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REDUCTION OF ENVIRONMENTAL POLLUTION DURING BIOFERMENTATION OF SOLID AND LIQUID WASTE OF ANIMAL ENTERPRISES

Abstract. Solid waste processing of livestock enterprises takes place under different types of composting. During composting, the nutrients of waste and desiccants become more accessible to plants, and the resulting product - organic good is safe for the environment.

It is established that the process of preparation and maturation of composts proceeds with a significant increase in biomass temperature. The latter contributes to the death of eggs and larvae of helminths and pathogenic bacteria. The course of biofermentation processes during compost maturation is influenced by the content of fats, waxes, resins, as well as substances with a significant amount of wood, which are difficult to decompose. Animal excrement, manure, household waste, garbage, manure and sludge are used to prepare compost.

Compost usually consists of two components that are resistant to microorganisms. Thus, manure, manure, feces and urine contain a significant amount of easily soluble nitrogenous organic compounds, and peat, straw, debris are able to absorb moisture, ammonia, which helps reduce their losses during the decomposition of organic matter.

Key words: disposal, waste, composting, anaerobic fermentation, manure, additives, biogas.

Introduction. Different compost mixtures, namely: peat, manure-soil, manure-straw, manure-sludge, compost with tree bark, or on the basis of household waste differ in chemical composition, and their maturation requires different amounts of oxygen and time [1, 2]. In order to synchronize the conversion of organic matter, various additives are added to composts, provide free access of oxygen and maintain optimal humidity [3].

Compaction of biomass during compost ripening slows down the rate of decomposition of organic matter. Increasing the value of the ratio of the total surface of the burt to its cross section - on the contrary, enhances the decomposition of biomass components. Optimal for composting are burts with a base width of 2.5 - 3 m, height - 1.5 m and any length. The size of the burrs also depends on the volume of the compost and the size of the composting site [4].

Review of literature sources. The composition of the components of the burt and their properties are the main factors that significantly affect the intensity of fermentation processes in the mixture. Addition to a mixture of minerals in different proportions accelerates these processes. In turn, the mixing of the components of the mixture affects not only the dry matter content and properties of organic compounds, but also significantly changes the sorption capacity of its components and the rate of maturation of biomass [5].

Thus, the additive to liquid peat waste, which contains a significant amount of organic matter, which in addition to sorption properties, have high nutritional value for plants, accelerates the decomposition of organic matter during composting. Therefore, wastes with a high content of easily hydrolyzed compounds require more additives that adsorb these substances well, and for those that are difficult to decompose - less [2, 4].

The rate of maturation of composts formed on the basis of manure of animals, where the high content of organic matter depends on the species composition of the beneficial microflora. The latter is extremely important for the cleavage of complex organic feed residues, which are easily decomposed into simple compounds [3, 6]. Adherence to the optimal mode of composting of waste of different origins and providing conditions for the activity of microorganisms, which is achieved by aeration of biomass are important parameters of the process.

The concept and scientific bases of the process of accelerated composting of animal manure with vegetable waste have been developed. This concept is based on research to study the processes of biofermentation of organic matter of waste and their acceleration by making various organic additives and optimizing process parameters. A block diagram of the process of accelerated composting of manure with organic waste is proposed and appropriate algorithms for balancing the composition of composts, their parameters and formulas for calculation are developed. Based on this, a mathematical model of the optimal composition of compost was developed based on studies of the physicochemical properties of its components [1, 2].

The course of the biofermentation process, which underlies the maturation of compost, depends on its humidity. At high humidity biomass burts are periodically mixed, and at low - periodically watered with water or manure. Therefore, the optimal air and water regime of burts are important conditions for the activity of microorganisms in the compost mass [3].

A method of manure processing by permanent composting has also been developed. This method uses a mixture consisting of 6/7 manure and 1/7 soil. The burting process takes place constantly, and the burt is gradually increased by 15-25 cm every 2-3 weeks. The process of decomposition of organic matter of manure takes place mainly in the upper layers of the burta [6].

Under such conditions, the processes of mineralization of the organic matter of manure significantly outweigh the reactions of formation of secondary organic compounds that form the humus complex. As the compost matures, it is enriched not only with organic compounds, but also with ash elements, including humic substances [4, 6].

The rate of decomposition of organic matter of compost by microorganisms is affected by changes in temperature, humidity and acidity of biomass, the degree of grinding of components. Under aerobic conditions, exothermic reactions predominate in compost, when heat transfer to the environment is complicated, and high temperatures develop in compost piles. Subsequently, it decreases with the use of microflora of easily degradable organic compounds [1, 2].

Studies have shown that the temperature of biomass in the compost pile during the first four days increases from 19 to 72 ° C, remaining at this level for 6-7 days, and then gradually decreases to 50 ° C on day 16 [5].

The maturation of composts is significantly affected by the pH of the mixture. As a rule, the neutral value of this indicator is optimal. The change in the pH value of the compost medium is a consequence of the course of biochemical processes in biomass under the action of enzymes of microorganisms [4].

In order to optimize the course of biothermal processes, in which manure is converted into compost and biomass is disinfected, the regulation of burr aeration is provided.

For the preparation and maturation of composts are used and surface-type bioreactors, in which biomass is mixed and ventilated, gradually moving from floor to floor to the bottom.

Thus, the process of composting organic livestock waste can be accelerated with the help of bioreactors, where the process of compost maturation takes from 3 to 15 days, while during compaction it lasts 3 months or more.

Materials and methods of research. Manure was removed from the sections mechanically, and from the premises - by hydro-washing through a system of manure channels into the sewage pumping station with the subsequent supply of manure effluents to the storage tank (lagoon).

Medium samples of excrement for research were taken in the morning after night rest of cows, before milking, and manure - from the sewage pumping station after mixing.

Study of the influence of physicochemical and biological factors, as well as technological parameters on the processes of conversion of organic matter (pollution) of manure effluents of livestock enterprises in order to improve processing methods based on the use of aerobic biofermentation processes.

In production conditions during the treatment of manure effluents, especially pig enterprises, this process was carried out in special tanks - aeration tanks-mixers equipped with an aeration system, and the separation of treated biomass into clarified aqueous fraction and sludge (activated sludge) was carried out in settling tanks. This system allowed part of the activated sludge to be returned to the bioenzyme (recirculation) and the other to be removed from the system separately from the clarified fraction of effluents.

The installation (Fig. 1) allowed to study the degree of removal of contaminants (PR) in the dynamics of the biofermentation process. Native manure effluents from a pork production enterprise were used for the experiment, which were pre-treated mechanically (gravitational lighting), which ensured the removal of various mechanical impurities and feed residues.

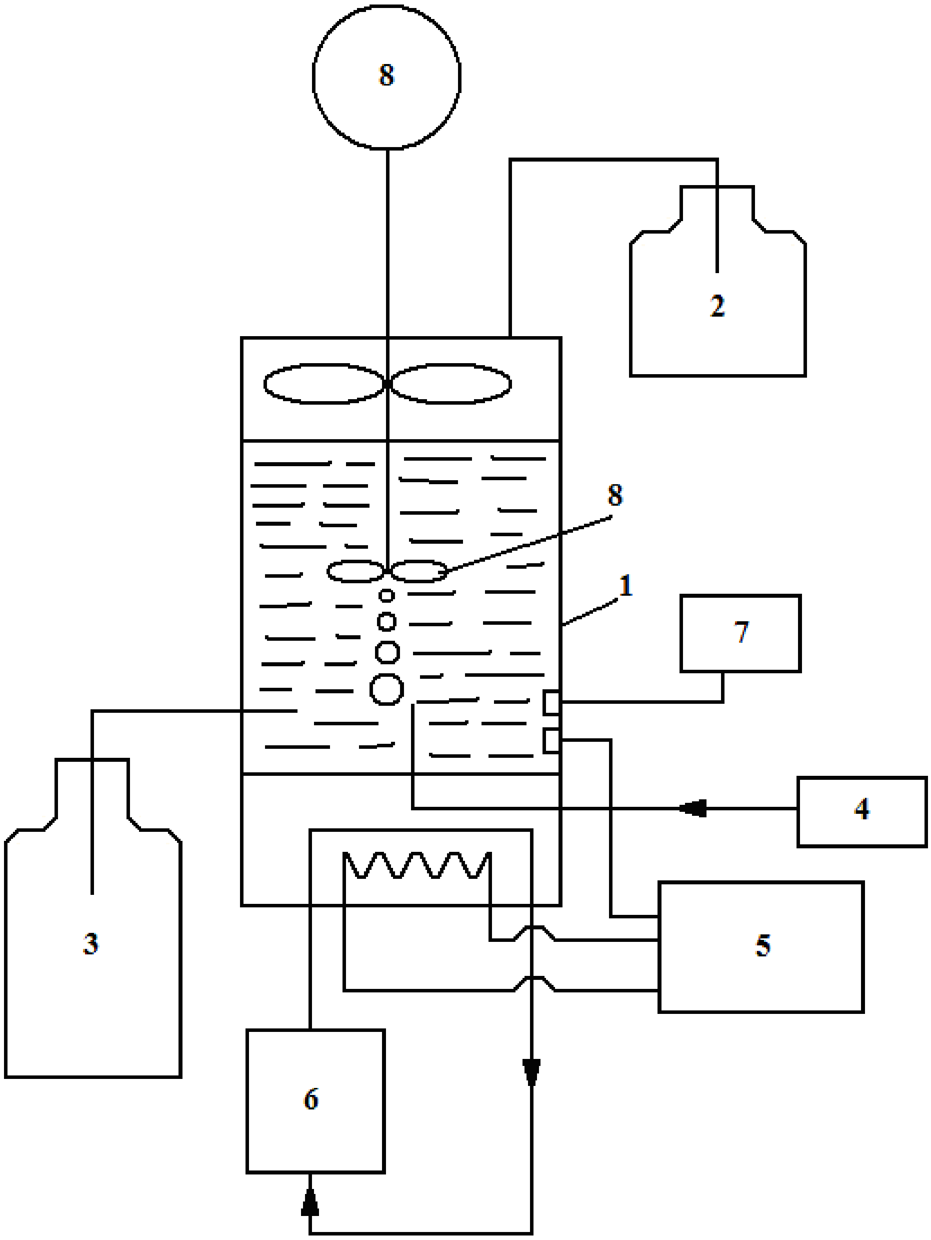

Fig. 1. Schematic diagram of the installation for the treatment of manure effluents under aerobic conditions (periodic mode).

The study was performed on a laboratory installation, which included two tanks (1) for native effluents and treated liquid in the first stage of treatment, devices (2) for flow flow, bioenzyme (glass container with a volume of 3 l), the first (3) and the second (8) wastewater treatment stages, biomass supply system (4) to the settling tank of the first (5) and second (9) wastewater treatment stages, wastewater supply system to the second treatment stage (6), activated sludge recirculation system (7, 10), sensors control of oxygen content (11), measuring device (12), lighting lamps (13), mechanical stirrers (14), thermostat system (15) (Fig. 2).

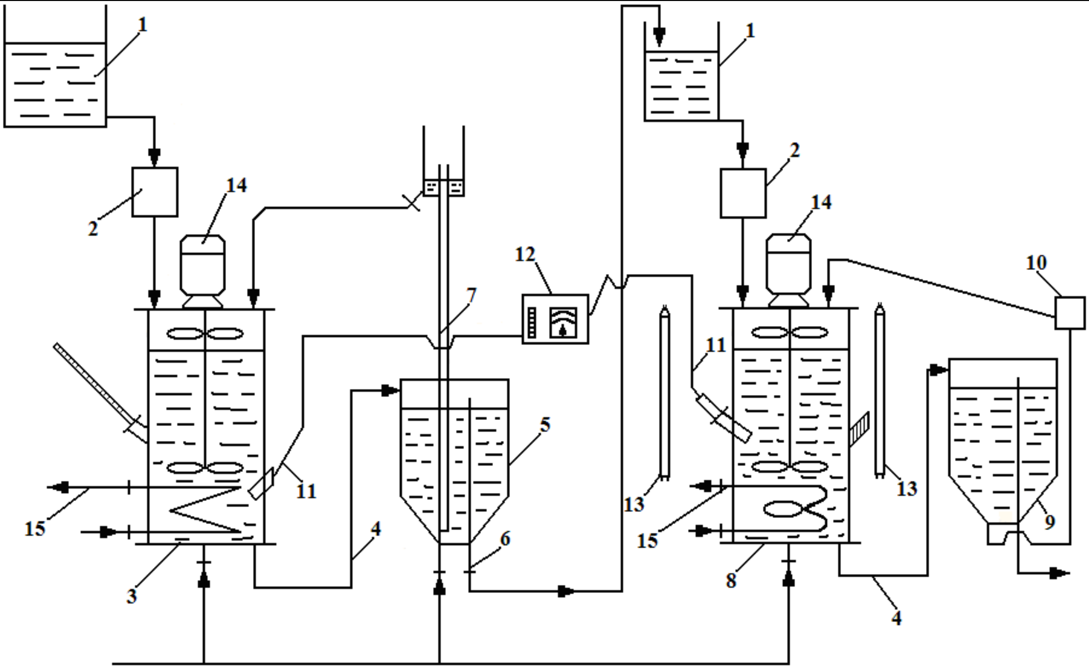

Fig. 2. Schematic diagram of the laboratory installation of manure effluent treatment by microorganisms and microalgae (flow regime).

Native manure effluents of the pig complex were previously subjected to gravitational light, after which 1.5 l were taken and introduced into the bioenzyme. The temperature of the mixture was maintained at 20 - 25 ° C, the intensity of aeration - 20 l / h, and the illumination of the incubation medium - 4000-5000 lux. The process of purification of manure effluents was started by introducing an association of symbiotic sludge microorganisms in the amount of 1.5 g / l, which was obtained by co-cultivation of microalgae and microorganisms (ratio 1:12 on dry matter) for 10 days at an illumination of 5000-6000 lux. The process of purification of the clarified liquid was continuous under flow mode.

Samples of manure effluents for research were taken before and after the completion of the purification process by the association of microorganisms and microalgae. Sanitary and hygienic parameters were determined in the selected samples of manure effluents, which were used to characterize the degree of their purification by associations of microorganisms.

Sampling of average samples of excrement, manure, products of their processing was performed according to the requirements [7]. The content of dry matter, moisture and ash in animal excrement, manure, manure and feed was determined by conventional methods [2, 3], as well as by methods selected and refined for livestock waste [5, 7, 8].

The samples of manure effluents were determined by the content of total nitrogen by wet ashing according to Kjeldahl (ISO 5663: 1984) [8], ammonium nitrogen - colorimetrically using Winkler-Nessler reagent (ISO 5664: 1984), nitrites - by reaction with Griss reagent Grandwal and Lem, and total phosphorus - by ashing in sulfuric acid [8].

The number of microorganisms in the samples on liquid media was controlled by the McCready method, and on solid - by counting the number of colonies grown in Petri dishes [1, 6].

The number of anaerobes and the total microbial count of effluents were calculated after incubation of samples at a temperature of 27 0C on Wilson-Blair medium [1, 6].

The technological parameters of the biofermentation process, namely the temperature of the mixture, the content of dissolved oxygen in the biomass, pH, redox potential, as well as the volume and flow rate of liquid in the biofermenter were determined by conventional methods using special sensors and measuring instruments.

The economic efficiency of the developed devices and methods of processing waste from livestock enterprises was calculated based on their capacity, available livestock, taking into account the amount of waste generated, the cost of manufacturing devices or purchasing additives, as well as data to reduce composting time, increase efficiency use of equipment, reduction of processing costs and use of the obtained organic fertilizers according to formula 1.

$$E = (Zz = Zd\text{-}E)\ n / Zz, \qquad (1)$$

where E - is the economic efficiency,%;

Zz - total costs, thousand UAH;

Zd - costs for the manufacture of devices, thousand UAH;

E - cost savings when using devices, thousand UAH;

n - is the number of cycles.

Statistical processing of the obtained results was performed using a special program in M. Excel, using the Student's probability criterion [102, 177, 256].

Research results. It is known that for the successful process of biofermentation of solid waste it is necessary to comply with the established technological requirements. One of which is to ensure proper air exchange in compost biomass, ie its aeration. This process is designed to provide oxygen to aerobic microorganisms involved in the oxidation of organic matter of manure, as well as the release of carbon dioxide and water vapor.

Quantitative characteristics of aerodynamic processes that occur during aeration of waste from livestock enterprises, in the literature is almost absent, which does not allow to develop rational methods of processing and improve existing and develop new engineering tools to ensure this process.

To this end, a number of model and analytical studies were conducted in which the quantitative characteristics of aerodynamic drag and kinetics of moisture loss during biomass aeration were determined.

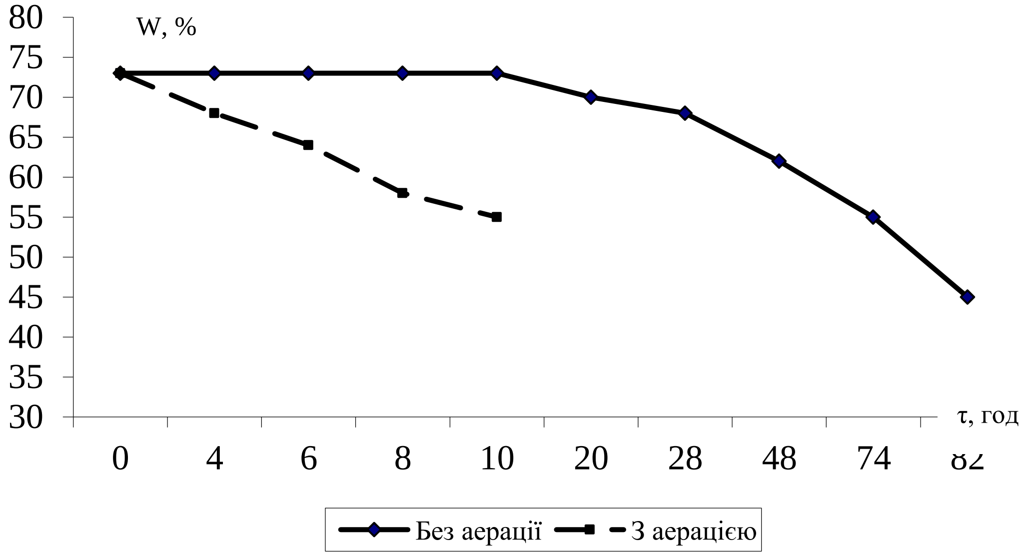

Fig. 3. Kinetics of moisture loss by compost mass of manure.

It is established that during aeration the loss of moisture by manure occurs in a clearly defined linear nature (Fig. 3). This significantly accelerates the kinetics of the process of transformation of manure. Thus, after 10 hours of aeration instead of 74 hours without aeration, the compost mass acquires optimal humidity (W = 55%). This is the most important for the beginning of the process of biothermal decomposition of manure (or mixture), the humidity of which often does not correspond to the optimal value for the composting process. The results obtained in the experiment can be used on an industrial scale with a known speed of air movement in the compost mass and its resistance.

From the obtained results it is seen that at different thicknesses of the compost mass layer the dependence of the air velocity on the backfill resistance is preserved (Table 1). This is typical of the laminar mode of air movement, in which for data channels of geometric dimensions (pore diameter and length) and at constant physical flow constants (kinematic viscosity coefficient and density) pressure losses are proportional to the first degree of change in air velocity.

Table 1

Pressure losses at different air flow rates in biomass, M ± m, n = 4 - 5

The thickness of the biomass layer, mm	Air flow rate, m / min	Pressure loss, Pa	Relative increase in pressure loss
100	1,04 ± 0,10 2,54 ± 0,09 3,24 ± 0,10 4,14 ± 0,15	572,00 ±52,88 1434,00 ± 134,20 1734,84 ± 161,79 2270,84 ± 149,60	1,00 ± 0,10 2,51 ±0,23 3,03 ± 0,28 3,97 ± 0,36
200	1,14 ±0,09 2,52 ± 0,09 3,40 ± 0,11 4,25 ± 018	1154,00 ± 107,60 2846,36 ± 264,08 3401,99 ± 315,13 4348,28 ± 410,56	1,01 ± 0,08 2,47 ± 0,22 2,95 ± 0,29 3,82 ± 0,35

It should be emphasized that in table. 2, the air velocities refer to the area of the column of the stand free from backfilling, and not to the microchannels of the backfill, in which the air velocities are much higher due to the reduction of the cross section of the air flow openings (conditional "live" cross section). Probably, this circumstance does not affect the quantitative characteristics of the above dependence, so in the calculations of aeration systems of the burt can be operated not by the actual air velocity in the burts, and the ratio of air flow velocity in the air duct to the surface area of the burt (or its unit).

The data are given show that at the same air flow rate, the pressure losses in the collar increase in proportion to the increase in the thickness of the layer (or the length of the channels) of the composted mass.

Using the results of laboratory tests, the feasibility of supplying the required amount of fresh air to the burt was carried out using ventilation systems with natural air draft. It is known that when composting livestock waste in open areas air exchange in the burt is provided by gravitational pressure due to the difference in density of atmospheric air and air inside the burt, as well as wind energy acting directly on the surface of the burt, and in the presence of a special nozzle on the head exhaust shaft (deflector) enhances the extraction of air from the backfill and, accordingly, the inflow of fresh air. In any case, the outside air enters the collar through the pores of the backfill over the entire surface.

Given what is formed in the production environment, the ratio of surface area to volume is $1.3 \div 2.5$ m^2 / m^3. Taking the average of the given values as a conditional unit of the surface area of the collar per 1 m3 of volume, we consider fy = 1.9 m^2. Focusing on the minimum specific flow rate of aeration air q = 1.2 m^3 / h. per 1 m^3 of backfill burta, you can calculate the conditional air velocity at the entrance to the backfill:

$$\nu_y = q/f_y \times 3600 = 1{,}2/1{,}9 \times 3600 = 0{,}00017{,}, \text{ m / s}$$

Using the results of our laboratory studies and the dependence, it was found that the specific pressure losses during the passage of air flow through the backfill at a conditional air velocity νy = 0.00017 m / s is 0.056 Pa per 1 mm of backfill layer thickness.

The gravitational pressure created by the exhaust shaft can be calculated by formula 2:

$$\Delta pgr. = 9.8\ h\ (\rho з - \rho б),\ Pa, \qquad (2)$$

where: ρз, ρб - density of external and internal air of a collar, kg / m^3;

h - height of the shaft, m.

Given the climatic conditions of most of Ukraine, we note that ρз = 1.26 kg / m^3 at an optimum temperature of 6.7 ˚C; ρб = 1.07 kg / m^3 at the optimal temperature of 55 ˚C; average annual air velocity νn = 5.2 m / s; the height of the mine is 5 m, then the gravitational pressure will be:

$$\Delta pgr. = 9.8 \times 5\ (1.26 - 1.07) = 9.31\ Pa$$

The dynamic pressure of the wind flow is:

$$P_Д = \frac{\upsilon_n{}^2 \times p_з}{2} = \frac{5{,}2^2 \times 1{,}26}{2} = 7{,}2$$

, Pa

If we assume that the wind energy is realized without losses on the deflector and during direct blowing of the collar, then the total calculated aeration pressure will be:

$$\sum pp = \Delta pgr. + 2pd = 9.31 + 2 \times 17.3 = 43.4\ Pa$$

Fluctuations in the value of ∑pp can be estimated in the direction of increase in the cold period by 60–80% and in the direction of decrease in the warm period by 40–50%. It should be borne in mind that the wind situation in different regions of Ukraine is characterized by the presence of calm within 10 - 30% of the year. Comparison of the expected values of ∑pp with the indicators given in table. 2, indicates that full-fledged natural aeration is possible only in certain periods of the year with a linear backfill size of not more than 1 m, and in other cases there will be a shortage of air.

The advantages of mechanical aeration systems are well known, but our research shows that the use of too powerful and energy-intensive high-pressure hydraulic machines (compressors, vacuum pumps, etc.), which require constant control of air flow, is not justified. The pressure of 150 - 300 Pa required for aeration at uniform time of air consumption, the minimum power consumption and without constant supervision can be provided by fans of low pressure. Only rational constructive schemes of their application are necessary. In particular, the presence of dust, fibrous and aggressive substances in the exhaust air implies the need to install general purpose fans for injection, not extraction.

Table 2

Estimated air pressure pressure losses at different flange thicknesses

Layer thickness, mm	Pressure loss, Pa
1000	56
1500	84
2000	112
2500	196

The obtained research results were the basis for the development of design solutions for devices and equipment for composting organic waste and materials that can accelerate the process of biofermentation and increase its economic efficiency. In addition, under these conditions, the level of environmental safety of the technological process increases due to the reduction of emissions of harmful components into the environment, including ammonia by 18 - 24%, dust and pathogens by 16 - 20%.

Therefore, the passage of air flow through the backfill is characterized by all the signs of laminar regime. In engineering calculations of air flow pressure losses instead of the actual air velocity in the microchannels of the compost mass, it is advisable to use its velocity in the air duct at the inlet to the backfill.

Aeration of industrial burrs with the help of engineering means that use natural factors (gravitational pressure and wind energy) is inefficient, because the thrust created by them is significantly less than the required amount of air supply.

The best way to solve the problem of environmental pollution is to create waste-free technological production. This way of solving environmental problems is possible only on the basis of an in-depth analysis of the physico-chemical properties of waste generated at livestock enterprises. The latter is necessary to create a modern strategy for the disposal of industrial waste.

Thus, the use of intensive biotechnological methods in the fermentation of livestock waste allows to obtain humified raw materials, the processing of which with the help of alkaline regeneration solutions, waste water treatment systems of the heat industry makes it possible to produce humic preparations. Therefore, one of the tasks was to study the technological parameters of the process of extraction of humic substances and optimize the technology of their production.

The use of 4% NaOH solution for regenerative OH filters made it possible to bind all the anions in the processed products, including organic compounds, the vast majority of which are humic and fulvic acids. The study of these solutions showed that they are mixtures of easily soluble in water substances with a weak specific odor, yellowish-brown color. The pH of this solution is 12, and the content of humic substances reaches 1 g / l. The dry matter of the solution is 14 - 27% with an ash content of 72 - 86% and is characterized by the presence of a small amount of free alkali.

Extraction of humic substances from humic raw materials is a complex process, the rate of which can be limited by the kinetics of chemical interaction of humic substances with alkali, the rate of diffusion of their sodium salts into solution, as well as the interaction surface of solution components. Humic substances have a significant molecular weight, and hence the corresponding molecular diffusion coefficient. Therefore, it is believed that the limiting stage of the process of extraction of humic substances from biomass is external and intraporous diffusion. It is possible to eliminate the first of them by introducing the process into the area of high turbulence, which is achieved by stirring the mixture. Intraporous diffusion can be eliminated by increasing the dispersion of the medium.

As can be seen the process of extraction of humic substances is completed mainly in 30 minutes, regardless of the particle size of the raw material, which affects only its efficiency. Thus, when increasing the particle size in the mixture from 100 to 500 μm, its efficiency decreases by 30%.

The study of the influence of temperature on the efficiency of extraction of humic substances showed that the highest intensity of the process is observed at 400C (Fig. 4).

It is established that the efficiency of clarification of the solution of humic substances depends on the time of gravitational settling and the size of its particles (Fig. 5). The best result for the extraction of humic substances was obtained at 50 <d <100 and the process duration was 4 - 6 hours.

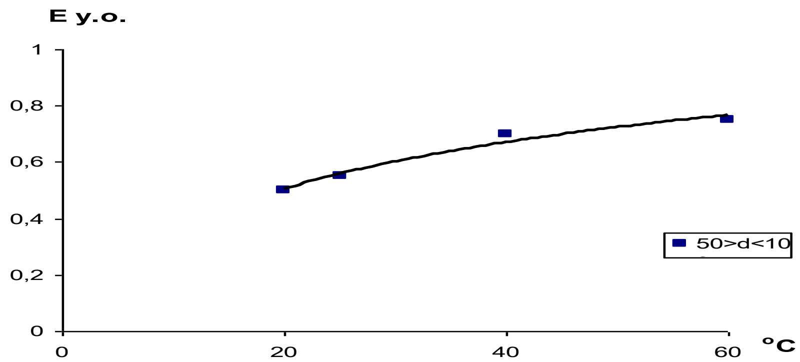

Fig. 4. The efficiency of the extraction process of humic substances under the influence of temperature.

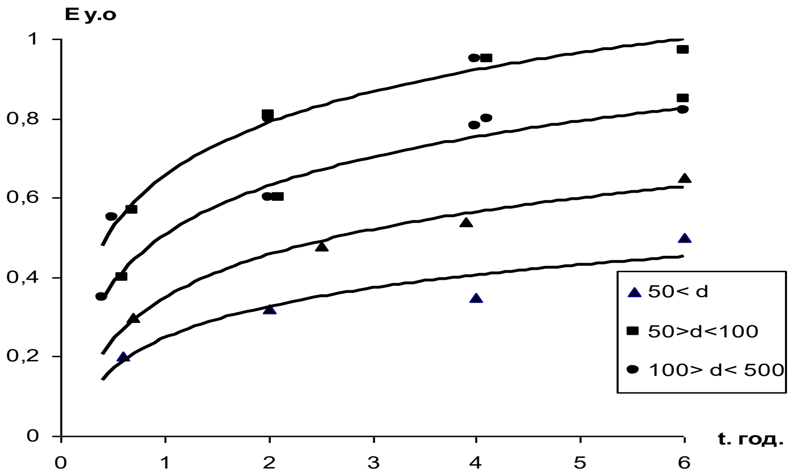

Fig. 5. The efficiency of clarification of the solution of humic substances from the term of settling and particle size.

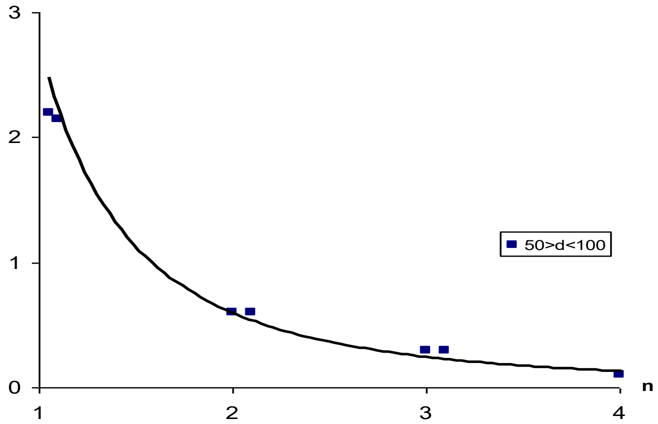

Fig. 6. Depth of extraction of humic substances depending on the number of extraction stages.

Since the extraction from the solid phase of soluble substances equilibrates between their number, which went into solution and remained in the solid state, the completeness of their extraction is determined by the number of stages of extraction. As can be seen from Figure 6, the extraction of humic raw materials is almost complete after the second stage under conditions of equilibrium in the solution after the first stage of extraction, separation of sediment and its treatment with fresh solution.

The obtained results formed the basis for the development of a technological scheme for the production of humic preparations, the introduction of which allows to obtain several types of final products. Biohumus sediment is used for the production of soil structurant and component of organo-mineral fertilizers, extracts saturated with humic preparations can be used as sources of biologically active substances in native form or after processing of film-forming adhesives.

Thus, the extraction of humic substances is determined by a number of factors, and the obtained products can be used in both animal husbandry and crop production, which makes this technology waste-free. The use of spent regeneration solutions of OH filters in the extraction of humic preparations reduces the man-caused pressure of livestock facilities on the environment.

The conversion of organic matter to solid waste, including cattle manure, liquid pig manure, and laying hen manure, is closely related to a number of factors. As established by experiments, they depend on the addition to the compost mixture of bioadditives in particular oxizin and bioalgen-G-40.

Studies have shown that the treatment of solid cattle manure with a moisture content of 76% oxizin at a dose of 0.05 g / kg OR significantly accelerates the rate of fermentation processes in biomass during compost maturation.

Thus, the maturation period of compost made from cattle manure with the addition of organic additive oxyzine is reduced to 30 days, as evidenced by the results of studies of the chemical composition of the compost mixture (Table 3).

Table 3

Chemical composition of compost biomass from cattle manure when using oxizin,%, M ± m, n = 3

Indicator	Research period		
	raw materials	in 15 days	in 60 days
Humidity	77,6±1,90	70,5±2,40	60,9±3,90*
Dry matter	24,4±2,25	29,5±2,66	39,1±3,86*
Raw ash	25,3±1,09	30,9±0,20	30,3±3,68
Crude fiber	39,9±2,53	38,8±1,82	37,2±3,54
Total nitrogen	1,87±0,42	1,61±0,19	1,54±0,14

* - $p \leq 0.05$ compared to the raw material

It was found that after 15 days of the biofermentation process of the compost, the content of dry matter, crude fiber and crude ash, as well as the level of total nitrogen in the biomass did not change compared to similar indicators of the raw material. However, after 60 days of the biofermentation process, the moisture content of compost biomass decreased by 21.5%, the dry matter content increased by 37.6%, and crude ash, fiber and total nitrogen did not change compared to the raw material.

Regarding the sanitary and hygienic requirements for the obtained composting products, they are safe from the point of view of veterinary and sanitary requirements, and reducing the maturation period of compost reduces the amount of harmful gases (mainly ammonia and hydrogen sulfide), dust and microorganisms entering the environment.

Confirmation of this conclusion is the results of studies on the use of bioadditives bioalgen-G-40 in composting liquid manure of pork enterprises.

Studies have shown that the treatment of liquid manure from pork enterprises with a moisture content of 94% bioadditive bioalgen-G-40 at a dose of 0.4 g / l of biomass significantly reduces its maturation and promotes better preservation of ammonium nitrogen (Table 4).

Table 4

The content of organic matter and ammonium nitrogen in the biomass of liquid pig manure when using bioalgen-G-40,%, M ± m, n = 3

Duration of composting, months	Indicators			
	Ammonium nitrogen		OR	
	without processing	with finishing	without processing	with finishing
Output manure	0,024±0,001	0,024±0,002	71,6±2,49	71,6±2,49
1,5	0,025±0,003	0,027±0,020	69,1±3,17	67,3±3,50
3,0	0,017±0,001	0,028±0,003*	67,3±4,58	66,4±7,03
4,5	0,015±0,002	0,030±0,003*	66,4±5,11	63,3±4,88
6,0	0,014±0,003	0,030±0,002*	63,2±3,41	61,2±5,18

* - $p \leq 0.05$ compared to indicators without biomass treatment

It is shown that the content of OP in compost biomass during 6 months of storage with both treatment of liquid manure with bioadditive and without treatment varied to the same extent, but a significant difference between the experimental samples of different groups was not found.

It was found that the content of ammonium nitrogen in the maturation of compost from liquid manure of pork enterprises in the period up to 1.5 months in the processing of bioadditive bioalgen-G-40, compared with similar data of compost without treatment, did not change in absolute terms and and in the dynamics of the process. However, after 3 months of composting, the content of ammonium nitrogen in the biomass of liquid manure, which was treated with bioadditive bioalgen-G-40, remained at the same level as at the beginning of the process, and in compost without treatment decreased by 29.2%.

This difference was significant between the content of ammonium nitrogen in the biomass of liquid manure and without this bioadditive after 3 months of composting. It was found that the content of ammonium nitrogen in the biomass of liquid manure without treatment with bioalgen-G-40 after 3 months was lower by 39.4%, after 4.5 months - by 50%, and after 6 months - by 53.3%.

The obtained data indicate better preservation of nitrogen during the maturation of compost biomass from liquid manure of the pork enterprise with the addition of bioadditive bioalgen-G-40.

On the other hand, the results of research indicate a significant reduction in ammonia nitrogen emissions into the atmosphere with harmful gases during the maturation of compost, which reduces the environmental pressure of pig farms on the environment.

Therefore, one of the important measures to increase the efficiency of processing solid manure from cattle, liquid manure from pigs and chicken manure is the use in the composting process of bioadditives oxyzine and bioalgen-G-40.

It is established that under these conditions the auto thermal processes in the biomass of the experimental burt actively take place for 5-7 days, while in the control - for 18-27 days. Under these conditions, the biomass temperature in the experimental burt stabilized for 30 days and was 26-32 ° C, in the control only for 72 days.

The study of the physicochemical composition of the obtained product showed that the term of biomassation of biomass in the experimental burr was reduced by 2.4 times, with a decrease in nitrogen losses - by 1.53 times, and OR - by 1.3 times.

Production verification of the effectiveness of the developed biotechnological measures and design solutions for optimization and intensification of solid-phase biofermentation processes of pig farm waste (530 heads) and dairy farms (300 heads of cows) in the conditions of DG "Artemida" of the Institute of Potato NAAS of Ukraine Vinnytsia region showed measures such as aeration of the burt, which increases the speed of air movement in the channels, as well as deep humidification of biomass with a solution of oxyzine at a dose of 10 mg of active substance per 1 ton of waste has significantly reduced (5 times) This made it possible to accelerate the process of compost ripening by 2-3 times while reducing the loss of OP by 25%. In addition, the ecological purity of the process has increased due to the reduction of emissions of harmful gases into the environment, in particular, ammonia by 18-24%, dust and pathogenic microorganisms - by 16-20%.

The economic efficiency of the implementation of the developed biotechnological solutions is expressed by a 1.5-fold reduction in the area of buildings for waste processing and the volume of investment in their construction, which is 21.6-32.5 UAH. reduces the cost of processing 1 ton of waste, increases the efficiency of the process by 40-48%.

Conclusions:

On the basis of complex researches of chemical composition, physical properties and sanitary-hygienic indicators of fecal masses of cows and pigs, liquid manure and sewage of the enterprises with intensive technologies of production of livestock products the expediency of application of biological methods of their processing is proved.

The dependence of the process of extraction of humic acids from compost on the term of interaction of components, particle size of raw materials, temperature of the mixture, and the extraction of humic acids - on the time of gravitational settling and the number of stages of the process.

1. The use of the drug "Oxyzine" in the composting of solid manure stimulates the fermentation process, reduces the maturation of compost by 2.0 - 2.4 times, the loss of OR biomass by 1.3 times, nitrogen - by 1.5 times, increases the content of ACP, crude ash, magnesium and phosphorus in the obtained products reduces its humidity, the level of OP, crude fiber, crude protein, fat, total and ammonium nitrogen. The expediency of using the bioadditive "Bioalgen-G-40" in composting liquid manure of pigs at the rate of 0.4 g / l is substantiated.

2. The use of the drug "Oxyzine" and the developed devices for aeration of burts in the composting of solid waste reduces the cost of disposal of 1 ton of waste by 21.6-32.5 UAH, increases the efficiency of the manure processing process by 40 - 48%.

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