

TRAINING MATERIAL

Title:

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

Training:

Main features of the subcategory

Digestate is a fertilizer obtained from anaerobic digestion processes where microorganisms break down organic materials in the absence of oxygen.

Digestate contains all crop nutrients including nitrogen, phosphorus and potassium. Since no nutrients are lost during anaerobic digestion, farmers can close the nutrient cycle and reuse the minerals. 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. The percentage of readily available nitrogen is higher in digestate compared to the same organic material in its raw form, thereby increasing its fertilizing value.

Input material

Biowastes, energy maize, pig manure, chicken manure from poultry farm, straw (residual vegetal biomass), urea, mix of manure and biowastes.

How to produce?

The anaerobic digestion consist in a series of biological processes in which the microorganisms break down the biodegradable material in absence of oxygen. The main end products is the biogas, which is combusted to generate electricity and heat, or can be processed into renewable natural gas and fuels.

During the anaerobic digestion the organic nitrogen is mineralized and at the end of the process the content of ammonia and total nitrogen may reach 70-80%. The increase of the ammonia nitrogen concentration also leads to an increase in pH usually between 8 and 9. However, the digestion process does not modify the total amount of nitrogen in the products. The anaerobic digestion represents a potentially very effective treatment in reducing greenhouse gas emissions (GHG): in fact, during the process the majority of fermentable organic matter is degraded to methane and carbon dioxide, obtaining an effluent (digestate) having a lower GHGs emission potential than the incoming products.

Separated digested solids can be composted or directly applied to the crops or also converted into other products. The liquid stream fraction, known as digestate, could be used in agriculture as N/P recovered fertilizer.

Typical nutrient content and availability for plants

The pelletized digestates usually contains 2.4-10% N (d.m.) and 3-5.5% P₂O₅ (d.m.) depending on the input materials and on the percentage of humidity (often around 3-10%).

The liquid digestates usually contains 0.05-1% N (d.m.) and 0.2-1% P₂O₅ (d.m.) depending on the input materials and on the percentage of humidity (often around 70-80%).

Examples for digestate products available on the NUTRIMAN Farmer Platform

- https://nutrیمان.net/farmer-platform/product/id_267 (Spain)
- https://nutrیمان.net/farmer-platform/product/id_268 (Spain)

Some digestates selected in the NUTRIMAN project are available in Southern Europe.

The pelletized digestate from mixture of pig manure, poultry manure and straw by "MIX-FERTILIZER" process (ID:267 – Figure 1) is made starting from digestate of pig manure, chicken manure from poultry farm, and straw (residual vegetal biomass), urea. This digestate fraction contains: 10% N (dm); 4% P₂O₅ (dm); - 4 % K₂O (dm).

The digestate from the co-digestion of vegetable oils waste and pig manure by "VALUVOIL" process (ID:268 – Figure 2) is made starting from organic wastes such as vegetable oils waste and pig manure, and it contains about: 0.09 N% (fw); 0.2% P₂O₅ (fw).



Figure 1. MIX FERTILIZER dried digestate (ID:267).



Figure 2. VALUVOIL digestate (ID:268).

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

These digestates are used at 0.2-1 t/ha (pelletized digestate ID:267) or at 40-80 m³/ha (liquid digestate ID:268) according to soil quality, season and crop uptake. They could be used to improve the production of a lot of cereal and horticulture crops.

Benefits for farmers

By using digestates the nutrients (N, P and others) can be more easily taken up by plants. This implies that digestate and derived products can be more suitable as fertilisers than the raw resources from which they originated (such as sludges, slurries, biowastes, etc.).

Treating the bio-wastes in biodigestion anaerobic conditions it is possible to:

- Produce renewable energy.
- Reduce odors.
- Stabilize the manure and co-substrates: the demolition of the carbonaceous organic load resulting from the anaerobic digestion gives the manure a sufficient stability in subsequent periods of storage; it causes a slowdown of the degradation and fermentation processes.
- Reduce the pathogens content of the input materials: the anaerobic digestion in mesophilic environment (40 °C) can partially reduce the pathogenic charge in the manure. By operating in thermophilic conditions (55 °C) it is possible, instead, to get the full hygienization of the sewage with the total destruction of the pathogens.

These are new fertilizers which contribute to increase the yields of the crops. They contribute to improve the quality of the soil. The soil after cultivation has higher proportion of organic matter. The controlled release of nitrogen reduces leachate losses (aquifer contamination). The GHG emissions are also lower.

Furthermore, when producing ID 267-268 not only there is a recovery of waste in the form of nitrogen and phosphate fertilizer but renewable energy is also produced.

Bottlenecks of application. Potential risk or limitation.

The main bottleneck for the application of digestates is when the product is applied in an area sensitive to nitrogen or phosphorus, according to the local regulations from directives 2000/60/CE and 91/676/CEE. Consequently, the application dosage must be chosen according to soil availability and crop uptakes.

For the transport and spreading of the liquid digestate (ID:268) a common slurry tank can be used. Given the high volumes of transport and the high level of humidity of the fertilizer, it would be better to promptly bury the distributed liquid digestate with a disc harrow or with a subsoiler, even better if combined with the slurry spreader in order to limit odor and ammonia emissions. It isn't recommended to deeply plow the plots immediately after the liquid digestate has been distributed as the soil, given the consistency of the fertilizer, is slimy and slippery, making the operation more expensive in terms of consumption and labour time.

As for the application of the pelletized dried digestate (ID:267), it is possible to use a common fertilizer spreader with double fan, to ensure a uniform spreading. It is always recommended to bury the fertilizer. In this case there are no problems in plowing the plots immediately, as the application of the fertilizer does not determine any effect on the pneumatic/soil traction.

Legal framework for usingSpecific national legal conditions

ID:267-268 respect the Spanish standard legislation.

EU Fertilizing Products Regulation

ID:267 is a PFC 1 B 'Organo-mineral fertilizer'. Furthermore, it is eligible to be categorized as Component Material Category (CMC) 5 'Digestate other than fresh crop digestate'.

ID:268 is a PFC 1 A 'Organic fertilizer'. Furthermore, it is eligible to be categorized as Component Material Category (CMC) 5 'Digestate other than fresh crop digestate'.

All these products (ID:267-268) are applicable only in conventional farming.

Economic evaluation of the application of the products

Usually digestates (ID:267-268) costs about 2-20€/t ex works depending on required volume and packaging. Considering improved yields and quality, these costs are generally sustainable (about 50-200€/ha).

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 fertilizers etc.).Application doses

- Organic/organo-mineral fertilizers:
 - ID:267 → from 0.2 to 1 t/ha (according to soil quality, season, crop uptake,...)
 - ID:268 → from 40 to 80 m³/ha (according to soil quality, season, crop uptake,...)

How to store, apply to land, machinery needs.

Solid digestates like (ID:267) should be stored in dry place and not directly exposed to the sunlight. It could be applied to the soil with a fertilizer spreader with double fans, like explained above.

Instead, liquid digestates like (ID:268) have a higher content of water (about 70-80%) compared to mineral fertilizers and/or to dried digestates, which increases transport costs, makes it necessary to distribute high dosages per hectare. So they have to be stored into underground slurry tank or in covered above-ground slurry tank in order to limit GHG and ammonia emissions. It could be applied to the soil with slurry spreader, like explained above.

For more information:

- https://nutriman.net/farmer-platform/product/id_267 (Spain)
- https://nutriman.net/farmer-platform/product/id_268 (Spain)