Advances in Manure Management Technologies

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Introduction

Everyone knows the statistics. The United States produces more milk today on fewer farms than ever before. The number of farms continues to decrease while farm size is on the upswing. The National dairy herd hovers around 9.3 to 9.4 million cows. With all those cows getting fed daily, it's a sure thing that manure is produced. Being able to transport manure to local fields is relatively easy with smaller herds. As herd size increases, the number of loads requiring transport can be quite high and the fields may not be local. Manure management practices that work with a 100-cow herd might not work with 2,500 cows. Practices that make sense with $9.00 labor might not make sense when labor is $15/hr.

Here we are in 2019 wondering what will be the next innovation in manure management. As herd size increases, the challenge with manure management is sheer volume. More cows means more bedding and more manure. Increases in herd size often trigger regulatory requirements to use or account for nutrients in a more detailed fashion.

For most people, manure management means maximizing clean animals and reusing nutrients while minimizing flies and odors. Changing the form of manure remains a key consideration for many producers. Getting manure to a dry state as soon as possible is desired. Keeping manure in the dried state is also important. For wet or slurry systems, maintaining manure in an environment where it can be stored without generating concern is important. For many, manure is used on near-by crop land to provide organic matter and nutrients to growing crops.

Pick up a dairy magazine or go to an Ag Expo and you'll find vendors selling products for manure. There's everything from microbes to consume the manure to equipment that will process it. Stop!

Before you spend a bunch of time roaming from booth to booth you need to plan. What is it you're specifically needing to accomplish? What's the job description you need to fill? How will you judge individual products against your needs?

Needs assessment tool

Every dairy is unique. The potential constituents of concern will vary depending on local climate, weather, soil, geography, growing patterns, etc. Often producers need to consider individual constituents separately before determining which technologies may be effective. Nitrogen and phosphorus often drive the decision-making process. However, organics, salts, potassium, pathogens and heavy metals may also impact the outcome. Addressing a few simple questions is a great start at potentially leaning one way or another toward a technology (Table 1).

Table 1. Do you have enough land to apply all manure at agronomic rates for each constituent?

YES	NO
Are current odor and dust control techniques used in the production unit sufficient? Are current practices for manure management sufficient? Would a different utilization strategy or technology be more cost effective or desirable?	What constituents must be reduced? What technologies can be added to the existing system to reduce each or all of these constituents? What new system(s) could be more cost effective to reduce each or all of these constituents? How will the modified or new system improve nutrient management? Is it important if you select a utilization or destructive treatment system?

Adapted from Humenik, 2001.

The first step before purchasing equipment or hiring employees is to identify the job description. Yes, a job description is needed even for manure technologies. Carefully think through what it is you want to accomplish. Then define the job description of any potential new technology.

One challenge, particularly with new technologies, is that they can accomplish one, two or even more things. However, they don't necessarily treat everything you want treated. At times, in the process of accomplishing what you do want, they also do something you don't want.

Manure treatment technologies can be categorized many ways, by solids removal, sedimentation, flocculation, aeration, anaerobic digestion, and natural systems. More advanced technologies include polymer-enhanced solids separation, impeller aeration, activated sludge treatment, various

Which technology should I choose?

- thermal conversion (including combustion and gasification)
- solid-liquid separation (including dehydration)
- composting
- anaerobic digestion
- aeration
- nitrification/denitrification systems
- covers for lagoons
- microbial cultures/enzymes/other additives
- feed management…..

types of aeration, even the use of duckweed, the list is almost endless. The question is how to make sense of all these options.

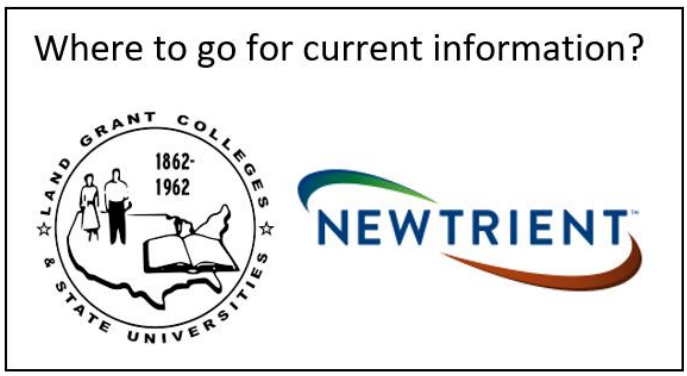
Get your score card out

In 2001, Frank Humenik at North Carolina State University summarized existing literature related to various manure treatment technologies. What Dr. Huminek did was incredibly useful. He took existing knowledge, based on research that had been done in Iowa and North Carolina with swine manure, and put it into a scorecard format. For each treatment technology or unit, he identified if organic material, nitrogen, phosphorus, heavy metals and pathogens had major, minor or little to no removal. He also summarized effluent gas increases, decreases or no effect. He categorized both capital and operating costs as high, intermediate or low and documented if it was tested on-farm. Bench top results from laboratory work is nice but on-farm data are far superior.

Another attempt to categorize technologies was undertaken in California where they created a Manure Treatment Technology Panel (ARB, 2005). Companies or vendors were asked to provide detailed data and information related to their product. Criteria were going to be used to evaluate technologies focused on pollution prevention or pollution control. Constituents of concern included air pollutants, nutrients, salts, odors, pathogens, etc. Air emissions of concern in California included: ammonia, volatile organic compounds, methane, hydrogen sulfide, particulate matter, odors, carbon monoxide and oxides of nitrogen. The end fate of nutrients was a key concern. As an example, it's potentially a good thing if a technology modifies organic nitrogen to nitrogen gas. Yet, it's not a good thing to modify organic nitrogen to nitrous oxide. Understanding the final form of individual nutrients is important. Generating electricity and economic performance were also evaluated.

Unfortunately, few companies were able to provide scientific data that informed the panel beyond best professional judgement to determine the environmental and economic performance of individual technologies. Few companies had tested their product on California dairies. Most of the information submitted was testimonial or marketing literature. Most technologies addressed a limited portion of environmental issues. Despite the poor data that was available, one thing was quite clear. Treating manure is expensive. Both initial costs to design and build treatment systems as well as costs to operate and maintain systems require human and financial resources.

Most recently, a consortium of dairy coops, National Milk Producers Federation and Dairy Management Inc. joined forces to form Newtrient LLC. The goal of Newtrient is to harness dairy manure's value while improving individual farm sustainability. Newtrient has enlisted consultants and scientists to review manure treatment technologies and developed the Newtrient Technology Catalog. This provides unbiased information related to



manure treatment technologies. A 9-point score card is used evaluate technologies based on the following:

- Commercial viability: operational history, reliability and market penetration;
- Economics and industry value: capital cost, operations and maintenance cost and value proposition;
- Transparency and interaction: vendor information sharing, case study, customer review

Technologies with a designation "Newtrient Recognized" indicates that a technology has been proven in the marketplace, on the farm. It does not mean Newtrient is recommending or endorsing one technology over another. It does mean that these technologies are proven. You may want to consider them if you are doing a similar project. Newtrient uses a separate classification for emerging technologies. This designation applies to technologies that are making progress through their 9-point scoring system. "Emerging Technologies" show promise and have not yet been on-farm long enough to receive the Newtrient Recognized designation.

The Technology Catalog focuses on solid liquid separation, nitrification/denitrification, salt removal, evaporation/drying, and energy generation/thermal conversion.

The future of Newtrient includes business development to advance manure-based technologies as well as driving adoption of ecosystem services marketplaces to create a market for manure derived environmental benefits. Both goals are admirable and will help move manure treatment technologies into the future.

Our panelists

Many producers have been incredibly innovative with advanced treatment technologies. Each panel member will explain why they sought out advanced treatment technologies and identify the process they used to select what they currently use. Lastly, panelists will share their experiences with their technology. Producers selected have been using their technology for more than 3 years.

References

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