On the development of technology for obtaining organomineral fertilizers

D N Klyosov and A A Orekhovsky

FSBEI HE Belgorod SAU, 1, street Vavilova, pos. Mayskiy, Belgorod region, 308503, Russian Federation

E-mail: klyosov_dn@bsaa.edu.ru

Abstract. The article deals with the problem of processing organic waste of animal husbandry in order to obtain granular organic mineral fertilizers. A technology was developed for the production of granulated organomineral fertilizers of a wide range based on cattle and pig manure or bird droppings with the addition of zeolite and mineral salts. The resulting fertilizer has good physical properties.

1. Introduction

Belgorod region is a dynamically developing industrial-agricultural region of Russia, having, according to independent experts, stable and favorable investment climate contributing to the prosperity of local animal husbandry number of cattle from 2000 to the present day has decreased to 1.98 times (227.5 thousand heads), and the number of pigs and poultry, increased 9.64 (4057.7 in thousand heads) and 6.96 times (44001.6 thousand heads), respectively [1-5].

In this regard, there is a problem of processing and disposal of animal waste. One of the promising ways to solve this problem is to develop a technology for producing organomineral fertilizers from cattle manure, pig manure and poultry manure with the addition of mineral components [6-12].

2. Materials and methods

In this paper, the aim of the research was to develop a technology for producing organomineral fertilizers. In the modern world, there are many types of organomineral fertilizers, but some are too expensive, others are difficult to obtain, and have rare components in their composition. Our technology allows you to avoid these disadvantages.

As an organic component, it is proposed to use cattle manure, pig manure or bird droppings, and as a mineral raw material – zeolites represented by zeolite-containing trepeles of the khotynets Deposit (Oryol region) with the following indicators: pH=8.3, the content of calcium oxide-8.17%, magnesium oxide-2.2, potassium oxide-1.82, zinc-7.4*10-3, manganese-4.6*10-3, copper-2.7*10-3, molybdenum-0.72*10-3, cobalt-0.12*10-3. The crystal structure of zeolite contains: clinoptilolite - 35%, cristobalite-27 %, montmorillonite-5, mica-8, calcite 3, the cation exchange capacity reaches 600 m-EQ/100 g, and to increase the content of nutrients – salts of alkaline or alkaline earth metals.

The implementation of the technology for processing manure or manure provides for the following conditions:

- Simplicity of the processing method;
- Minimization of energy costs;
• Preservation of product quality during long-term storage and transportation;
• Processing of both manure and manure of different humidity and content of pollutants (straw, feather, etc.) using the same technology.

3. Results
We have developed a technology for producing organomineral fertilizers from cattle manure, pig manure or poultry manure with the addition of a mineral component. The main stages of it are shown in figure 1.

![Diagram of the technology](image)

**Figure 1.** The stages of the technology of obtaining organic and mineral fertilizers.

4. Discussion
The essence of the technological process consists in the following operations. Cattle manure is loaded on a loader, moved to the processing line, where it is moved by means of a "movable floor" on a chain conveyor. The manure moves at an adjustable speed due to the movement of the "movable floor" blades, which are controlled by a hydraulic drive. After that, the manure enters the dryer-chopper.

In the dryer, the manure is first dried, and then crushed. This is due to the supply of warm air to the chamber. This process occurs at a given frequency and is controlled from the control panel. At the exit of the chamber there is a filter that passes small and dry particles of manure, and larger and smaller ones are returned back to the chamber of the dryer-shredder. This will be repeated until all particles pass through the output filter.
After leaving the chamber of the dryer-shredder, dried and crushed manure particles enter the disk separator, where they are mixed with mineral salts. From there, the resulting fertilizer is fed by means of a screw conveyor to the granulator chamber, where the mixture is granulated under high pressure. After that, the pre-crushed zeolite is sprayed onto the obtained granules. This procedure allows you to reduce caking, as well as increase the strength by 35-40%.

Then the pellets are cut to the required size using a stationary knife. They have a high temperature, low strength, so with the help of a screw conveyor with an adjustable speed of movement they are fed into the cooler chamber. Here, with the help of a cyclone, air is sucked in to cool the pellets. In addition, ungranulated particles are removed. As a result of cooling, the moisture content of the granules decreases, and the physical and chemical properties change.

After cooling, the pellets are fed to the sorting center, where they are divided into suitable pellets and defective ones. Suitable pellets enter the discharge pipe, and from there to the conveyor of finished products, and defective ones are sent to the shredder and repeat the entire process of obtaining fertilizer pellets.

From the conveyor of the finished product, the pellets enter the filling chamber, where the fertilizer pellets are scattered on the package. Packed and sealed bags are also weighed here. After that, with the help of a loader, they are moved to the warehouse for subsequent storage and sale.

5. Conclusion

Thus, it can be concluded that a new technology has been developed for the production of granular organomineral fertilizers of a wide range, which have a number of advantages over traditional organic and mineral fertilizers:

- Contain the entire complex of essential nutrients;
- Do not contain pathogenic microflora, weed seeds, eggs and larvae of pathogens;
- Have the possibility of local machine application of serial agricultural machinery;
- Do not stick, are not subject to self-heating and self-ignition,
- Shelf life is not limited, practically do not lose their properties even after opening the package;
- Eco-friendly, do not have a strong unpleasant smell;
- Non-toxic, with skin contact do not have a harmful effect on the human body.

References

[1] Belgorod statistical yearbook 2019 (Belgorod: Belgorodstat) 600
[2] Zdorovets Yu I and Goncharenko O V 2014 Assessment of the economic efficiency of pig breeding in large integrated structures of the Belgorod region. Economic analysis: theory and practice 1(352) 35-41
[3] Turianskii A V, Dorofeev A F, Akinchin A V, Linkov S A and Stupakov A G 2018 Agroecological and economic substantiation of agriculture biologization elements. Research journal of pharmaceutical, biological and chemical sciences 9(5) 1836-45
[4] Shinkarenko O, Kolesnikov A and Smurov S 2020 Economic feasibility of organic agriculture in the Belgorod region. Revista turismo estudios & practicas 54 7
[5] Stupakov A G, Orekhovskaya A A, Kulikova M A, Manokhina L A, Panin S I and Geltukhina V I 2019 Ecological and agrochemical bases of the nitrogen regime of typical chernozem depending on agrotechnical methods. IOP Conf. Series: Earth and Environmental Science 315 052027
[6] Budaeva A D, Antropova I G, Alekseeva E N and Khomoksonova D P 2017 Production of organomineral fertilizers from coal mining waste and mineral raw materials. International research journal 12-3(66) 85-88
[7] Dzhanmuldaeva Z K, Kadirbaeva A A, Seitmagzimova G M, Altybaye, Z M and Shapalov S K 2018 On the method of manufacture of organomineral fertilizer based on double superphosphate. News of the National Academy of Sciences of the Republic of Kazakhstan,
Series of Geology and Technical Sciences 3(429) 218-22

[8] Gribut E A, Kulikova M A and Kasharin D V 2020 Optimization of organic fertilizers production technology for fractional separation of biodegradable organic waste. Materials of the 3rd International Conference on Agribusiness, Environmental Engineering and Biotechnologies Krasnoyarsk 548(5) 162670

[9] Lyaskovsky M I 1998 New forms of complex organomineral fertilizers as a factor for sustainable development of biosphere and plant productivity. Acta agronomica hungarica 46(3) 237-57

[10] Miroshnichenko I V, Nikulina N V and Petrosov D A 2020 Prospects for processing manure into biogas when using the probiotic drug "Amilocin" in the diet of chickens. Biotechnology 36(5) 72-80

[11] Naliukhin A N, Glinushkin A P, Khamitova S M and Avdeev Yu M 2018 The influence of biomodified fertilizers on the productivity of crops and biological properties of soddy-podzolic soils. Entomology and applied science letters 5(3) 1-7

[12] Skovorodnikov P V and Cherepanova M V 2017 Methods of granulation of organo-mineral fertilizers. Bulletin of the Perm national research Polytechnic University. Chemical technology and biotechnology 3 117-27