revenue rather than a cost. Moderate cost practices will add on a daily basis to the cost per hundredweight milk being produced. High-cost practices require a considerable initial investment (methane digester) and significantly increase the cost of production per hundredweight of milk.

## Final Recommendations

Simple modifications of current management practices can sometimes lead to dramatic improvements in odor emission from dairy farms.

These modifications should be considered "best management practices," examples of which are adequately balancing diets, using highly digestible feeds, preserving forages properly, changing bedding often, and scraping manure frequently.

Odor from land application of manure can be virtually eliminated by injecting manure into the soil. Likewise, odors from earthen basins can be greatly reduced by allowing a natural crust to develop on the surface, making amount and choice of bedding a critical issue.

More elaborate practices should be considered and implemented only after management flaws conducive to odor generation are corrected. Artificially covering manure storage alone or in combination with biofilters can further reduce odors. A biofilter may be a moistened mix of woodchips and compost attached to building exhaust fans. Containment practices in large dairies may be combined with a solids separator and (or) a methane digester.

Research in the area of odor reduction is ongoing, and many new technologies are being developed. As independent research establishing their value becomes available, some of these technologies may prove to be even more effective than those listed above.

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**Table 1. Odor reduction practices for dairy operations**

| Practice | Description | Advantages | Disadvantages | Effectiveness | Cost | Comments |
|---|---|---|---|---|---|---|
| **I. Generation** | | | | | | |
| a. Diet manipulation | Feed closer to protein requirements | N excretion decreased by 10-15% yearly 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 | N excretion decreased by 14% per year. | None | Low to moderate | Low | Returns in production offset costs. Should be considered a BMP |
| | Addition of amino acids protected from rumen degradability | Protected methionine, when lysine was adequate, resulted in 10-15% reduction in N excretion | None | Low | Low | Returns in production offset costs in high producing dairy herds |
| | Increased diet digestibility | Increasing diet digestibility from 55 to 70% reduced fecal N by 23%. Increased milk production and N deposition in milk protein decreases N excretion | None | Moderate | Low | Returns in production offset costs. Forages must be harvested at optimum maturity. Should be considered a BMP |
| 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 offset costs. Should be considered a BMP |

**Table 1. Odor reduction practices for dairy operations (cont.)**

| Practice | Description | Advantages | Disadvantages | Effectiveness | Cost | Comments |
|---|---|---|---|---|---|---|
| **II. Emission** | | | | | | |
| a. Building | Frequent scraping and manure removal. Daily bedding replacement | Should be considered a best management practice | None | High | Low | Additional effects on cow comfort, longevity, and milk quality offsets labor requirements. Should be considered a BMP |
| b. Manure storage | Biofilters in vents from air exhausting the reception pit | Ease of construction. Materials readily available | None | High | Moderate | Biofilters can be made out of a mixture of 30% to 50% compost and 50% to 70% wood chips. |
| Earthen basins (single or double cell) | Covers:<br>Natural crust<br>Biocovers (straw)<br>Inorganic geo-textile<br>Inorganic clay balls<br>Inorganic 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 biofilter. | Natural crust: High<br>Bio-covers: High<br>Inorganic covers: High | Low<br>Low<br>Moderate to high | Odor potential if slurry is not injected. Local ordinances may limit design options. Effectiveness highly dependent on proper management. |
| Steel or concrete tanks (above or below ground) | Covers:<br>1. Impermeable (PVC, wood, concrete)<br>2. Permeable (straw) | Duration (10-15 years)<br>Cost | Cost.<br>Duration. Sometimes difficult to maintain afloat. | 1. Impermeable: High<br>2. Permeable: High | Moderate to high<br>Low | Impermeable cover: A bio-filter needs to be added at the end of the vents to treat exhaust gases. |
| 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. |
| 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 | |
| Flush system | Manure from the alleys is flushed. Ammonia emission from the building decreases | Reduced labor. Easily automated. Lower operating costs. Floor dries out better; maintains dry cow's hooves.. | Storage of large amounts of water required. Freezing can be a problem. High costs of recycling pump and flush devices | Moderate to high | Moderate | Solids separation desirable. A lagoon is required to receive, store, and provide a source of water |
| Methane digesters | Biogas production from manure | Generation of electricity. | Currently suitable for larger dairies | Has shown high odor reduction | High | The USDA is currently testing smaller digesters (300 cows) |

**Table 1. Odor reduction practices for dairy operations (cont.)**

| Practice | Description | Advantages | Disadvantages | Effectiveness | Cost | Comments |
|---|---|---|---|---|---|---|
| **III. 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 |
| **IV. 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 is 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 is 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 000000is needed. |