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TECHNOLOGIES AND TECHNICAL MEANS FOR INTRODUCING ORGANIC FERTILIZERS

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Abstract

Analysis of the current state of livestock farming in the Republic of Kazakhstan, as well as statistics on the number of livestock enterprises and farms, on solving the issues of efficient use of livestock waste as organic fertilizers and considering world experience in this industry, it was decided to create a machine for spreading domestic fertilizers. A review of existing technological machines produced abroad was carried out and some of the disadvantages of foreign analogues were considered when designing this machine. For spreading solid organic fertilizers, manure, composts and peat, and for transporting agricultural goods, we have designed an organic fertilizer spreader. All design and technological parameters of the designed organic fertilizer spreader were determined and, using Autodesk Inventor, a three-dimensional solid-state and surface parametric design (CAD) system, the design documentation of the spreader was created.

Key words: livestock waste, manure, organic fertilizer, manure spreading machine, design and technological parameters, design documentation.

Introduction

Against the background of priority issues of preserving human health, the current situation in world agriculture served as an incentive for the development of the so-called "organic" (synonyms: ecological, biological, alternative) agriculture.

Organic agriculture implies a system of agricultural production, which is less negative than traditional technologies, affects the environment and natural resources and allows to get environmentally friendly food.

Organic farming began to take shape in the United States and Western Europe in the 1970s. These countries showed the highest rates of intensification in agriculture, and they were the first to realize the negative effects of the use of a large number of chemical fertilizers, plant protection products and animal products. Organic agriculture gained rapid

development after 1990, when the area of organic agricultural land increased on average by 30% per year.

Currently, 41.9 million hectares of agricultural land are involved in organic farming in the world, which is 0.9% of their total area. Wild areas also belong to them. Since 2008, this indicator has increased by 10 million hectares (24%) [1, 2].

The situation on the global market for organic products is characterized by steady growth by an average of 15% per year, but in the coming years, as several Western experts predict, growth will increase substantially - up to 50% per year. According to international organizations (FiBL, IFOAM), environmentally friendly products are produced in 160 countries, 84 countries have introduced international organic standards.

In recent years, organic livestock has gained significant development. So, the production of organic beef in Germany amounted to 39.5 thousand tons, milk - 595.3 thousand tons. In the whole European Union, since 2005, there has been a steady increase in the number of farm animals in the organic livestock sector: sheep - from 2.5 to 3.5 million heads, cattle - from 2.2 million to 2.8 million heads A significant role in the production of organic livestock products is played by organic pastures, the share of which reaches 44% of the total organic agricultural land of the European Union [3].

In a relatively short period of time, organic agriculture has developed into an independent agricultural sector, with its own instruments of state support, a system of certification and promotion of products on the market.

In Asia, about 10% of the world's organic agricultural land is concentrated. The leaders in this indicator are China (2.3 million ha), India (528 thousand ha) and Indonesia (41 thousand ha). In the CIS countries, organic agriculture is at an early stage of development. However, close attention is being paid to it by national governments. For example, in Moldova, 35 thousand hectares of agricultural land are involved in organic production (3% of the total area in the country). Ukraine in 2009 took the 20th place in the world in the number of agricultural land under biologically clean farms (280 thousand hectares). In the Russian Federation there are more and more prerequisites for the production of environmental products and the creation of a market for organic products. Despite the significant potential in the Republic of Kazakhstan, this area has not yet received significant development in both science and industry.

Northern and Central Kazakhstan have sufficient conditions for the production of organic products, namely, the presence of extensive, ecologically clean agricultural land, a large number of agricultural entities, and the provision of a concentration of cattle in large farms due to the transition of households to the production of organic products that are more profitable in conditions of small production. The possibilities of fermentation of organic waste in the conditions of Northern and Central

Kazakhstan will also be studied in order to economically generate energy to meet the needs of rural residents.

The number of cattle currently in Kazakhstan is 8.79 million heads and has a tendency to increase from 5% to 20% annually [4]. At the same time, the output of manure from one conditional head of cattle for a stall period (200-210 days) is 9.5 tons and in the whole country is 83.5 million tons, which makes it necessary to store and dispose of it. The problem of utilization and storage of manure is aggravated every year, however, according to established practice, these issues are resolved last. But the increase in the profitability of livestock and agricultural enterprises directly depends on the efficiency of the use of organic fertilizers.

A review and analysis of methods for solving the problem of manure utilization shows that the effectiveness of this process depends on a very large number of influencing factors: production volumes, climatic features of livestock breeding areas, features of applied technologies and technical means, and environmental requirements for environmental protection. Changes in these factors determine the costs of implementing a particular technology for the disposal of manure. However, all existing methods for the disposal of manure require significant capital investments and currently farmers in our country can not afford it.

Research methods

One of the main reserves for increasing the yield of all crops is the use of fertilizers. In the changing economic conditions, agricultural producers are forced to use expensive mineral fertilizer as economically as possible and gradually switch to affordable organic fertilizer - manure. Currently, for the conditions of our country, the most promising way to solve the problem is the use of manure as organic fertilizer. Manure is the main organic fertilizer containing nitrogen, phosphorus, potassium, calcium, trace elements. It not only stimulates the vital activity of plants, but also improves the physical properties of the soil: clay becomes looser, sand becomes denser. The composition of manure depends on the type of animal, feed, litter and duration of storage. In terms of nutrient content, horse and cattle manure is of the greatest value.

Semi-rotted manure is usually used as fertilizer. It is not recommended to bring it to a rotted state due to large losses of nutrients (therefore, it is not recommended to store manure for a long time). Fresh manure is also undesirable because of the large amount of weed seeds in it. When calculating the dose of manure, you should know that in the first two years after application it contains (kg per 1 ton): nitrogen 1.5, phosphorus 2, potassium 3.5.

Accordingly, the interest and requirements of farmers to technologies and means of mechanizing the application of organic fertilizers increase, the task of which is to reduce labor costs for soil cultivation, improve soil structure, increase its biological activity and, of

course, increase the quantity and quality of the crop. The following fertilizer application schemes are used: once-through, reloading, transshipment and spreading of fertilizers from heaps. Solid organic fertilizers are applied mainly according to two technological schemes: once-through and transshipment. With direct-flow technology, fertilizers are transported from the accumulation places and brought in by mobile spreaders without burling in the field, followed by incorporation into the soil. Such a scheme is used only for a short transportation distance (up to 8 km) and in spring-autumn sowing companies, during periods when they are closed up after the application of solid organic fertilizers. Transshipment technology at a considerable distance from the place of accumulation has the same time limitations. In this case, fertilizers are transported by tractor trailers or dump trucks to the field and then loaded into low loader spreaders, which they bring to the soil surface or are unloaded onto the field in separate piles in a checkerboard pattern with a distance in rows of 30-60 m, of which they are scattered by rotary spreaders. Fertilizers uniformly distributed over the surface of the field are immediately embedded in the soil.

Key results

Agrotechnical requirements and quality control of the application of organic fertilizers. The quality of manure and compost components is controlled by the following main indicators: humidity, ash content, organic matter content, medium reaction, gross content of nitrogen, phosphorus and potassium.

Agroecological requirements for the quality of non-traditional solid organic fertilizers include control over the content of heavy metals, radionuclides, other toxicants, the presence of pathogens and helminths.

The quality assessment of solid organic fertilizers is carried out by service divisions of the agrochemical service within 10 days after delivery of representative samples for analysis, taken no earlier than 2 months before fertilizing the soil.

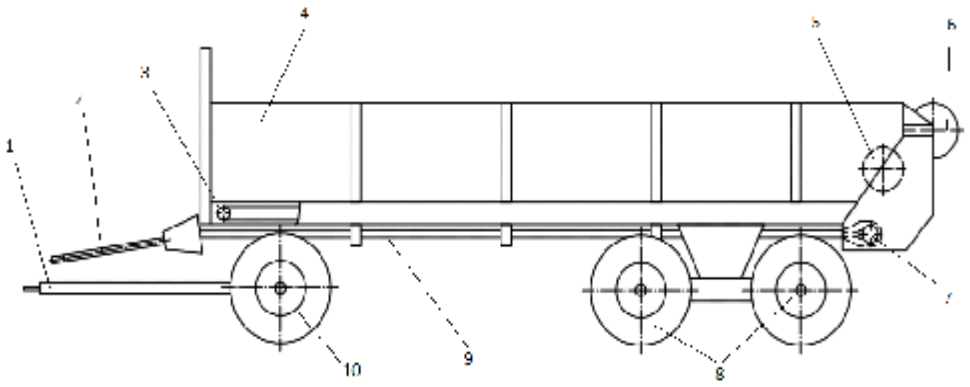
When applying solid organic fertilizers, the following basic agrotechnical requirements must be observed: constant speed of the unit moving in the field of 7-12 km/h; deviations of the actual application rate from the target should not deviate%; uneven distribution of fertilizers across the working width%; instability of the application rate in the direction of movement of the unit%; there should be no blemishes and missed areas on the field. When using fertilizer spreaders, it is necessary to control the speed of the unit and the working width. The actual working width is determined in at least five places along the headland, as well as when the unit enters and exits into operating mode. The presence of flaws in the field, overlap at the butt passages, the quality of application on the headlands, the loss of fertilizer at the loading point is determined visually. Organic fertilizers uniformly distributed over the soil surface must be embedded in the soil to the required depth with general tillage implements in

compliance with established agrotechnical requirements.

Depending on the type of fertilizer, method and technology of their application, choose one or another complex of machines.

In Kazakhstan, foreign machines are mainly used to apply organic fertilizers to the soil. Organic fertilizer spreaders are produced in Europe, North America, the CIS countries and the customs union. The world leaders in the production of such machines are KUHN, OPTIUM, Ferti-Cargo, Herkules, Titan, Bergmann, LMRAzene-PTU, etc. From neighboring countries, we are importing the brands Host, PRT, ROUM, MTT, MTU, Giant, Pronar and many othersю The main importers are Russia, Ukraine and Belarus, as their machines are more affordable at a price than competitors from far abroad. In direct-flow technology, spreaders like PRT-10 and PRT-16 are loaded with fertilizers using a single-bucket excavator EO-2515, loaders PFP-1.2 and PE-0.8B. When spreading fertilizers, the aggregates move in the field by shuttle. Recommended speeds are 10 ... 12 km/h. When spreading fertilizers from heaps with RUN-15B rotary spreaders, organic fertilizers are laid out in a checkerboard pattern in heaps weighing no more than 3 tons. The distance between the rows should equal the width of the swather-spreader, and the distance between the heaps in the rows is determined depending on the application rate fertilizers. It is recommended to work at a speed of 6 ... 8 km / h. In all of these technologies, loading and transport vehicles are used, which are available in farms in sufficient quantities; there are no directly domestic organic fertilizer spreaders. Having analyzed all the available information on the current state of livestock farming in the Republic of Kazakhstan, all the statistics on the number of livestock enterprises and farms, on their solution to the issues of efficient use of livestock waste as organic fertilizers, considering world experience in this industry, we decided to create a machine for spreading organic fertilizers of domestic production. A review was conducted of existing technological machines that are produced abroad. When designing this machine, several shortcomings of foreign analogues were taken into account.

For spreading solid organic fertilizers, manure, composts and peat, as well as for transporting agricultural goods, we designed an organic fertilizer spreader, Figure 1.



1 - tow hitch, 2 - driveshaft, 3 - feed conveyor, 4 - body, 5 - chopping drum, 6 - spreading drum, 7 - gearbox, 8 - rear wheels, 9 - countershaft, 10 - front wheels

Figure 1 - The technological scheme of the spreader of organic fertilizers

It has a body 4, along its bottom during operation the feed conveyor 3 moves, which is driven from the tractor power take-off shaft through gearbox 7 and conveyor drive mechanisms. Fertilizers are crushed by the grinding lower drum 5, and the upper drum 6 scatters them from the body. They are driven by a tractor PTO. On the drums there are plate coils directed from the middle to the ends with right and left windings, so that the width of the spread of fertilizers reaches 9 m.

The design parameters of the main working units of the developed spreader were determined as follows [5,6,7].

Body volume affects the capacity of the spreader and it is determined by the formula

(1)

where *L*-run length from loading to loading, м;

B-machine spreading width;

Q-organic fertilizer application rate, kg/ha;

- organic fertilizer density, kg/m3;

-coefficient of body utilization usage capacity equal to 0.85-0.9.

The estimated spreading width of the particles of organic fertilizers is taken equal to 9 m. The rate of application of organic fertilizers depends on the type and condition of the soil and the recommended range of norms is within 2 * 104-6.0 * 104 kg / ha. The density of organic fertilizers depends on many parameters, it is in the range of 400-1000 kg/m^3 [8].

We set the overall dimensions of the feed conveyor constructively in accordance with the dimensions of the body, and its remaining parameters are determined from the following terms:

(2)

(3)

where v_{mp} -conveyor speed, m/s;

b_{mp} -conveyor width, m;

h-reduced fertilizer conveyor thickness, m;

b-fertilizer spreading width, m;

$v_м$ -vehicle speed, м/с.

To ensure the normal operation of the spreading machine, it is necessary

$$Q_{mp} \, Q_{pom} \, , \tag{4}$$

or

$$hb_{mp}v_{mp} \, b_p h_p v_a \, , \tag{5}$$

where b_p-the capture width of the fertilizer mass with the rotor blade of the spreading machine, m;

h_p-capture height of the fertilizer mass with the rotor blade of the spreading machine, m;

v_a- the absolute velocity of the fertilizer particles when leaving the rotor, m/s.

The angular velocity of the rotor of the spreading device to ensure the estimated width of the machine is determined from the term:

(6)

where r-spreading machine rotor radius, m;

-angle of departure of fertilizer particles, degrees.

Conclusion

Given the calculated design and technological parameters of the machine using the above dependencies, we determined all the structural and technological parameters of the designed organic fertilizer spreader and, using Autodesk Inventor, Autodesk's three-dimensional solid-state and surface parametric design (CAD) system, created the spreader design documentation.

Currently, according to the working drawings, the working units of the organic fertilizer spreader are being manufactured for laboratory and field tests to clarify the design and technological parameters of the machine.

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ТЕХНОЛОГИИ И ТЕХНИЧЕСКИЕ СРЕДСТВА ДЛЯ ВНЕСЕНИЯ ОРГАНИЧЕСКИХ УДОБРЕНИЙ

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Резюме

Проведенный анализ состояния животноводства Республики Казахстан, показал, что создание машин для разбрасывания органических удобрений отечественного производства на сегодня необходимо. С учетом некоторых недостатков иностранных аналогов спроектирован разбрасыватель органических удобрений для разбрасывания твердых органических удобрений, навоза, компостов и торфа. Определены все конструктивные и технологические параметры проектируемого разбрасывателя органических удобрений и с помощью Autodesk Inventor, системы трехмерного твердотельного и поверхностного параметрического проектирования (САПР) создана конструкторская документация разбрасывателя.

Ключевые слова: отходы животноводства, навоз, органическое удобрение, машина для разбрасывания навоза, конструктивные и технологические параметры, конструкторская документация.

ОРГАНИКАЛЫҚ ТЫҢАЙТҚЫШТАРДЫ ЕНГІЗУГЕ АРНАЛҒАН ТЕХНОЛОГИЯЛАР МЕН ТЕХНИКАЛЫҚ ҚҰРАЛДАР

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Түйін

Қазақстан Республикасының мал шаруашылығының жағдайына жүргізілген талдау көрсеткендей, өндірісте органикалық тыңайтқыштарды шашуға арналған отандық машиналар жасау қазіргі таңда өте қажет. Шетелдік аналогтардың кейбір кемшіліктерін ескере отырып, қатты органикалық тыңайтқыштарды, қиды, компост пен шымтезекті шашуға арналған шашқыш жобаланған. Ұсынылған органикалық тыңайтқыштарды шашыратқыштың барлық конструктивтік және технологиялық параметрлері анықталып, Autodesk Inventor - үшөлшемді қатты денелі және беттік параметрлік жобалау жүйесі (ПЖЖ) көмегімен шашыратқыштың конструкторлық құжаттамасы жасалды.

Кілттік сөздер: мал шаруашылығының қалдықтары, қи, органикалық тыңайтқыш, қиды шашуға арналған машина, конструктивтік және технологиялық параметрлер, конструкторлық құжаттама.