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THE Manager
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MANAGING NUTRIENTS

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What's ahead for manure management?

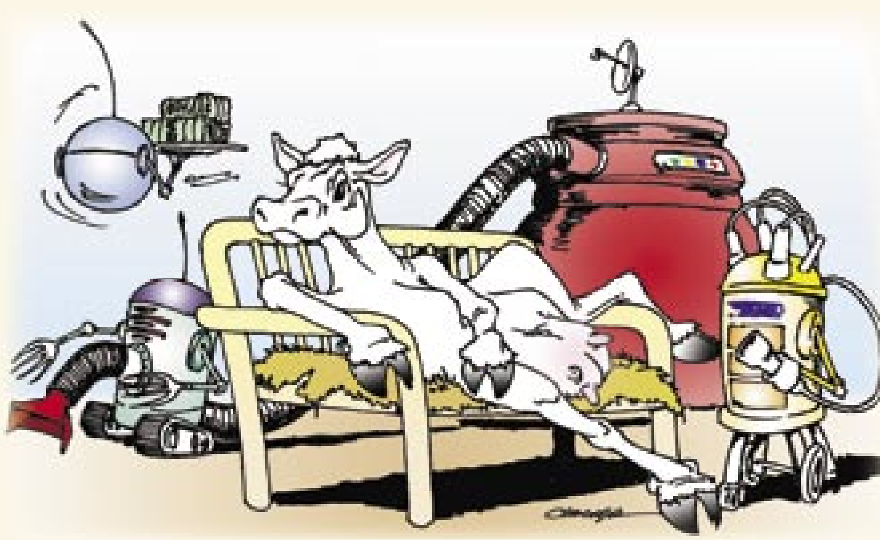
Don't expect to see genetically modified manure to solve environmental and economic challenges of manure management. But you can look for new technologies to help.

By David Belcher

Imagine dairy cows living in climate-controlled barns where all their needs are provided by robots and advanced machinery. Cow-specific total mixed rations will minimize nutrient excretions and maximize milk production. Ration components, grown in controlled environment production systems, are mixed and delivered to each cow by feeding robots.

Air recirculation equipment precisely manages temperature and humidity while removing ammonia and volatile organic compounds from the air and concentrating them for commercial sale. Sanitation robots scour the stall beds and alleys for traces of pathogens, treating areas instantly with UV light and disinfectants.

Laser-guided waste collection robots anticipate the release of manure and urine from cows and silently vacuum these wastes and send them to the processing area. Cost-effective, efficient digester systems process the dairy's manure and other organic materials. The system produces all the hydrogen-based fuel needed for the dairy and the local community. Manure nutrients, fibers and water are separated and either recycled into the overall farm production system or sold commercially.



What to expect

It will be some time – if ever – before these processes become reality for dairies. But several trends in manure management are emerging along with the technologies to address them.

Here's a look at four trends.

1. Total environmental systems management. Evolving federal air regulations that have the potential to limit dairy farm air emissions are likely to influence how the dairy industry approaches manure management in the next few years.

Reducing air emissions such as ammonia can occur across an entire dairy operation, so look for the development of multiple-part reduction strategies that reduce the off-site migration of nutrients through air and water.

Research will continue to improve diets that minimize nutrient excretions. And new technologies will be developed to minimize and/or treat air emissions from manure collection and storage areas. Examples include vacuum systems, biofilters for animal housing air filtration systems and manure storage additives that minimize ammonia

INSIDE

What's ahead for manure management? page 19

Striking the right balance page 21

Which fields need extra N? page 24

Nitrogen management tools for corn page 34

Understanding nitrogen use in dairy cattle page 36

How much N does first-year corn need? page 38

Nothin' but politics page 39

Status of biogas across the "big pond" page 40

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formation and volatilization.

2. Solids separation and nutrient concentration technology. There are many reasons to separate and concentrate dairy manure nutrients. Odor reduction, use of solids as bedding and reduced manure application costs are the three most important advantages to solids separation.

Effective concentration of nutrients, particularly phosphorus, in the solids fraction of separated manure can save application costs through more precise nutrient management. By pumping and incorporating liquids of lower nutrient strength on closer fields and spreading higher strength solids on outlying fields, producers can maximize nutrient uptake and minimize application costs. Higher nutrient-strength separated solids may be exported off the dairy as a fertilizer or soil amendment.

Irrigating low-strength liquid manure on crop fields throughout the growing season can improve crop growth and reduce liquid storage needs. And there's the potential to reduce soil compaction.

Improved solids separation can reduce manure storage. Separated liquids, if cleaned up enough, could be applied to certain fields or constructed wetlands nearly year round. This might eliminate the need for liquid manure storage, or result in storing water instead of manure.

Over the next few years, expect to see improvements in two areas: mechanical solids separators and rotary drum composters to heat-treat and dry solids for use as bedding.

Also look for increased use of chemicals/polymers in manure separation systems to improve the segregation of nutrients into the solids portion of separated manure. The use of membrane filters to separate nutrients such as ammonia nitrogen currently is being studied and pilot-tested in the United States and Europe. They may eventually be adopted depending upon cost and nutrient separation needs.

Finally, look to new biological methods to sequester manure nutrients. One example is the on-site production of highly nutritious aquaponic plants that could uptake nutrients from separated manure liquids and perhaps be fed to cattle, reducing a dairy's reliance on purchased concentrates.

3. Lower cost digester systems. Reducing manure's odor, pathogens, weed seeds and organic content, along with producing renewable energy, are good reasons to consider anaerobic digestion. But if more dairies are to build digester systems, their financial performance must improve.

Improved economic incentives for renewable energy such as the New York Renewable Portfolio Standard (RPS) and the Regional Greenhouse Gas Initiative (RGGI) may help increase digester system revenue. But a key way to improve a digester's financial performance is to reduce the system's capital costs. Both digester developers and dairy farmers cite the need for this to happen. Lower costs would also improve the availability of debt financing.

Over the next few years, expect to see these technologies and others made available to answer the environmental and economic challenges of managing manure on dairies.

Low capital cost digesters make sense for dairies that only want to reduce manure odors and produce enough power for their businesses. They will not, however, optimize methane production for maximum energy production.

Evolving digester designs that could lead to reduced capital costs include fixed-film digesters and high solids anaerobic digesters. Fixed-film digesters can treat low-solids manure, including separated manure liquids from scrape facilities. Treating only separated manure liquids reduces the size and costs of digester construction. These systems also reduce biogas production.

High solids anaerobic digester systems include anaerobic compost systems that can digest manure mixtures of up to 20% total solids or recycle a portion of post-digested separated solids back into the digester influent. By using concentrated solids, these systems also reduce the total reactor size and capital costs compared to more traditional systems.

4. Alternative fuels. While biogas from digesters is most often used to power reciprocating engines, the methane and carbon dioxide of biogas can be processed into several other types of fuels including compressed natural gas (methane), hydrogen and liquid fuels such as methanol.

High temperature and pressure methods to produce biogas and/or liquid fuels from biomass include such processes as pyrolysis and thermal depolymerization. These high-temperature processes, along with improved biogas-purifying technologies, are being developed for biomass, including manure.

High capital and operating costs may limit the application of some of these technologies on dairy farms for a while. However, rising fuel prices and greater government interest in renewable energy may hasten their development.

Over the next few years, expect to see these technologies and others made available to answer the environmental and economic challenges of managing manure on dairies. Stay tuned for technology performance information and updates. ■

FYI

■ **David Belcher is a member of the PRO-DAIRY environmental systems management team at Cornell University. He has research and extension responsibilities in waste treatment systems. Reach him at (607) 227-6412 or dmb45@cornell.edu.**

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