GREENHOUSE GAS FROM DAIRY MANURE MANAGEMENT AT THE FARMSTEAD

Part 5: GHG REDUCTION FROM CRUSTS ON STORAGES

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The methane conversion factors (MCF) in Table 1.5 for a liquid long-term storage with a natural crust are lower in both summer and winter than without a crust and even though the emission factor (EF_3) for nitrous oxide (N_2O) is slightly increased, a storage with a crust reduces storage emissions of greenhouse gas (GHG) emitted. As methane (CH_4) moves up through the crust, a portion of it can be intercepted and degraded as it moves into the aerobic upper part of the crust. The global warming potential (GWP) from GHG emitted from dairy manure management systems need to include both GHG emissions of CH_4 and N_2O. The GWP for the manure storage is obtained by using equation 1.2 from fact sheet 2 and equation 1.3 from fact sheet 3 along with their respective tables, 1.2 for methane contributing factor (MCF) and table 1.3 for the EF_3 for N_2O emissions.

Advantages

On a heavily organic bedded and/or a high forage diet herd, there are a large amount of organic particles that often float to the top of an un-agitated manure storage. Additional factors that encourage a crust to form include less dilution water (milking center wastewater, rainfall) added, less surface storage area, deep manure storage structures, and less wind disturbance. Since a crust can naturally occur, the GHG reductions from a liquid storage without a crust may take little management. Another advantage of a crusted storage is some odor reduction can be expected during the storage period.

Considerations

Additional organic matter may need to be added to the manure to obtain or maintain a crusted surface. A crust on the surface of a manure storage will have to be broken up by intense mechanical agitation when attempting to obtain a homogeneous nutrient concentration immediately prior to spreading operations. There may be some difficulty getting a timely nutrient value for the manure to be spread as application should follow immediately after agitation and so any concentrations from the samples taken will be evaluated too late to inform the application rate. Some farms have been successful in leaving the crust for several years and just agitating the material underneath. Over time, however, without complete agitation, solids will build up both in the growing crust and in the bottom of the manure storage reducing the storage volume. A thick crust can be difficult to break up and any additional use of fossil fuel will increase the GHG footprint of the farm. Care must be taken when agitating the manure storage as odors and dangerous gases can be released. Ensuring adequate ventilation in confined spaces and being mindful of the wind direction and natural air drainage are important concerns.

Cost

There may be a cost in adding any additional organic matter that is needed. The additional cost of agitation to break up the crust when needed for solids management in the liquid storage can add both time and fuel cost to the manure management enterprise.

Table 1.5 Global warming potential (GWP) estimates[2] for liquid storage with a crust compared to liquid storage without a as manure management storages

MCF[1] (winter - summer)	EF_3[1]	Manure Management BMP	Annual GWP lbs. from CH_4 CO_2eq/cow/yr.[2]	Annual GWP lbs. from N_2O CO_2eq/cow/yr.[2]	Total Annual GWP lbs. CO_2eq/cow/yr.[2]
(10 – 22)	0.005	Liquid/Slurry with crust	5,670	846	6,516
(17 – 35)	0	Liquid/Slurry without natural crust	9,213	- 0	9,213

[1]Source: IPCC (2006) and EPA (2016) [2]Calculated

Planning considerations

The availability of pumps or impeller mixers with aggressive agitation should be considered if planning to develop a natural crust on the manure storage.

Table 1.5 shows the MCF, EF_3, and GWP as the carbon dioxide equivalent (CO_2eq) per cow per year for a liquid storage with and without a crust. Partial crust or crusts that are temporary in these systems will still partially reduce GHG emissions.

The assumptions used are that each manure management system that stores manure stores it for both the summer period and the winter period, the nitrogen content of the manure excreted is 0.99 lbs./cow-day, the volatile solids (VS) in manure is16.9 lbs./cow-day (ASAE), and for this example, summer ambient temperature is assumed to be 18°C (64°F) and winter is assumed to be < 10°C (< 50°F) so an average MCF value is used for the whole year. Even though the liquid storage with a crust has the potential for more N_2O emissions the reduction in CH_4 emission from the crust gives it a lower GWP.

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FACT SHEET SERIES: 1 HOW ARE GREENHOUSE GASES GENERATED?, 2 DAIRY MANURE MANAGEMENT IMPACT ON METHANE, 3 DAIRY MANURE MANAGEMENT IMPACT ON NITROUS OXIDE, 4 COMBINING METHANE AND NITROUS OXIDE EMISSIONS FROM DAIRY MANURE MANAGEMENT, 5 GHG REDUCTION FROM CRUSTS ON STORAGES, 6 GHG REDUCTION FROM LIMITING SUMMER STORAGE, 7 GHG FROM SOLID STORAGE SYSTEMS, 8 GHG REDUCTION FROM SOLID/LIQUID SEPARATION, 9 GHG REDUCTION FROM AN IMPERMEABLE COVER, 10 GHG REDUCTION FROM AN ANAEROBIC DIGESTION SYSTEM.

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