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THE ENERGY EFFICIENCY OF THE CLOSED SYSTEM OF SMALL ENTERPRISES ON PRODUCTION OF MILK AND BEEF

Abstract. The calculation of livestock farm planning under the self-sustaining system of livestock production is carried out and the method of technical and economic substantiation is offered.

It is established that with the introduction of loose housing of heifers in deep litter, the volume of the bioreactor is 626 m^3 with a single load of 85 kg / m^3 with an energy balance of the biogas plant 58149 MJ / day.

Transformation of the livestock building for different physiological groups of livestock, which were in separate buildings and transformation into a large industrial building - monoblock requires a clear account of the specific features of these buildings in the development of energy-saving technological production of livestock products.

To increase the efficiency and energy efficiency of design solutions can be achieved through the use of technological systems that reduce the area required for their placement; changing the configuration of a rectangular structure to a square one as more rational; reduction of the total volume of the room and intensive use of the volume of the room, taking into account the possibility of tier operation; using the optimal flat or lantern coating of buildings.

Key words: calculations, products, farm, production, milk, beef, biogas, energy carriers.

Introduction. According to VNTP-APK-09.06, three methods of anaerobic fermentation of organic matter are provided: mesophilic at 35 ° C for 15-30 days, thermotolerant at 40 °C for 7-15 days and thermophilic at 55 ° C for 5-10 days. Manure is an organic fertilizer that is a source of energy when using anaerobic digestion.

The farm receives a number of advantages: relatively fast payback, self-sufficiency in electricity, heat and fuel, destruction of helminths, weed seeds and harmful microorganisms, much lower price compared to traditional energy sources, compliance with environmental norms and standards, replacement of worn-out fixed assets with more efficient fixed assets. , the progress of science and technology on the basis of the old farm, the opportunity to get the best growth and milk yield, especially in the cold season, the comfort of animals and the safety of housing conditions.

The disadvantage is that at the initial stage you need to have start-up capital (credit) for the construction of a biogas plant, but according to literature sources payback in 2-4 years according to existing forecasts of rising energy prices. And the mechanism of action of the Kyoto Protocol on financing of projects of introduction of unconventional and renewable energy sources allows to realize everything in life.

Review of literature sources. The market transformation of milk production has shown that the supply of milk and dairy products must be adjusted to demand, and not vice versa [5]. This leads to the need to adapt the dairy subcomplex to market requirements, ie to the preferences and needs of consumers. This is especially important in the context of the strategy of European integration, as failure to realize this will make unrealistic and impossible competitiveness of the domestic dairy subcomplex [7].

It is necessary to search for innovative effective levers for further improvement of organizational and functional structures of the market, the formation of its food resources, focus on the production of quality products [9].

For self-sufficiency of farms with energy in the conditions of keeping cattle for beef and milk production in livestock enterprises of Vinnytsia region it is possible to successfully introduce biogas plants.

The state program for the development of dairy farming provides for a significant increase in milk production, application of new technologies, technical and architectural solutions in the creation of industrial dairy complexes, reconstruction of existing enterprises and small farms, improvement of feeding and exploitation of animals, improvement of livestock reproduction and veterinary support. industry [9].

Therefore, scientific and methodological justification of the closed system of self-sufficiency of enterprises for the production of livestock products is relevant and will increase the efficiency of the livestock and crop production.

Materials and methods of research. Substantiation of the farm's capacity for the transition to self-sustaining milk and beef production.

The study was conducted in livestock farms in the Vinnytsia region on cattle of Ukrainian black-and-white dairy and Simmental combined breeds.

Experimental groups were formed for comparisons and a general assessment of productivity was obtained to obtain alternative energy sources for the introduction of energy-saving technologies. We studied the possibility of self-sufficiency of farms in bioenergy, under the conditions of obtaining biogas from the excrement of heifers.

The analysis began with technical and economic calculations, marketing research.

Research results. According to the Departmental standards of technological design (VNTP-APK-09.06) and the data of the Departmental standards of technological design of livestock enterprises [2, 3] set the number of cattle for livestock, obtained data for use to calculate the number of cows in the herd and calculation coefficients (Table 1).).

Fresh feedstock should be fed to the reactor in small portions several times a day. During fermentation, organic matter inside the manure is metabolized (converted) by microorganisms. At the output we have two products: biogas and substrate (composted and liquid). The latter is taken to the fields for fertilization. And biogas is stored in a gasholder. Here, in the gasholder, the pressure and composition of the gas are equalized.

Given that livestock farms are kept in four buildings 12 × 72 m with an internal area of 768 m^2, and a total of 3072 m^2 for lighting requires 96 lamps or 24 per building (100 watts). Technological processes to perform various operations requires 6 hours a day. Electricity consumption 576 kW per day or 2073.6MJ.

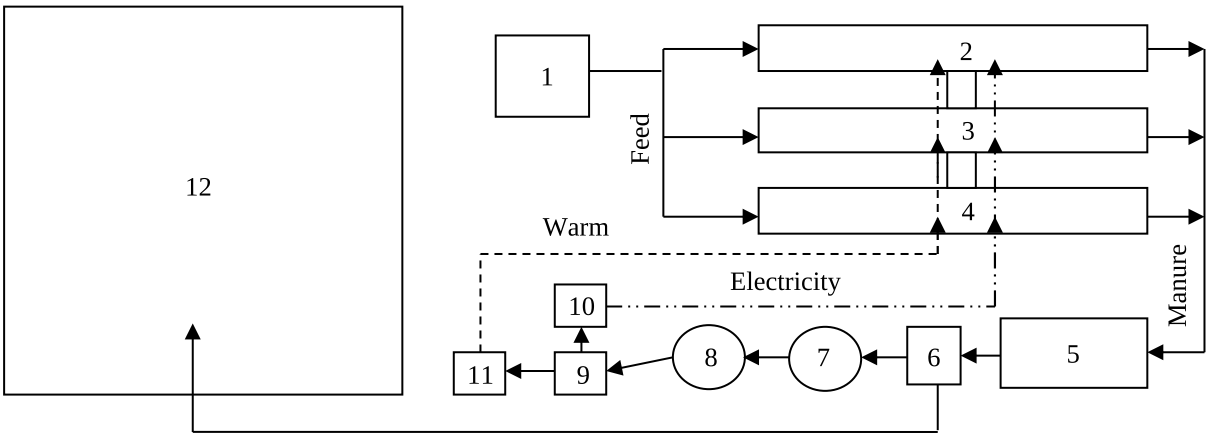

Fig. 1. Scheme of cyclic processing of manure
1- feed shop; 2- cowshed; 3- premises for repair young growth; 4- premises for keeping overhauled young stock; 5- manure storage and homogenizer; 6- fermentation chamber; 7- fermentation reactor; 8- substrate; 9- biogas storage; 10- electricity generator; 11- heat generator (boiler room); 12- agricultural land (arable land).

Table 1

Yield of excrement and energy production by different methods of keeping heifers, n = 10 (M ± m)

Indicator	Heifer groups				Average value
	1 grup	2 grup	3 grup	4 grup(k)	
The average daily yield of manure from the heifer per day, kg	28,4±2,26	27,4±2,42	31,3±2,95	26,9±1,92	28,5
Manure yield per day per group, kg	284	274	313	269	285
Biogas production, m^3 / kg of organic matter***	113,6	109,6	125,2	107,6	114
Electricity output, kW / m^3 of biogas**	227,2	219,2	250,4	215,2	228
Energy yield to control,%	105,5	101,8	116,3	100	-

It is more efficient to build your own biogas plant, which will allow you to get - 0.31-0.62 m^3 of biogas with a methane content of 50-65% from 1 kg of cattle organic matter. At its processing from 1 m3 receive 2 kW of the electric power or 21 MJ of heat. Heat from cooling the generator or from burning biogas can be used to heat the farm, obtain hot water for irrigation and perform technological operations. It is known that when drinking cows with warm water and washing them, it gives more milk and less sick, especially mastitis. Number of cattle for the farm 200 cows - 458 heads.

When processing 1 m^3 of biogas in the generator receive 2 kW of electricity or 21 MJ of heat. The total daily energy yield from cattle (Table 2).

Table 2

Total daily energy yield from cattle

Groups of animals	Manure yield, kg	Litter rate, kg	Livestock, ch	Manure yield, kg	Biogas output, m3 (0.45)	Electricity output, kW / m3 of biogas	Heat output, MJ / m3
Bulls	40	1,5	2	83	37,35	74,7	784,35
Cows	55	1,5	200	11300	5085	10170	106785
Heifers	28	0,5	24	684	307,8	615,6	6463,8
Young heifers	24	5	90	2610	1174,5	2349	24664,5
Calves up to 6 months	7,5	5	120	1500	675	1350	14175
Preventive calves	4,5	3	24	180	81	162	1701
Total	215	22	458	16357	7360,6	14721,3	154573,7

Thus, the data in Table 2 show that from 458 head of cattle received per day - 16.3 tons of manure. In the process of processing 7360.6 m^3 of biogas are obtained, from which 14721.3 kW of electricity and 154573.7 MJ of thermal energy are produced.

In one cycle, the biogas plant produces - 154573.7 MJ of thermal energy. Given that biogas plants spend 15% on energy production, hence - 23,186 MJ (154573.7 × 15: 100).

Residual energy (Zen.) For technological operations - 131387.7 MJ (154573.7 - 23186).

We calculate the required volume of the bioreactor for a farm of 200 cows when kept using litter - 626 m^3 (100 × (125.2 × 4) / 80).

One-time portion of manure loading - 85 kg / m^3 (0.313 × 4) × 80 × (100-90) × (100-15): 1000).

The efficiency of the energy balance of the biogas plant after deductions of energy consumption for technological needs - 58149 MJ per day.

Currently, in all developed countries, milk production is increasing due to the construction of candy bars. The concentration of animal husbandry at large milk production enterprises requires a new approach to the design and construction of main buildings. In the construction of such and other buildings, the so-called monoblocks are becoming more common.

When organizing construction, a special place is given to the search for effective use of building materials. The internal layout of the premises and the methods of servicing the animals to some extent depend on their category and physiological condition. In the first case, planning is complicated by the need to isolate certain groups of animals [8].

Evaluated technologies of feed distribution, manure removal, milking. The use of production areas for functional purposes is determined. Studies of the criteria for the rational use of livestock buildings and their energy-saving purpose. Optimization of spatial planning solutions is installed. The technical and economic indicators of monoblocks are given.

At mobile means their loading occurs in the feeding aisles placed in an end part of the room. The use of such conveyors involves their location in the middle part of the candy bar. The use of a mixed feed system on belt conveyors is allowed. From both ends of the monoblock there are feeding aisles, and in its center - the conveyor for loading. The use of internal belt conveyors with reverse allows you to duplicate a stationary loading system in case of failure. With such methods, the maximum feed range by longitudinal conveyors from the place of loading does not exceed 90 m.

When using stationary feed distribution systems there is every opportunity to reduce labor costs and increase energy efficiency of energy, increase the area occupied by livestock facilities. The study showed that the stationary feed distribution system occupies 13.6-18.1% of the premises, while for mobile vehicles - 27.7-37.9%. This is a very important argument for the efficient use of production space in monoblocks.

Manure removal in monoblocks is carried out by hydraulic systems. Between the boxes and feeding distributors there is a manure passage, which serves as both a cattle run and a place for defecation of animals (its width is 2.8-3.6 m). Excrement through the slotted floor of this passage enters the underground trays, then by gravity are discharged into the transverse channels and further outside the building. Manure is removed from the transverse channels by hydraulic washing, scraper conveyors or fecal pumps. In this case, the channels serve as small storage tanks. For example, in one variant of the monoblock, the manure from the longitudinal trays enters four storage channels 2 m wide and 23 m long, from where it is pumped through a pipeline from a storage tank (its volume is 25 m^3) located in the annex. Then, through extended canals, the manure is removed by pneumatic transport outside the building.

The main characteristics of hydraulic manure removal systems from monoblocks are as follows: width of trays - 1.15-2.60 m. Depth - 0.80-1.80 m, maximum free length of the tray (distance between two adjacent gates) - 17-28.8 m, total length - 469.8-1279.2 m, the volume of underground trays and canals per one cattle place - 2.1-5.2 m^3. The use of hydraulic manure removal systems from underground trays does not require additional usable area, which is especially important to increase the useful production capacity of the building, and thus reduce the cost of building materials and energy.

One of the main criteria for the rational use of livestock facilities is the cost-effectiveness of their planning and energy-saving architectural and construction solutions.

The layout of technological zones essentially determines the planning structure of monoblocks. There are three most characteristic schemes: with central, peripheral and combined placement of auxiliary premises. The central placement is designed for a significant (more than 150 m) length of the candy bar.

Under modeling conditions, it is possible to divide the monoblock into two parts, which improves the placement of different production groups of animals, as well as reduce the length of feed transportation indoors. Thus, auxiliary premises can divide a cowshed into two halls: in one dairy cows are placed, in another - pregnant heifers. The total length of the room is 180 m.

Most buildings have a gabled combined coating, the slope and height of which depend on the design solution. Thus height of monoblocks makes 6,8-8,3 m whereas it is necessary to have it indoors only 2,4 m according to norms (at such decision of a covering and considerable width of buildings it is inevitable). Application of a horizontal covering with internal drains at width of the monoblock of 48 m allows to reduce its general height to 5 m.

It is known that the increase in the height of livestock buildings for design reasons adversely affects the volume-planning indicators. In such buildings, the volume per capita increases sharply, its cost increases, and operating costs increase. Analysis of domestic and foreign practice shows that this problem can be solved in two ways. The first is the efficient use of the volume of the premises, the second is the use of the most rational design solutions for the coating. If we consider the efficiency and energy-saving operation of buildings not only horizontally but also vertically, then at a significant height of monoblocks intensively used a small part of it: from floor to mark 2 m. Here are animals, almost all technological equipment and utilities. The upper part of the volume, from the mark of 2 m to the bottom of the coating, is not actually used. The efficiency of using the building only horizontally was justified when the buildings had a relatively small height and their internal specific volume (per capita) was designed only for the vital functions of the animal's body. Another thing is in monoblocks, where there is 3.7-6.8 m^3 of volume per 1 m^2 of usable area, which is much more than in small buildings.

Therefore, in monoblocks it is necessary to occupy also the top part of the room. Tiered use of monoblocks is a prerequisite for optimizing spatial planning solutions. So, in the monoblock at an arrangement of the ventilating chamber at height of 2,8 m in the room for animals, the part of rooms in the top zone is taken out. This reduces the total area of the candy bar, which reduces both the total and the specific value of its volume, reduces energy efficiency and increases the efficiency of livestock production.

It is worth noting that the reduction in the volume of candy bars due to not only planning, but also other - constructive. Regardless of the number of spans, the coverage of monoblocks is gabled or single-vise. It is established that with the increase of the width of the building its height also increases (with the same type of covering construction). For example, with a roof slope of 0.05 °, the difference between the cornices and the canopy marks for a building with a width of 18 m is 0.45 m, and for a building with a width of 60-1.50 m.

Therefore, the task is to reduce this difference in large buildings. This can be achieved by replacing the single-visor coating with multi-visor. The arrangement in the cross section of monoblocks on the principle of combining (depending on its width) several single-span gabled buildings will significantly reduce the difference between the lower and upper mark of the coating, which will reduce the volume of the room, and this technical solution is another energy saving measure.

Thus, the rationality of spatial planning solutions of monoblocks is significantly influenced by the adopted system of layout (shaping) of the building as a whole. Currently, in the monoblock, as a rule, under one roof are areas of different functional purpose, while it is known that the height of the premises should be differentiated depending on the characteristics of the technological process. Thus, for the premises where the animals are housed, this figure is regulated by the minimum volume of air per head; for feeding passages - dimensions of feeders; for domestic premises - creation of favorable conditions for service personnel and so on.

This shows that the space of the candy bar should consist of separate parts (elements), united by a common production cycle and building area, technical communications, energy, excrement removal, microclimate equipment, etc. The volume and surface area of each part must be different. Thus, the main room of the monoblock, with large spans and a reduced number of internal supports, it is still more rational to build one-story. Its height is dictated by the design of the floor and the type of roof. Domestic premises, construction, which according to the classical scheme (longitudinal walls, which are load-bearing, with a span of 6 m) does not cause difficulties in planning, can be 2-3-storey. Another may be the height of the premises where there are milking parlors, feeding aisles. Placing all these rooms under one roof leads to unjustified overestimation of the volume of monoblocks. Thus, the volume per 1 m^2 of usable area is 5.1-5.8 m^3. At the same time in the monoblock for 400 cows, it is equal to 3.7 m^3. This is achieved in part due to the fact that from the total volume removed and reduced in height to the optimal size of living quarters, milking parlor, feeding aisles. However, the building has not lost its integrity, both technologically and architecturally.

Thus, it is established that the improvement of design solutions for large buildings can be due to more efficient and energy-saving use of usable space, where technological systems are used that significantly reduce or do not require the removal of the floor area of buildings. The tier placement of these systems in monoblocks should also play a role: the floor area is for animal and milking parlors, above them there are feed distribution systems, under the floor there is a network of trays for manure removal.

Conclusions:

1. The introduction of a biogas plant is best suited to loose housing livestock in deep litter, as will receive the most manure - 66669 kg, and, accordingly, biogas - 26667.6 m^3, electricity - 53335.2 kW, heat - 560019, 6 MJ, compared to control.

2. It is proved that with the maintenance of cattle on the farm of 458 heads it is possible to fully self-sufficient production of energy of own production from processing of excrement of cattle.

3. It is substantiated that during the cycle the biogas plant will be able to produce - 154573.7 MJ of thermal energy, which requires 23186 MJ, of which the residual energy is 131387.7 MJ for use in technological operations.

4. Improving technological and architectural and construction solutions of monoblocks becomes an important task to increase the energy efficiency of livestock production using alternative energy sources and improve energy and environmental safety.

References

1. Varpikhovsky RL, Smirnova AV, Varpikhovskaya TV (2010). Self-sufficiency of the farm with energy sources using the latest manure processing technologies. Collection of sciences. Proceedings of Vinnytsia National Agrarian University. Vinnytsia. Vip. 42. T. 2. S. 117-120.

2. Departmental standards of technological design (2005). Livestock enterprises (complexes, farms, small farms), VNTP APK 01.05. K .: Ministry of Agrarian Policy of Ukraine. 110 s.

3. Departmental standards of technological design (2006). Manure removal, treatment, preparation and use system: VNTP APK 09.06. K .: Ministry of Agrarian Policy of Ukraine. 101 s.

4. Польова О.Л. (2010). Efficiency of energy-saving animals. Monograph. Zhytomyr: Ruta. 179 s.

5. Field LV, Yaremchuk OS, Zakharenko MO (2009). Design and construction of enterprises for the production and processing of livestock products: Workshop. Vinnytsia: VSAU Publishing House. 320 s.

6. Savitskaya VP Actual problems of development of the market of milk and dairy products. Economics of agro-industrial complex. 2002, № 11. S. 102-106.

7. Ushatsky SA, Sheiko YP, Triger IM (2007). Construction organization. Textbook. K .: Condor. 521 s.

8. Yaremchuk OS, Zakharenko MO, Kurbatova IM (2010). Ethological and sanitary-hygienic aspects of monitoring of livestock enterprises. Collection of scientific works of Vinnytsia National Agrarian University. Vinnytsia: Series: Agricultural sciences. Vip. 5. pp. 152-154.

9. Yaremchuk OS, Varpikhovsky RL (2014). Chemical composition and properties of heifer excrement for different ways of keeping. Scientific Bulletin of Lviv National University of Veterinary Medicine and Biotechnology. SZ Gzhytsky. Lviv: Series: Agricultural Sciences. T. 16, № 2 (59). Ch. 3. S. 247-252.