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INNOVATIVE AGRO-ENVIRONMENTAL

Technologies

FOR SUSTAINABLE FOOD PRODUCTION IN THE BALTIC SEA REGION

Cover photo

Three of the speakers at the recent workshop about 'Qualitative and quantitative assessment of livestock manure: methods for efficient management and enforcement': Luisa Samarelli, DG ENV, Hanne D. Poulsen, Aarhus University, and Maret Oomen, the Dutch Ministry of Economic Affairs, Agriculture and Innovation.

This issue

P 1: Tools for better manure management

p 3: EuroTier – fair concerning livestock manure processing technologies

p 4: Environmental effect of sealed grain stores

p 5: Costs for mixing and heat loss/insulation are important factors for digester tanks

p.6: Status for VERA Verification Statements

p 6: New report: "Needs, wishes and guiding principles for the development of the AgroTechnologyATLAS"

p 7: Pamphlet about controlled drainage and other SCIEN drainage technologies

p 7: Governance Innovations for Improved Phosphorus Management and Reuse -Voices from the Baltic Sea Region

p 8: Enterprise Europe Network partner searches:



Tools for better manure management – towards a bluer Baltic Sea

By Knud Tybirk, Agro Business Park, Baltic Manure

Manure certificates, quality measurements and manure standards are partial solutions to the challenges of the Nitrates Directive. Different countries have different approaches and exchange of knowledge is a prerequisite for learning and adoption of existing technologies. We do not need to re-invent the wheel, was the conclusion of the parallel session on manure management in Copenhagen.

One parallel session at the conference A Greener Agriculture for a Bluer Baltic Sea in Bella Centre, Copenhagen, October 25, 2012, was devoted to discuss existing and potential technologies to improve the handling and sustainable use of manure in the Baltic Sea Region. These issues are key elements in both Baltic Manure and Baltic Compass, and the parallel session was attended by over 60 participants.

Nitrates Directive is the frame

Luisa Samarelli of DG Environment introduced the session by a brief overview of the Nitrates Directive and how this has been implemented in different countries. The objective of the Nitrates Directive is to reduce water pollution caused by nitrates from agricultural sources, using maximum nitrogen fertilizer levels, requirements for manure storage, green cover and designated nitrate vulnerable zones etc.



Hanne Damgaard Poulsen, Aarhus University, is presenting the Danish Normative system.



The results on water quality have not been impressive after 20 years of implementation, and it might be the time to reinforce the measures. Manure efficiency and spreading techniques are on the agenda as well as measurements and control of manure when moved off farm. It is obvious that inspiration between different solutions in manure 'hot-spots' are needed to stimulate further development and international exchange.

There is a real need for effective manure movement control as well as continuous focus on increased manure efficiencies, notably in highly intensive livestock regions towards sustainable farming, Luisa Samarelli said to the audience.

Three different approaches for inspiration

Kiel University has developed a new methodology for manure measurements while applying the manure in the field. The technology is based on Near Infra Red Spectroscopy (NIRS) enabling good and cheap manure quality measurements. **Christian Moschner** from Kiel presented the technology and results from a study on how it can be used in the future. Ideally, it will enable the farmer to realize a nutrient specific as well as site specific application of slurry – although still some adaptation and calibration is needed. But NIRS is definitely a promising tool for improved manure management.

The Danish normative system for manure quality was presented by **Hanne Damgaard Poulsen, Aarhus University.** This approach used as the official tool in Denmark including all input and output for cattle, pigs, poultry, fur animals etc. in different housing systems. The method is based on a combination of feeding experiments, measurements and modelling of mass balances and gives a good framework for calculation the losses of nutrient at different stages from animal to field. This system is the official basis for fertilizer plans and control calculations and has contributed very much to the high manure nitrogen efficiency in Denmark.

In The Netherlands, the challenge for manure distribution is immense. High animal density leads to surplus of nitrogen and phosphorous in many areas and this has created a cross-border market for manure. This in turn has created the necessity for detailed knowledge of manure nutrient content and control of the manure being transported to ensure the correct handling and use. **Maret Oomen** from the Dutch **Ministry of Economy, Agriculture and Innovation** presented the manure transport certificate to follow each tonne of manure being traded between farmers and cross borders. Samples are taken and all manure carriers are certificated. The system is rather expensive, but allows for effective traceability of manure.

Cross border inspiration

The three cases of difference technologies and approaches all can contribute to the implementation of the Nitrates Directive. **Henning Lyngsø Foged**, Agro Business Park, organizer of the session, raised further questions for the future debate:

- How could the Nitrates Directive be simplified, so that the farmers themselves can make a fertilizer plan?
- How can the Danish normative system be adapted and adopted by other countries?
- Can we equip all larger manure transports with the traceability system used in the Netherlands, maybe in combination with NIRS, in order to accommodate needs for enforcement and for efficient manure management?

Continuous work is to be done towards a sustainable manure handling and a bluer Baltic Sea. It requires cooperation and dedication. The idea of the session was to make a status for the needs, methods and technologies, and enable authorities, companies and research to inspire each other across borders, technologies and methods. This aim has been accomplished and we have inspired for further activities, said Henning Lyngsø Foged in his concluding remarks.

EuroTier





Farmatic container solution for separation of digestate and drying of the separation solids.

EuroTier – important German fair concerning livestock manure processing technologies

By Henning Lyngsø Foged, WP4 leader, BalticCOMPASS

At EuroTier, a more and more clear trend is that the exhibitors also comprise suppliers of livestock manure processing technology, in addition to more conventional companies, such as providers of animal feedstuffs and genetic material.

One of the large halls were dedicated decentralised bioenergy production, mainly biogas production, and here were both companies who offered turn-key biogas plants, as well as companies offering components for biogas plants, such as biogas generators, plants for upgrading biogas to bio-methane, and steering /monitoring systems for biogas plants. One example of such suppliers was the German company, Farmatic, who exhibited an integrated container solution for separation of digestate and drying of the separation solids – see http://farmatic.com/komponenten/garrestetrockner-contitroc/.

In this way, the excess heat from the biogas generator can be used to dry the separation solids, and the biogas plant can according German subsidy rules obtain an extra subsidy of € 0.03 per kWh it produce. Otherwise, many German biogas plants cannot find use of the heat, which is ventilated away and lost. The feasibility of the technology must be evaluated on a case-by-case analysis, and it might be an interesting technology for biogas plants that separates the digestate, which in this way becomes even easier and cheaper to store and transport.

Also many other technologies were shown, for instance concerning manure/digestate storage and handling, tanks for digestion, various separation technologies, field spreading of manure/digestate, algae production, manure acidification, air cleaning, cleaning of reject water, and slurry additives.

For German agriculture, livestock manure processing has an increasing importance. The most livestock dense area is in Lower Saxony, one of Germany's 16 regions, situated in the north-western part of Germany, bordering the Netherlands. There are now around 7,500 biogas plants in Germany, and it is estimated that 29% of the livestock manure production in Germany is anaerobic digested. Besides that there is in Germany a large maize silage based biogas production, which however, is facing troubles with both sustainability demands and economic problems associated with the relation to prices on grain and other commodities.

EuroTier is a large fair, organized every second year at the fairgrounds in Hannover, Germany. The fair is with its 220 ha and 15 large indoor halls enormous, and has around 180,000 visitors, hereof around 25,000 international guests, and around 2,000 exhibitors.



Sealed, air-tight silos for grain storage are available in farmscale as well as industrial scale. Photo provided by Assentoft Silo, <u>www.assentoftsilo.dk</u>

Environmental effect of sealed grain stores

By Henning Lyngsø Foged, WP4 leader, BalticCOMPASS

Aarhus University¹ has in a pig feeding trial shown that grain from sealed air-tight storage had 3% higher digestibility of the protein, and 12% higher digestibility of the phosphorus due to higher phytase effect. The differences are statistically significant. The trial results are interesting from an environmental perspective, and shows that sealed grain storing has the potential to be a technology that can help closing nutrient cycles in agriculture, because it enable pig production with less input of protein (nitrogen) and phosphorus.

Background

Most grain is used for feeding, and the normal practice is to conserve it by drying it to less than 14% moisture at harvest and keeping it in open, roofed stores until use.

Another way is to store it in sealed air-tight silos. What happen under such conditions is that the grain quickly converts the oxygen in the silo to carbon dioxide (CO2) and alcohol - i.e. the grain "kills itself". The grain loses its germination ability, and there is no risk of vermins, as they cannot live in oxygen-free surroundings. The process preserves and ferments the grain. Farmers invest in the sealed grain stores simply to save the drying costs and to avoid risks of spill.

Feeding trials

A feeding trial undertaken by Aarhus University now also show an improved feeding value of grain that has been stored in air-tight silos.

The trial was made as a digestibility and balance trial with 16 slaughter pigs (8 for trial, 8 for control) at about 45 kg's weight. The pigs were fed the same diet, the only difference being the way the grain, constituting 70.9% of the ration, had been stored. The results of the trial are shown in the following table:

Digestibility trial with slaughter pigs, jed with normal versus air-tight store grain.			
	Control (normal stored grain)	Trial (air-tight stored grain)	Significance
Digestibility of:			
Dry matter, %	82.9	83.5	NS
Protein, %	78.2	80.7	p = 0.10
Phosphorus, %	41.4	46.0	p < 0.10
Calcium, %	38.9	40.3	NS
Energy, %	81.7	82.3	NS
Feed units per kg dry matter	1.13	1.14	NS

Digestibility trial with slaughter pigs, fed with normal versus air-tight store grain.

While the trial showed significant effects of air-tight storing of grain on the digestibility of protein and phosphorus, it is interesting to see that other observed feed parameters also were affected positively, although not significantly.

Activities are going on to further validate the documented effects.

¹ Poulsen, Hanne Damgaard. 2010. Næringsværdien i gastæt lagret korn sammenlignet med lagerfast korn. Aarhus University. Report. Not published. 5 pages.



Digester tank of steel before insulation. The cost of insulation material is negligible and should never be less than 20 cm in the Baltic Sea area. Photo provided by Assentoft Silo, <u>www.assentoftsilo.dk</u>

Costs for mixing and heat loss/insulation are important factors for digester tanks

By Henning Lyngsø Foged, WP4 leader, BalticCOMPASS

Most countries in the Baltic Sea Region have a high electricity price, a negligible price for insulation material, and frost in the winter time. The operational economy of biogas plants is under such conditions favored by least possible heat loss and cost for mixing, which is obtained by steel tanks with relatively low diameter/height ratio. This is especially the case, where interest rates for financing the investment are low, where digestion happens at thermophile temperature, and where the entire biogas production including the excess heat from the CHP unit has a value. The temptation to invest in a cheaper concrete tank is big, but will most often have adverse effects on the economy of the entire biogas plant in its entire lifetime.

Background

We see in practice mainly two types of digester tanks, namely a) concrete tank with a diameter, that is often 4-5 times the height, for instance with 23.5 meter in diameter and 5 meter height, and b) steel tanks where the diameter is approximately the same as the height, for instance 13.92 meter in diameter and 14.22 in height. In the following we will use these two examples, which in both cases have net volumes of around 2,000 m3, anticipating 0.5 meter freeboard.

The investment price

For the mentioned examples the concrete tank would cost app. \leq 255,000, all included, such as soil works and erection, foundation, mixers and insulation. The price of the steel tank would be about 25% higher. Therefore, the investment in a concrete tank seems immediately the natural and best choice.

However, before the decision is taken, it is important to consider the operational economy of the biogas plant.

Cost for mixing

Mixing of the digester tank is one of the main components in the operational costs of a biogas plant. The costs are in the form of electricity consumption, and in depreciation of the investment in mixers.

For the used examples, the concrete tank would due to its shape simply need to be mounted with three mixers, while the steel tank can do with one. The required power for steering the tanks would be around 130,000 kWh for the steel tank, but three times more for the concrete tank.

The difference of about 260,000 kWh per year in favor of the steel tank is multiplied with the price per kWh, and even with a low electricity price of $0.038 \notin kWh$ the difference is \notin 10,000 per year.

Heat loss / insulation

The heat loss from a digester tank naturally depends on the difference in temperature inside and outside the digester tank, as well as the surface area of it.

When designing a biogas plant and making business plans for it, a normal assumption is that it is in constant operation 365 days per year. Therefore, to comply with this assumption, it must be able to keep the temperature inside the digester tank on even the coldest winter day that can be foreseen. The methanogenesis depends on the rather temperature sensitive microbes in the substrate. At mesophile operated plants with target temperatures normally around 37°C, the methanogenesis is inhibited by temperature deviations of +/- 2°C, while at thermophile operated plants of normal target temperatures of 52°C, only a variation of 0.5°C can be accepted.

Using the above examples, the surface of the concrete tank is 26% higher than that of the steel tank. The heat loss to the surroundings is therefore by default 26% higher.

It is here important to keep in mind that the constant heat loss probably is a minor problem, compared to the risk for inhibition of the anaerobic digestion due to temperature chock of the methane forming bacteria as a consequence of insufficient insulation of digester tanks. When methanogenesis is first stopped, it takes some time before the biogas production is reestablished at normal and stable temperatures, and disturbance of the methanogenesis has therefore large consequences for the production economy.

The heat loss is in any case larger via the cover, than via the sides of a tank, simply because the direction of heat is upwards. The most risky is therefore to build digester tanks made of concrete, and only with a thin and non-insulated rubber cover or alike.

Status for VERA Verification Statements

By Peter Engel, Secretariat Director, Danish Standards Foundation

In October the first VERA Verification Statement was granted to the Danish company BioCover and their technology SyreN. SyreN is an acidification technology applied during spreading of manure.

More VERA Verification Statements are on their way. Over the next half year the International VERA Secretariat expects to issue around 6 more statements and the first ones will be issued before the end of 2012. The upcoming statements include air cleaning technologies for pig stables, acidification of slurry in cattle stables and a management initiative in fur production.

New report about "Needs, wishes and guiding principles for the development of the ATLAS, and how it will be tested, used and maintained"

It is the intention that the ATLAS shall improve the access to scientifically validated and trustworthy information about agro-environmental technologies, including about the Best Available Techniques in relation to EU's Industrial Emissions Directive (2010/75/EU – follower of the IPPC Directive) – the legal BAT-notes – from the Baltic Sea Region countries. The aim of the ATLAS is to function as a reference and tool in situations where investments in agro-environmental technologies are considered, especially in connection to the process of environmental permitting of intensive livestock farms.

A new report provides an overview of the needs, wishes and guiding principles for the development of the AgroTechnologyATLAS, and how it will be tested, used and maintained. The report is also providing an insight into the situation about environmental permitting of intensive livestock farms in the Region. The report is largely based on a workshop with participation of two representatives of each country in the Baltic Sea Region, convened in Copenhagen on 16 May 2012.

The report can be downloaded in PDF format from this link: <u>http://agro-technology-atlas.eu/docs/21205 proceedings from ATLAS workshop.pdf</u>. A package of all presentations given on the workshop can be downloaded from the frontpage of the ATLAS via this link: <u>http://agro-technology-atlas.eu/</u>.



VERA 🐼



One of four regulation wells with connected inspection well with flow meter, water level sensor and data logger with communication, which are now in operation at Hofmansgave.

Pamphlet about controlled drainage and other SCIEN drainage technologies

The pamphlet includes also a description of the BalticCOMPASS investment project in controlled drainage at Hofmansgave. Click at this link: <u>http://agro-technology-atlas.eu/docs/Kontrolleret%20dr%C3%A6ning%20og%20andre%20SCIEN%20dr%C3%A6ningsteknologier%20final.pdf</u> to download the pamphlet in Danish version. The pamphlet will soon be available in English language.

Governance Innovations for Improved Phosphorus Management and Reuse - Voices from the Baltic Sea Region

In recent years, there has been mounting awareness that phosphorus is not only essential for agriculture/food production, but that it is also a limited resource, and that new governance measures are required to ensure its use is sustainable. More effective reuse of fertiliser nutrients could potentially save agricultural communities significant sums of money, reduce the dependence of the Baltic Sea Region on fertiliser imports and lessen vulnerability to price shocks, and benefit the overall environment and citizens' well-being.



Photo by: Anu Suono

With the September 2011 Roadmap to a Resource Efficient Europe, the European Commission received approval to explore future governance alternatives for promoting effective recycling across sectors in society. A European Green Paper on Phosphorus is being prepared by the European Commission.

In recognition of the opportunity to contribute to new European policy developments in the area of phosphorus management and reuse, the Baltic COMPASS project (through Work Package 6: Governance and Policy Adaptation, led by SEI) decided to convene stakeholders in the Baltic Sea Region to provide a collective set of messages from a regional perspective.

The report can be downloaded from here:

http://balticcompasss.businesscatalyst.com/PDF/Reports/BalticCOMPASS_PhosphorousP aper_.pdf



Business Support on Your Doorstep

Enterprise Europe Network provides internationalisation and innovation services to small and medium sized companies. The network is a project co-financed by the European Commission and is being implemented as part of the Commission's Competitiveness and Innovation Framework Programme. The European-wide network consists of 3,500 experts in 45 countries and reaches almost 23 million SMEs.

Click on the headings if you are interested in one of the shown partner searches, or visit <u>http://portal.enterprise-europe-</u> <u>network.ec.europa.eu/</u>

Examples of current Enterprise Europe Network partner searches:

Single machines and complete system for dissolving and separating household waste for bioenergy/biogas production (ref.:12 SE 6721 3QX5)

A Swedish company active in the cleantech sector has created a unique system for dissolving and separating household waste and other organic materials. The technology is an enabler for effective production of bioenergy. The company is now looking for new cooperation partners in Europe for technical and commerical agreements such as public actors interested in having a complete install of a pre-treatment system for handling organic waste and turnkey plant suppliers in the bioenergy sector.

Detailed information:

http://www.enterprise-europenetwork.ec.europa.eu/matching/completerec.cfm?BBS ID=174857&COMPANY=732180

Greece - Albania cross-border S&T collaboration: Application of innovative organic production methods in conventional farming (Ref: 12 GR 49R0 3QQ0)

Greek cluster active in the field of organic products is looking for an agricultural organisation with expertise in innovative farming methods in order to study the reduction of use of chemical pesticides in conventional farming. The proposer intends to submit a project proposal under the cross boarder programme for scientific and technological co-operation between Greece and Albania.

Detailed information:

http://www.enterprise-europenetwork.ec.europa.eu/matching/completerec.cfm?BBS_ID=174830&COMPANY=732180

Automatic Manure Separation Barn System (Ref: 12 DK 202G 305D)

An International Danish company has developed a new full automatic manure separation barn system, suitable for e.g. industrial pig or cattle production. The system is easy and simple to implement in traditional farms or in new so-called green city integrated vertical farm concepts. The Danish company is looking for joint venture and/or commercial agreement(s) with interested parties within the agriculture industry, European building construction companies and financial institutes.

Detailed information:

<u>http://www.enterprise-europe-</u> <u>network.ec.europa.eu/src/request/completerec.cfm?BBS_REF=12%20DK%20202G%2030</u> <u>5D&MENU=search</u>

Novel process for utilizing residues from biogas plants considerably reducing costs (Ref: 12 AT 0105 307F)

An Austrian company developed a process for efficient treatment of fermentation residues of anaerobic digestion plants. It is an excellent supplement to existing or newly built biogas plants with more than 1 MW electrical power. It produces high quality dry fertilizer for sale and nutrient poor liquid for application on local fields. Costs are considerably reduced compared to disposal or use of membrane processes. The company is looking for plant manufacturers for commercialising the process.

Detailed information:

http://www.enterprise-europe-

network.ec.europa.eu/src/request/completerec.cfm?BBS_REF=12%20AT%200105%2030 7F&MENU=search

Multi-phase separation process for digestate treatment. (Ref: 11 DE 0855 3NJM)

A German company offers a multi-phase process for digestate treatment that requires little volume and storage capacity, thus significantly reducing transport costs. The process results in high quality fertilizer and re-useable effluents. Applications are e.g. in wastewater and waste treatment and in biogas industry. Industrial partners are sought for commercial agreements with technical assistance.

Detailed information:

<u>http://www.enterprise-europe-</u> <u>network.ec.europa.eu/src/request/completerec.cfm?BBS_REF=11%20DE%200855%203NJ</u> <u>M&MENU=search</u>

Manure Separation Technologies (Ref: 11 DK 20B7 3KG3)

A Danish company has developed new simple manure separation technologies without the use of chemicals and with a large flexibility for treatment of different sorts of liquid media. The company is looking for an investor who ideally invests in existing innovative companies (developing companies) with main activities within manure separation. An investor is thus invited to take part in the development of the company and its technologies.

Detailed information:

<u>http://www.enterprise-europe-</u> <u>network.ec.europa.eu/src/request/completerec.cfm?BBS_REF=11%20DK%2020B7%203K</u> <u>G3&MENU=search</u>

Colophon

This electronic newsletter is sent out quarterly from <u>http://agro-</u> <u>technoloy-atlas.eu</u> with the purpose to support innovation and investments within agroenvironmental technology in the Baltic Sea Region by publishing relevant knowledge about the issue to the Baltic Compass WP4 Network.

To read more about the project please go to:

http://www.balticcompass.org

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Upcoming events

Meeting on mobile slurry separation and its contribution to the visions for energy supply and the role of farming at Bornholm

Venue: Bornholm, Denmark

Date: 3 December 2012

The event: The meeting will give an opportunity to see the mobile separation equipment in operation, as well as to participate in a debate with local politicians, farmers, representatives from the municipal waste handling and energy supply about mobile slurry separation and its contribution to the visions for energy supply and the role of farming at Bornholm. The meeting is organised in cooperation between BalticCOMPASS / Agro Business Park, BalticDEAL / Bornholms Landbrug, Biokraft and AL-2.

More info: The meeting will be held in Danish language. The final program can be found here: <u>http://agro-technology-</u><u>atlas.eu/docs/invitation_mobile_separation_meeting.pdf</u>

Meeting on extrusion and biogas production from solid plant biomass

- Date: 7 December 2012
- The event: Is extrusion a technology that can ensure sustainable and profitable biogas production while providing a contribution to the development of organic agriculture, improved water environment and a sound use of buffer zones and similar areas?

Agro Business Park invites in cooperation with AU Foulum and Økologisk Landsforening interested to come and see an extruder in operation at AU Foulum's biogas plant, and subsequently obtain information about its operating economy and discuss perspectives for this pretreatment technology on biogas plants.

Agro Business Park has on behalf of the Baltic Compass project invested in the extruder. The BioM project has also contributed to the investment, and the plant is now fully operational and has been used in a few months for different types of biomass with good results. Competence Centre for Organic Biogas (KØB) collects practical and theoretical knowledge on biogas production for organic farmers and see extrusion as an interesting technology to ensure self-supply with both plant nutrients and energy.

More info: The meeting will be held in Danish language. The final program can be found at this link: <u>http://agro-technology-atlas.eu/docs/invitation_extrusion_meeting.pdf</u>