A clear solution for farmers

CATCHMENT SENSITIVE FARMING

Reducing Ammonia Emissions by Focusing on Building Design on Dairy Farms

Why is ammonia a problem?

Ammonia is a key air pollutant that can affect both the environment and human health. Ammonia emissions are one of the largest contributors to acidification of soils and nutrient enrichment of habitats and water bodies. Ammonia emissions combine with pollution from industry and transport (e.g. diesel fumes) to form very fine particulate matter ($PM_{2.5}$), which can then be transported significant distances in the air, adding to background levels to which people are exposed. When inhaled particulate matter can contribute to cardiovascular and respiratory disease.

In the UK around 87 per cent of ammonia emissions come from agriculture. A Defra report in 2016 stated that dairy farms are responsible for approximately 28 per cent of the ammonia emissions produced by agriculture and housing is estimated to contribute 27 per cent of the agricultural ammonia emitted. Ammonia in buildings is produced when the urease enzyme within animal excrement reacts with urea in urine.

Dairy farm case study

This case study presents the approach, decision making and experience of a dairy farm in the south east of England. The farm is located in West Sussex and the land drains into the River Adur. The farm is not in a Nitrate Vulnerable Zone (NVZ).

AHDB has produced a new low emission UK dairy housing best practice advice report and this case study draws on the findings of this document.

The business supports approximately 420 dairy cows plus followers and youngstock. The farm is 567 hectares (ha), growing maize, winter wheat, winter barley, and grass (permanent and temporary leys). The dairy cows are grazed for five months of the year and are housed in cubicles during the winter period. Some of the youngstock are loose housed in straw yards.

Catchment Sensitive Farming (CSF) is delivered in partnership by Natural England, the Environment Agency and Defra.

Department for Environment Food & Rural Affairs

Environment Agency

NATURAL ENGLAND

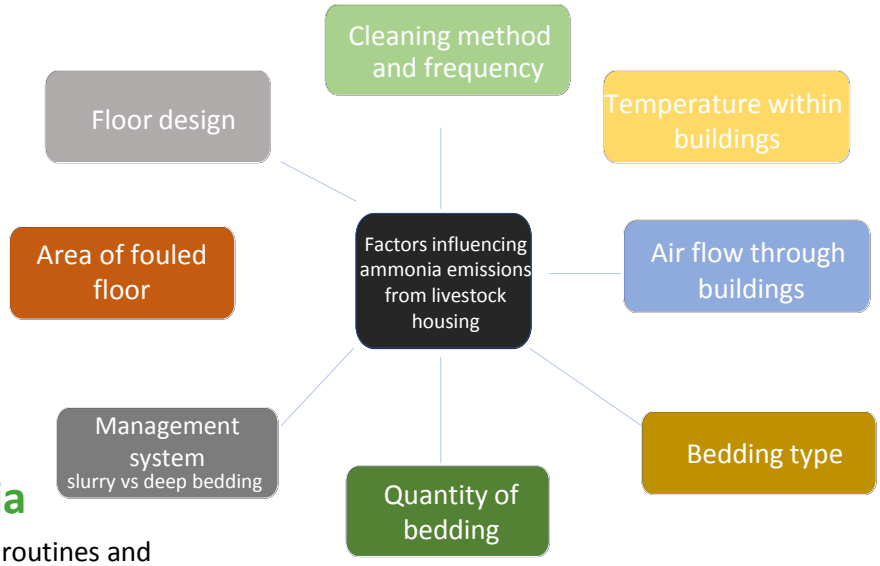
Funding is from the European Agricultural Fund for Rural Development: Europe investing in rural areas.

A clear solution for farmers

CATCHMENT SENSITIVE FARMING

What are the risk areas within UK dairy housing?

The management of livestock housing is a very important factor in ammonia mitigation. The production of manures and/or slurries from the management system, temperature and air flow all significantly influence the proportion of emissions arising from housing infrastructure. These factors are presented in the following graphic .



Options to reduce ammonia

There are a range of techniques, cleanliness routines and improvements in technology that when applied to cattle housing can reduce ammonia emissions by up to 20 per cent. These options can be low cost and with knowledge and understanding can be incorporated into existing practices. Three options are particularly effective in reducing ammonia emissions on farm and also provide other benefits:

1. Frequent removal of manure – passages, collecting yards and loafing areas within and adjacent to cattle housing are risk areas because they become fouled with excreta. Increasing frequency of cleaning from once to four times per day will reduce emissions.
2. Floor construction – effective drainage is a key aspect of floor designs to reduce ammonia emissions. Grooved floors and slatted floors incorporating non-return 'flaps' can all reduce the ammonia production within buildings.
3. Loose housing – utilising deep straw bedding in cattle housing can result in up to a 25 per cent reduction in ammonia emissions per cow. This is dependent on the quality and age of building design to ensure the area of bedding can be maximised.

How did this farm assess and quantify the most appropriate options?

This case study concentrates on the inclusion of developments in new floor design and construction. The farm built new dairy cow housing in 2015 to extend existing dairy housing.

The building incorporated a higher quality slat which keeps the floor cleaner and incorporates rubber to reduce cattle slips.

Since these slats were installed, technology has improved further and now incorporates rubber flaps (see page 3) which restricts the gaseous exchange of slurry beneath the floor reducing ammonia emissions.

These designs helped to reduce ammonia emissions from the floor and from the underground pit below.

Catchment Sensitive Farming (CSF) is delivered in partnership by Natural England, the Environment Agency and Defra.

Department for Environment Food & Rural Affairs

Environment Agency

NATURAL ENGLAND

Funding is from the European Agricultural Fund for Rural Development: Europe investing in rural areas.

A clear solution for farmers

CATCHMENT SENSITIVE FARMING

What were the benefits and costs of adapting the floor construction?

Benefits

For the case study farm, the priority for improving farm infrastructure was to improve cow health, comfort and welfare. Reducing ammonia emissions initially was not a primary objective. In addition, in 2015 ammonia did not have as much national focus. That said, the farm had already begun to focus on measures which were contributing to reductions in ammonia emissions beyond building design. They were focusing on dairy herd dietary protein levels and have reduced this to 16.7 per cent.

The farm is monitoring milk urea through milk recording and this is currently 250 mg/kg. The UK bulk tank average is around 300-350 mg/kg. The farm looks at urea levels in conjunction with the milk protein levels to understand what is happening with cows' diets and ammonia.

The benefits that resulted from the new slats provided win-win solutions as they have also identified significant improvements in animal health and welfare by addressing cow comfort:

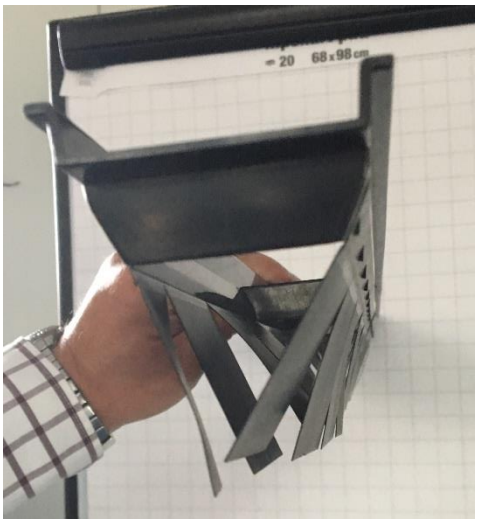
- Increased cleanliness and dryness within the passage way resulting in more rapid draining of urine to channels underneath.
- Honeycomb grooving improves drainage and has reduced cattle slips.
- Reduction in cow lameness.
- Reduction in digital dermatitis.
- Open ridges have been incorporated at the top of the building to improve natural ventilation and reduce temperature within the building.

Costs

Slatted floors cost more than conventional solid concrete flooring and costs will be specific to the site, systems chosen and scale of the project. Cost appraisals should look at the full economic cost and include the wider benefits such as lower labour and machinery, and improvements in cow foot health.

The cost of standard slatted floors is approximately £35 per square metre (m^2). The cost of the newly designed slat as illustrated and installed on the case study farm is 50 per cent more than the standard slat. This is based on the best available information provided by the case study farm.

Retro-fitting this type of infrastructure can be challenging and is dependent on building design. It is recommended to seek building design expertise and engage with appropriate installer companies who can advise on the suitability of replacing existing slatted floors.



The photograph above has been provided by AHDB. It shows an updated version of the slat design which was installed on the case study farm. The rubber flaps reduce the gaseous exchange between the slurry store beneath and the walking surface above thus reducing emissions.

Catchment Sensitive Farming (CSF) is delivered in partnership by Natural England, the Environment Agency and Defra.

Department for Environment Food & Rural Affairs

Environment Agency

NATURAL ENGLAND

Funding is from the European Agricultural Fund for Rural Development: Europe investing in rural areas.

A clear solution for farmers

CATCHMENT SENSITIVE FARMING

Learning lessons from the Netherlands in reducing ammonia emissions

Effective drainage is a key aspect of floor design to reduce ammonia emissions. AHDB has produced a dairy building design guide and reported that in the Netherlands these new slat designs are necessary to comply with building regulations.

The photograph is taken on the case study farm and shows the new floor design which has been installed in the cubicle barn.

Newly installed floor systems need to have an emission factor no more than 8.6 kilogrammes (kg) ammonia per head per year. On the case study farm, using a publicly available tool such as Simple Calculation of Atmospheric Impact Limits (SCAIL), it has been estimated that the installation of the new slat design has reduced ammonia emissions from 1431 kg to 924 kg per annum.

Three 'take-away' messages

1. Compared with the other ammonia mitigation options, improving building management techniques is a lower cost option. However, it is strongly advised to seek professional, impartial, technical and structural engineering advice.
2. Retrofitting existing buildings can be difficult, expensive and ineffective if it compromises animal health and welfare and existing building design e.g. new slat design cannot be installed as 'best practicable environmental option' (BPEO).
3. Multiple benefits can outweigh the costs in terms of increases milk output and animal health. However, these are farm specific and difficult to quantify. It is essential the selection of the right slat is chosen from a cow comfort perspective.

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.

SCAIL tool for agriculture can be accessed here.

Agriculture and Horticulture Development Board (AHDB) has been working to build knowledge and information for dairy producers across the UK. AHDB have a range of resources available to better understand dairy housing best practice. We are grateful for the assistance of AHDB Dairy in preparing this case study.

Department for Environment, Food and Rural Affairs (Defra) published a code of good agricultural practice for reducing ammonia emissions in 2018.

Catchment Sensitive Farming (CSF) is delivered in partnership by Natural England, the Environment Agency and Defra.

Department for Environment Food & Rural Affairs

Environment Agency

NATURAL ENGLAND

Funding is from the European Agricultural Fund for Rural Development: Europe investing in rural areas.