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Obtaining of wood waste based organic-mineral compost

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Abstract
The article discusses methods for producing organic-mineral compost based on low-value wood waste, including grinding wood waste, displacing it with urea, ammonium, nitrate (as a source of nitrogen) and adding ash from burning of wood waste (a source of phosphorus). The main goal of the work is to improve the method of producing organic-mineral compost from little-used wood waste and mineral fertilizers.
It was found that when the duration of the composting process is less than 40 days, the required degree of conversion of wood matter is not achieved. The composting period is more than 70 days, the intensity of composting increases, which leads to the loss of organic matter and nitrogen.

Keywords: wood waste, compost, ammonium nitrate, urea, ash, organic fertilizers

Introduction

In the current difficult financial and economic conditions of the activities of agricultural organizations, the main factor in increasing soil fertility and obtaining high yields of agricultural crops is the biologization of agriculture, aimed at the predominant use of biological rather than chemical and technical factors to increase the economic efficiency of agricultural production. The system of agricultural biologization assumes the use of a systematic approach. Currently, the problem of soil improvement is becoming more acute, because the process of degradation of arable land has accelerated significantly. This is due to a large number of reasons, but the main one is the uncontrolled use of mineral fertilizers by humans. And therefore, ensuring the replenishment of soil fertility, preventing the erosion of agricultural land, increasing the acidity of the lands used in agronomy comes to the fore. The leading powers set the preservation and restoration of soils as a national wealth and a strategic natural resource as a priority goal, because for society, the soil acts as a living space for the existence of people and as their economic basis. It is the fertility of the soil that constitutes the special productive force of the land, which has a significant impact on the productivity of labor in agriculture and the value of the production product. In addition, the process of increasing soil fertility ensures not only the sustainable development of agricultural production, but also, most importantly, increases the ecological sustainability of agricultural landscapes. As it is known, a person is unable to prevent dry or hot summer, but taking into account modern technologies, a person can significantly weaken the effect of drought on the final yield by increasing the moisture reserves in the soil and developing more hardy varieties and crops. However, the state of the soil plays a major role here. According to A.I. Shugurov, “The soil is a complex living body that cruelly takes revenge on a person for his mistakes”. And therefore, it is necessary to be very respectful to the needs of the soil. The fertile layer that has been formed for centuries thanks to microorganisms and plant matter can’t be used recklessly. It is not infinite, and its loss may turn out to be one of the most serious threats to the existence of humanity in general. The challenge facing the world community today is to create conditions for the life of soil microorganisms that will increase the volume of humus produced on arable land. Moreover, this should be done not by increasing the use of mineral fertilizers, but by using organic fertilizers. Unfortunately, the traditional fertilization system shows such significant shortcomings that its reform in favor of new methods of fertilizing arable land is not only desirable, but perhaps is the only way to ensure the preservation of soil fertility, and hence the yield of cultivated crops. And one of these methods is the use of very voluminous waste of various industries as fertilizers. Large-scale waste requires special storage conditions and often, despite all measures taken, significantly contaminate the land, taking precious hectares away from the growing humanity. In this case, an expedient and rational solution may be the use of these wastes containing nutrients and valuable substances as a secondary material resource. Degradation of the soil cover is one of the most acute problems of modern nature management. With the depletion of humus and biophilic elements in the soil, there is a sharp disruption of the organic and mineral nutrition of the soil biota, the conditions of oligotrophy increase, the overall biological activity and soil fertility decrease, and their resistance to erosion, chemical and bacterial pollution decreases [1]. The severity of this problem is aggravated by the lack of organic fertilizers, without which it is impossible to count on the reproduction of soil fertility [2].
The most economically feasible method of waste recycling is composting [3]. However, composting has a relatively low popularity compared to other methods of waste disposal due to its disadvantages such as a long production cycle and sometimes obtaining a product of unstable quality. Therefore, a lot of research in the field

of solid waste processing is devoted to ways to speed up the composting process [4, 5, 6]. To eliminate these disadvantages, we propose a method for producing organic-mineral compost based on low-value wood waste, including grinding wood waste, mixing it with urea, composting it during self-heating, and then lowering the temperature of the reaction mixture. As a source of nitrogen, ammonia nitrate is additionally used in an amount of 3-4%, which is introduced into the modified wood waste. Ash is used as a source of phosphorus in an amount of 4-6% from burning wood waste (bark from various types of woodworking). After composting the mixture and lowering its temperature, while stirring urea is added to the reaction mixture, 0.75% to the mass of the original mass of absolutely dry substance (a.d.s). Then they are piled and composted for 30-70 days.

Experimental Part

Waste of wood processing (bark from various types of woodworking) has been used as raw material. Large pieces of bark have been crushed (0.5 kg). The humidity was 70%. A weighed portion has been mixed with ammonium nitrate in an amount of 0.003 kg. This mixture is enriched with ash (ash mass - 0.01 kg - 2%). The compost is wrapped in plastic wrap. The composting process from its filling to the mixture takes no more than 40 days and it moistened as needed. When the temperature of the mass drops to 40°C, urea is introduced as 9×10^{-4} kg, mixed and composted for 70 days, keeping the humidity constant. Organomineral compost with a mass yield of 53% has been obtained.

Results and their discussion

A method for producing organic-mineral compost based on low-value wood waste, including crushing wood waste, mixing it with urea, as a nitrogen source, and with a source of phosphorus, rolling the resulting mixture, composting it during self-heating and the subsequent decrease in the temperature of the reaction mass, which is different the fact that ammonium nitrate is additionally used as a source of nitrogen in the amount of 3-4% of the mass of absolutely dry substance, which is introduced into the crushed wood waste together with a source of phosphorus, the resulting mixture is enriched with ash from burning wood waste in the amount of 4-6% of the mass of absolutely dry substance, after composting, displacement and lowering of its temperature, urea is introduced into the reaction mass with stirring in an amount of 0,75 % to the mass of the original a.d.s, piled and composited for 30 - 60 days.

The invention relates to the processing of low-value wastes of the timber industry and to agriculture, and in particular to the improvement of the method for the production of organomineral compost from little-used wood waste and mineral fertilizers.

The closest to the claimed method in terms of the technological essence and the achieved result is a method for producing organomineral compost, including grinding wood waste, mixing it with urea, superphosphate in an amount of 1% by the active ingredient to the mass of a.d.s. rolling and bioconversion of woody substance. The disadvantages of this method are significant nitrogen losses, reaching 12-25%, the absence of potassium and trace elements in the compost and a long composting period (at least 90 days).

The advantage of using ammonium nitrate and urea as nitrogen sources and their separate introduction into the compostable mass in comparison with the prototype is a significant reduction in nitrogen losses and organomireral compost.

The introduction of ammonium nitrate stimulates the process of assimilatory denitrification with its reduction to ammonia, which serves as a source of nitrogen for the development of microorganisms and bacteria that decompose wood matter. Denitrification is carried out by mesophilic microorganisms and thermophilic Microorganisms 55-65°C. Thus, the resulting ammonia form of nitrogen during the entire bioconversion process is completely consumed for the development of microorganisms that destroy wood matter, which can significantly reduce nitrogen losses.

The introduction of urea with the specified consumption with a decrease in the temperature conditions for the bioconversion of wood matter allows it to be uniformly converted by microorganisms into ammonia and carbon dioxide. Ammonia formed in small quantities is well absorbed by microorganisms and the developed porous structure of the degradable wood material, which can significantly reduce nitrogen losses. Simultaneously with the introduction of ash, organic-mineral compost is enriched with potassium salts and essential microelements.

From literary sources, it is not known the combined use of ammonium nitrate and urea as a source of nitrogen in organic-mineral compost, as well as the introduction into the reaction mixture with the additional introduction of wood ash in order to reduce nitrogen losses and accelerate the bioconversion of low-value wood waste, has been proposed for the first time. The mass consumption of ammonium nitrate and urea in the range of 3-4% and 0.75% to the mass of absolutely dry wood waste is determined from the conditions of nitrogen sufficiency for the bioconversion of wood matter. A decrease in the consumption of ammonium nitrate and urea below 3-0.75% of the mass of a.d.s. leads to an increase in the composting period and nitrogen losses. An increase in the consumption of ammonium nitrate and urea above the indicated upper limits, respectively, leads to intensive formation of ammonia and significant losses of nitrogen.

Ash consumption is selected based on the conditions for achieving the best result in bioconversion of nutrients from compost.

A decrease in ash consumption below 4% of the mass of a.d.s. leads to a lack of K + salts and microelements, which slows down the process of biodegradation of wood matter and nitrogen losses. An increase in ash consumption by more than 10% of the mass of dry matter leads to alkalization of the reaction mass and nitrogen

losses due to volatilization, as well as to the transition of phosphorus compounds into an insoluble form that is indigestible for plants and microorganisms.

Thus, the claimed method makes it possible to reduce the loss of nitrogen to 0.65 - 8.3% of the gross amount and, therefore, to bring its content in the initial product to 93-99 %. At the same time, the time of bioconversion of woody substance is reduced by 2 times in comparison with the prototype.

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