Alternative slurry amendments for cattle slurry storage

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Summary

- Some alternative slurry amendments to sulphuric acid were successful in reducing both methane and ammonia emissions including alum, lactogypsum and zeolite.
- Ammonium thiosulfate reduced methane emissions but did not impact ammonia emissions.
- Commercial amendments one and two, biochar and dairy processing waste did not reduce either methane or ammonia emissions during cattle slurry storage.

Introduction

Agriculture is responsible for 37.5% of national greenhouse gas emissions and 99% of national ammonia emissions. Manure management contributes a substantial proportion of these emissions, 11.7% of agricultural greenhouse gas emissions and 78% of agricultural ammonia emissions. The release of these gases pollute the atmosphere and local sensitive areas, as well as liberating nutrients from the slurry, decreasing the slurry's fertilisation value. Methane is responsible for the vast majority of GHG emissions from cattle slurry and is produced via a process known as anaerobic digestion. Anaerobic digestion is a process that is sensitive to temperature, pH and oxygen levels which are the main inhibition pathways. Ammonia emissions are emitted or volatilised from the slurry surface through a physicochemical process that is dependent on the concentration of nitrogen, wind speed, temperature and pH, all of which can be controlled to reduce the loss of nitrogen during storage. Cattle slurry is also an important organic fertilizer with many benefits for the soil that it is applied to and is a good source of both phosphorus and potassium for deficient soils. To-date, the most popular and well researched slurry amendment is sulphuric acid, which has been shown to be an effective and economic way of reducing greenhouse gas and ammonia emissions. There are however other amendments that have potential to achieve similar results. Therefore, in this study, alternative amendments were chosen in order to assess their ability to reduce both greenhouse gas and ammonia emissions to provide stakeholders with a wide range of options to reduce emissions from slurry storage.

Results

Slurry was collected from an underground storage tank on a commercial beef and dairy farm. The slurry was stored for 85 days and emissions were measured regularly throughout the storage period. As shown in Figure 1, a total of eight treatments were examined, along with a control slurry treatment that was not amended, for their ability to abate methane and ammonia emissions during storage.

Amendments that reduced methane emissions significantly were alum (64%), ammonium thiosulfate (37%), lactogypsum (47%) and zeolite (24%; Figure 2A). Emissions were increased significantly by all other amendments including both commercial additives one and two.

Figure 1. *Medium scale slurry storage experiment in which multiple slurry amendments were examined*

Amendments that reduced ammonia emissions significantly, shown in Figure 2B were alum (84%), lactogypsum (44%) and zeolite (28%). All other amendments had no effect on ammonia emissions. As such any amendments that reduced ammonia volatilisation had increased concentrations of total ammoniacal nitrogen compared to the control. All other amendments had reduced levels of total ammoniacal nitrogen, reducing fertilisation value.

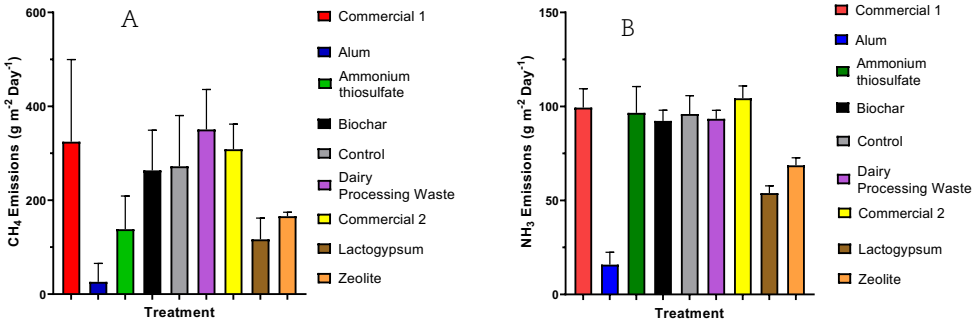

Figure 2. *A) Methane emissions from stored cattle slurry over 85 days; B) Ammonia emissions from stored cattle slurry over 85 days*

Conclusions

Alternative slurry amendments such as alum, lactogypsum and zeolite are effective in reducing both methane and ammonia emissions during slurry storage. Ammonium thiosulfate reduced methane emissions but had no effect on NH_3 emissions. All other amendments had either no effect or increased emissions as a result. Alum, lactogypsum and zeolite may be considered alternatives to sulphuric acid as amendment options to reduce methane and ammonia emissions from slurry storage.

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