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Put a lid on it: Cover options for manure storage

Progressive Dairy Editor Karen Lee

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Covering manure storage is growing in popularity for a number of reasons, from odor control to minimizing rainwater accumulation to capturing biogas.

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"A cover keeps oxygen and ambient air out," explains Craig Hartman, civil engineer with Hartman Engineering.

Anaerobic conditions, without the presence of oxygen, allow the microbes that produce biogas to thrive. Open-air storage basins can be influenced by sunlight and wind. The introduction of atmospheric oxygen is non-conducive for anaerobic microbial activity in the top 3 to 4 feet of the lagoon.

"Adding a cover converts the full pond to an anaerobic digester," says Hartman, who has worked on covering 54 units in the last 13 years, most of which are lined earthen lagoons covered with a high-density polyethylene (HDPE) material for biogas production.

"HDPE is thick and pretty strong," he says, noting it works with a very small amount of gas pressure, has a very low permeability for water and gas, and can hold up against the sun's ultraviolet (UV) rays.

Dave Anderson, technical sales manager at IEC Covers, also uses this material for covering large dairy and hog ponds and holding tanks.

"Polyethylene is a great product. It is impervious to biogas and most wastewater constituents, while providing the end-user with a very long lifespan," Anderson says. Over the past 31 years, he has worked on over 1,300 covers for a wide range of clients across North America and 20 different countries.

The material is flexible and in a positive-pressure system will bag up to hold the gas produced. In areas that are subject to higher wind velocities, the negative pressure cover design is typically preferred because they lay flat on the water and are less susceptible to movement caused by wind gusts and storms. In the negative-pressure system, a vacuum removes the gas, which prevents the cover from ballooning and improves the longevity of the material. Different mil thicknesses, design and type of polyethylene is selected depending upon the type of basin and the engineer's and farmer's operational parameters. Colder climates typically need insulated covers to retain water temperature during winter months to promote and maintain biological activity.

As an engineer, Hartman says it is important the covers adhere to building and fire protection codes. Since the cover will hold dangerous gases, such as hydrogen sulfide, it needs to be safe in instances of high winds.

Earthen lagoons make up 90% to 95% of the cover installations Anderson has worked on. In this scenario, the edges of the cover are buried in an anchor trench around the lagoon and are backfilled and compacted. He said the cover could be attached to concrete and metal using stainless steel batten bar and hardware.

Plumbing is installed to collect the biogas so it can be cleaned and sold as renewable natural gas, used to fuel an engine or flared.

If the amount of biogas can be quantified as it is drawn from the storage and analyzed for content, the project may qualify for grants and credits for reducing carbon emissions, Anderson explains.

"It is a way of offsetting the capitol cost," he says. "Depending on the number of head and enough [manure] to generate biogas, the cover will pay for itself and generate money for the farm."

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Capturing and processing the biogas also reduces odor on the farm.

The covered anaerobic digester is positioned within a farm's manure management system. On the flush dairies Hartman primarily works with, the manure leaves the barn and is processed through a screen separator and sand lane before entering the lagoon digester.

The effluent entering the digester contains 1% to 2% total solids. The microbes will aid in processing any remaining organic material, and a sludge removal system can be installed prior to the cover to take out any inorganic material that settles in the storage.

From the covered digester, the effluent typically flows into an open storage pond. The volume of the digester remains fairly stable, whereas the storage pond will fluctuate as it is used for the farm's agronomic needs.

The goal is to never have to remove the cover until it needs to be replaced.

"With really good solids separation up front, you can get 20 years life out of it," Anderson says.

For maintenance, the cover must be monitored for any defects from UV or stress, as well as puddling from rainfall.

Anderson explains their covers have sand tubes that create a spine and rib pattern. Rainwater falls into these depressions and flows to a collection site.

"A properly designed cover will not have any issues," he says.

Each cover is custom-designed and built to the project specifications. The most economical method of installing covers is on dry, empty ponds. Covers can be installed with liquid; however, it takes slightly longer and requires different methods for deployment.

Reducing odor with activated carbon

Another cover option that has been implemented in Latin America and is starting to gain traction in the U.S. is focused on odor reduction without the use of chemical additives.

Its primary use has been in municipal, industrial, and food and beverage applications, but could also be used in agriculture.

"The systems consist of geomembrane covers with housings for activated carbon filters. Airflow has to go through the filter, and they capture and treat odor from the tank or pit," says Bob Negley, sales manager for Anue Water Technologies.

The membrane is supported by a cable grid and batten bars above the surface, making it unaffected by aeration, changing effluent levels, foaming, bacteria and other common issues.

The lifetime of the carbon filters is nine to 18 months, depending on emission levels.

The filter is engineered to allow gases and water to flow freely through while the activated carbon in the filter traps the odor causing contaminants. Gas-specific filters for hydrogen sulfide and ammonia can be combined in the system to control the various odors from manure.

"Each system is custom-designed to the specification," says Greg Bock, vice president general manager of Anue Water Technologies. They can be made to fit any shape and size and are expected to last over 10 years, even in harsh conditions.

The edges are fastened to the perimeter of the metal or concrete storage structure and can be engineered for an earthen basin as well.

Each cover can also contain viewing ports to see what is happening inside the structure.



There are no pumps or motors involved, and the system has been shown to remove hydrogen sulfide by as much as 95%.

Negley says activated carbon is currently used to remove carbon dioxide in other applications. This system may qualify for carbon credits if the amount of gases present both before and after the filters can be quantified for the individual application. "I think this is possible but not something we've done for [agricultural] application," he explains.

Whether controlling odor or collecting biogas, cover options available today are custom-built for many applications and require minimal, if any, maintenance.

PHOTO 1: Covering liquid manure lagoons traps odors and funnels the biogas for further processing. *Photo courtesy of IEC Covers.*

PHOTO 2: Another way to address odors from manure storage is with a geomembrane cover with activated carbon filters specifically designed for treating hydrogen sulfide and ammonia. *Photo courtesy of Anue Water Technologies.*



Karen Lee

Editor

Progressive Dairy

[Email Karen Lee](#)

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(800) 320-1424
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Progressive Dairy
PO Box 585 (Mailing)
238 West Nez Perce (Physical)
Jerome, ID 83338, USA



editor@progressivedairy.com

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