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BIOTECHNOLOGICAL PROCESS OF METHANE FERMENTATION IN MANUFACTURING FARMS

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Conduction. Methane fermentation is a biotechnology method which consists in the fermentation conversion of anaerobic microorganisms by biocenosis of most organic polymeric and other compounds into methane and carbon dioxide.

Methane fermentation is used for the treatment of concentrated wastewater, the disposal of some waste, biogas production, fertilizers containing B vitamins (especially important is the presence of vitamin B_{12}). Methane fermentation occurs at different temperatures. There are psychrophilic (<20 °C), mesophilic (20…40 °C) and thermophilic (45…65 °C) fermentation.

One of the ways of rational use of the energy of liquid manure from livestock farms is its methane digestion, which eliminates waste, releases biogas, which is used as an alternative source of energy, and also produces a fermented mass, which is used as an organic fertilizer.

At the Department of Environmental Safety and Labor Protection of the National University of Food Technologies (Kyiv, Ukraine), the biotechnological process of methane fermentation of livestock manure was conducted.

The results of research and their discussion. Waste of livestock complexes with humidity of 96 %, 93 % and 91 % were subjected to methane fermentation. The process was carried out at a temperature of 45 °C, which, on the one hand, provides the necessary intensity of the fermentation process in comparison with the mesophilic regime, and on the other – requires less energy consumption compared to the thermophilic regime. Fermentation was carried out in batch mode. For this purpose, loading doses of 25 and 45 % of the total volume of culture fluid in the methane tank were used. At a loading dose of 25 %, the process lasted for 5, 7 and 8 days, depending on the humidity, and at 45 % for a dose of 7, 9 and 11 days, respectively. As the loading dose increases and the substrate humidity decreases,

the total volume of biogas produced increases. Thus, when the substrate is digested with a moisture content of 96 % and a change in the loading dose from 25 % to 45 %, the amount of biogas produced increases by 38 %. The same is true for processes with manure moisture of 93 % and 91 %, because with increasing loading dose, the amount of biogas increases by 35 % and 36 % respectively. The results of studies on the manure breeding of livestock farms are given in table 1 and 2.

Table 1. **Effect of substrate moisture and loading dose on biogas volume**

Substrate humidity, %	Download dose, %	Volume of biogas, dm^3/dm^3 of the culture fluid	Volume of biogas, dm^3/kg of dry matter loaded	Volume of biogas, dm^3/kg of dry matter digested
96	25	3,2	270	523
	45	5,1	258	575
93	25	5,0	279	583
	45	8,0	260	626
91	25	7,7	280	643
	45	12,1	261	691

At the same time, it is shown (table 1) that the specific biogas output per unit of loaded solids of the substrate decreases with increasing loading dose at the same manure humidity. This indicates that the increased amount of dry matter does not allow the active sludge microorganisms to fully assimilate them, which in turn affects the duration of fermentation and is confirmed by the final values of chemical oxygen demand (COD) (table 2).

Table 2. **Effect of substrate moisture and loading dose on fermentation performance**

Substrate humidity, %	Download dose, %	Methane content in biogas, %	pH is finite	COD final, mgO_2/dm^3	Efficiency of purification by COD, %
96	25	83	8,0	1 050	91
	45	80	8,1	1 200	90
93	25	80	8,0	1 500	89
	45	74	8,1	1 700	87
91	25	75	8,2	2 500	88
	45	68	8,3	2 700	86

Increased loading doses and concentrations of substrate solids have been found to adversely affect methane formation processes, which is manifested in the reduction of methane in biogas. Thus, the maximum amount of

methane in biogas (83 %) was obtained at the highest humidity and loading dose of 25 %, and the minimum (68 %) at the lowest humidity and 45 % loading.

Conclusion. The study of biotechnological purification processes showed that increasing the concentration of solids in the culture fluid leads to prolonged adaptation of the anaerobic activated sludge, increasing the duration of fermentation and reducing the purification effect (Table 1, 2). This is obviously due to the fact that some components of the substrate undergo incomplete path of biotransformation, which causes their accumulation in the culture fluid.

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