

## INFLUENCE OF BIOGAS PLANTS DIGESTATE ON SOIL FERTILITY

**Vovk V. Yu.**, postgraduate student  
e-mail: vvovk\_2703@ukr.net  
*Vinnytsia National Agrarian University*

**Abstract.** Digestate – organic substrates after fermentation in biogas plants, saturated with nutrients and excellent for soil fertilization. Re-fermented sludge (digestate) is a highly effective disinfected fertilizer that returns nutrients and lignin to the soil as the basis of humus formation and ensures the production of ecologically clean products. Any organic waste of vegetable and animal origin can be used to obtain digestate.

**Keywords:** agricultural waste, biogas, digestate, biofuel.

For intensive agricultural production and full reproduction of humus reserves in Ukraine, 320-340 million tons of organic fertilizers must be applied annually. Previously, this balance was maintained mainly at the expense of domestic livestock. However, the livestock population in Ukraine has been reduced to nothing. Currently, 1 hectare of arable land in Ukraine has ten times less cattle than in the countries of Western Europe.

The result of a decrease in the share of organic substances in soils is their depletion and a decrease in the yield of crops (the loss of 0.1% of humus in the soil reduces the yield of crops by 0.5 c/ha). If no measures are taken, a serious environmental problem may arise in Ukraine in a few dozen years - a humus famine.

To ensure a deficit-free balance of humus in soils and their deoxidation, an urgent task is to change the mineralization system with a reorientation to increase the share of organic fertilizers. One of the ways to solve the problem of soil degradation in Ukraine is to use digestate as an organic fertilizer – a by-product of the processing of organic mass that remains after the production of biogas. During the separation of digestate, solid (sludge) and liquid (concentrate) fractions are formed.

As a result of methane fermentation of organic substances in biogas plants, only 10% of gas is formed from the total biomass from which it is produced, and the remaining 90% of biomass is digestate [2, p. 33]. Digestate is an organic mass (humidity 87-98% and pH 7.3-9.0) with an improved composition and almost no unpleasant odor. It also contains the following components: nitrogen – 2.3-4.2 kg/t, phosphorus – 0.2-1.5 kg/t, potassium – 1.3-5.2 kg/t. Only those macro- and microelements that were in the input raw materials get into the digestate, with the exception of part of carbon, hydrogen, oxygen, sulfur and nitrogen, which are lost with biogas.

This substance is similar in chemical composition to compost, so it can be used as an additional fertilizer to increase soil fertility. Digestate can be liquid or solid. Liquid digestate is applied to the soil, and the solid fraction of digestate can be dried, granulated and conveniently combined with other waste. It is also convenient to

combine it with other waste or organic products, such as wood shavings and sawdust. Digestate improves the condition of agricultural crops by providing additional nutrients and helping to maintain the necessary soil moisture. If mineral fertilizers are absorbed by only 35-50%, then biofertilizers are absorbed by almost 99% [3, p. 27].

Currently, the total production of digestate at biogas plants in Ukraine is about 2 million tons and will grow with the increase in the number of biogas capacities in Ukraine. Thus, 1 ton of corn silage produces 780 kg of digestate, 1 ton of chicken manure – 890 kg, 1 ton of manure – 910 kg, cattle manure – 920 kg, and pig manure – 990 kg. For each megawatt of biogas plant capacity, 40-50 thousand tons of such digestate is produced per year.

The first experiments using digestate as a fertilizer showed that it gives an effect and this effect is even higher than that of more traditional analogues. For example, in England, digestate (admittedly, from food waste) provided an increase in the yield of winter cereals by 10% in an average of 3 years, while green compost – by 7%, mixed compost (from green mass and food waste) – by 8%, manure – by 9% and manure with straw – by 10%. In another experiment, the application of 30 m<sup>3</sup>/ha of digestate, each ton of which contained 3.6 kg of nitrogen, 1.7 kg of P<sub>2</sub>O<sub>5</sub> and 4.4 kg of K<sub>2</sub>O, made it possible to save 108.6 euros/ha on fertilizers [5].

For the first time in Ukraine, the digestate from biogas plants was used as an organic fertilizer by the Myronivskiy Hliboprodukt company, which owns powerful biogas plants in Dnipropetrovsk Oblast and Vinnytsia. The main raw material of biogas plants is chicken droppings. In Dnipropetrovsk region, small amounts of sorghum silage are added to it, in Ladyzhyn - straw and cattle manure.

The digestate obtained at the biogas plants of the MHP had the following composition:

Liquid fraction: pH – 7.7-9.1. In 1 m<sup>3</sup> of total: nitrogen – 6.6 kg, phosphorus – 1.9 kg, potassium – 6.2 kg. Manganese – 21 mg/kg, zinc – 8.2 mg/kg, copper – 14.1 mg/kg, cobalt – 7.2 mg/kg, sulfur in liquid – 0.27%.

Solid fraction: pH – 7.7-9.3. Total: nitrogen – 6.8 kg/t, phosphorus – 3.1 kg/t, potassium – 2.7 kg/t. Manganese – 47.65 mg/kg, zinc – 12.5 mg/kg, copper – 34.5 mg/kg, cobalt – 18.1 mg/kg, sulfur in liquid – 1.56%.

In Vinnytsia region, the experiment was set up in the winter wheat fields of a farmer in the village of Vasylivka near Ladyzhyn, not far from the biogas plant. The soil in this area was acidified and low in humus (only 1.5%). Two variants of applying digestate were tested - in August (by barrels for applying liquid fertilizers) and in March (through hose-drum irrigation machines). In the first plot in February, the wheat was denser and generally better than in the control. On the second, after some time, it was also noticeable that the wheat was greener than on the neighboring plots, where the traditional scheme of feeding with fertilizers was used [5].

The digestate of biogas plants can be a valuable resource for maintaining/restoring soil fertility in Ukraine and make a significant contribution to replacing imported mineral fertilizers. During the use of digestate, it was found that it is universal and suitable for all soils, as well as for feeding all types of plants; increases the content of organic matter (humus); improves the water and air conditions of the soil; it can be made at any time; has neutral acidity and deacidifies the soil; absence of

pathogenic organisms; allows you to increase the yield, as it contains a complete complex of necessary macro- and microelements, organic compounds that improve the soil structure, and humic acids; creates prerequisites for the development of organic agricultural production and increased income from the sale of products.

### References:

1. Zakhariy, O.Ya. (2019). Efektyvnist vykorystannia dyhestatu iz biohazovykh reaktoriv dlia fermerskykh gospodarstv [Efficiency of using digestate from biogas reactors for farms]. Zbirnyk naukovykh prats TDATU imeni Dmytra Motornoho (ekonomichni nauky) – A collection of scientific works of the Dmytro Motorny Technical University (economic sciences), 2 (40), 79-86. DOI: 10.31388/2519-884X-2019-40-79-86.

2. Honcharuk, I.V., Vovk, V.Yu. (2020). Poniatiinyi aparat katehorii silskohospodarski vidkhody, yikh klasyfikatsiia ta perspektyvy podalshoho vykorystannia dlia vyrobnytstva bioenerhii [Conceptual apparatus of the category of agricultural waste, its classification and prospects for further use for bioenergy production]. Ekonomika, finansy, menedzhment: aktualni pytannia nauky i praktyky – Economics, finance, management: topical issues of science and practical activity, 3 (53), 23-38. DOI: 10.37128/2411-4413-2020-3-2.

3. Honcharuk, I.V. (2020). Vyrobnytstvo biohazu v ahrarnomu sektori – shliakh do pidvyshchennia enerhetychnoi nezalezhnosti ta rodiuchosti gruntiv [Biogas production in the agricultural sector is a way to increase energy independence and soil fertility]. Ahrosvit – Agroworld, 15, 18-29. DOI: 10.32702/2306&6792.2020.15.18.

4. Kaletnik, G., Honcharuk, I., Okhota, Yu. (2020). The Waste-Free Production Development for the Energy Autonomy Formation of Ukrainian Agricultural Enterprises. Journal of Environmental Management and Tourism, 11, 3 (43), 513-522. DOI: 10.14505/jemt.v11.3(43).02.

5. Yak u biohazovykh ustanovkakh dobryvo vyrobliaiut [How fertilizer is produced in biogas plants]. URL: <https://propozitsiya.com/ua/yak-u-biogazovyh-ustanovkah-dobryvo-vyroblyayut>.

6. Vovk, V.Yu. (2020). Ekonomichna efektyvnist vykorystannia bezvidkhodnykh tekhnolohii v APK [The economic efficiency of using zero-waste technologies in agriculture]. Ekonomika, finansy, menedzhment: aktualni pytannia nauky i praktyky – Economics, finance, management: topical issues of science and practical activity, 4, 186-206. DOI: 10.37128/2411-4413-2020-4-13.

**Анотація.** Дигестат – органічні субстрати після ферментації на біогазових установках, насичені поживними речовинами та відмінно підходять для удобрення ґрунту. Реферментований осад (дигестат) – це вискоєфективне незаражене добриво, яке повертає ґрунту поживні речовини та лігнін як основу гумусоутворення та забезпечує виробництво екологічно чистої продукції. Для отримання дигестату можна використовувати будь-які органічні відходи рослинного і тваринного походження.

**Ключові слова:** сільськогосподарські відходи, біогаз, дигестат, біопаливо.