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Quality of digestate used as biofertiliser

Teodorita Al Seadi, Managing Director
BIOSANTECH - Biogas advisory and consulting
Lerhøjs Allé 14 - DK - 6715 Esbjerg - Denmark
teodorita.alseadi@biosantech.com +45 30 51 15 53
www.biosantech.com

Content

1. What is digestate
2. Why is quality important
3. Managing digestate quality
4. Quality assurance
5. Summing up

Teodorita Al Seadi teodorita.alseadi@biosantech.com +45 30 51 15 53 www.biosantech.com

Why is quality important

Utilisation as biofertiliser - the most sustainable
High potential world wide, limited by quality and safety
Barrier or incentive for development of AD technologies
Impact on food safety

Driving forces

- Confidence in digestate quality and safety
- Enhanced utilisation as fertiliser
- Preventing health and environmental hazards
- Improved veterinary safety
- Positive effect on food safety
- Public acceptance of biogas technologies
- Improved market conditions for high quality digestate
- Removal of barrier for the development of biogas

Teodorita Al Seadi teodorita.alseadi@biosantech.com +45 30 51 15 53 www.biosantech.com

Sustainable use as biofertiliser requires highest quality

Main features

Nutrient content and availability; pH; DM etc

Purity: no physical impurities (plastic, stones, glass, non-digestible material etc.)

Hygiene: effective inactivation of pathogens and other undesired biological content

Safety: no hazardous chemical pollutants (for living organisms and for the environment)

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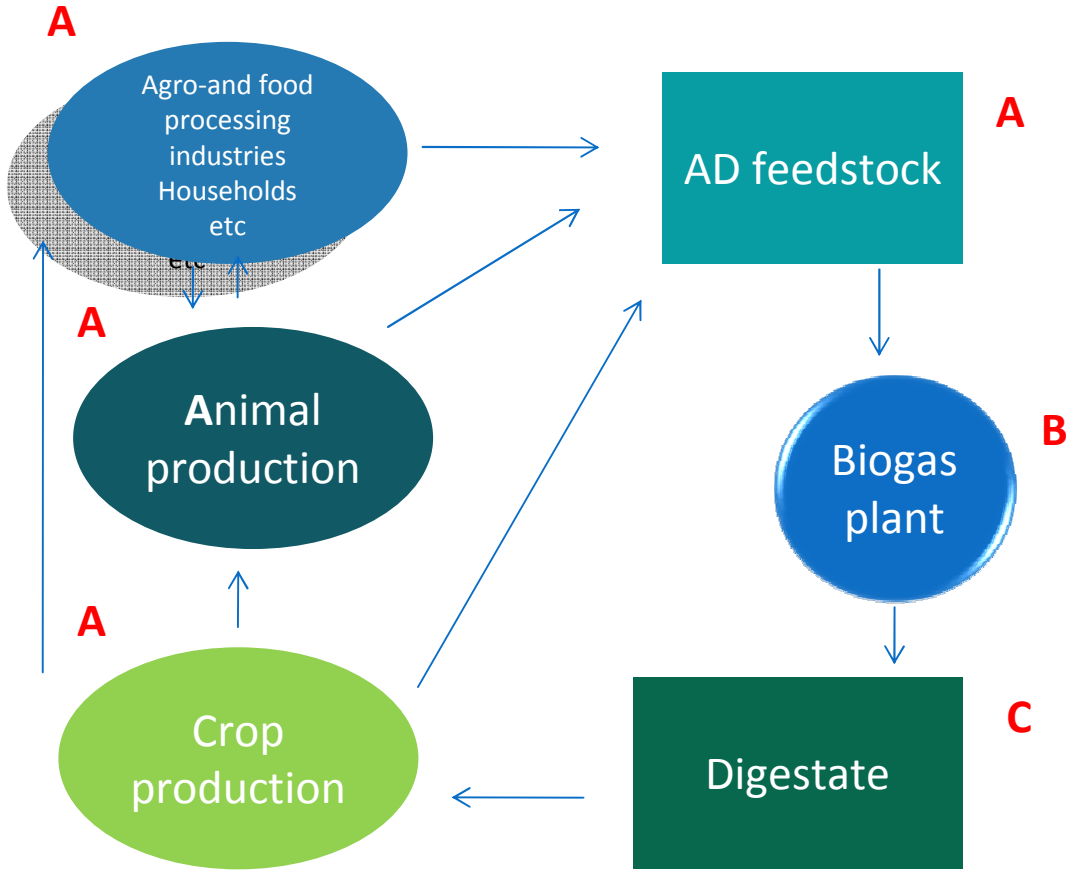
Managing digestate quality



Critical check points quality providing/preserving

A AD feedstock
B AD process
C Digestate (processing, storage, application)

Managing digestate quality

Focus areas

Biological pollutants

Chemical pollutants

Physical impurities

Managing digestate quality

The essential element of quality: the AD feedstock

- Managing input feedstock
- Animal manure and slurries
- Vegetable by-products, residues and wastes from agriculture, horticulture, forestry, etc
- Digestible residues from human and animal feed industries (of vegetable and animal origin)
- Organic fraction of household waste and food remains (of vegetable and animal origin)
- Animal by-products, as defined by the EC-Regulation 1069/2009
- Other industrial residues (tannins, bleaching clay from paper and textile industry, glycerol from biorefineries etc)
- Crops (compromised or specially cultivated for energy production)
- Aquatic biomass
- *Sewage sludge*

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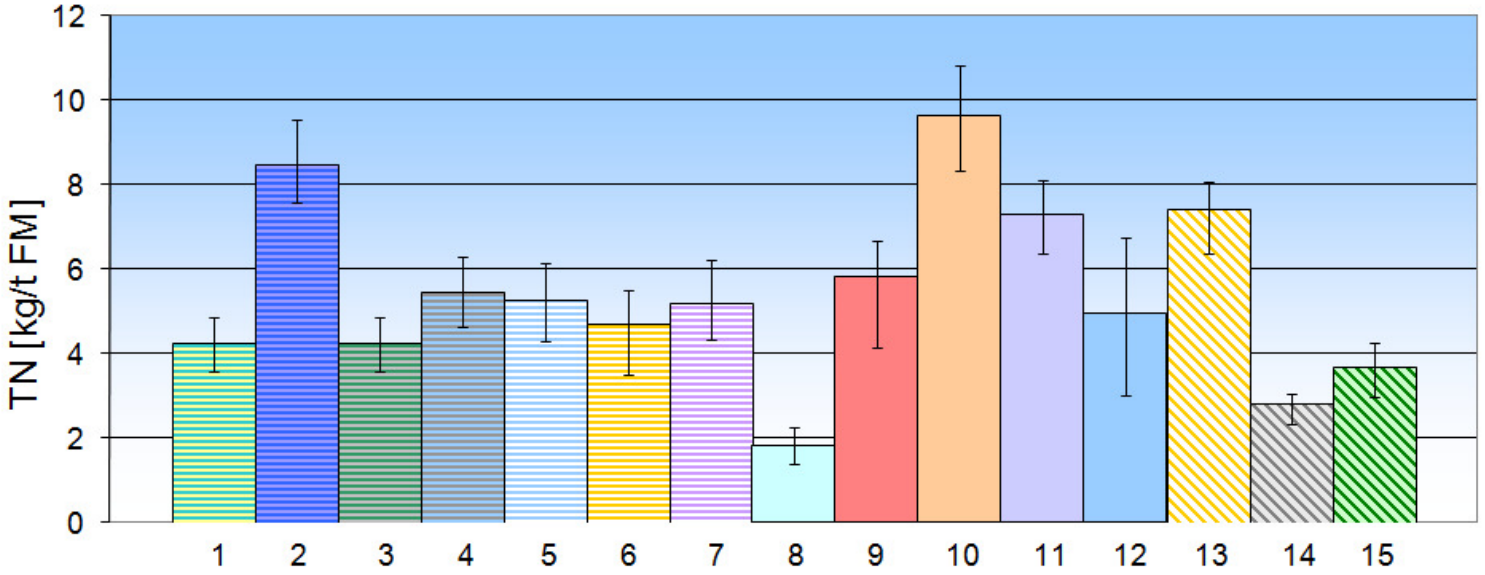
Examples of total nitrogen concentration (TN) in different feedstock types (kg/ton fresh material)



1…Maize silage, grass silage, sunflower, clover
2…Manure, maize silage, agricultural wastes
3…Maize silage, grass silage
4…Maize silage, grain silage, agricultural wastes
5…Energy crops and manure, 2-stage (9 plants)
6…Energy crops (no manure), 2-stage (15 plants)
7…Energy crops, 1-stage (6 plants)
8…Organic waste, food leftovers
9…Organic waste, expired food, blood
10…Manure, slaughterhouse waste, organic waste, maize
11…Expired food, blood, organic waste
12…Organic waste (9 plants)
13…Slaughterhouse waste
14…Brewers´ spent grains
15…Thin stillage

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Managing digestate quality

AD feedstock description

- Origin
- Methane potential
- Area of collection etc.
- Chemical composition
- Content of physical and chemical pollutants
- Potential pathogen contamination
- Safe handling and storage
- Availability
- Other

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Physical impurities in AD feedstock

Which feedstock: Animal manure and slurry, straw, garden waste, crop wastes, energy crops, source separated organic household waste, food waste

What are: Non- digestible materials: pieces of plastic , rubber, glass, metal, stones, sand, excessively large pieces of organic material, ligno-cellulosic materials (roots, wood and bark), other

Effects: Perturbation of the operation stability, damage of pumps, pipes and stirrers etc.

If present in digestate: Decrease fertiliser quality, decrease public acceptance (e.g. visible plastic pieces from un-degradable household collection bags),harmful effects on the environment

Management measures:

- Physical barriers (screens, sieves, stone traps, protection grills)
- Pre-treatments (chopping, maceration)
- Source separation/separate collection
- Exclusion of highly polluted material

Chemical impurities in AD feedstock

Which feedstock: Sewage sludge, mixed waste (bulk collected waste), domestic wastewaters, some industrial organic wastes, household waste and even in food waste and agricultural biomass

What are: Inorganic pollutants: Heavy metals (HM): Cd, Pb , Hg , Ni, Zn, Cu, Cr

Organic pollutants: POPs, other xenobiotic compounds, emerging OPs

Effects: Toxic to biota; persistence and bioaccumulation, ecotoxicity

Management measures: Selection and control of AD feedstock; Two stages AD process (HM); Some degradation of OP during AD

Limit values of HM in (mg/kg DM) in 'waste' products applied on land

Country/Region	Cd	Pb	Hg	Ni	Zn	Cu	Cr
Austria	3	100	1	100	-	-	100
Canada	3	150	0,6	62	500	100	210
Denmark	0.8	120	0.8	30	4000	1000	100
Finland	1.5	100	1	100	1500	600	300
France	3	180	2	60	600	300	120
Germany	10	900	8	200	2500	800	900
Ireland	20	750	16	300	2500	1000	1000
Norway	2	80	3	50	800	650	100
Sweden	1	100	1	50	800	600	100
Switzerland	1/0.7	120/45	1/0.4	30/25	400/200	100/70	70/-
The Netherlands	1,25	100	0,75	30	300	75	75
United Kingdom	1,5	200	1	50	400	200	100

conventional /organic

Limit values of OP in 'waste' products applied on land

Organic pollutant	Country		
	Austria *(Düngemittelverordnung, 2004)*	**Denmark** *(Slambekendtgørelsen, 2006) Danish Ministry of Environment*	**Switzerland** *(Swiss guidelines for utilisation of compost and digestate in conventional /organic farming ,2010)*
PAHs	6 mg/kg DM	3 mg/kg DM	4 mg/kg DM
PCDD/F	20 ng TE/kg DM		20 ng I-TEC/kg DM *
Chlorinated pesticides (HCH, DDT, DDE etc)	0.5 mg/kg Product		
PCB	0.2 mg/kg DM		
AOX	500 mg/kg DM		
LAS		1300 mg/kg DM	
NPE		10 mg/kg DM	
DEPH		50 mg/kg DM	

Biological contaminants in AD feedstock

Which feedstock: All feedstock materials can contain biological contaminants in various amounts

What are: Animal and human pathogens, plant pathogens, weeds seeds

Effects: Animal and human health hazards; Cross contamination; Damage on crops and their nutritional and comercial value.

Management measures: Exclusion of high risk AD feedtock materials. Pre-sanitation, AD treatment, post-sanitation.

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Decimation time (T-90)* of some pathogenic bacteria in the AD process compared to untreated manure

Bacteria	AD system		Untreated slurry system	
	53°C	35°C	18-21°C	6-15°C
	hours	days	weeks	weeks
Salmonella typhimurium	0.7	2.4	2.0	5.9
Salmonella dublin	0.6	2.1	-	-
Escherichiacoli	0.4	1.8	2.0	8.8
Staphylococcus aureus	0.5	0.9	0.9	7.1
Mycobacterium paratuberculosis	0.7	6.0	-	-
Coliform bacteria	-	3.1	2.1	9.3
Group D Streptococci	-	7.1	5.7	21.4
Streptococcus faecalis	1.0	2.0	-	-

*) Destruction of 90% of the pathogens

The effect of the AD process on digestate quality

- Provides DM content and increases nutrient availability (mineral N)

- Pathogen reduction: Combination of HRT and process temperatures, pasteurisation, presure sterilisation

- Heavy metals: no influence; two stage processes can dissolve and extract HM from digestate

- Organic pollutants: some degradation can occur in special AD process conditions

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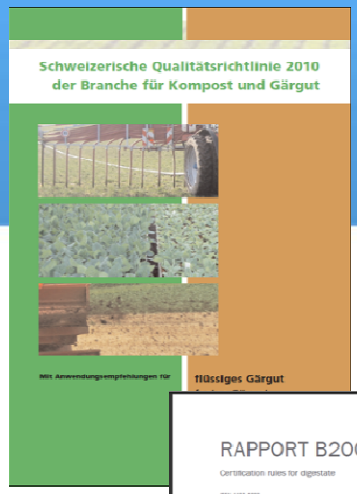
Quality assurance / national standards for digestate



Means

- Environmental, waste and/or agricultural legislations
- Digestate certification systems and quality standards
- Guidelines of recommended practices of digestate use
- Positive lists of AD feedstocks:
  - **Must be permanently updated**
  - **Are only a guide for selection suitable AD feedstocks**
  - **Cannot supersede the ongoing feedstock quality control**

Aims

- Guarantee that digestate is suitable and safe for use as fertiliser
- Perception of digestate as a safe product and confidence in its quality
- Facilitate market penetration of only high quality digestate
- Enhance sustainable use of digestate as fertiliser
- Remove this barrier for develoment of AD

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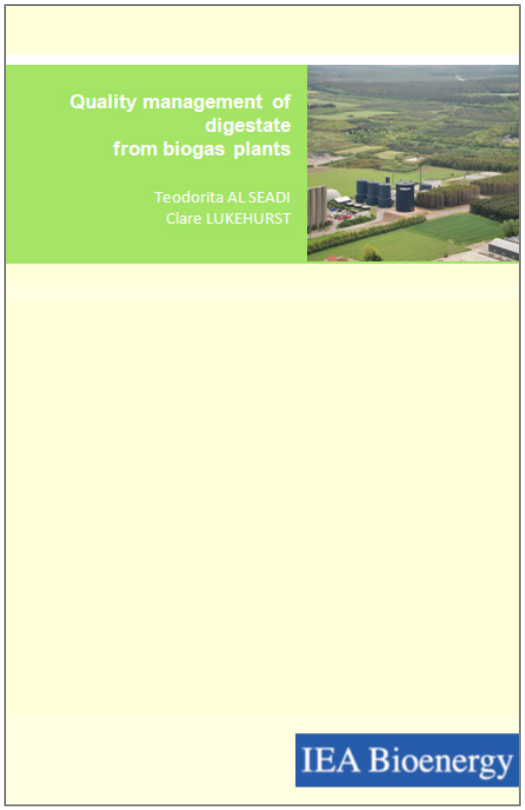
Summing up

Recycling as fertiliser - the most sustainable utilization of digestate

Safe recycling requires digestate of highest quality: and safety

Quality management /assurance aim - to secure production of high quality digestate and to enhance its use as fertilizer

Quality management requires quality control throughout the whole AD cycle and responsible actions from all the actors involved



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