What can I do to my liquid manure storage to increase nutrient value and decrease application costs?

The soil fertility benefits of applying livestock manure are significant. But storage is key. Uncovered storage facilities result in manure with a high volume of water and low nutrient value being shipped to fields. Fortunately, changes to storage facilities can improve efficiency of nutrient transport.

The simple answer

By covering liquid manure storage and diverting wastewater, a 100-cow dairy herd operation with a manure storage capacity of one year could:

- Increase nutrient value by 50%
- Increase storage capacity by more than 70%
- Reduce application costs by more than $8,000
- Reduce manure storage odours

A little more information

Additional water that enters manure storage dilutes nutrients and adds to application costs. Nutrient losses during storage can be significant. Anaerobic conditions in liquid storages drive nitrogen loss and methane emissions, especially during warm temperatures.




Types of coverings

A straw or woodchip cover will reduce methane (CH_4) losses by forcing aerobic activity at the top of the pit to consume the methane before it is emitted. A geotextile cover at the surface of manure may reduce ammonia (NH_3) and nitrous oxide losses, but likely not CH_4 losses. Neither of those permeable covers would exclude rainwater. An impermeable storage cover over a pit will exclude rainwater. More information on storage coverings can be found at: https://www.ontario.ca/page/permanent-liquid-nutrient-storage-covers

The full story

Manure storage is used for many years, and over time the impact of reduced storage capacity and the cost of applying excess water may make it economical to cover an existing storage or consider a cover when constructing a new storage.

Rainwater

Ontario farms receive about 33 inches of rain per year. This can result in 134,000 Imperial gallons of rainwater going into an uncovered storage that is 100 ft in diameter (7,854 ft^2), reducing the days of storage by 18%.

Farmstead water

If runoff water from barn roofs and cement yards is added to the manure storage, approximately 1,140 Imp gallons of water are added to the storage for every 100 ft^2 of collection area. Divert rainwater away from a manure storage using eavestroughs, and sloped areas around the farmstead to prevent additional water in loafing yards. A year's worth of roof water from a 10,000 ft^2 barn entering a manure storage could reduce storage by an additional 35-40 days.

Wash water

Cleaning barns and milking centres is an important part of farm and food safety. However, wash water entering the manure storage adds significantly more water. Milking centre wash water can add an average of 3-7 Imp gallons/cow/day to the storage, or more than 250,000 Imp gallons for a 100 milking cow dairy. This extra water volume could reduce storage by almost 60 days. Alternatives could include a separate storage for wash water, a sediment tank with treatment trench (e.g. septic system), vegetated filter strip systems or engineered wetlands.

Separating solids/recycling water

Separating solids requires handling liquid and solid manure separately, but increases liquid storage capacity and provides an opportunity to use liquids that are less than 1% dry matter for irrigating crops during dry seasons. Recycling/re-using liquids for in-barn flush systems to move/scrape manure from ally floors or using separated liquids to separate sand in a sand lane reduces the need for additional clean water.

Sand bedding

Although not a liquid, the use of sand bedding displaces storage capacity. Sand is inert and doesn't add any nutrient value, can increase nitrogen (N) loss in storage and is abrasive to manure handling equipment. The use of sand bedding is ideal for cow comfort but adds cost to manure handling. Separating and recycling sand is a best practice that will be easier to implement as technology options become more affordable.
A comparison of different manure storage approaches to a 100 dairy cow operation (Table 1) that provides an example of the potential value of covered manure storage.

Table 1. Comparing the economic benefits in less transported water and more concentrated nutrients for a covered and uncovered liquid dairy storage (with and without milkhouse wash water).

1,246,500 gal capacity	Uncovered	Covered	Covered (no wash water)
Rainwater ft^3	45, 204	0	0
Milkhouse wash water ft^3	43,928	43,928	0
Days of storage	**365**	**464**	**643**
Manure dry matter (DM) at application	5.8%	7.0%	8.6%
Total N lb/1,000 gallons	31	36	42
Value of available N in tank @$0.78/lb N	**$10,830**	**$12,800**	**$15,000**
P_2O_5 lb/1,000 gallons	10.3	13.4	17.3
Value of P in tank @$0.78/lb P_2O_5	**+$9,300**	**+$14,720**	**+$17,270**
K_2O lb/1,000 gallons	23.3	26.2	29.8
Value of K in tank @$0.53/lb K_2O	**+ $14,290**	**+ $16,700**	**+ $19.960**
Cost of transporting extra water @ $0.015/gal	**-$8,328**	**-$4,224**	**0**
NPK value of full storage	**$ 34,420**	**$ 44,220**	**$ 51,960**

Source: AgriSuite Manure Storage and Sizing tool www.agrisuite.omafra.gov.on.ca (with Oct 2023 fertilizer prices)

More concentrated manure can be applied at lower rates, reducing the number of loads taken to a field. Water content in manure from uncovered storage would increase application costs by more than $8,000 when transporting manure to fields further away from the storage.

Determining the return on investment to cover manure storage will vary from farm to farm. Considering the costs over the lifetime of the storage and the distance manure is applied in relation to its location will help determine if covering a storage and making other changes to reduce water content in manure is economical.