



# A clear solution for farmers

CATCHMENT SENSITIVE FARMING

## Reducing Ammonia Emissions from Pig Finishing Units – the Benefits and Opportunities of Lowering the pH of Slurry

### Background

Livestock production is the most important source of ammonia in the atmosphere in Europe (ECETOC, 1994; Hutchings et al. 2001). In the UK around 87 per cent of ammonia emissions come from agriculture. The pig sector is responsible for about seven per cent of emissions (Defra, 2016). The intensive pig and poultry sector has been operating under Integrated Pollution and Prevention Control (IPPC) and Environmental Permitting Regulations in order to reduce the impact of ammonia emissions.

This case study presents the best practice which is being implemented by a large scale pig producer in Lincolnshire. The farm business has multi-operational breeder and finisher sites on an indoor system. The farm operates an integrated system where the slurry and manures generate nutrients for the arable enterprise which in turn provides feed and straw for bedding.

In spring 2017 the Environmental Permitting Regulations changed for new pig buildings and new criteria were established. The case study farm started to monitor and record ammonia levels within the buildings to demonstrate to the Environment Agency (EA) that all compliance measures were being taken. Although the farm was able to report reductions to below the permit levels they made a decision to invest in pH reduction. This decision was made after extensive research and visits to Denmark. Less costly options such as frequent removal of slurry would not have been as effective.

This case study aims to demonstrate how pH reduction works, considerations taken by the farm, cost-benefit and impact it will deliver once in operation in 2019.



### What is pH reduction?

Reducing the pH of slurry involves treating the chemical and physical properties of slurry through an automated treatment process.

This system has been widely adopted across Denmark. There are now about 170 farms (cattle and pig) which have this technology operating on their farms.

The process involves applying sulphuric acid to slurry in order to lower the pH to under 6.0. The results have been shown to reduce ammonia emissions from livestock housing, stored slurry and the following land application.





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## How did the farm decide to invest in pH reduction?

The farm business started to investigate what would be the most effective investments in mitigation methods to reduce ammonia emissions. The business identified the following five specific actions and undertook an economic appraisal to understand the cost-benefit of each option:

1. Regular emptying of tanks under buildings
2. Adapting diets
3. Slurry cooling
4. Air scrubbing
5. pH reduction

Option one was discounted due to labour costs. Option two was discounted due to potential impacts on animal health and welfare. Options three and four could have been viable but on closer investigation these options were felt to be more appropriate to new build sites and not retrofitting. The economic appraisal identified that these technologies would have been too expensive for the farm in terms of capital, and annual operation and maintenance costs.

After visiting several farm systems in Denmark, pH reduction seemed more scaleable, efficient and could deliver greater reductions in ammonia mitigation. In addition, the farms visited in Denmark had no odour issues and the farmers gave positive feedback. AHDB analysis of systems in Denmark have shown that using pH reduction contributes to a 65 per cent reduction in ammonia emissions and a 43 per cent reduction in odour from pig housing. The University of Aarhus reports ammonia emissions from pig houses with pH reduction systems as 0.13 kilogramme Ammonia-N per pig produced and from houses with untreated slurry it was 0.43 kilogrammes Ammonia-N per pig; this equates to a 70 per cent reduction.

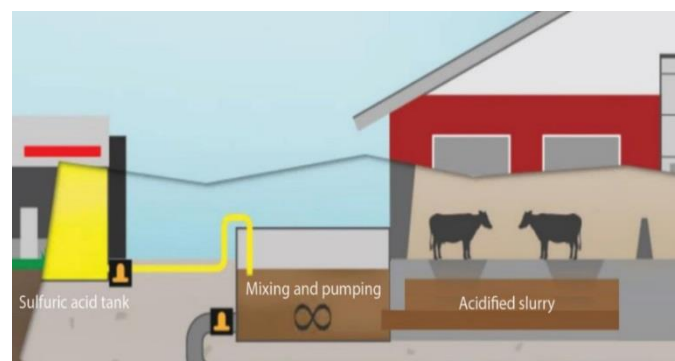


The photograph above shows the groundworks of the site which will house the sulphuric acid tank, and mixing and pumping chamber.

## How does pH reduction work?

The figure below is kindly provided by J H Agro. This system works by adding sulphuric acid to reduce pH and is well documented in pig enterprises. Reducing the pH of pig slurry to below 6.0 results in the ammonia being converted to ammonium which will not volatilise. This is a specialist process, widely used in Denmark, and should only be considered with expert advice.

The system works by pumping slurry from the underfloor store to a mixing tank, where the sulphuric acid is added lowering the pH from, typically, around 7 to around 5.3. The process is controlled by pH sensors. When the desired pH is reached, slurry is automatically pumped to the main store and a smaller amount of freshly acidified slurry is pumped back to the underfloor store. The process is, typically, repeated once a day for each livestock shed.



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## What is the cost of investing in pH reduction?

Based on the experience of the farm, there is no 'one size fits all' technology selection for pH reduction. This farm business is going to integrate pH reduction systems across all 11 farm sites.

Each farm site has different design requirements and the buildings (old and new) present challenges which need to be considered. Floor area and depth below the slats determines the number of valves and pumps necessary to treat the slurry. In this farm's case it means some of the buildings only need four valves whereas others could require 12. Each valve controls tanks holding 225 cubic metres (m<sup>3</sup>) of slurry.

Investment in pH reduction by the farm business across each site is between £250,000 and £500,000 per site. This includes the pH reduction system, groundworks, acid store and bund, and installation.

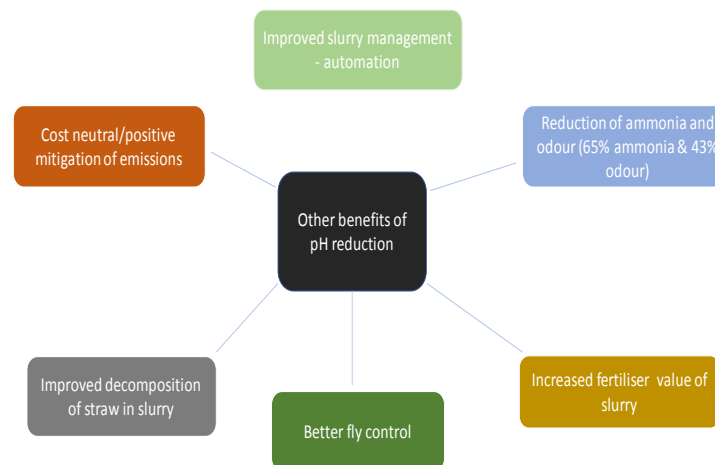
The annual operation and maintenance expenditure is about £20,530 (based on a 500 sow unit).



## What are the benefits of pH reduction to the farm?

The schematic below provides a summary of the primary benefits. The farm is currently in the process of undertaking the building works for the first pH reduction scheme. It will be commissioned in January 2019 and it will be the first of its kind in the UK. Based on the results of farmers in Denmark, the following are identified as the principal benefits:

- Reduction in pig mortality rate
- Increase in daily liveweight gain
- Improvement in feed conversion
- Increased crop available nitrogen in the slurry
- Less variability in nitrogen content of slurry





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## What are the wider benefits of the pH reduction?

There are improvements for staff in terms of reduction in odour and better air quality creating a cleaner working environment. Experience from Denmark also suggests there can be a reduction in labour intensive tasks, for example moving slurry, which can also pose a pollution risk. Training and development which is necessary for the successful implementation of pH reduction technology results in 'upskilling' of farm staff and benefits a safer working environment on farm.

pH reduction systems can play an effective role in reducing the risk of pollution effects on environmentally sensitive habitats. They can also minimise the risk to human health as a result of ammonia combining with other pollutants to create fine particulates.



## Key contacts and information

[Catchment Sensitive Farming \(CSF\)](#) is able to provide events, tailored advice, individual visits and grant support to farmers on [air quality measures](#) and reducing water pollution on farm.

Agriculture and Horticulture Development Board (AHDB) has been working to build knowledge and information for pig producers across the UK. AHDB has a range of resources available to better understand [pH reduction of slurry](#).

Department for Environment, Food and Rural Affairs (Defra) published a Code of Good Agricultural Practice for [Reducing Ammonia Emissions](#) in 2018.



## Three 'take-away' messages

1. Investment in pH reduction is not cheap. However, the returns outweigh the costs for farms of about 500 sows and above. The system is more likely to be viable for farms with finisher pigs rather than breeder units only. Economic appraisal is essential for any farm considering this option due to the complexity of the treatment system required.
2. This is a new technology to the UK. It is essential farmers 'do their homework' and visit operational farms where possible. Experience of site visits has been key to this farm as it enabled them to build their confidence in the technology supplier to design a system appropriate to their farm.
3. Attention to detail – measuring and recording current performance has been critical to determining the cost-benefit for this farm.

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