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ANALYSIS OF TECHNOLOGIES FOR PROCESSING POULTRY WASTE BY GRANULATION AND DRYING

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At present, the technology of applying organic fertilizer in the form of simple composts is low-cost due to high transportation costs. Unlike mineral fertilizers, organic fertilizers are still applied by scattering in fields with subsequent plowing (humus) or by spraying from mobile tanks (liquid fertilizers) [1].

Therefore, in our opinion, the most effective way to dispose of chicken manure is application of granulation followed by dehumidification. The advantages of this scheme are the following considerations [1,2]:

- fertilizer is virtually sterile from pathogenic microflora and weed seeds;
- dried at relatively low temperatures manure contains 80-85% organic matter, 4-5, 5% nitrogen, 2,6-2,8% P_2O5, 1,3-1,8% K_2O;
- after thermal drying, the mass of manure decreases by 3-4 times, therefore;
- now all serial agricultural machinery is fully adapted for the application of fertilizers in granular form.

The most common methods of granulation: extrusion, in the fluidized state, powder pressing. Extrusion granulation is carried out in special installations - press granulators with an annular or flat matrix. The granulator consists of a press mounted on a frame and a mixer [2]. The press is designed to form granules by pushing it with pressing rollers through the radial holes of the annular matrix.

The formation of granules in a fluidized state occurs by spraying liquid manure with nozzles into the free volume of the dryer, followed by pressing the formed powder. The disadvantages are [1,2]:

1) inefficient disinfection of pathogenic microorganisms after a short stay (15-20 s) in the flame of the torch - the microorganisms are in the thermal insulation of the upper layer of particles;

2) high residual moisture (within 18-20%), because the granulation by pressing is impossible at lower humidity, and, as a consequence, the inplasticity of the molded mass;

3) low bulk density of the granular product, which increases the cost of packaging, storage facilities, transportation.

The heat exchange process during granulation in fluidized bed apparatus differs from drying in that liquid and organic particles 10-20 μm in size are constantly fed to the surface of the granules. The intensity of heat exchange depends on the air temperature and the flow rate of the coolant, particle size and their physicochemical properties [3].

In contrast to raw chicken manure, dried manure (powder) has a low bulk density (0,25-0,3 t/m^3), that is high ability to dust. To avoid this disadvantage, the manure must be granulated. Granular manure has a bulk density of 0,6-0,65 t/m^3, which can at least halve the area of storage warehouses, increases environmental safety for workers.

Table 1 presents the numerical indicators of changes in mass and volume of manure due to drying, granulation and incineration.

Table 1

Indicators of change in mass and volume required for manure storage

Physical state of chicken manure	Weight from the initial quantity, %	Required storage volume, m^3
Raw chicken manure (humidity 70%)	100	1,5
Dried manure (powder)	35	4,0
Granulated manure	35	1,5
Ash (after burning)	3,5	5,0

The disadvantage is the high cost of the coolant. 450-500 kg of standard fuel must be used to dry 1 ton of manure.

Thermal drying of manure takes place in special installations (dryers) of different types: drum (direct-flow or counter-current), mine-drum, fluidized bed dryers, dryers contact (conductive) drying, tunnel and belt drying [4]. In drum-type installations, manure is dried by spilling from blade to blade during drum rotation. The supply of coolant (hot air or flue gases) is direct or countercurrent. In tunnel-type installations, drying takes place while traveling by rail in a tunnel with brick walls. Hot air heated by heaters is used as the coolant. In belt-type plants, the coolant circulates everywhere from bottom to top, from top to bottom, along the conveyor in a direct or countercurrent manner.

The drying temperature can range from 80 °C to 100 °C, depending on the type of dryer. The main goal is to destroy pathogenic bacteria, viruses, larvae and eggs of helminths. In direct-flow dryers, the manure is disinfected at the temperature of the inlet gases from 800 °C to 1000 °C, the outlet from 120 °C to 140 °C and the exposure for at least 30 minutes. In countercurrent dryers, decontamination of raw materials is provided at the temperature of the input gases from 600 °C to 700 °C, in the drum from 220 °C to 240 °C, gases at the outlet of the drum from 100 °C to 110 °C and exposure from 50 to 60 min. The temperature of the manure in this case does not exceed 90 °C. The product is dried to a humidity of 10-12% [5].

Chicken manure, dried at a temperature of 600-700 °C, loses up to 18-50% of total nitrogen [5], up to 4-12% of inorganic manure and up to 6-18% of potassium.

Presents the results of research on the kinetics of manure drying in a wide range of changes in thermal loads (from 70 to 700 °C) and particle size (from 1 to 6 mm), as well as at different velocities of the coolant (1-3-5 m / s), that can be used for the method of calculating the drying installation. Particles with sizes 4 - 6 mm in the process of drying above T = 500 °C began to ignite without reaching the equilibrium moisture. Heat treatment of raw materials is carried out in an oven countercurrent with the coolant in three stages: at a temperature of 90-100 °C in the first stage, 270 °C in the second stage, 650-700 °C in the third stage. Conducting the process with a gradual increase in temperature allows you to lose a significant portion of valuable nitrogen due to the release of ammonia.

The method provides for heat treatment of raw materials with heat carrier in a drying chamber of drum type at the initial stage at T = 1200 °C and temperature reduction to 400-600 °C at the final stage with humidity of the finished product 10-12% [5,6]. The disadvantage of this method is the loss of the organic part of the manure, high heat treatment temperature, which can lead to changes in the microclimate, as well as a long process time (5 hours). the movement is a gradual heating of the mass. After reaching the zone of maximum temperatures, a reversal of 180° is performed, and then the movement continues to flow directly with hot gases. At the same time there is a gravitational separation by the fractional composition of the finished crushed product [7].

Therefore, it can be concluded that granulation followed by thermal drying is the optimal solution to the problem of preserving all the positive qualities of chicken manure. The temperature inside the chamber rises to 70-90 °C due to friction during grinding. Dehydrated thus the product is returned to the main mass in order to form granules (humidity is then reduced from 70 to 65%). The obtained granules are dried to a humidity of 35%. The disadvantage of this method is the emission of ammonia, pathogenic microorganisms remain, wet straw straw is difficult to grind.

Analysis of these examples shows that new types of fertilizers are being developed that are more efficient than traditional mineral and organic fertilizers. We are looking for ways to increase the duration of action and reduce the proportion of lost nitrogen. Processing of chicken manure requires the preservation of certain parameters of the material - the appropriate humidity, fineness and homogeneity of the mass [1,5,8]. All this will determine the further selection of technology for the production of organic fertilizers. The advantages of granular organic fertilizers are ease of transportation and application to the soil for the consumer; easy dosing of fertilizer directly into the hole (point or local application) contributes to the uniformity of their distribution, which significantly increases the agrochemical efficiency. Thanks to granulation, fertilizers better retain their marketable appearance, do not dust, and are slowly washed away by groundwater. Granular fertilizers have high flowability and density, narrow particle size distribution, which facilitates pneumatic transport, dosing, packaging, automation and mechanization of production processes.

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