GREENHOUSE GAS FROM DAIRY MANURE MANAGEMENT AT THE FARMSTEAD
Part 8: GHG REDUCTION FROM SOLID-LIQUID SEPARATION SYSTEMS

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Reducing the manure volatile solids (VS) exposed to anaerobic storage will reduce the production of the greenhouse gas (GHG) methane (CH_4) from the manure storage. The screw-press solid-liquid separator (SLS) used by many farms produces a "liquid stream" effluent that is about 80% of the influent mass with only 50% of the original VS and a "solid stream" that is 20% of the initial influent mass but contains about 50% of the VS (Gooch et. al., 2005). Other types of SLS will give varying results depending on the technology, screen size, flocculants, throughput, initial manure condition and management.

Advantages

The decreased viscosity of the SLS liquid effluent increases the efficiency of pumps, reduces plugging in pipes, reduces solids build-up in the bottom of the storage, essentially eliminating natural crusting and makes it easier to agitate. The mass that is removed means that the storage itself will either hold about 20% more product or can be built 20% smaller for the same target storage period. The reduction in the amount of VS in the storage means there is less microbial activity in the storage so there will be a significant reduction in the CH_4 emissions. A 50% reduction in the VS content will yield a 50% reduction in CH_4 emissions.

Some producers have found that separated solids can be successfully used as bedding in well-ventilated dairy barns where prudent stall management protocols are in place. Typically, the amount of separated solids will sufficiently meet the bedding needs of a freestall dairy with some additional to spare. SLS manure solids can be used on-farm as a soil amendment delivering not only nutrients but also organic matter in a transportable form with less moisture. In some locations the solids can also be composted and sold. There is a significant reduction in the CH_4 emitted from a static solid storage. The outside of the pile will be aerobic limiting the release of CH_4.

Considerations

The added SLS equipment and the need for two types of manure handling equipment (liquid and solid) are considerations a farm must evaluate. A natural crust will not likely form with the solids reduced in the separated liquid storage. Periodic preventive maintenance is needed to keep a SLS performing effectively. Some farms have experienced udder health and milk quality challenges in cows bedded with separated manure solids.

Cost

Costs for separation equipment can vary and need to include the building and plumbing to move the manure. The operation and maintenance costs include daily monitoring and maintenance of the equipment, replacing the screens and augers as they wear, electric power cost, and cleanup of spills as they occur.

Planning considerations

Barns with a direct push off into storage will have to do some major retrofitting to collect manure for separation. Liquid spills may occur from SLS malfunctions. The solid manure will need a roofed area large enough for storage and handling. Contact a Natural Resources Conservation Service office, the local Soil and Water Conservation District office, or a qualified professional for design assistance.

The global warming potential (GWP) can be determined by using Equation 1.2 from Fact Sheet 2 and Equation 1.3 from Fact Sheet 3 along

Table 1.8 Global warming potential (GWP) estimates[2] for liquid storage with a crust only compared to a manure management system using Solid-Liquid Separation and storing the separated liquid without a crust and storing the separated solids

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]
(2 – 4)	0.005	Solid storage	106	169	276
(17 – 35)	0	Separated Liquid without natural crust	3,685	0	3,685
Total liquid and solid storage from a Solid Liquid separation system			3,791	169	3,961
(10 – 22)	0.005	Liquid/Slurry with natural crust	5,670	846	6,516

[1]Source: IPCC (2006) and EPA (2016) [2]Calculated based on 50% Volatile Solids (VS) separation

with their respective Tables, 1.2 for methane contributing factor (MCF) and Table 1.3 emission factor (EF_3) for N_2O emissions will give the GWP for the manure management system.

Table 1.8 shows the MCF, EF_3, and GWP as the carbon dioxide equivalent (CO_2eq) per cow per year for a both a liquid storage with and without SLS. The system with SLS includes a static solid storage. So the combined GWP is estimated to be 3,685 + 276 or 3,961 lbs. CO_2eq per cow per year. These systems are sometimes managed with a composting component for the manure solids but sometimes managed with very little storage as the solids are utilized rapidly as bedding for the cows. Variations in these systems will change the GWP.

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 (ASAE), the volatile solids (VS) in manure is16.9 lbs./cow-day (ASAE), and that for simplicity, 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. If the solid is reused as bedding the solid storage GWP will be reduced..

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Intergovernmental Panel on Climate Change (IPPC) Tier 2 method from the 2006 IPCC Guidelines for National GHG Inventories, Volume 4, Chapter 10: