Bring your lagoon back to life

by Chuzhao Lin

MANY dairy farms use earthen lagoons or aboveground, non-earthen structures for manure storage and treatment. While we would like to recall the good old days when there was less regulation and fewer neighbors complaining about odor, times have changed. New regulations are in place, urban sprawl is in full bloom, and the total amount of manure produced from an average farm has grown.

While we cannot do much with the regulations but to comply with them or the urban sprawl but to cope with the city folks, we might be able to do something with the manure. I will briefly describe how a manure lagoon is supposed to work and provide examples of how we can improve the functionality of our lagoon to make it work better.

Lagoon basics . . .

With the exception of the surface layer, a manure lagoon is an anaerobic system. The system is not that different from the rumen of a cow. The only difference is there are few readily digestible fibers left in the manure. Rather, there are more hard-to-digest plant fibers, and these fibers require a longer time to break down properly. The results are still the same, volatile fatty acids, hydrogen, carbon dioxide, and others which eventually lead to methane production. Methane production is a good thing as it will lead to both manure solid breakdown and odor reduction.

If the manure lagoon is properly sized to include enough storage (about 10,000 gallons per cow per year plus allowance for runoffs and rain) and proper treatment volume, it will do more than just hold manure, it will treat it and reduce odors as well. The key here is establishment of an aerobic surface layer. As you see in the figure, the aerobic surface layer is created when oxygen from the air is dissolved in the surface of the lagoon, creating an odor cap. Aerobic bacteria living in the surface layer feed on volatile fatty acids coming up from the anaerobic bottom, reducing potential odor.

Many large farms do not have enough storage space or proper treatment volume in their lagoon. Although the amount of manure going into the lagoon per cow is the same, there is manure from more animals going in than before.

Whole system shuts down . . .

Suddenly we are dealing with a lagoon that is a storage facility at best. It does not function as a treatment facility any longer. A large amount of volatile fatty acids is produced by the solids breakdown and retained in the lagoon, lowering pH. Methane bacteria, unfortunately, are sensitive to low pH and are easily inhibited. The robust fermentative bacteria continue to do their work creating more volatile fatty acids and causing the whole anaerobic manure system to shut down. The accumulation of high concentrations of volatile fatty acids leads to offensive odors.

As more manure is added, the lagoon becomes anaerobic all the way to the top. The aerobic surface layer is minimized or destroyed and cannot function as an odor cap anymore.

In addition, copper sulfate is commonly used in foot baths. Copper sulfate (and other naturally-occurring sulfate compounds from the manure) can provide energy to a different group of bacteria known as sulfate reducers that produce hydrogen sulfide. The smell from the combination of high concentrations of volatile fatty acids and hydrogen sulfide is beyond offensive.

What are our options?

There are many innovative technologies in the marketplace to solve the odor and solids problem. A solids liquid separator takes out manure solids before they get into the lagoon. This serves to reduce both the storage and the treatment volumes by taking out between 20 and 30 percent of the solids.

Another technology brings the lagoon back to life by providing air to the surface layer and providing the lagoon with aerobic and facultative microbes. These microbes convert the excess volatile fatty acids to carbon dioxide and water in the presence of air. Thus, the microbes recreate the lagoon odor cap.

With the volatile fatty acids siphoned off, the methane bacteria are relieved from inhibition and start to produce methane again. Sulfate-reducing bacteria are also no longer dominating the lagoon, and much less hydrogen sulfide will be produced.

Studies confirmed that ammonia and hydrogen sulfide concentrations in lagoon water were greatly reduced when the microbial populations return to normal. Results are shown in the table and compare how quickly ammonia and hydrogen sulfide levels reached 20 milligrams per liter in the manure slurry.

When a solids separator is used in conjunction with the surface air and microbes, the results are even better. This is because the solids in the lagoon tend to be harder to digest compared to the animal feed. It is important to note that the aerobic/facultative bacteria added to the lagoon are naturally occurring microbes but are not normally found in manure lagoons so they have to be added periodically to keep the system working.

As a manure lagoon is a living microbial system, anything that upsets the microbes should be avoided, if possible. For instance, copper sulfate will kill the bacteria present in the lagoon, and the anaerobic microbial system will break down.

The lagoon may not smell, but solids will become a big problem. Likewise, the use of other disinfecting products such as formaldehyde should be minimized.

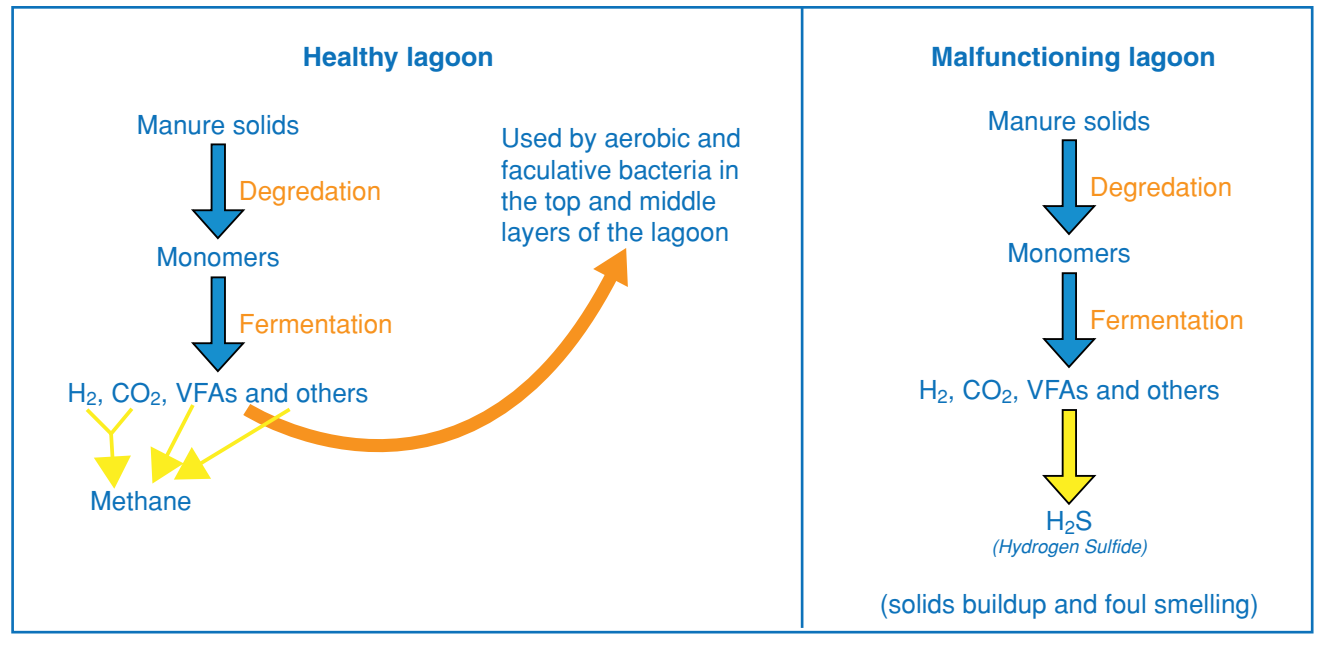
Dairy lagoons can be both a storage facility and a manure treatment system if they are properly sized and not used as a dumping ground for disinfectants.

If your lagoon smells, a separator or microbial augmentation in the presence of surface air diffuser, or preferably a combination of the two, can often bring any substandard lagoon back to life.

Comparison between a lagoon with and without added microbial bacteria

	Time (seconds)	
	Control	Treatment
Ammonia		
Top	388.50	480.25
Bottom	474.00	630.00
Hydrogen sulfide		
Top	451.50	1,848.50
Bottom	430.00	1,217.75

Time in seconds required for ammonia and hydrogen sulfide levels in the manure slurry to reach 20 mg/L.



The author is an adjunct professor of biology at Johnson and Wales University, Providence, R.I.