Greening Agriculture
Copenhagen 24.04.2013

BioCover a|s

Agromek prize winner
2008 and 2010

SyreN

Reduction of odour and ammonia emission from slurry during application

BioCover a|s

SyreN system

Fronttank with sulphuric acid, iron sulphate and water.

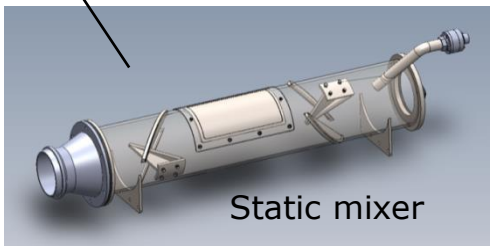
Tractor with computer control

Slurry tanker with acid injection

H_2SO_4 (sulphur acid) = Hydrogen - Sulphur - Oxygen = Sustainable

Processes when adding sulphur acid to slurry:

NH_3 (ammonia) + H^+ = NH_4^+ (ammonium)
NH_3 = gas - may evaporate NH_4^+ = salt - does not evaporate)



Ammonia emission

Grass / cow slurry: Emission 18.8 % applikation in April
30 t/Ha = app. 25 kg N more pr Ha = 175 FE yield pr Ha.

Winter seed / swine slurry: Emission 12.9% applikation in April
24 t/Ha = app. 10 kg N more pr. Ha = + 2 Hkg yield pr. Ha

Emission factors:

- Application rate pr. Ha
- Amount of ammonia in slurry.
- pH value
- Wind speed
- Temperature
- Plant cover
- Soil moisture

Normal variation: 5 to 50 kg pr. Ha

Ammonia emission - Legislation

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SyreN system cost neutral without legislation to support its use

3 countries have incentive structures:

Denmark – Kvota on use of nitrogen
Injection of slurry on grass and black soil
Environmental planning permission with use of SyreN

Holland – Injection of slurry

Finland – Subsidy to encourage the use of injection in stead of broad spreading

Ammonia emission in praksis in Denmark

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Example: Jens Peter Pors Eriksen – Hulvadgaard, 6600 Vejen
property with 300 Ha winter wheat and 6000 m3 swine slurry
Ammonia contens of 3.5 kg N pr. m3 - 20 ton slurry pr. Ha

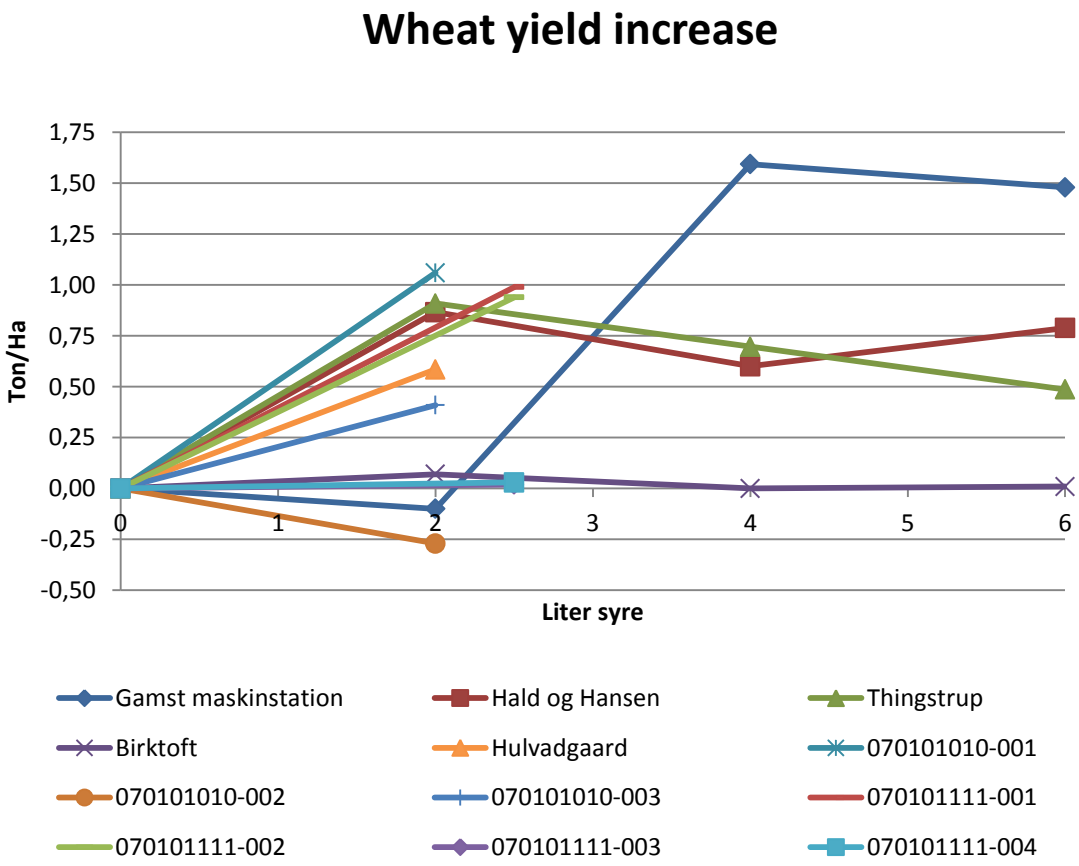
Expences:

Acid: 6000 x 1.5 liter x 0.30 Euro =	- 2.700 Euro
Application: 0.5 Euro x 6000 m3	- 3.000 Euro
	- 5.700 Euro

Income:

Yield increase winter wheat – 6.6% / 5.8 Hkg	
+ 5.8 Hkg pr. Ha = 5.8 x 25 Euro = 145 x 300 Ha	43.500 Euro
Sulphur fertilizer 15 kg x 300 Ha x 0.5 Euro =	2.250 Euro
	45.750 Euro
Net income	40.050 Euro

Landsforsøg + demonstration test: Wheat



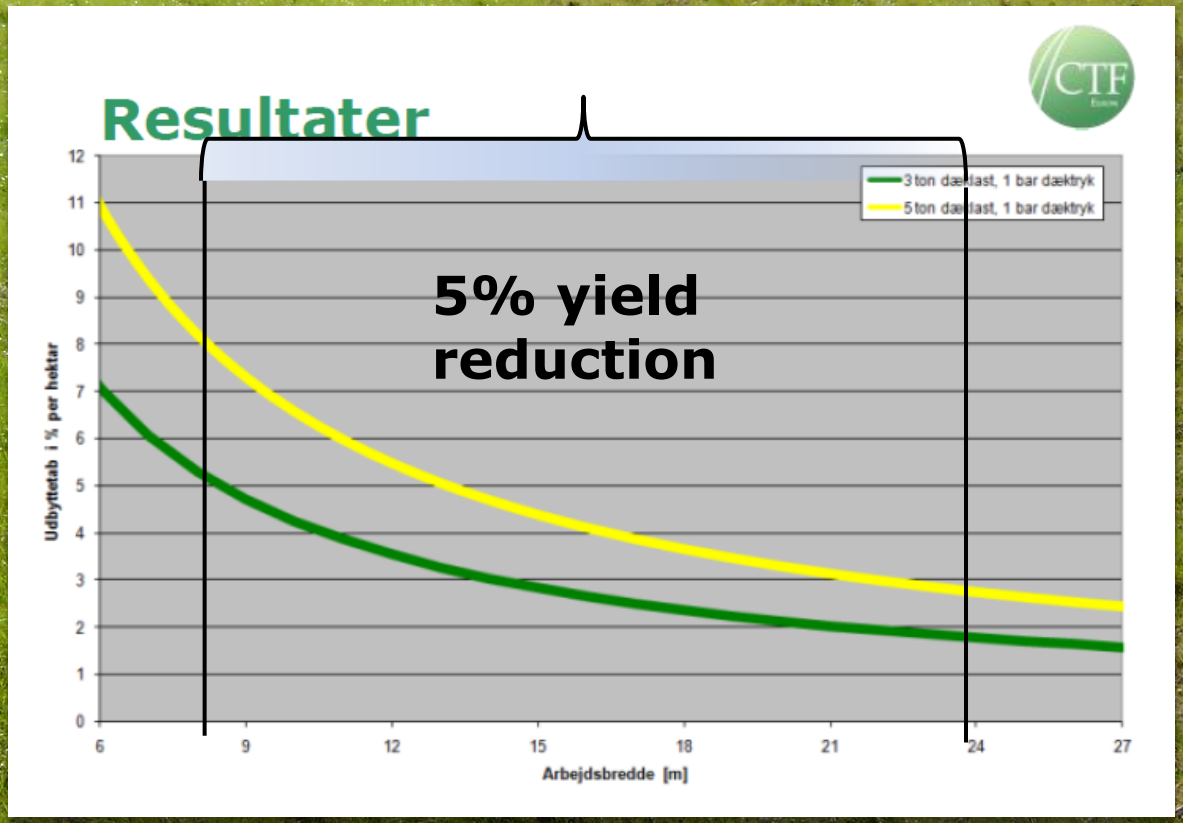
68% sikkerhed	noter til gyllens dag 2012		
	min	gennemsnit	max
2L	0,32	0,46	0,60
4L	0,39	0,72	1,05
6L	0,38	0,69	1,00

95% sikkerhed	noter til gyllens dag 2012		
	min	gennemsnit	max
2L	-0,03	0,46	0,95
4L	0,07	0,72	1,38
6L	0,08	0,69	1,31

Traffic dammage

Grass

Source: DJF – Ole Green



10 ton swine slurry pr. Ha SyreN treated – 4 liter sulphuric acid pr. m3

10 ton swine slurry pr. Ha

Grass injection vs. acidification

Advantage bandspreader	Advantage injection
• Wider working with: 50 – 66% reduction in traffic damage from slurry tanker in grassfields 100% reduction in injection tool damage in grassfield 24 -30m workwith – app 25% increased capacity for slurry applicaiton • Dependable and good ecconomy • Unchanged need for powerconsumption / diesel use • Less structual damage caused by heavy traffic • Improved weight distribution between tractor – slurry tanker • No risque of drought damage from dry root • No wear parts in contact with soil	• --- • --- • --- • --- • --- • --- • --- • --- • --- • --- • No risque with handeling of acid • Reduction in risque of transport of slurry drymatter back to stable

Acidification in Denmark 2013:

	Number of units	m3 slurry
Stable acidification:		
Infarm	110 systems	900.000 m3
Hyldegaard staldservice	15 systems	100.000 m3
Tank acidification:		
Harsø	35 systems	1.200.000 m3
Ørum	30 systems	1.000.000 m3
Field acidification:		
BioCover	86 systems	2.000.000 m3
Total amount		5.200.000 m3
% of DK slurry (30 mill.)		app. 17.3 %

Estimated environmental effect from acidification:

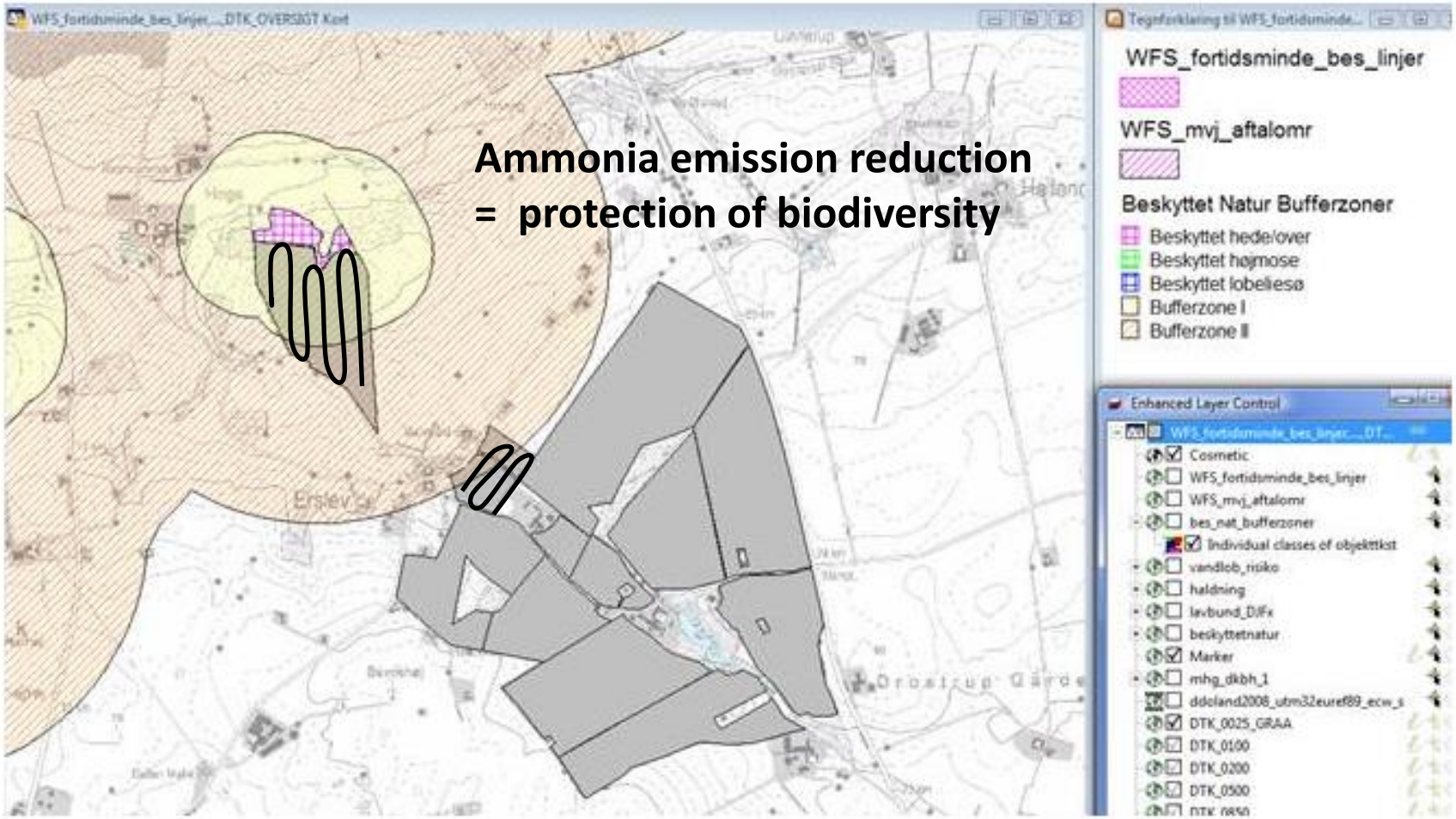
Theoretical formular for reduced ammonia emission effect:

16% average x 3.5 kg/m3 x 3.4 mill m3 = 1.900 ton N
Potential i DK: 17.300 ton N
Yield increase estimat app 2 hkg

Practical formular for reduced ammonia emission effect:

Yield increase 4.5 hkg average
Potential reduction in N leaching in DK 17.300 x 2.25 = 39.000 ton N

Bio diversity cover = BIOCOVER a|s



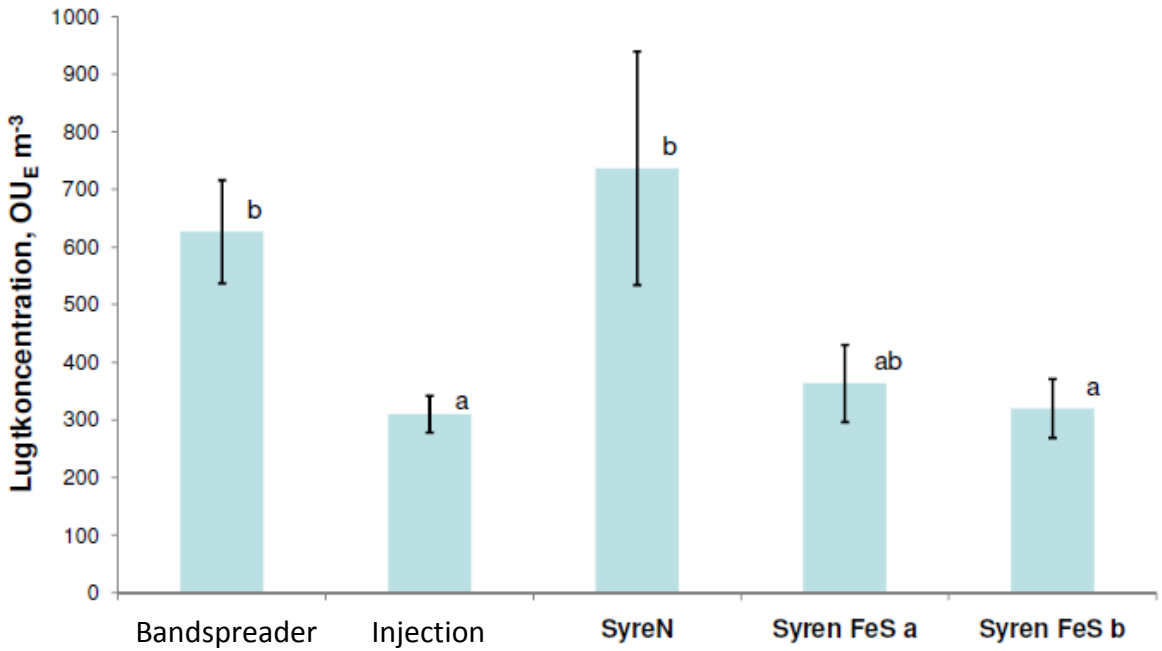
Air particle pollution (smog)

Emission factors	Contribution i % to the total health related external cost from danish emissions	
	Contribution to Europe	Contribution in Denmark
Central powerstations	10.3 %	5.7 %
Household heating incl. fireplaces	9.3 %	16.3 %
Decentral powerstations in combination with industrial production	5.3 %	4.3 %
Production processes such as cement, paper, metal.	1.9 %	3.1 %
Extraction and distribution of fossile fuels	1.7 %	2.3 %
Use of organic soulables such as in paint.	2.6 %	2.5 %
Road traffic	17.6 %	19.3 %
Other mobile sources (tractors, lawnmowers etc.)	7.9 %	7.2 %
Waste management and burning	0.6 %	0.1 %
Agriculture	42.8 %	39.4 %
Total	100.0 %	100.0 %

”The contribution from agriculture is caused by emissions of ammonia (NH3) which is converted to particles in the atmosphere (ammoniumsulfate and ammoniumnitrate)”

Potential to reduce total air particle polution with +20%

Reduction in odour from slurry application



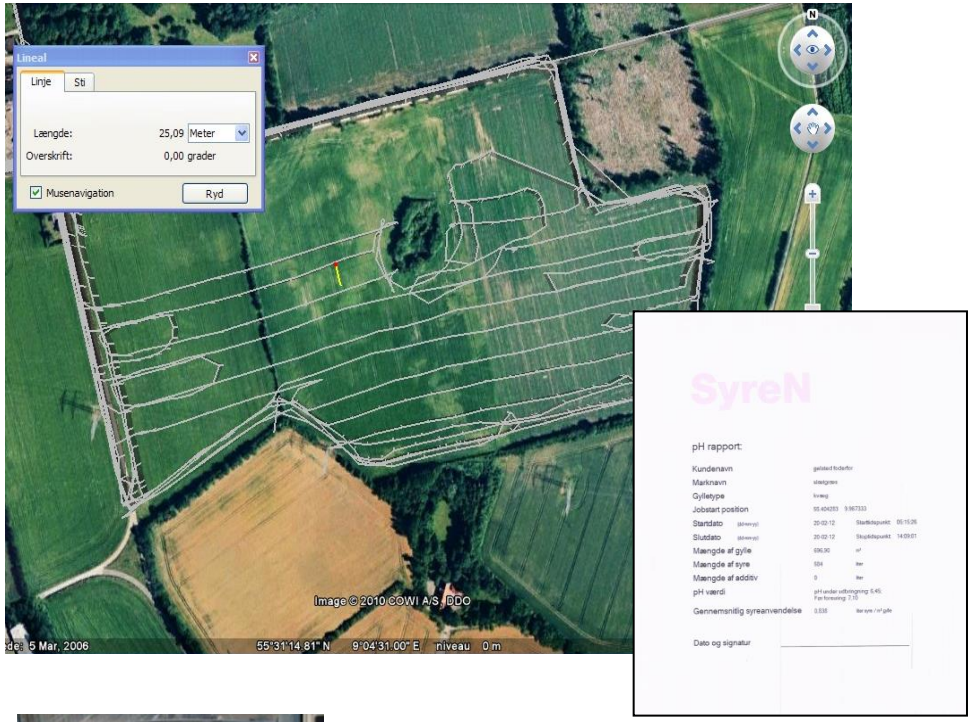
Reduction with use of iron sulfate

- Adding sulphuric acid => H^+ + NH3 ammonia transform to ammonium NH4+ = no odour
- Adding iron sulfate causes hydrogen sulphide to react => H_2S + $FeSo_4$ = FeS + H_2So4 = no odour
- Changes the dominance of different odour components = changed odour

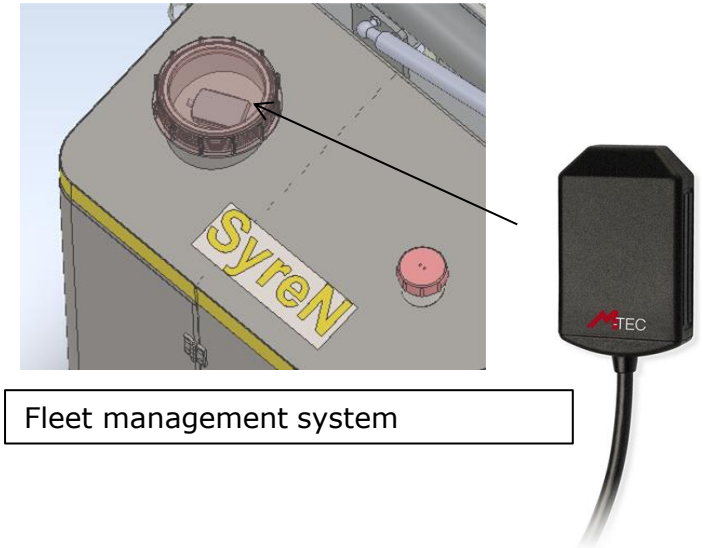
SyreN system – SyreN pH report

Documentation strategy

- Online documentation of environmental effect
- Server based software
- 5 years data hosting
- Fully automatic operation



pH rapport and management data



Fleet management system

ISObus terminal

SyreN+

Vision:
Acidification of slurry with slurry volume based on phosphorus contends and with adjustment of nutrient value N, K and S based on plant needs.

Result:
Sustainable use of organic fertilizers (slurry)

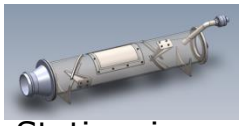
BioCover a|s

SyreN+ system

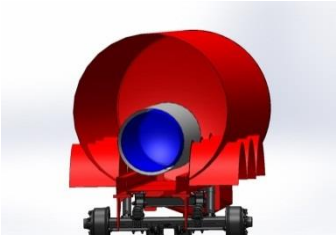
Fronttank with sulphuric acid, iron sulphate and water.

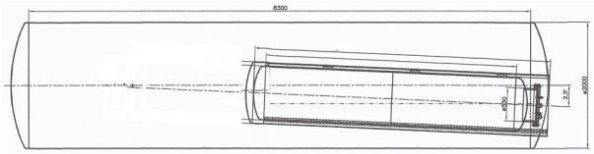
Tractor with computer control

Slurry tanker with acid injection



Static mixer





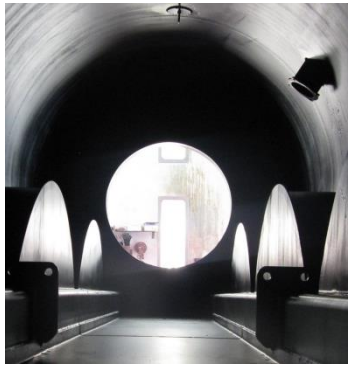
Ammonia pressure tank integrated into slurry tank.

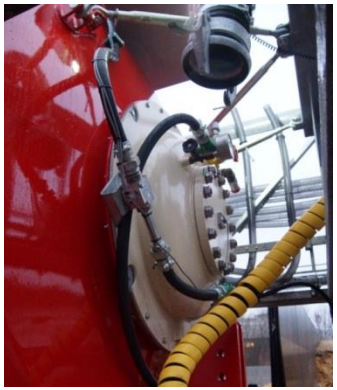
pH sensor with sump

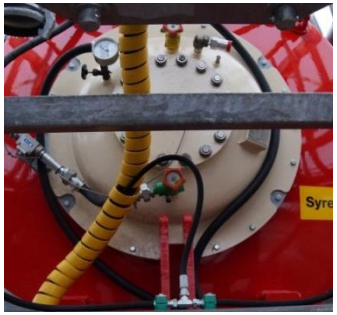
SyreN+ system

Ammonia injection in slurry:

- Varriable tank size
- 2300 l ammonia pressure tank
- 1200 kg – 83% = 1000 kg N
- Volume: 2.5 m3
- Extractable for inspection
- Easy acces for refilling
- Possibility for use as conventional slurry tanker
- Dosing during recirculation of slurry
- Manuel activated
- Control and adjustments integrated into SyreN ISObus





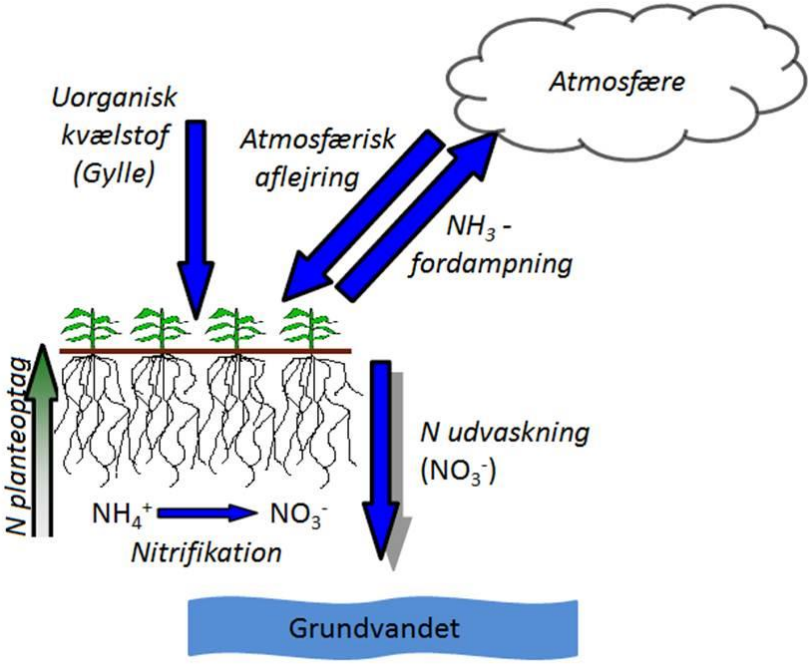


SyreN system – SyreN+

One pass fertilizing with ammonia - NH_3

- Ammonium fertilizer instead of nitrate
- Flexible dosage rate – individual NPKS formula pr. field / crop
- Nutrients dissolved in large amount of fluid - quick absorption by plant roots
- Cost reduction on fertilizer purchase
- Precise dosage
- Reduction in field traffic
- Yield increase with acidification
- Sustainable environmental profile in combination with acidification
- Band spreading or injection

SyreN system – SyreN+

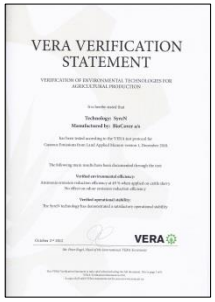


AARHUS UNIVERSITET

"Danish environmental regulation: Reduction in the GHG emission of 0.028-0.133 mio. ton kg CO_2-eq./ha
Under European conditions is the potential effect larger, up to twice the effect of the Danish estimate"

VIDENCENTRET FOR LANDBRUG

"Replacement of nitrate with ammonium nitrogen reduces average leaching of nitrogen with 3 kg / ha pr. year"


VERA VERIFICATION STATEMENT

49% reduction from cow slurry using band spreading

Use of nitrogen inhibitor TBA

SyreN+ system – Cost of fertilizer

Example of fertilizer strategy
witer rape

Winter rape, Sandmixed claysoil, JB 5-6					
		N	P	K	S
Crop need		194	32	91	35
Swine slurry	28 ton/ha	95	26	60	0
Rest		-69	-6	-31	-35
Liquid ammonia	84 kg/ha	69	0	0	0
Sulphuric acid	2,5 liter/ton				40
Total		194	26	60	40

Swine slurry: 30 ton/ha		80 kg/N
Conventional fertilizer strategy	Slurry + sulphuric ammonia	
Fertilizer	2,25 kr./kg	860,- kr./ha
Application	140 kr./ha	140,- kr./ha
Total		1000,- kr./ha
Alternative with SyreN+		
Slurry + Sulphuric acid + liquid ammonia		
Fertilizer	5,00 kr./kg	485,- kr./ha
Sulphuric acid (3,0 l/ton)	2,25 kr./l	205,- kr./ha
Application cost SyreN	4,00 kr./ton	120,- kr./ha
Application cost lliquid ammonia	1,00 kr./kg	100,- kr./ha
Total		910,- kr./ha
Difference		90 Kr / ha 12 Euro / ha

Summary – Bennefits with SyreN

- Potential environmental bennefits in Denmark

- Reduction of 17.000 ton ammonia emission pr. year
  Historic rescue mission for bio diversity
- + 100.000 ton reduction in CO_2 emission pr. year
- 20.000 ton reduction in nitrogen leaching to ground water pr. year
- 20% Reduktion i air particle pollution
- Reduction in use of 13.000 ton phosphorus pr. year

- Exceptionally good ecconomy

- +1000 Kr. / ha in grass compared to injection
- Average 4.5 Hkg yield increase in wheat

Summary - Bennefits with SyreN

- Fertilizing with SyreN / SyreN+

- Sulphuric acid creates acidification effect while fertilizing with sulphur
- Phosphorus acid creates acidification effect while fertilizing with Phosphorus
- Very fast plant responce to fertilizer
- Very precise distribution
- Flexible combination of fertilizer formulars – may replace all granular or fluid fertilizers.
- Reduction in traffic on field
- Reduction in purchase price on fertilizers
- Ammonium fertilizer not water soluble
- Precise dosage of micro nutrients – individually or in combination
- Effective method for manganese deficiency – also in root zone
- Eliminating ammonia is helpfuld for micro climate in soil

Summary – Bennefits with SyreN

- Bandspreading replacement of injection
  - Avoid traffic- and injection damage in grass fields
  - 24 -30m working with – increased capacity for slurry application
  - Addition to existing technology
  - Unchanged need for power / diesel use
  - Better weight distribution between tractor and slurry tank
  - Less structual damage as a result of less heavy traffic on fields
  - No risque of emission of NO_2

- Environmental planning permission
  - Contribution to- or direct cause for environmental planning permission in Denmark

Summary – Bennefits with SyreN

- Nitrogen in addition to kvota limitation

  - Ammonia emission reduction – from 5 to 50 kg extra N pr. Ha
  - Slurry can be applied without considerrations to weather- or climatic influence on emission

- Odur reduction

  - Odur reduction by injection of iron sulfate
  - Good neighbour strategy

- Documentation strategy

  - Simple and efficient documentation of environmeltal effect from application of slurry

Tak for opmærksomheden

Thank you for your attention