

Additive reduces methane during long-term storage of dairy cattle and fattening pig slurry

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In his doctoral thesis, Felix Holtkamp from the University of Bonn investigated processes that can be used to reduce methane emissions from slurry. Credit: Felix Holtkamp

Livestock farming produces large quantities of greenhouse gases, especially methane, which is particularly harmful to the climate. Among other things, it escapes during the storage of animal excrement, the slurry. A study by the University of Bonn now shows that methane emissions can be reduced by 99% through simple and inexpensive means. The method could make an important contribution to the fight against climate change. The results have now been published in the journal *Waste Management*.

Greenhouse gases act like a layer of window glass in the atmosphere: They prevent heat from being radiated from the Earth's surface into space. Methane does that 28 times as effectively as carbon dioxide—it is (to stay in the picture) a kind of invisible double glazing.

Over the past 200 years, the concentration of methane in the atmosphere has more than doubled. This is mainly due to human meat consumption. For one thing, cows and other ruminants produce methane during digestion. Another important source is the excrement of the animals. "One-third of the world's man-made methane comes from livestock," explains Felix Holtkamp, who is completing his doctorate at the INRES Institute of Crop Science and Resource Conservation at the University of Bonn. "It's estimated that up to 50% of it originates from fermentation processes in the slurry."

Researchers around the globe are therefore looking for ways to suppress these processes. Holtkamp, his scientific supervisor Dr. Manfred Trimborn from the Institute for Agricultural Engineering at the University of Bonn, and Dr. Joachim Clemens from the fertilizer manufacturer SF-SoepenberG GmbH have now presented a promising solution to the problem. "We combined slurry from a farm in the lab with calcium cyanamide, a chemical that has been used as a fertilizer in agriculture for more than 100 years," Holtkamp says. "This brought methane production to an almost complete halt."

Emissions fell by 99%

Overall, emissions fell by 99%. This effect started barely an hour after the addition and persisted until the end of the experiment half a year later. The long effectiveness is important, because slurry is not simply discarded. Rather, it is stored until the beginning of the following growing season and then spread on the fields as a valuable fertilizer. Months of storage are therefore quite common.

During this time, the slurry is transformed by bacteria and fungi: They break down undigested organic material into smaller and smaller molecules. Methane is produced at the end of these processes. "Calcium cyanamide breaks this chain of chemical transformations, and does so simultaneously at different points, as we were able to see in the chemical analysis of the slurry treated accordingly," Holtkamp explains. "The substance suppresses the microbial degradation of short-chain [fatty acids](#), an intermediate in the chain, and their conversion to [methane](#). Exactly how this happens is still unknown."

But the substance has other advantages as well: It enriches the slurry with nitrogen and thus improves its fertilizing effect. It also prevents the formation of so-called floating layers—these are deposits of organic matter that form a solid crust on the slurry and hinder gas exchange. This

crust usually needs to be regularly broken up and stirred in.

The process also has advantages for the animals themselves: They are often kept on so-called slatted floors. Their excrement falls through openings in the floor into a large container. Microbial conversion allows the fecal-urine mixture to foam up over time and rise back up through the gaps. "The animals are then standing in their own excrement," Holtkamp says. "Calcium cyanamide stops this foaming." The costs are also manageable—they are around 0.3 to 0.5 cents per liter of milk for cattle farming.

Slurry 'purity law' currently prevents use

It is still unclear how the method affects the release of ammonia from the slurry. Ammonia is a toxic gas that, while not harmful to the climate itself, can be converted to dangerous [greenhouse gases](#). "We have initial indications that the amount of ammonia is also reduced in the long term," says Dr. Manfred Trimborn of the Institute of Agricultural Engineering at the University of Bonn. "We can't say for sure at this point, though."

In Germany, an environmental law currently prevents the addition of calcium cyanamide: A strict purity requirement applies to conventionally stored slurry at present.

More information: Felix Holtkamp et al, Calcium cyanamide reduces methane and other trace gases during long-term storage of dairy cattle and fattening pig slurry, *Waste Management* (2023). [DOI: 10.1016/j.wasman.2023.02.018](https://doi.org/10.1016/j.wasman.2023.02.018)

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