DEVELOPMENT OF A METHODOLOGY FOR CALCULATING THE WORKING CHAMBER OF A COMBINED DRYING AND GRINDING PROCESSES EQUIPMENT

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Abstract
In Ukraine, the utilization of organic waste from poultry production remains one of the priority tasks of the state environmental policy. Chicken production reaches millions of tons per year [1]. Organic waste also reaches millions of tons per year. The introduction of technologies and equipment is very important for the national economy [2-4]. Organic processing products can be used both in energy plants or as organic fertilizers.
Keywords: *organic waste, biomass, utilization, drying plants, engineering calculation*

Introduction. Ukraine has a high level of development of industry, agriculture and consumption. As a result of incomplete use of extracted substances and products of their processing, a significant amount of waste is returned to the natural environment, polluting soils, water bodies, and air. Landfills occupy large areas, the land under them has been out of production for a long time, and they pollute the natural environment. The main reasons for waste generation: lack of effective technological processes and capacities for processing residual products, spatial and chronological discontinuity of waste generation processes and their use, lack of a sufficient sales market.

Materials and methods. The obtained experimental data on the physical and mechanical characteristics and thermophysical properties and on the kinetics of the drying process of single elements of small geometric sizes of chicken manure and the study of heat and mass transfer processes that were carried out at the experimental facility were used in the creation of a methodology for engineering calculation of a heat-labile materials processing facility operating using the method of combined drying and grinding processes.

The scheme of the experimental facility for combined drying and dispersion processes is given in Fig.1. Fig.1 shows the calculation scheme of the working chamber with overall dimensions.

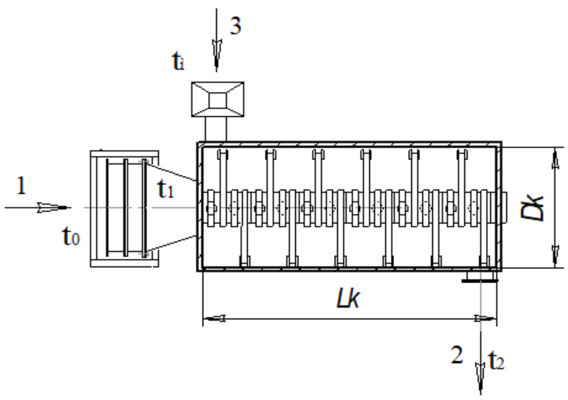

Fig. 1. Calculation diagram of the chamber of combined processes:
1 – inlet of atmospheric air into the heat generator; 2 – outlet of the gas-dispersed flow from the installation and the finished product; 3 – loading of the initial raw materials.

Fig. 2 presents the structure of the methodology in the form of an algorithm.

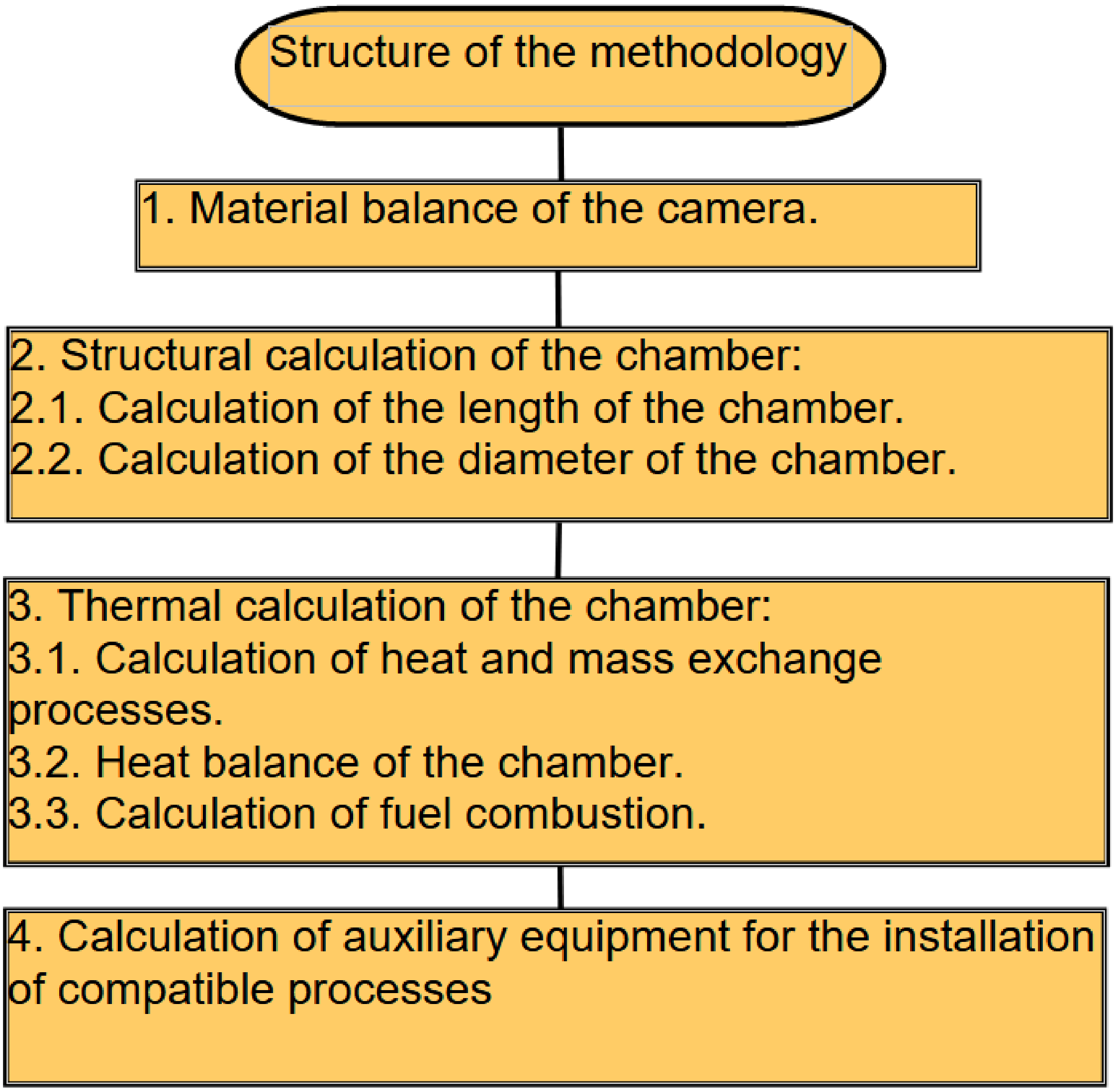

Fig. 2. Structure of the method for calculating the working chamber of a combined drying and grinding process installation.

Results and discussion. As a result of research at an industrial research facility, the average specific heat consumption per 1 kg of evaporated moisture is from 3100 to 3700 kJ/kg of evaporated moisture.

As a result of the developed methodology and calculations, fig. 3 presents the data obtained with the following process parameters:

Raw material humidity: initial – W=80%; final – W=17%.

Heat carrier temperature: t1= 700ºC; t2=120ºC.

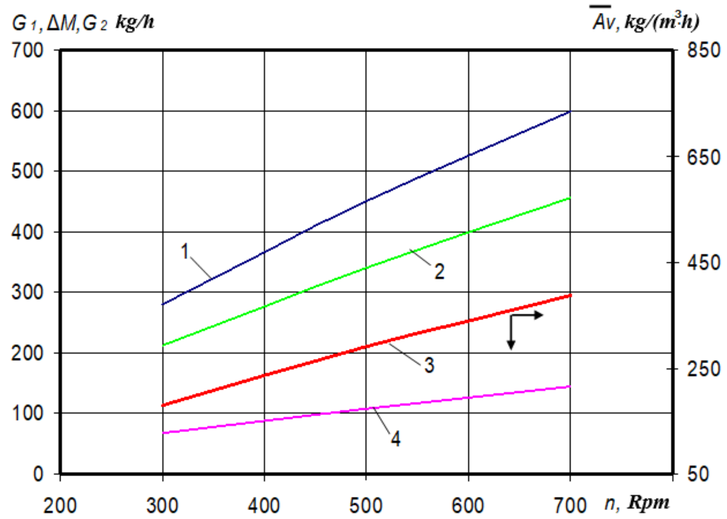

Fig. 3. Calculation data obtained using the developed methodology for engineering calculation of the working chamber of the installation of combined drying and grinding processes: 1 – chamber productivity for raw materials from the number of rotor revolutions n, kg/h; 2 – amount of evaporated moisture from the number of rotor revolutions n, kg/h; 3 – change in the average volumetric stress of the chamber from the number of rotor revolutions n, kg/(m³·h); 4 – chamber productivity for the finished product from the number of rotor revolutions n, kg/h.

Analysis of fig. 3 shows that an increase in the number of shaft revolutions by 2.3 times leads to an increase in productivity in raw materials by 2.3 times, in finished product by 2.1 times, in the amount of evaporated moisture by 2.1 times, and an increase in the average volumetric stress of the working chamber by 2.3 times.

Conclusions. As a result of the work, a methodology for engineering calculation of the working chamber and auxiliary equipment of the combined drying and grinding process installation was developed.

The calculated data obtained using the developed methodology for engineering calculation of the working chamber of the combined drying and grinding process installation from the productivity of the chamber for raw materials, the amount of evaporated moisture, the average volumetric stress of the working chamber, the productivity of the chamber for the finished product from the number of rotor revolutions make it possible to select equipment for forming a technological line for the production of organo-mineral fertilizers based on chicken manure and other similar products.

References:

1. Ukraine S. S. C. o. State statistics committee of ukraine. URL: http://www.ukrstat.gov.ua.

2. Ляшенко А. В. Аналіз способів інтенсифікації тепломасообміну в процесі сушіння та особливості зневоднення термолабільних органічних матеріалів. *Технологический аудит и резервы производства*. 2015. No. 4/4 (24). P. 16–19. URL: https://doi.org/10.15587/2312-8372.2015.47597.

3. Liashenko A. Intensification of heat and mass transfer and dewatering of thermolabile organic materials. *Наукові праці ОНАХТ: енергоефективні процеси і обладнання харчових виробництв*. 2021. No. 85. P. 63–68. URL: https://doi.org/10.15673/swonaft.vi1.2071.

4. Ляшенко А. В. Визначення теплофізичних властивостей органічних відходів птаховиробництв. *Енергетика і автоматика*. 2022. No. 3. P. 50–61. URL: https://doi.org/10.31548/energiya2022.03.050.