GREENHOUSE GAS FROM DAIRY MANURE MANAGEMENT AT THE FARMSTEAD

Part 9: GHG REDUCTION FROM AN IMPERMEABLE COVER

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An impermeable cover may be used to reduce the greenhouse gas (GHG) emitted from long-term liquid manure storage. By covering a manure storage, emissions from the liquid to the gas phase are reduced. Covers create reduced air movement over the manure surface, and liquid turbulence is minimized. The major reduction in GHG emissions is due to the installation of a flare or biogas utilization system to combust as much of the CH_4 produced as possible.

Almost all manure systems should consider manure solid liquid separation (SLS) if a cover is installed. A typical screw-press solid-liquid separator (SLS) produces a "liquid stream" effluent that is about 80% of the influent mass with only 50% of the VS and a "solid stream" that is 20% of the initial influent mass but contains about 50% of the VS (Gooch et. al., 2005).

Advantages

Impermeable covers combined with a biogas collection and combustion mechanism reduce GHGs, and odor emissions during storage. With a properly selected and well-operating flare, CH_4 is destroyed, yielding significant reduction of GHG emissions. Another advantage is the potential to sell carbon credits if CH_4 is captured and destroyed.

Considerations

Estimates of 90% combustion in a flare are often used (EPA, 2011). Since the flare converts the higher global warming potential (GWP) CH_4 to CO_2, the GWP is greatly decreased. To achieve both the full GHG benefit it is important that leaks in the cover are minimized. Gas escaping from access ports, connections, and pipes will allow CH_4 (as well as odors) to escape. Due to safety concerns, rigid covers that allow a gas space under the cover have the potential for oxygen and fuel mixing in the air space within the combustible range and should not be used.

Cost

Maintenance and repair costs vary depending upon the cover material chosen and are typically performed by the installer or an associated service provider. Fact Sheet SC2: "*Estimate Your Annual Cost and Benefit*" (PRO-DAIRY, SC2), has been developed to assist in determining the potential economic impact of installing a storage cover based on farm specific information. A properly designed and maintained impermeable cover is expected to have an operational life of 20 years. Installed costs vary depending on the site, price of crude oil, the gas handling equipment and manufacturer/installer. The cost of gas handling will depend on the system chosen, applicable regulations, and carbon credit market requirements. At the end of the cover's useful life, it will need to be removed and properly disposed of.

Planning considerations

Covers need to be sealed at the edges to prevent escaping gas. Permanent appurtenances where manure enters, and exits, where agitation occurs, and where gas is collected, need to be designed into the cover to keep it gas tight. The flare needs to be located where it will not create a fire hazard and where inadvertent un-combusted gases will not create a hazard. A design professional should be consulted when considering covered manure storage.

The GWP can be determined 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 emission factor (EF_3) for N_2O emissions will give the GWP for the manure management system.

Table 1.9 shows the MCF, EF_3, and GWP as the carbon dioxide equivalent (CO_2eq) per cow per year for a liquid storage with SLS and a manure storage system with an impermeable cover and a

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Table 1.9 Global warming potential (GWP) estimates[2] for SLS liquid storage without a crust compared to a storage covered with an impermeable cover with the gases flared. Both systems would have a SLS solid storage for the separated solids as manure management systems

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]
(17 – 35)	0	Liquid/Slurry without natural crust after SLS	3,685	0	3,685
(2 – 4)	0.005	Solid storage	106	169	276
(17 – 35)	0	Covered liquid storage and flare	369	0	369

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

[2]Calculated based on 50% VS removal from the SLS and 90% efficient flare

90% efficient flare. Both of these systems would include solid storage. The separated solids in excreted is 0.99 lbs./ cow-day (ASAE), the volatile solids (VS) in manure is16.9 lbs./cow-day (ASAE), SLS will divide the mass of the manure into 20% solids and 80% liquid, SLS will divide the VS 50% into each of the solid and liquid masses, the separated solids are assumed to be stored in a static storage and that in 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.

The total GWP manure management system using a SLS storing the solids in a static pile and the liquids in an uncovered storage is a of 3,685 + 276 =3,961 lbs. CO_2eq per cow per year. This compares with a manure management system using a SLS and a covered liquid manure storage with a flare operating at 90% efficiency that has a GWP of 369 +276 = 645 lbs. CO_2eq per cow per year.

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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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PRO-DAIRY Program, Cornell University. SC2: Covers for Long-Term Dairy Manure Storages Part 2: Estimating Your Farm's Annual Cost and Benefit Updated Nov. 2015 Dairy Environmental Systems Program http://www.manuremanagement.cornell.edu/