



A clear solution for farmers

CATCHMENT SENSITIVE FARMING

Reducing Ammonia Emissions from Slurry Storage 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 eutrophication 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. Dairy farms are responsible for 28 per cent of the emissions produced by agriculture and the storage of slurry and manure is responsible for approximately 9 per cent of emissions from agriculture. Ammonia will be lost from a slurry store surface and be replenished in the surface layer from lower levels in the store. Placing a cover above or on the slurry surface prevents the removal of emitted ammonia thereby retaining nitrogen in the slurry.

This case study presents the approach, decision making and experience of a dairy farmer in the south west of England. The farm is in Devon and the land drains into the River Coly, which is a tributary of the River Axe. The farm is not in a Nitrate Vulnerable Zone (NVZ).



The business supports approximately 260 dairy cows and 150 youngstock. The farm is around 168 hectares (ha), growing 15 ha of maize and 8 ha of whole crop. The remainder of the farm is grassland. The dairy cows are grazed for six months of the year and housed in cubicles during the winter period. Some of the youngstock are loose housed in straw yards.



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Options for covering slurry stores and lagoons

Slurry towers (steel store) and lagoons can be fitted with either a rigid cover or a floating flexible cover. In both cases, they reduce the emission of ammonia during storage and provide benefits in terms of diverting rainfall to reduce the volume of slurry stored on farm. Not all slurry stores and lagoons are structurally suitable for having a fixed or floating cover installed. Any farmer seeking to explore options should seek appropriate technical and structural engineering advice.

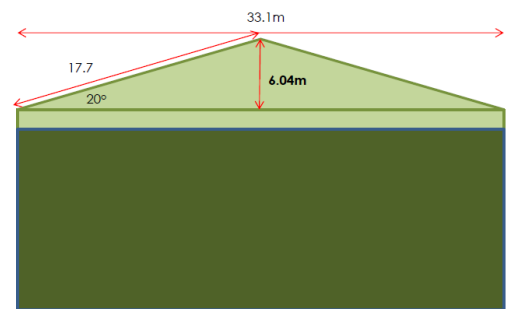


Slurry store cover options

- Lightweight rigid covers – incorporating a central supporting pole mounted onto the slurry store floor. From this a metal framework is constructed out to the perimeter of the tank.
- Floating LECA balls/hexa-covers – create an artificial crust, simpler to install but lower ammonia emissions reduction, rainfall not excluded and require maintenance.
- Flexible tent covers – often made of heavy polyester with PVC coating and incorporated onto a central mounted pole on the floor of the store.
- Floating covers – most appropriate to slurry lagoons and mounted to the bank of the lagoon. Structural capability of the lagoon walls is essential given the volume of rainfall which sits on the top of the cover and will add weight to the lagoon.

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

Initially the farm requested technical advice to accurately quantify the requirements of storing slurry during the winter period to ensure that existing slurry storage structures were compliant with Silage, Slurry and Agricultural Fuel Oil (SSAFO) regulations. The advisor also reviewed existing livestock numbers, age and yield of the cows, number of months housed, area generating slurry and rainfall collection plus the volume of wash water produced during milking every month. The farm generates 3,347 m³ of slurry per annum (including rainfall and wash water) entering the store from collecting areas. Options around the most effective covering system were considered and engagement with potential installers confirmed the 'Best Available Technique' for covering the store.



To find the curved surface area of any cone, multiply the base radius of the cone by pi. Now multiply the answer by the length of the side of the cone.

Curved surface area: 923 m²

Over-run: 104m x 60cm = 62m²

Total area: 985m²

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What were the benefits and costs of installing a cover on the slurry store?

Benefits

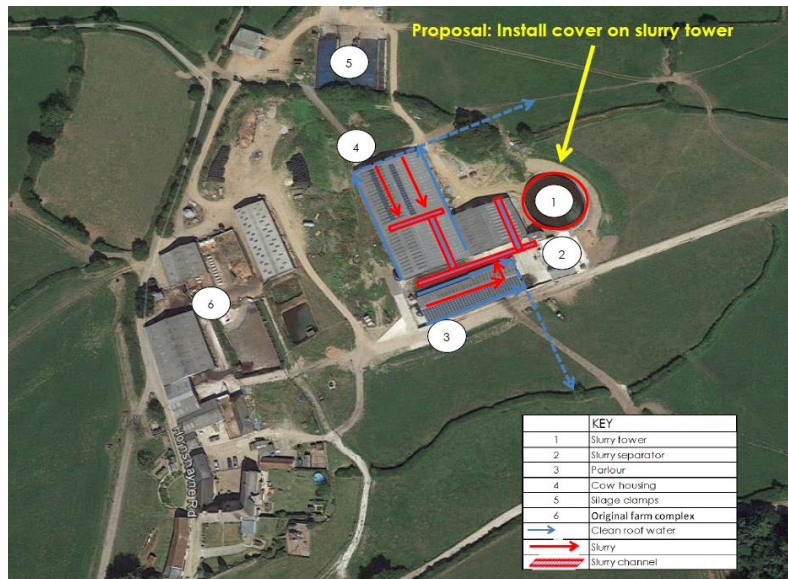
For the case study farm there were a range of positive benefits which contributed to the decision to invest in a fixed cover:

- A reduction in ammonia emissions from the store and environmental impacts on local environmental sites.
- Improved water management and reduction in diffuse pollution.
- Reduced slurry volumes requiring storage and spreading.
- Maximising nutrient management to reduce fertiliser costs.
- Improved compliance with SSAFO and other regulatory requirements.

Using a publicly available tool, SCAIL, ammonia losses were calculated and it has been quantified that the installation of the fixed cover has reduced ammonia emissions from the slurry store from 546 kg to 109 kg. This equates to an 80 per cent reduction in emissions and an additional 360 kg of nitrogen in the slurry. The farm achieves additional benefits through applying slurry using a trailing hose. This low emission spreading equipment reduces further ammonia losses and provides an additional 6 kg of nitrogen per hectare, worth £4.20 per hectare.

The farm has improved its environmental compliance, reduced volumes of slurry and improved storage availability by 25 per cent.

By diverting water away from the slurry store, the cover has contributed towards reducing the volume of rainwater entering the store by 921 m³. At a spreading cost of £1.80 per m³ this represents a saving of £1,658 per annum.



The aerial photograph above provides a location of the farm, the slurry receptor and the flow of slurry and water to the tank.

Costs

The slurry store was installed in 2015. The fixed cover was installed by Storth Machinery in 2017 and cost approximately £61,000. The recent installation of the slurry store limited the additional cover costs as it was not necessary to undertake further structural reinforcement support. Older steel tanks might require additional rings as part of some retrofitting schemes.

This farm already had a slurry separator in place which reduces the volume of slurry requiring storage. This separator provides a bedding material for the cows, reducing costs to the farm.





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Importance of utilising best practice slurry spreading techniques when applying slurry from covered stores

If farms investing in slurry covers to reduce ammonia emissions do not have the appropriate low emission spreading equipment or utilise contractors with this equipment, this can significantly limit any benefits from covering a tank or lagoon. The use of poor spreading techniques result in 25 per cent emissions of ammonia to atmosphere (Defra, 2016). By using a trailing hose, ammonia losses can be reduced by about 60 per cent compared with a splash plate spreader.

The installation of a slurry cover on this farm has provided additional benefits in terms of fertiliser replacement value savings. The fixed cover has reduced the loss of ammonia to the atmosphere during the storage period and the slurry has retained nitrogen, maximised when applied through using a low emission spreading technique (see photograph).

Three 'take-away' messages

1. Compared with the other ammonia mitigation techniques, covers are an expensive option that cannot be implemented on every farm without technical and structural engineering advice. However, there are significant ammonia emission reduction benefits to installing a cover as well as benefitting nutrient and water management, and saving storage and spreading costs.
2. It is essential that appropriate low emission spreading technology is used otherwise savings made from installing a cover are lost. A trailing hose (or similar), trailing shoe or slurry injection are strongly advised.
3. Benefits outweigh the costs but selection of the right cover is important, particularly for lagoons. This can require additional management and pumping requirements on lagoons and embankments suitable for fixing.



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 for Agriculture can be accessed [here](#).

Construction Industry Research & Information Association (CIRIA): [Livestock manure and silage storage infrastructure for agriculture](#).

Department for Environment, Food and Rural Affairs (Defra) published a new code of good agricultural practice for [reducing ammonia emissions](#).

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