Digestate Use on Agricultural Land

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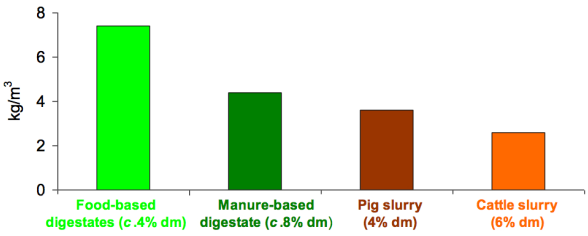
Digestate

- With energy crops, nutrients v similar to slurry
- Enhances fertiliser value to crop
- Weed seeds killed
- Pathogens killed
- Odour reduced

Digestate

- Digestate is the residue slurry remaining after anaerobic digestion
- Digestate consists of left-over indigestible material, process intermediaries, and dead micro-organisms

Total nitrogen (N) in digestate and livestock slurries (kg/m^3)



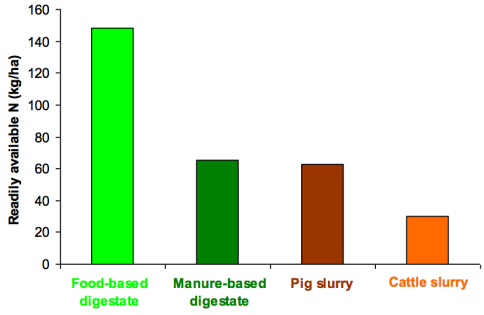
'Typical' slurry values taken from "Fertiliser Manual (RB209)"

B Chambers

Digestate

- Digestate will represent 70-95% of the volume of feedstock
- The TS content, quality and composition of digestate will depend on the feedstock
- All the NPK present in the feedstock will remain in the digestate

Readily available N (kg/ha) – application rate of 25m^3/ha



'Typical' slurry values taken from "The Fertiliser Manual (RB209)"

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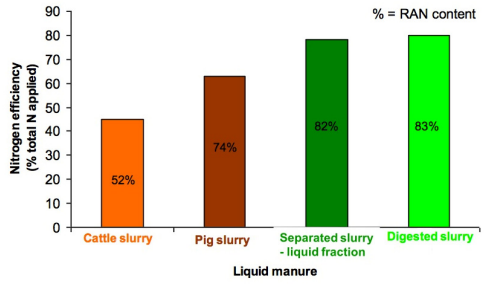
Nitrogen efficiency of slurry/digestate applications to winter wheat



Birkmose (2009)

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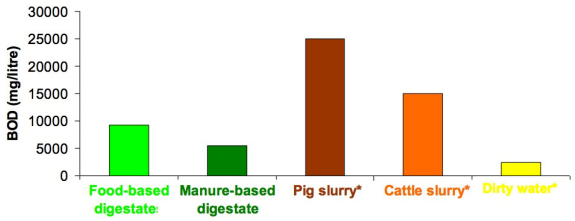
Biochemical oxygen demand - BOD



['Typical' sewage works discharge consent = 20 mg/litre]

*Defra Water Code (1998)

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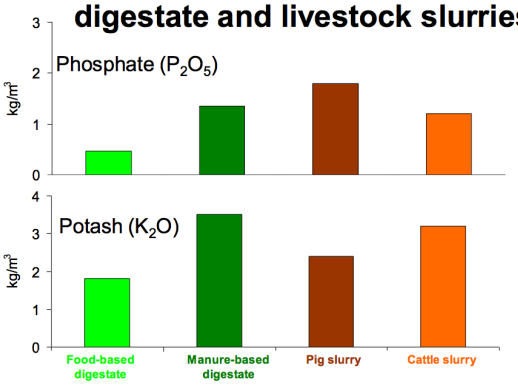
Total phosphate and potash in digestate and livestock slurries



'Typical' slurry values taken from "The Fertiliser Manual (RB209)"

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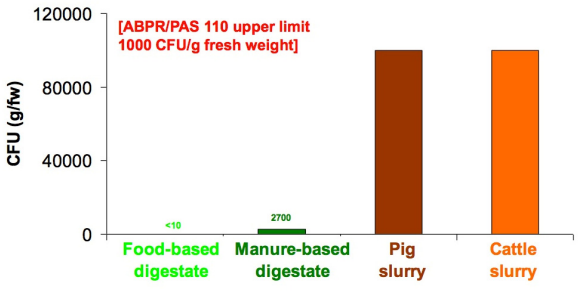
Odour

Digestate will always have *some* odour.

- Estimated to be a **factor of 10 less** than the odour associated with raw slurry
- In some cases, AD has been installed specifically as an odour abatement technology
- The more efficient your AD plant, the less the digestate should smell (VFAs)
- Neighbours/planners will always want to know about 'odour', especially if accepting external wastes

Microbial pathogens - *E.coli;* colony forming units (CFU)/g fresh weight



*Data from Defra FIO-FARM project

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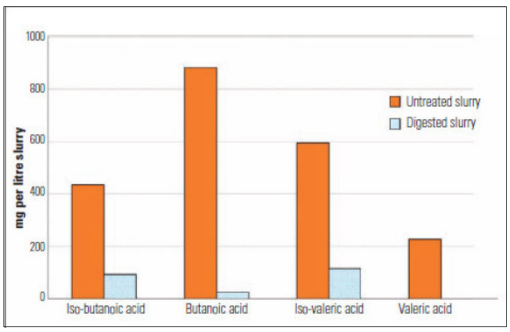
Odour



Source: IEA Bioenergy

Odour

Odour (10^3 xouEm^{-3})

- Pig slurry 15,125
- Cattle Slurry 2,542
- Digestate 178

- Anaerobic digestion reduces slurry odour considerably

Benefits of Digestate

- Nutrients are considerably more bio-available than in raw slurry
- Digestate can be used straight from the digester, separated or further treated
- Less 'refusal'

Benefits of Digestate

Digestate	Vs	Slurry
↑	Nitrogen availability	↓
↑	Phosphorous availability	↓
↓	DM%	↑
↓	Pathogen Load	↑
↓	Odour	↑
5		**0**

Digestate

All the NPK present in the feedstock will remain in the digestate.

Total-N Kg/m³	NH_4-N Kg/m³	NH_4-N/N % total	P_2O_5 Kg/m³	K_2O Kg/m³	DM %
4.5 - 6.5	2.5 - 5.0	55 - 75	1.5 - 3.5	2.5 - 5.5	5.5 - 8.5

Source: Slack 2010

highly dependent on the NPK in the incoming feedstock

Digestate

- Good quality digestate can be spread on farmland. It is rich in nutrients and organic material
- Poor quality digestate can be used as landfill cover or as refuse derived fuel (if it is de-watered)






Nutrient Value

- 3.0 kg N = £2.88
- 1.2 kg P_2O_5 = £1.02
- 3.5 kg K_2O = £2.03
- Total = £5.93/m³

- N @ £260/t = 96p/kg
- P @ £400/t = 85p/kg
- K @ £350/t = 58p/kg

Total value of £5-7/m³ once it is applied

The Value of Dairy Cattle Slurry

Spring applied

Volume applied	Size of Area	Nutrient Value
33 m³	1 Ha	£125/Ha
3,000 gals	1 Acre	£50/ac

To get the most from slurry and manure try to apply it in the same conditions, for ground and weather, as you would apply chemical fertiliser.

Digestate

Store and Spread

- Digestate can be stored and spread direct to land using existing slurry spreading equipment.
- Similar to slurry, it will be necessary to store digestate for application at optimum times.
- NVZ / Nitrogen loading rules will need to be adhered to.
- This will be the low cost, low maintenance option of choice for most farm-scale systems

Digestate Application

- Spreading window
- Growing crop
- NVZ's
- Weather
- Spreading costs (£40-£60 per hour)

Digestate

Separate to 'fibre' and 'liquor'

- Digestate can be separated (chemically/mechanically/physically) using polymers, belt or screw-presses, or excess heat from the AD plant
- NPK split between liquid/solid depending on method

Digestate

Treatment Options

- Store and spread
- Separate to 'fibre' and 'liquor'
- Further treatment (composting, pelletising)

Digestate

Further Treatment

- 'Designer digestates'
- Organic Fertiliser pellets
- Animal bedding
- Biomass fuel pellets

Digestate Quality Standards

Manures and slurries

'Agricultural manures and slurries are not considered waste if they are processed on their own via AD, and are used in the same manner that undigested manures and slurries are normally used ie spread as a fertiliser on agricultural land' (DOE NI)

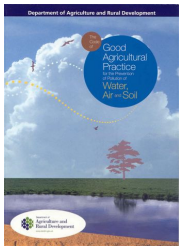
When any material such as digestate is mixed with livestock slurry, the total volume is regarded as livestock slurry for the purposes of land spreading

External wastes

For AD plants accepting external wastes the situation is more complicated – waste licensing and PAS 110 required

If no livestock slurry is included, then the resulting digestate is regarded as an organic manure

Code of Good Agricultural Practice (CoGAP)



Contains practical information and guidance for the prevention of Pollution of Water, Air and Soil.

By observing the Code you will be compliant with most Environmental Legislation

Digestate

Digestate Quality Protocol and PAS 110

PAS 110 and the Digestate Quality Protocol are voluntary standards.

Designed to give confidence to digestate end-users (usually farmers) that what they are receiving is a 'quality-assured product', which will be of genuine benefit. Free from pathogens and chemical and physical contaminants.

The Nitrates Action Programme 2011-2014

Cafre offers Nitrates Training Workshops

cafre
College of Agriculture, Food & Rural Enterprise

Pollution Control Legslation

- Nitrates Action Programme
- Code of Good Agricultural Practice (CoGAP)
- The Control of Pollution - SSAFO Regs
- Agricultural Waste Management Regs
- Cross-Compliance
- Integrated Pollution Prevention & Control (IPPC)

Spreading Slurry & Manure

Closed Periods

Slurry, poultry manure & digestate

- Midnight 15th Oct to midnight 31st Jan

Farmyard manure

- Midnight 31st Oct to midnight 31st Jan

Chemical N fertiliser

- Midnight 15th Sept to midnight 31st Jan

Spreading Slurry, Manure & Digestate

Should not be applied within:
- 10m of a waterway,
- 20m of a lake,
- 15m of a limestone feature,
- 50m of a borehole,
- 250m of a borehole used for public supply.

In addition never apply on snow covered, waterlogged or frozen ground or when heavy rain is forecast within 48 hours.

Spreading Methods

Spreading Slurry, Manure & Digestate

A risk assessment is required for steeply sloping land i.e. when grassland is over 20% and arable land is over 15%.

Risk factors include:
- Distance from water
- Type of manure to be applied,
- Soil and weather conditions.

Further details of the Nitrates Action Programme are in the Nitrates Guidance Booklet available at www.dardni.gov.uk

Working safely with slurry

- Slurry gases are a silent killer.
- Take care as lethal concentrations of gases build up within a few minutes from starting to mix slurry.

For further information see
The Health and Safety Executive for NI (HSENI) website
www.hseni.gov.uk

Digestate Management

Good agricultural practice
- use of trailing shoe
- use of shallow injection

Reduction of nutrient loss

Trailing hose vs. surface broadcast slurry application

Trailing hose Surface broadcast

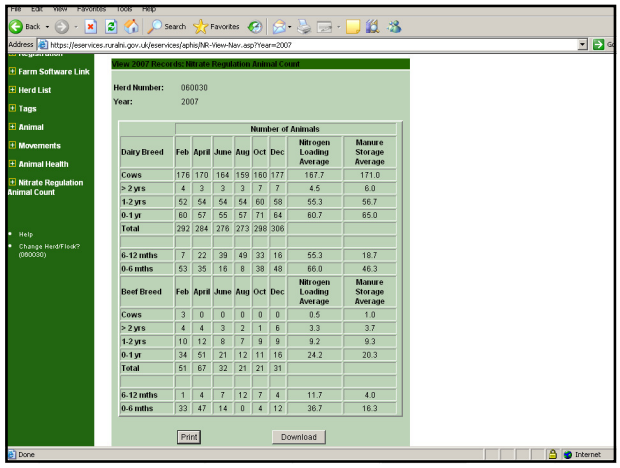
Livestock Nitrogen excretions

Livestock type	Nitrogen excreted kg/year
Dairy cows	91 kg
Cattle over 2 years	54 kg
Cattle 1-2 years	47 kg
Cattle 0-1 year	19kg
Ewe/ram	9 kg
Lamb 0 – 1 year	4.4 kg
Breeding sow	15.9 kg
Broiler places (1000)	255 kg (38.6 kg)

Fertiliser Savings From New Technology

Slurry Application System	Splash Plate	Trailing Shoe
Application Rate (m^3/ha gal/acre)	50 m^3/ha **(4,500)**	50 m^3/ha (4,500)
Available N from slurry (kg N/ha)	**30**	**57**
N from bag fertiliser (kg N/ha)	**70**	**43**
Total N available (kg N/ha)	**100**	**100**
Savings in fertiliser costs (£/ha)	-	**£26**/ha (£11/acre)

Assumes 27% N @ £260 / tonne



Livestock Manure Nitrogen Limit

Stocking rate limit

- Farm limit of **170kg** N per ha per year

  (Derogation to 250kg N per ha per year)

How is it calculated?

$$\frac{\text{Total nitrogen from livestock excretions}}{\text{Agricultural area controlled}}$$

Annual Livestock Manure Nitrogen Loading

$$\frac{\text{Total nitrogen from livestock excretions}}{\text{Agricultural area}}$$

$$= \frac{7906 \text{ kg}}{48 \text{ ha}}$$

$$= 165 \text{ kg N/ha/year}$$

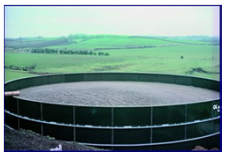
Livestock manure nitrogen loading calculator
www.ruralni.gov.uk

What if I am above the 170kg N/ha/year limit?

Options:

- Take control of additional land
- Export livestock manure
- Apply for a derogation
- Reduce stock numbers

Slurry Tanks, Stores & Lagoons



1. Check tanks regularly for leaks,
2. Farms must have 26 weeks storage for pigs & poultry and 22 weeks for cattle,
3. Must allow 300mm of freeboard on tanks built after 1st Dec 2003.
4. Must allow for 750mm of freeboard for earth bank lagoons built after 1st Dec 2003.

Soil P Status

- Large number of soil samples indicate that 41% of NI soils are at soil index 3 or higher for phosphate
- Very little requirement for additional phosphate on these fields
- No scope for additional organic manure containing phosphate

The Farm Nutrient & Waste Management Plan

is a requirement of

Agri-Environment Schemes

and it must be updated annually.

Phosphorus Regulations

- Can only apply **chemical P** or P from organic manures where a need is demonstrated by soil analysis
- **Soil test:**
  - every 4 yrs (grass or crops)
  - 3 months after last P application
  - Up to 4 ha per sample
- Apply fertiliser according to soil P levels
- Must account for P in organic manures

Additional records required

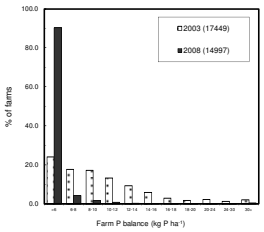
Paper Work!

- ✓ Land area
- ✓ Livestock nos
- ✓ Manure storage capacity
- ✓ Imported/exported manures
- ✓ Fertiliser purchased
- ✓ SNS for crops
- ✓ Chemical P fertiliser

Percentages of farms with P balances in excess of 10 kg P/ha in 2003 and 2008.

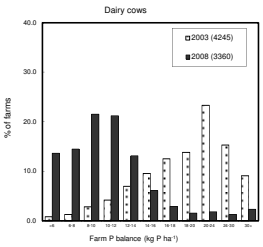
Beef cattle farms

2003 = 40% 2008 = 3%



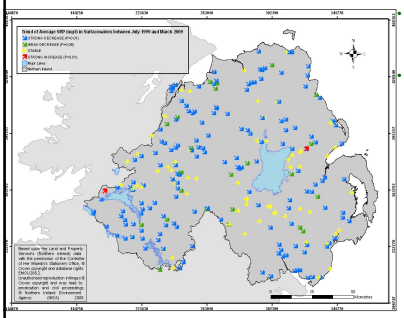
Dairy farms

2003= 95% 2008 =50%



Practical On-farm Renewable Energy Event

Long term trends of soluble reactive phosphorus concentrations in rivers 1999-2008



- **Only two sites show SRP increase over 10 years.**
  - **182 sites (74%) in decline**
- **Decreases widespread in many rural areas.**

Change	probability *p* value	% of sites
Strong decrease	$p<0.01$	64.5
Weak decrease	$p<0.05$	9.8
Stable	No trend	24.9
Weak increase	$p<0.05$	0
Strong increase	$p<0.01$	0.8

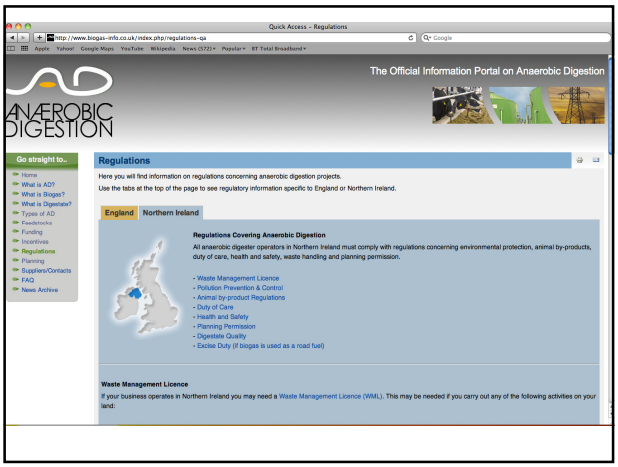
Renewables Training Programme

- Energy Efficiency
- Introduction to Renewables
- Energy from Wind
- Heat from Biomass
- Anaerobic Digestion
- Utilisation of Solar Energy
- Power from Hydro

AD Portal

www.biogas-info.co.uk

- Home
- Digestate Quality
- Funding
- Incentives
- Planning Permission
- Regulations
- Useful Contacts



Total Nutrient Content of Slurry & Manure (kg/m³)

Livestock Type		N	$P_2 0_5$	$K_2 0$
	6% dry matter	3.0	1.2	3.5
	10% dry matter	4.0	2.0	5.0
	6% dry matter	2.3	1.2	2.7
	10% dry matter	3.5	2.0	3.8
	4% dry matter	3.0	2.0	2.5
	6% dry matter	4.0	3.0	3.0
	Broiler litter (60% Dry Matter)	30	16	18

1kg/m³ = 9 units/1000 gal