Possibility of construction of mobile waste incineration plants for agricultural producers

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Abstract. Currently, the problem of waste disposal of agricultural products is becoming the most urgent due to the dynamic development of the agro-industrial complex, which is the leader among the manufacturing industries in terms of the amount of waste generated. This article is devoted to the possibility of building mobile waste incineration plants for agricultural producers. The branches of agricultural production were considered, the analysis of waste generated and methods of their disposal was carried out. Based on the study, a model of a mobile waste incineration plant was proposed, as well as the construction of sites for its placement. This installation will provide a faster and more convenient way to dispose of waste in agricultural production.

1 Introduction

Agriculture plays an important role in human life and is the main source of food, income and employment of the population. Today, this industry has a high rate of development. Over the next ten years, the volume of world agricultural and food production will continue to grow. It is expected that the total volume of food consumption will increase by 1.3 percent per year until 2032, which indicates an increase in the share of agricultural goods [1]. According to the Federal State Statistics Service in Russia, agricultural production has also shown positive dynamics in recent years (Figure 1).

In 2017, agricultural products worth 5109 billion rubles were produced, and in 2021 - 7710 billion rubles. Over 5 years, the indicators have grown by 50.91%.

In 2022, the agricultural production index was 110.2%; this means that farmers produced 10.2% more products than in 2021.

The development of the agricultural industry in Russia is associated with a number of reasons:

- dynamic population growth;
- technological progress (mechanization);
- infrastructure development;
- increase in acreage;
- the growth of import substitution.

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The processes of recycling and recycling of garbage do not keep up with the dynamic growth of agricultural products, so there is a problem of the presence of non-utilized waste and their negative effects on the environment. The device of a mobile waste incineration plant at the place of their formation is proposed.

2 Objectives

The relevance of the construction of a mobile waste incineration plant is justified by the fact that the processes of waste accumulation in the agro-industrial complex (AIC) are periodic and depend on the agricultural season. It should also be noted that some types of waste must be disposed of in a timely manner. This installation makes it possible to incinerate waste at the place of its formation, having a positive impact on the environment, reducing waste volumes, which is a useful addition to existing waste disposal methods.

3 Methods of disposal of agricultural waste

The agro-industrial complex (AIC) is divided into several branches, in each of which waste is generated [2] (Figure 2).
The processes of recycling and recycling of garbage do not keep up with the dynamic growth of agricultural products, so there is a problem of the presence of non-utilized waste and their negative effects on the environment. The device of a mobile waste incineration plant at the place of their formation is proposed.

The largest part of waste falls on the livestock industry (56%), the second place is occupied by crop production waste (35.6%). In accordance with Federal Law No. 89-FZ of "On Production and Consumption waste" waste is classified according to hazard classes:

- Class I - extremely hazardous waste;
- Class II - highly hazardous waste;
- Class III - moderately hazardous waste;
- Class IV - low-hazard waste;
- Class V - practically non-hazardous waste.

In agriculture, waste of hazard classes III, IV and V mainly prevail.

For example, plant-growing waste includes plant components of agricultural crops:

- Straw;
- Corn stalks;
- Sunflower stalks;
- Waste during harvesting of grain and leguminous crops.

These wastes are disposed of in several ways: composting, landfilling and burning. [3]

In animal husbandry there are wastes that remain as a result of the vital activity of farm animals, birds: [4]

- Waste from cattle breeding;
- Waste from breeding and keeping horses and other animals of the equine family of the order of ungulates;
- Sheep and goat breeding waste;
- Poultry farming waste;
- Waste from breeding and keeping other animals.

Animal waste is disposed of in such ways as: disposal of manure/litter, removal to fields, fermentation, vermiculation, thermal drying, processing of excrement into compost, etc. [5]

However, existing disposal methods have a number of disadvantages. For example, rotting waste is not the best solution, since waste will emit unpleasant odors. Some types of
crop waste, such as straw, tops, husks, under certain weather conditions can dry out, and not rot. Such piles of dried waste are dangerous due to their fire hazard.

Also, some animal husbandry waste must be disposed of immediately. These include meat, bones and animal skins. Meat waste decomposes under the influence of the environment. Bacteria and insect larvae multiply in spoiled meat, as well as toxins are released. All this can get into the soil or groundwater, which becomes dangerous for humans and animals. It is for this reason that these wastes are forbidden to be thrown into ravines and taken to landfills.

To solve this problem, it is proposed to consider the possibility of building a mobile waste incineration plant.

4 A model of a mobile waste incineration plant and a site for its placement

The waste incineration plant is a complex technical equipment designed for the efficient disposal of various types of waste by incineration.

This installation can burn waste at the place of its formation, which makes it possible to dispose of waste in a timely manner (Figure 3).

![Fig. 3. Layout of the mobile installation in agricultural fields.](image)

It is necessary to determine the optimal location for mobile waste incineration plants in the agro-industrial complex. The selected location must meet a number of criteria:

1. Waste application: The location should be close to the sources of waste generation in the agro-industrial complex. This reduces the cost of waste transportation and reduces the environmental burden.
2. Safety: The place must be safe for the installation and operation of the waste incinerator. This includes assessing the risks associated with fire, emissions and other potential hazards, as well as taking into account the sanitary protection zone.
3. Accessibility for personnel: The location must be accessible to the personnel working with the installation. This is important to ensure the safety and efficiency of work.
The site for the installation is a precast reinforced concrete road slabs. The advantage of these plates lies in the simplicity and high speed of installation, reduction of construction costs compared to other types of foundations, uniform redistribution of the load from the higher installation to the base and, accordingly, uniform precipitation. For ease of movement, this installation is located in a block container made of profiled sheets. The installation consists of several cameras connected to each other (Figure 4).

![Diagram of mobile installation site](image)

**Fig. 4.** a)‐plan of layout of the mobile installation site: 1-block container for installation; 2-waste container; b)‐section 1-1 of the mobile installation site.

The installation workflow includes the following components:

1. **Waste supply:** The waste to be disposed of enters the installation through a special receiving unit.

2. **Combustion chamber:** This is the main place where the incineration process takes place. The waste is subjected to high temperature and oxidizing conditions, which leads to its decomposition and transformation into ash and gases.

3. **Gas purification:** Gases generated during combustion may contain harmful substances and pollutants. The installation is equipped with a gas purification system that captures and removes these substances, reducing the negative impact on the environment.

The development of agriculture is accompanied by an increase in the need for electricity. Various renewable energy sources [6], such as the sun, wind, provide the opportunity to use...
installations with the help of which animal and bird feed is prepared, grain and hay are dried, fields are irrigated, products are processed, used for cultural and household purposes. A useful addition to existing sources of electricity can be the waste incineration plant described above, which can also generate electricity, where the waste itself plays the role of fuel. It should also be noted that due to the development of digitalization and automation, including agriculture, [7] this installation can be used for such needs as: recharging electric vehicles, batteries, temporary lighting of fields during harvest. Taking into account the above, the correct choice of location will minimize the negative impact on the environment, ensure safe and reliable operation of the installation, as well as achieve economic efficiency.

5 Conclusion

Having considered the possibility of building mobile waste incineration plants for agricultural producers and sites for their placement, we can talk about the sufficient effectiveness of their use. The analysis of a more rational location taking into account environmental, economic and transport factors is carried out. It is established that these installations can solve the problem with the accumulation of waste in agricultural production, ensuring their timely disposal and reducing the negative impact on the environment, as well as being a source of electricity for their own needs.

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