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Technical Note

Low rate intermittent aeration of slurry on Northern Ireland dairy farms

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Introduction

The Nitrates Action Programme in Northern Ireland requires farmers to adhere to non-spread periods for slurry from mid October to the end of January. As a result farmers have undertaken significant capital investment in slurry storage systems. During storage slurry can settle and crust leaving it difficult to handle when it needs to be spread. Therefore the use of low rate intermittent aeration offers the opportunity to assist with slurry handling and management. Low rate intermittent aeration of slurry is achieved by the use of a compressor to feed compressed air through a network of pipes to the base of a slurry tank/store, where the air is released into the slurry, bubbling to the top of the tank. The bubbling effect keeps the slurry agitated and prevents settling or crusting. The structure of the tank does not need to be altered for installation of the system. This allows aeration systems to be installed in existing tanks (above or below ground).

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What are the benefits?

The main benefits to be gained from use of low rate intermittent aeration systems, compared to normally managed slurry systems are:

1. Mixing of the slurry is not required before removal.
2. The slurry is much more homogenous compared to normally managed slurry and therefore, has a more consistent distribution of nutrients. Each tanker load will contain similar amounts of nutrients and this should aid distribution of nutrients in the field.
3. The health and safety risks associated with slurry mixing are greatly reduced. However, there may still be some hydrogen sulphide (H_2S) gas released during aeration.

How the system works in practice

Before operating the system, it is important that there is water or parlour washings in the bottom of the tank covering the air outlets. This will ensure the system is bubbling well before any higher dry matter slurry is introduced into the tank. Manufacturers recommend that the system should be run for up to a 6-hour period each day, to ensure optimum agitation of the slurry until the tank is emptied. The aeration system is usually run during the night, using electricity at a reduced price per unit. A compressor delivers 20-40m^3/hour of air (depending on size). The number of air outlets required depends on the size and shape of the slurry store.

Health and Safety

There have been many serious incidents and one fatality, where farmers or farm workers have been overcome by gas released from slurry during mixing. Hundreds of farm animals have died as a result of insufficient ventilation during slurry mixing. Use of low rate intermittent aeration should greatly reduce the dangers posed by the release of slurry gases, particularly H_2S.

Research findings

Research carried out by AFBI (Hillsborough) and Teagasc (Grange) examined the effect of low rate intermittent aeration on H_2S concentrations just below slat level in a house containing store beef cattle. H_2S is the gas that poses the greatest health and safety risk when mixing slurry. This study also examined the impact of low rate aeration on nutrient concentrations in the slurry and its ease of pumping (emptying or moving to another tank).

This research demonstrated that during the use of the aeration system, H_2S concentrations below slat level were less than 10 parts per million (eyes get irritated at 10ppm). It was also shown that normal mixing of slurry produced H_2S concentrations well in excess of the recommended exposure limits. However, monitoring of H_2S levels on 3 dairy farms in Northern Ireland that employed low rate aeration systems, indicated H_2S concentrations below slat level much higher than those found at Grange with beef cattle. This may be related to diet and/or the addition of silage effluent to tanks. However, even in these situations, at animal level H_2S concentrations should be greatly reduced, depending on the amount of ventilation in the shed. Low rate intermittent aeration reduces the health and safety

risks normally associated with the release of H_2S during slurry mixing. In addition, it was also found that the aerated slurry could be pumped or removed without the need for further agitation. There were no significant differences between the nutrient analysis of the aerated slurry and the conventionally managed slurry.

In summary, the health and safety risks associated with conventional mixing are greatly reduced with the use of low rate intermittent aeration and the slurry is adequately mixed to allow removal from the tank at any time, without the need for agitation. These benefits were achieved with no detrimental effect on the nutrient content of the slurry.

Cost of installing and running the system

For the purpose of this example, slurry produced from a 100 cow dairy herd (1000m^3) will be used for calculation purposes.

Average supply and installation costs for a system to accommodate the excreta from 100 dairy cows as quoted by manufacturers;

1000m^3 capasity below ground	£13,070	
1000m^3 capacity above ground	£10,853	
Average	**£11,962**	**(March 2009)**

Assumptions: 10-year depreciation costs, interest at 3% pa

Running costs, assuming the 1.85 kW motor is operated for six hours per day between the hours of 1AM and 8AM on Northern Ireland Electricity's Farm Night Saver Tariff (6.86p/kW hr) would be approximately £278 over a 12-month period. It is assumed that the system runs throughout the year as the tank will never be completely emptied, due to summer accumulations of slurry at milking time and slurry stored for utilisation between silage cuts.

Assuming the system runs continuously, maintenance costs are low and for the purpose of this note are assumed to be £100 per year.

Depreciation	£1196
Opportunity cost (3%)	£ 378
Electricity running costs	£ 278
Annual maintenance costs	£ 100
Total annual costs	**£1952**

How does this compare with conventional mixing of slurry? For the same 100 cow dairy unit assuming the following:

- Slurry pump cost £3000 (Farm Business Data 2009) (depreciation costs averaged over 10 years)
- Tractor 100hp 4WD £15.65/hr (Farm Business Data 2009),
- Labour costed at £10/hour
- Mixing times: For mixing a 1000m^3 tank it is assumed that 30 to 50 hours per year are required (average 40 hours). This allows for mixing at the beginning of the growing season and for each silage cut thereafter.

Labour cost	£400
Slurry pump depreciation	£300
Opportunity cost (3%)	£103
Tractor costs	£500
Total annual cost	**£1303**

Alternatively employ a contractor for 40 hours to complete the mixing operation at £22.50/hour (Farm Business Data 2009) total annual cost would be £900.

On the basis of these assumptions, the aeration system costs £649 per year more than conventional mixing and £1052 per year more than using a contractor. However there are several important non-quantifiable benefits including:

- Ease of management and the fact that slurry can be removed at any time without mixing.
- Elimination of the need to remove stock for slurry agitation.
- The greatly reduced health and safety risks associated with the release of H_2S during mixing.

Summary

Based on the assumptions above, the low rate aeration system is more expensive than conventional methods of slurry agitation, but has major management benefits, which are difficult to financially quantify.

- With the slurry in a homogenous state where it can be pumped and spread without further action, timeliness of application is a great benefit of the system. When conditions are suitable, slurry can be spread without having to start the mixing process.
- Slurry gases are potentially a major health risk on farms and a low rate intermittent aeration system should greatly reduce this risk to livestock and people.

The decision on whether or not to install a low rate aeration system depends on the value a farmer places on the management advantages associated with such a system and on the greatly reduced health and safety risks associated with the release of slurry gases.

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