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Alkalisation as Efficient Slurry Treatment Reduces Ammonia and Methane Emissions and Enables P-recycling

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Abstract

Slurry has become a substance of concern, especially in regions with high animal density. The conventional way of fertilising arable land with slurry is no longer feasible, as too large nutrient loads are applied per unit of area. The excessive addition of nutrients pollutes the soil, the groundwater, and releases high quantities of methane (CH_4), carbon dioxide (CO_2), and nitrous oxide (N_2O) into the atmosphere. Slurry management is responsible for 0.7 Gt CO_2-eq. a^{-1}, which is more than 25 % of the emissions generated by the whole livestock production sector.

Therefore, this study investigates aspects of an innovative and decentralised solution strategy that is based on the alkalisation of slurry to reduce emissions and to separate nutrients via precipitation processes. This involves the characterisation of buffer capacities that are present in the slurry to optimise the application of bases or alkaline acting additives. We have found that buffers functioning in the acidic milieu are subject to a microbial decomposition process, which paradoxically can lead to an increase in the consumption of bases in the alkaline milieu. Consequently, buffers must be considered as complex and interacting systems. Furthermore, alkalisation sanitises the slurry, which can inhibit or eliminate microbial activity, resulting in lower emission rates. This study showed that a pH of 10 reduces CH_4 and CO_2 emissions by about 99 % and N_2O emissions by about 60 % after a storage period of 8 weeks.

The alkalisation via calcium additives allows Ca-phosphates to be precipitated and separated so that they can be used as mineral fertiliser. Furthermore, the alkalized slurry can be combined with a stripping technology, allowing the rate of ammonia removal to be increased. The released ammonia can be further processed to create ammonium sulfate. Plant trials will finally be conducted with ryegrass (Lolium perenne) and maize (*Zea mays*) to evaluate the produced fertiliser and the treated slurry in terms of their value as a fertiliser and to determine if alkalized slurry poses a potential risk to these crops and the soil.

Keywords: Ammonia Emissions, Buffer Capacities, Fertiliser, Greenhouse Gas Emissions, Nutrient Recycling, Phosphorus Elimination, Slurry Alkalisation, waste Management

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