

TRAINING MATERIAL

Title:

The use of **digestate** as fertilizer in **Northern Europe**.

Training:

Main features of the subcategory

Digestate is a wet mixture obtained from an anaerobic digestion process where microorganisms break down organic materials in the absence of oxygen. The anaerobic digestion process converts around 15 % of the feedstock to gas and 85 % remains as organic solid/liquid material. Depending on the composition of the feedstock (biodegradable waste) that is digested, the digester type and process parameters, the composition of digestate may vary strongly. The digestate is usually separated into a solid fraction which contains most of the dry matter, and a liquid fraction which generally has a higher content of mineral N.

Input material

All kinds of biodegradable organic wastes including animal manure, farm yard manure, green manure, food waste, food-processing wastes, municipal waste, corn silage, sewage sludge, effluent from wastewater treatment plant etc.

How to produce?

In an anaerobic digester, the digestion process begins with bacterial hydrolysis of the input materials. Insoluble organic polymers, such as carbohydrates, are broken down to soluble derivatives that become available for other bacteria. Acidogenic bacteria then convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia, and organic acids. In Acetogenesis, bacteria convert these resulting organic acids into acetic acid, along with additional ammonia, hydrogen, and carbon dioxide amongst other compounds. Finally, methanogens convert these products to methane and carbon dioxide. The released mineral ions and the undigested materials are left in the non-gaseous phase which so-called digestate.

To fit in different feedstock requirements, anaerobic digesters can be designed and engineered to operate using a number of different configurations and can be categorized into batch vs. continuous process mode, mesophilic vs. thermophilic temperature conditions, high vs. low portion of solids, and single stage vs. multistage processes.

Typical nutrient content and availability for plants

The contents of nutrients and availability in digestate can vary a lot due to the variation in the composition of the feedstock (biodegradable waste), the digester type and process parameters. The typical nutrient contents of the digestate products can be N 2.4 – 9.9%, P₂O₅ 2.1 – 6.4% and K₂O 1.5 -8.9% on dry matter basis.

Examples for digestate products available on the NUTRIMAN Farmer Platform

- https://nutrیمان.net/farmer-platform/product/id_264 (Belgium)
- https://nutrیمان.net/farmer-platform/product/id_270 (Belgium)



Figure 1. Agrogas' solid fraction digestate (ID:264).



Figure 2. Arbio Bvba pelletized digestate (ID:270).

There are two digestate products available in Northern Europe that were selected on the NUTRIMAN Farmer Platform. The liquid and solid (dried) fraction digestate from manure and energy maize by "Agrogas" process (ID:264) is produced by physically separating the raw digestate into a liquid and a solid fraction. A 'vegetal' or animal manure status liquid fraction with a dry matter-content of 3,5-8,5% – issue of the digestate passing a screw press – contains 5,7 – 9,9% N (dm), 2,1 – 6,4% P₂O₅ (dm) and 5.4 -8.9% K₂O (dm). Agrogas' solid fraction digestate (with animal manure-status) – issue of the digestate passing a ('sieve' or 'screen') belt press – is usually dried until reaching a dry matter- content of 80-90% and contains N 2,4 – 3,1% N, 3,7 – 5,5% P₂O₅ (dm) and 1,5 -4,2% K₂O (dm).

The high NP pelletized digestate from animal manure and organic waste digestate by "Arbio and NPirriK-project" process (ID:270) is provided by Arbio Bvba in Belgium. Firstly, the digestate of Arbio (biogas installation digesting manure and organic wastes) is separated into a liquid and a solid fraction. The liquid fraction is concentrated via Reverse Osmosis (RO). This concentrate (NK) is then backmixed into the drying of the solid fraction digestate just before drying. Finally, pelletised, this results in an easy to distribute fertiliser-pellet with an optimised and higher N/P-content: 5,9% N (dm) of which 50% mineral N, 3% P₂O₅ (dm) and 2,5% K₂O (dm)

Fields of application in agriculture: crop, dosages, application method and practical recommendations.

The digestate product in Northern Europe is recommended to be applied in conventional low input farms. It can be used as fertilizer for cereals, fresh vegetables and strawberries, potato, sugar beet, fresh vegetables and strawberries, grapes, permanent crops (fruit trees), permanent grassland, etc. The recommended application dose range between 2-4 t/ha of solid fraction (ID:264-270) and average 30 t/ha for liquid fraction (ID:264) (depending on soil, season, crop,...). To reduce the ammonia volatilization during field application, it is recommended to incorporate the digestate into soil immediately after spreading, or use low emission application techniques like injection.

Benefits for farmers

Digestate contains most of the nutrients and micronutrients demanded by plants, including a high content of nitrogen, phosphorus and potassium. After anaerobic digestion, the percentage of readily available nitrogen is higher in digestate compared to the same organic material in its raw form, thereby increasing its fertilising value. The recovery of nutrients from digestate as crop fertilizer can help to close the nutrient loops and contribute to a more sustainable agriculture. Additionally, organic matter in digestate can build up the humus content in the soil which is particularly crucial for arid and semi-arid lands with low carbon content.

Bottlenecks of application. Potential risk or limitation.

The main bottleneck for the application of digestate in Northern Europe is that this product is still regarded as manure according to the Nitrate Directive (91/676/EEC) which means no more than 170 kg total N from digestate is allowed to be applied to the field. As 30-50% of the digestate N is organic which is not directly plant available, the actual effective N supply may not fulfill the requirement of crop and thus need supplement from synthetic fertilizers. Besides, the slow-degradable organic matter from digestate may increase the risk of post-harvest N leaching if applied improperly.

Legal framework for usingSpecific national legal conditions

ID:264 and ID:270 both follow the Flemish Manure Decree as the transposition of the European Nitrates Directive in Flemish legislation. When manure is co-digested, the digestate is considered as 100% manure and must be applied according to the fertilisation restrictions for "animal manure".

EU Fertilising Products Regulation

In the new EU Fertilising products regulation 2019/1009 the dried digestate (ID:264) can be categorized as PFC 1 A (solid organic fertiliser) or PFC 3 A (organic soil improver)(or in blend). For ID:270 the dried digestate pellets can be categorized as PFC 1 A (solid organic fertiliser) or PFC 3 A (organic soil improver) or in blend).

Economic evaluation of the application of the products

Prices for digestate ID:264 can vary between negative prices – depending on NPK-content and whether or not the digestate has an animal manure status (competition with manure in e.g. Flemish region) and positive prices (35€/ton) for dried digestate with high dry weight (85-90%).

The market price for ID:270 is estimated to rise due to the optimised post-treatment add-on from 25€/t to 45€/t.

Best management practice guideline, taking into account of specific conditions of the given territory, for the use of the product to the specific applications (soil improvers, growing media, organic fertilisers etc.).

Application doses

- Organic fertilizers:
 - ID:264 → average 2 t/ha for dried solid and 30 t/ha for liquid fraction (according to soil quality, season, crop uptake,...)
 - ID:270 → around 4 t/ha (according to soil quality, season, crop uptake,...)
- Organic soil improvers:
 - ID:264 → average 2 t/ha for dried solid fraction (according to soil quality, season, crop uptake,...)
 - ID:270 → around 4 t/ha (according to soil quality, season, crop uptake,...)

How to store, apply to land, machinery needs.

One of the most common methods of storing digestate is through the use of a portable tank. Storage facilities for digestate should be constructed in line with the Water Resources regulations 2010 (SSAFO) which also strongly recommends for the digestate to be covered. Correct storage of digestate and covering solutions, ensure that rainwater cannot mix with the digestate solution, ammonia emissions and nitrogen loss is reduced and odour pollution and nuisance is kept to a minimum.

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