

## A SIMPLE SOLUTION TO NEUTRALISING AMMONIUM FROM LIQUID MANURE

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Currently the Netherlands are having a huge problem due to emissions.

These emissions are caused by Nitrogen Oxides (caused by vehicles and industry) and ammonia (caused mainly by dairy cows and pigs) which come back down as nitrogen and caused elevated nitrogen levels in soils which is undesirable in the natural environment.

In this paper we look at the possible use of GierO2 as a solution for neutralising ammonia emissions from dairy sheds. This method is also applicable to pig manure but no real data exists to-date.



Figure 1- Liquid manure in pit

### Number of animals and annual manure production (estimated):

	Per year	Total number of animal	For all animal
Manure cow	26 m <sup>3</sup>	1.7 million	442,000,000 m <sup>3</sup>
Pig manure	16 m <sup>3</sup>	12.5	200,000,000 m <sup>3</sup>
		<b>Total</b>	<b>642,000,000 m<sup>3</sup></b>

It is estimated that the total ammonia emissions per year is between 110-115 million kg – slightly below the 128 million kg allowed by the EU. But because Holland is a very small country this works out at 60 kg/ha which is the highest level in the EU which is the main reason why other countries don't have this problem as they are far bigger and therefore have more land over which to spread out the ammonia emissions.

### **The problem:**

The problem occurs when animals are housed inside buildings. Manure and urea come together in large manure pits often located under the shed so that the manure and urine fall straight through. This mixture produces ammonia which is a volatile gas which can then escape into the air and later comes back down as nitrogen.



Figure 2- Typical flooring in a Dutch cow shed

### **Is there a solution?**

To date there has been not ideal solution and certainly no treatment during the time the liquid manure is stored, thereby allowing most of the ammonia to freely escape. The main treatment was to inject some of the liquid manure into the soil as soil fertiliser. This reportedly eliminated 70% of the ammonia emission, but recent findings actually suggest that this may be only 30%.

There are serious downsides to injecting liquid manure directly into the soil:

- Liquid manure is anaerobic and therefore will suffocate the top soil

- It takes weeks before the soil recovers and processes the liquid manure
- Encourages pathogen bacteria to develop in oxygen deprived soils
- Worms escape the soil and are then easy prey to birds
- Soil microbiology is destroyed.
- Anaerobic liquid manure is a very poor soil fertiliser.
- After injecting liquid manure, farmers usually apply nitrogen fertiliser straight after as ammonia is not available for plants even though it will eventually become nitrogen somewhere... This practice only serves to accumulate the amount of nitrogen added to the environment.
- Soils regress due to continual injections of anaerobic liquid manure.

### GierO2



In 2013 we developed GierO2 as a treatment for liquid manure. The aim was to reduce ammonia emissions to zero while treating the manure in situ (ie in the manure pit) prior to injecting into grass fields – for those who don't know, growing good quality grass for animal nutrition is very serious business.

#### How does it work:

It's actually very simple and low tech (i.e. no need for any large investment). The GierO2 treatment is a combination of 2 separate products – GierO2 and M1 - which have to be added separately into the manure. Dosage of GierO2 is 50 ml per ton of manure which is diluted with water and poured over the roosters above the manure pit. M1 is dosed at 250 g per ton, also diluted in water. Both solutions have to be added whilst the manure mixer is on so that they are properly mixed into the manure.

First results are after about 30 minutes when a decrease in ammonia smell can clearly be detected.

GierO2 converts ammonia in nitrite and nitrate. Another advantage is that it converts most of the phosphate to inorganic phosphate which means that it can rapidly be absorbed by plants and therefore less phosphate will leach out. Treating liquid manure will also temporarily turn the manure from anaerobic to aerobic.



Ammonia that has been converted to nitrite and nitrate will not reverse once the effects of GierO2 has worn off. Any new ammonia emissions originate from new manure that is produced.

The advantage of using GierO2 is not that we eliminate nitrate, but that we eliminate ammonia emissions which when they escape will eventually come down again and pollute unwanted areas (water, forests, etc). But treating the ammonia with GierO2 we contain the ammonia as nitrite and nitrate which can then be disposed of in a chosen method.

#### Field results using GierO2

Although over the last 7 years we have tried numerous times to find funding / subsidy to test GierO2 by official instances, so far this has not succeeded. All our results have been done on farms in real life situations.

	At start	After 1 hour	After 24 hours
Ammonium	885	325	0-3
Nitrite	3.30	2.70	NA
Nitrate	58.53	66.40	NA
Phosphate	55% inorganic	77% inorganic	NA

- Increases microbial protein % in grass by 70%. Microbial protein in grass is 85% on average. In untreated manure the ratio between microbial and non-microbial protein is 50:50. Due to higher microbial protein in grass, we have measured higher protein % in milk ranging between 0.5 to 1%.
- Increases inorganic phosphate from  $\pm 55\%$  to  $\pm 78\%$ . Inorganic phosphate is directly absorbed by plants, which means that it is very likely that less phosphate leaches out.
- Manure treated with GierO2 versus untreated manure + 80 kg pure Nitrogen fertiliser (NF):
  - Result: Untreated manure + NF grew better initially, but was rapidly surpassed by manure treated with GierO2.
- Higher fertilising value of liquid manure when applied to field. No nitrogen fertiliser is required.
- Nutritional value and volume of grass treated with manure + GierO2 was much better.
- Manure absorption by the soil on average 5 times faster than untreated manure.
- Because GierO2 makes liquid manure aerobic it is much friendlier to the soil micro-flora.
- Treated manure becomes more fluid and much easier to pump from manure pit. Hard pieces of manure are pretty much eliminated.
- Encourages faster grass and root development.
- Colour of treated manure from dark green / brown to a lighter colour.
- No investment cost, low tech, low cost
- Significantly higher yields obtained with maize and potatoes when grown in soils fertilised with manure treated with GierO2.
- Farmer can save money on fertiliser and on supplementary cow nutrition. This easily covers the cost of using GierO2



*Figure 3- This cow has a milk fat content of 4%. It used to be 3,25% and went up after eating grass that was grown on soil fertilised with liquid manure treated with GierO2*

GierO2 and M1 are completely environment friendly products and fully decompose into water, oxygen and easily absorbed sugars.