

A black and white cow is the central focus, standing in a lush green field. The background shows a rolling landscape with other cows grazing, trees, and a clear blue sky. The overall scene is bright and sunny.

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Factsheet 5

Efficient Milk Production

Climate Change

What you can do about
ammonia emissions

DairyCo

What you can do about ammonia emissions

Adopting ammonia reduction methods represents an opportunity not just to contribute to protecting the environment, but to improve nitrogen utilisation and depending on the method chosen, to potentially reduce production costs.

Emissions of ammonia (NH_3) are environmentally harmful because of their damaging effect on sensitive plants and soil ecosystems, and increasingly implications for human health through the formation of fine atmospheric particles are being recognised. It is important to consider ammonia emissions from dairy farming systems - as although ammonia itself is not a greenhouse gas (GHG), this is necessary for two reasons:

- 'Indirect' nitrous oxide (N_2O) emissions (a potent greenhouse gas) occur following ammonia deposition
- Ammonia reduction methods may influence nitrous oxide emissions

In the UK, agriculture accounts for more than 85% of total ammonia emissions. This comes mainly from livestock urine and manures, and also from nitrogen (N) fertiliser applications (and particularly urea-based fertilisers).

Ammonia emissions will occur:

- From areas where livestock are present (eg, livestock housing/yards, grazing)
- From manure management (storage and spreading)
- Following spreading of N fertiliser

The dairy sector accounts for approximately one-third of ammonia emissions from agriculture, with housing/outdoor yards and land application of manures the most important sources. Ammonia emissions during livestock manure management are typically in the range 10 - 20% of the N excreted by dairy cows, representing a large loss of agronomically valuable N.

The UK is required under international legislation to reduce ammonia emissions, and it is very likely that ammonia reduction methods will be required to meet future targets. A number of methods to reduce ammonia emissions from dairy farms have been identified and are focussed on the following areas:

- Housing
- Storage
- Manure application to land
- Fertiliser application to land

Reducing emissions from housing

Options for reducing ammonia from dairy cattle housing include:

- More frequent removal of slurry from the cubicle house floor
- Changing from a slurry-based housing system to a straw-bedded system
- Decreasing the time cattle spend in buildings

For dairy cubicle housing, increasing the frequency of scraping the fouled floor areas from once up to four times per day has been shown to reduce ammonia (by up to 20%), where this was combined with a floor design which leads to the rapid draining of urine. Similarly, research has shown that cleaning dairy cow collecting yards through pressure washing can be very effective in reducing ammonia emissions (by 90% compared with daily scraping), although this requires additional labour and increases slurry/dirty water volumes.

Straw-bedded housing systems are associated with lower (about 25%) ammonia emissions than cubicle housing, so a potential reduction measure would be to change housing system. However, this measure is likely to be associated

with considerable building conversion and higher manure management costs, along with potential animal hygiene/milk quality concerns.

Extending the grazing period (ie, earlier in the spring and later in the autumn) will reduce ammonia emissions, as ammonia losses from livestock grazing in the field are much lower than from housing. However, extended season grazing needs to be carefully managed in order to avoid soil compaction and sward damage associated with grazing under marginal conditions, and associated water pollution risks.

Reducing emissions from manure storage

A highly effective method to reduce ammonia emissions from manure storage is to cover the slurry store or farmyard manure (FYM) heap. Helpfully, the majority of dairy slurry stores will naturally develop a crust, which will reduce ammonia emissions by about 50% compared with a non-crusting store. Alternatively, above ground slurry stores (tanks) may be fitted with a rigid cover (Figure 1), which will reduce ammonia by around 80%, or floating covers (eg, plastic, straw, bark etc.) may be used which have been shown to reduce ammonia emissions by about 50%. Research has also shown reductions (of up to 90%) from covering FYM heaps with heavy duty polythene.



Figure 1. Slurry store fitted with a rigid cover

Reducing emissions following manure application to land

Slurry bandspreading application methods (eg, trailing hoses and trailing shoes) and shallow injection techniques (Figure 2) have been shown to effectively reduce ammonia emissions following land application. Similarly, rapid soil incorporation of slurry and FYM following application to tillage land will reduce emissions.

Trailing hose and trailing shoe slurry application equipment places the slurry in narrow bands above (trailing hose) or on the soil surface (trailing shoe). Typically, trailing hose slurry application reduces ammonia emissions by about 30% compared with surface broadcast application. Similarly, trailing shoe application typically reduces ammonia by about 30% (short grass) and 60% (taller grass) compared with surface broadcast application.

The shallow injection of cattle slurry (into slots 5 -10 cm deep) is an effective method of reducing ammonia, typically by about 70% compared with surface broadcast application. However, the technique can have limitations on stony soils and under dry soil conditions.

Reducing ammonia emissions through rapid soil incorporation of manures on tillage land will depend on the method and timing of incorporation. Best practice advice (RB209) is to incorporate slurry applications into the soil within six hours of spreading and FYM within 24 hours to ensure that worthwhile reductions in ammonia emissions are achieved – although clearly the sooner the better. Immediate incorporation of slurry or FYM by ploughing will give reductions of up to 90%.



Figure 2. Slurry application using trailing hose and shallow injection equipment

All of these ammonia reduction methods (which retain N within the soil) have the potential to increase emissions of nitrous oxide and nitrate leaching losses to water. However, in terms of overall farm N efficiency minimising ammonia emissions, will on balance, be of benefit.

Reducing emissions following fertiliser application to land

Ammonia emissions from N fertiliser applications can be reduced by replacing urea-based fertilisers with other types of N fertiliser. Research has shown that typically around 20% of the N content of applied urea was lost to the atmosphere as ammonia. Losses were more closely related to soil moisture and weather conditions than to soil type, and were minimised where urea was applied shortly before rain and/or shallowly cultivated into tillage soils.

Future developments

- Dietary manipulation: Livestock N excretion and associated ammonia emissions can be reduced by avoiding excess N (as crude protein) in the diet and/or making dietary N more available, without adversely affecting cow performance. However, for dairy cows which are predominantly on forage-based diets, and particularly while at grazing, control of dietary N intake is recognised as presenting a major challenge. It has been estimated that reductions in ammonia emissions of up to 20% could be achieved through strict control of dietary N intake.
- Increased straw bedding use: Reductions in ammonia emissions (of up to 50%) have been achieved by providing an additional 25% of bedding (above the standard farm rate) where use was targeted to dirty areas.
- Outwintering cattle on woodchip pads: The use of outwintering pads (woodchip corrals) as an alternative to winter housing for part, or all, of the herd is likely to be associated with reductions in ammonia emission. Ongoing research is seeking to provide further information on the potential benefit of such systems.
- Urease inhibitor incorporation with urea-based fertilisers: The inclusion of a urease inhibitor with urea-based fertilisers was shown to typically reduce ammonia emissions by about 70%. However, at present in the UK, urease inhibitors are not widely available.

Summary

The most practical methods to reduce ammonia emissions are:

- Using slurry bandspreading or shallow injection techniques
- Rapidly incorporating manures into tillage land

Using improved slurry application methods/soil incorporation practices will retain N in the soil and thereby reduce the need for manufactured fertiliser N, with possible cost savings.

- Reducing ammonia emissions from manure storage can be achieved by:
 - allowing slurry stores to develop a crust
 - fitting rigid covers to above ground slurry stores
 - covering FYM heaps with polythene sheeting
- Dietary manipulation offers great potential for reducing ammonia emissions and other N losses, but there are challenges to implementing strict dietary control in forage-based feeding systems
- Washing down hardstanding areas can be very effective in reducing ammonia emissions, but will increase volumes of slurry/dirty water

This is one in a series of six factsheets that have been prepared by ADAS, North Wyke Research and the University of Reading for DairyCo.