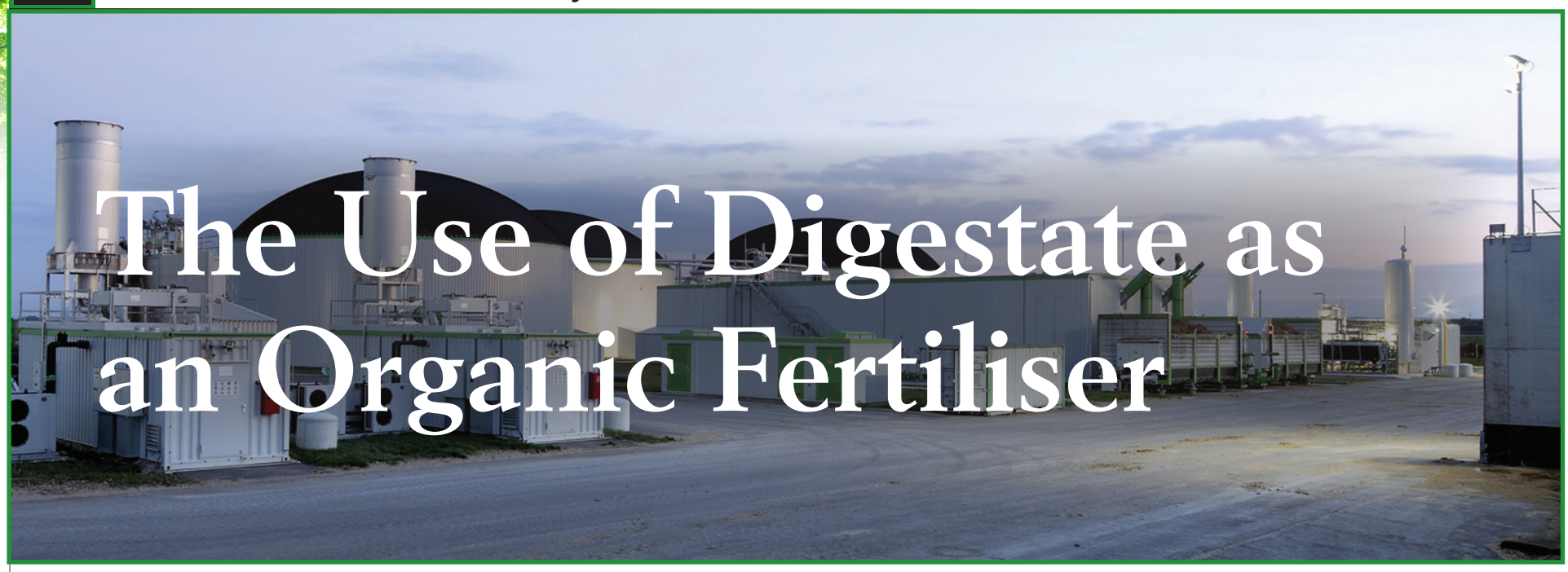

The Use of Digestate as an Organic Fertiliser

The process of anaerobic digestion (AD) results in two products: biogas and digestate. So far, AD has been primarily known as a technology producing biogas, a climate-friendly renewable energy source. Another important function of this process, however, is to recycle plant nutrients through the use of digestate as a biofertiliser. This article will focus its attention on this so far less exploited but highly important second product of AD: digestate.

"The utilisation of digestate as a biofertiliser benefits both farmers and the environment."

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Digestate is a fully fermented nutrient-rich material, which can be used as such, or can be further processed by separating it into liquid and solid fractions to be upgraded, for example. 100% of nutrients included in the used feedstock are contained in the digestate. For this reason, digestate serves as an excellent organic fertiliser that can replace inorganic fertilisers and raw manure whilst providing various benefits:

• Reduction of energy consumption and CO_2 emissions

Digestate arises naturally as a result of controlled biological decomposition of biodegradable substrates and, unlike inorganic fertiliser, does not require any additional energy in the production process. Moreover, by using digestate as an organic fertiliser for crops and as a soil improver, the production of artificial fertilisers, which results in additional costs and emissions, can be reduced. Studies have shown that around 13 kg CO_2eq/tonne can be saved when digestate replaces mineral fertiliser.

• Greater environmental compatibility through efficient prevention of land contamination and cutback of methane emissions

The treatment of manure by AD helps prevent land contamination. In many EU Member States manure is spread out on fields without prior treatment against pathogens causing potential biological contamination. The AD process at mesophilic temperatures, typically between 35 and 45°C, greatly reduces the number of plant and animal pathogens within the feedstock and at thermophilic temperatures (above 50°C) even destroys viruses in most cases.

Another environmental benefit regards the reduction of greenhouse gas emissions: Digesting farm manure reduces nearly 90 % of usual greenhouse gas emissions caused by conventional farm manure storage. When, in turn, organic waste is digested instead of used in landfill, detrimental methane emissions are significantly reduced. Additionally, valuable and scarce nutrients such as phosphorus can be recycled back into the soil, thereby contributing to the circular economy without polluting groundwater through landfill leakage.

• Simple application and greater agricultural output

When digestate is used to replace raw manure as a fertiliser, plants recieve a greater benefit. The reason for this is that unlike the nitrogen in the raw manure, the ammonia within digestate is absorbed immediately by the soil. In this way, it directly contributes to plant growth without adhering to plants or the surface of the ground. Furthermore, digestate has three other remarkable advantages for the agricultural practice: 1) it does not present the odour nuisance specific to raw manure, therefore providing increased land application options; 2) it makes weed control easier and more efficient for farmers, as the process of anaerobic digestion helps to destroy unwanted weeds and viable plant propagules; and 3) it is more homogenous, which makes fertiliser spreading more uniform.

With regard to the agricultural output, it is important to consider effective nutrient management while applying the product. As in the case of all fertilisers, it is crucial to optimise the spreading season of digestate in order to prevent nutrient leakage. This means that digestate should not be applied during low plant take-up, but instead it should be stored until the growing season. Furthermore, the application of digestate should be taken into consideration and adjusted according to the types of crops grown, as well as according to the type of soil.

Content of nutrients and organic matter

A broad range of nutrients are contained in digestate including, among others, nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg) and sulphur (S). The fertiliser value of digestate depends on the nutrient value of used feedstock. Since almost all macro- and micro-nutrients are conserved during anaerobic digestion, high-quality

digestate can be ensured by feeding AD plants with high-quality substrate, such as source separated organic waste. Against this background, the content of the digestate strongly varies between AD plants and even between batches from the same digester. Therefore, in order to market a digestate product, its content must be carefully analysed and declared.

By means of using digestate as a fertiliser, the natural loop of nutrient recycling is closed. It is well known that macro-nutrients are vital for both plants and animals. However, since animals do not utilise all nutrients, high proportions of nitrogen, potassium and phosphorus are excreted. The resultant manure and animal slurry thus constitutes a highly valuable substrate.

Additionally, digestate is rich in organic matter and therefore it is a valuable humus producer. Usually more than 50% of dry matter content is organic matter, which represents the basis for humus production.

European legislation

In order to use digestate as a fertiliser, certain regulatory requirements, both on national and European level, must be met. In this regard, the existing national regulations which guarantee high-quality digestate, as well as the ongoing European harmonisation procedure designed to facilitate cross-border trading with digestate, are to be mentioned.

Taking a look at the EU regulation is essential, as it reveals important gaps but also areas of great improvement. To start with, digestate is currently classified as 'waste' in the European legislation. The so-called end-of-waste (EoW) criteria, on which the European Commission is currently working, shall, however, allow (under certain conditions) the status change from 'waste' into 'product' which would in turn make trading activities easier.

The possibility of introducing such EoW criteria was enabled by the Waste Framework Directive which endeavours to remove administrative burdens within legislation regarding safe and high-quality waste materials, with the purpose to facilitate recycling. The process of defining the EoW criteria for digestate started in 2007 and was followed by the establishment of a technical working group in 2010. Ever since, the European Biogas Association (EBA) has participated in the working group meetings, supporting the elaboration of legislative measures that ensure minimal administrative burdens. A relevant example in this regard is the EBA's proposal to exclude mixed municipal waste and sewage sludge from the positive list, as their exclusion contributes to a substantial reduction in the measurement frequency of organic contaminants – for example the so-called PAH16.

In general, the EoW criteria is based on 5 main principles:

- quality and testing requirements, including independent and frequent sampling and analysis of the product;
- input material requirements referring to what is allowed on the so-called positive list;
- treatment processes and techniques regarding a suitable time-temperature profile;
- information requirements such as nutrient content, biological properties etc. ; and
- quality assurance requirements, which demand that digestate

producers operate a quality management system in compliance with quality assurance standards that are recognised as suitable for digestate production by Member States or by the European Community.

In January 2014, the European Commission's Joint Research Centre (JRC) released the final report with technical proposals for EoW criteria for compost and digestate. In order to effectively become EU legislation, the Commission's Directorate General (DG) for Environment will still need to decide, on the basis of the technical report, whether it will propose a regulation. The European Biogas Association is strongly supporting the Commission to put forward such a proposal which could noticeably simplify the industrial treatment of biowaste.

Alternatively, if there will be no separate Regulation, the criteria may also be included in the revised EU Fertiliser Regulation, which is ought to be published, as a Commission proposal, in autumn 2014. This revised legislation is expected to harmonise the European fertiliser market and safety standards while also adding organic fertilisers (e.g. digestate and compost) as well as growing matter and soil improvers into its scope. Unlike a directive, the regulation will become immediately enforceable as law in all Member States without any further adjustments of national legislations.

The inclusion of digestate in the EU Fertiliser Regulation after reaching the required EoW status will result in a better market value for digestate. On the other hand, there may be yet another administrative challenge lurking: digestate, unlike biogas and compost, is not exempt from the European chemical legislation, REACH. This means that if chemically modified feedstock is used in anaerobic digestion, the registration requirements under REACH will apply. This, in turn, could lead to an irrational situation where some plant operators might not apply to receive the EoW status for their digestate, in order to avoid the administrative burden related to REACH. In autumn 2013, EBA provided the European Commission with a position paper explaining the composition of digestate and the technology of anaerobic digestion, while delivering arguments for digestate's exclusion from REACH. The main argument of EBA's position is that digestate cannot be subject to REACH, as it is, in most cases, composed of either whole living or unprocessed dead organisms or, alternatively, waste. These types of feedstock do not fall under the scope of the regulation.

Conclusions

The utilisation of digestate as a biofertiliser benefits both farmers and the environment. In the first place, it helps restore the natural recycling process of valuable and scare nutrients, such as phosphorus. By spreading digestate on soil, the phosphorus contained in the biodegradable AD feedstock is brought back into nature to be incorporated into new organisms and to continue its cycle. Furthermore, this practice contributes to the avoidance of detrimental greenhouse gas emissions, caused by raw manure and waste, as well as to the production of mineral fertilisers. Finally, by replacing mineral fertiliser with local biofertiliser, farmers will enjoy financial gains.

The clear picture of the advantages regarding the application of digestate as a fertiliser stays, however, in the shadow of regulations – at least for now. The full deployment and integration of digestate into the European market is only possible after the finalisation of European-wide End-of-Waste criteria for compost and digestate, as well as the introduction of a new Fertiliser Regulation. Along these lines, given the fact that compost and digestate have the same sort of input substrates and the same application possibilities, entry 12 of the REACH regulation, which exempts compost from the scope, should also apply to digestate. Otherwise, this European legislation would discriminate digestate and would affect its potentially notable contribution to a bio-based economy.

[1]Position Paper: Digestate and REACH, 28 November 2013: http://european-biogas.eu/wp-content/uploads/files/2013/11/2013-11-28-Position-paper-digestate-and-REACH-EN-final.pdf