## Measure 46: Slurry Acidification

This fiche is entirely based on the 2015 UK agricultural MACC (Eory *et al.* 2015).

### Category

Livestock management: slurry management

### Overview

Slurry acidification is achieved by adding strong acids (e.g. sulfuric acid or hydrogen chloride) to the slurry to achieve a pH of 4.5-6.8 depending on the slurry type, the acid used (Fangueiro *et al.* 2015). There are three main types of technology relating to the stage at which the acid is added to the slurry: in-house, in the storage tank, or before field application.

### Applicability

This technique is applicable to slurry which is stored in tanks, regardless of the livestock type. For dairy, beef and pig excreta, 41%, 4% and 38% respectively is stored in liquid form (Webb *et al.* 2014), half of which is stored in slurry tanks as opposed to slurry lagoons (Defra 2014a). Therefore the applicability of the measure is 21%, 2% and 19% for dairy cattle, beef cattle and pigs.

### Abatement rate

According to a review by Fangueiro *et al.* (2015), reductions of 67-87% of manure $CH_4$ emissions were achieved using $H_2SO_4$, and 90%, 40-65% and 17-75% reduction was observed with lactic acid, hydrochloric acid and nitric acid, respectively. Ammonia emissions also decreased by 50-88% with sulphuric acid and 27-98% with other acids – therefore indirect $N_2O$ emissions must have decreased as well.

In the current study we assume a 75% reduction in the methane conversion factor and 70% decrease in the fraction of the manure N which is volatilised.

On the other hand, $N_2O$ emissions after manure spreading can increase by 23% (Fangueiro *et al.* 2015), this increase is deducted from the GHG mitigation.

### Current and additional future uptake

This technique is established and commonly used in a few countries, like Denmark, where in 2013 25% of the slurry was acidified (Fangueiro *et al.* 2013), but hasn’t been adopted yet in the UK. We assume that uptake will not happen on smaller farms (< 50 dairy cows: 6% of the herd, up to 30 beef cows: 28% of the herd, up to 25 sows: 5% of the herd (Defra 2014b)). Therefore the maximum additional future uptake is estimated as 94%, 72% and 95% of dairy cattle, beef cattle and pigs, respectively.

**Cost**

The cost of implementing a measure is £2.40 (t slurry)$^{-1}$, according to the Baltic Deal farmers' organisation (Baltic Deal 2015). With annual slurry production of 0.35, 0.2 and 0.03 t for dairy, beef and pigs this translates to £44, £25 and £4 head$^{-1}$ y$^{-1}$, respectively. Kai *et al.* (2008) provided a cost estimate of £43 y$^{-1}$ for a 500 kg livestock unit, which is roughly the same value for dairy and slightly lower than the previous values for beef and pigs. We use the value of Kai *et al.* (2008) in the current study.

On the benefit side, the reduced N loss can increase the N content of the slurry, increasing the mineral fertiliser equivalent value of the manure by 39-100% (Fangueiro *et al.* 2015), thus reducing the need for additional synthetic N fertilisation. These savings in synthetic N equivalent were reported to be 26 kg N (100 kg slurry N)$^{-1}$ (Kai *et al.* 2008). This benefit is approximated here by assuming that every 100 kg N excreted slurry which is subsequently stored as acidified is worth an additional 10 kg synthetic N.

**Assumptions used in the MACC**

| Parameter | Change in value | Notes |
|---|---|---|
| Slurry tank $CH_4$ conversion factor | -75% | |
| Slurry tank N volatilisation factor | -70% | |
| Annualised cost | dairy: £45.82 head$^{-1}$ year$^{-1}$<br>beef: £35.59 head$^{-1}$ year$^{-1}$<br>pigs: £6.88 head$^{-1}$ year$^{-1}$ | |

References


Baltic Deal 2015 Slurry acidification http://www.balticdeal.eu/measure/slurry-acidification/

Defra (2014a) Farm practices survey 2014 - Greenhouse gas mitigation, National Statistics.

Defra (2014b) Farming statistics - provisional crop areas, yields and livestock populations at 1 June 2014 - UK, Defra.

Eory, V., MacLeod, M., Topp, C. F. E., Rees, R. M., Webb, J., McVittie, A., Wall, E., Brothwick, F., Watson, C., Waterhouse, A., Wiltshire, J., Bell, H., Moran, D. and Dewhurst, R. J. (2015) Review and update of the UK agriculture MACC to assess the abatement potential for the 5th carbon budget period and to 2050, the Committee on Climate Change.

Fangueiro, D., Surgy, S., Regueiro, I., Gioelli, F., Hjorth, M. and Coutinho, J. Animal slurry acidification: more than a solution for ammonia emissions abatement?, pp. 1-29.

Fangueiro, D., Hjorth, M. and Gioelli, F. (2015). Acidification of animal slurry - a review. Journal of Environmental Management 149, 46-56.

Kai, P., Pedersen, P., Jensen, J. E., Hansen, M. N. and Sommer, S. G. (2008). A whole-farm assessment of the efficacy of slurry acidification in reducing ammonia emissions. European Journal of Agronomy 28, 148-154.

Webb, N., Broomfield, M., Brown, P., Buys, G., Cardenas, L., Murrels, T., Pang, Y., Passant, N., Thistlethwait, G. and Watterson, J. D. (2014) UK Greenhouse Gas Inventory, 1990 to 2012, Report No Ricardo-AEA/R/3407, Defra, Ricardo-AEA, London.