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Creation of a Mini Crusher-Grinder for Small Livestock Farms

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Abstract: The purpose of the study is to substantiate the parameters of a mini crusher-shredder for processing coarse feed stalks in farms. The feasibility of using a mini crusher-shredder for processing coarse feed in the conditions of farms and farms with a small number of animals, which has a rotary-type shredder that combines the operations of grinding and crushing, is justified. The research uses the laws and rules of mathematical statistics, mathematical planning of experiments, and the methods given in existing regulatory documents. Experimental studies were carried out to study the influence of the rotor parameters of the mini crusher-shredder on its quality performance. A compact crusher-shredder has been developed, which has a good visibility of the working bodies, high reliability and quality of work due to zoo technical requirements.

Keywords: animal husbandry, coarse feed, crusher-chopper, rotor, splitting, grinding.

Introduction. Livestock farming in Uzbekistan is one of the important branches of agriculture. Therefore, the Government of the Republic has paid great attention to the development of livestock farming according to the state program, the basis of which is the creation of small livestock farms with a small number of animals.

An increase in livestock production largely depends on the high-quality preparation of feed in accordance with animal requirements. Consequently, their rational use involves feeding animals only in a prepared form with high quality preparation, especially in the conditions of small-scale enterprises. An effective solution for farmer preparation of feed at livestock enterprises of small forms of farming while reducing labor costs is the use of rational resource-saving technical solutions [1].

Stem feeds contain a significant amount of energy, but due to the presence of indigestible fiber (up to 40%), they are very tough and, without prior preparation, are poorly eaten by animals, and as a result, only 30...35% is used energy contained in them [2]. In this regard, the rational use of stem feeds should be considered feeding them only in prepared form and of high quality.

One of the most important processes in the preparation of stem feeds is their grinding, which is a complex technological process that requires significant costs of material and technical labor - the preparation of rough stem feeds accounts for 15...25% of all labor costs and funds spent on obtaining livestock products [3].

For crushing stem feeds, grinders with hammer working bodies are mainly used. The latter have a number of advantages: they are universal in relation to the processing of feed with different humidity and physical and mechanical properties, simple in design, and reliable in operation. At the same time, they are characterized by high energy intensity of the process and significant unevenness in the granulometric composition of the grinding product [4].

Therefore, increasing the efficiency of the hammer rotor in stalk feed grinders is an urgent task, especially in today's conditions [5].

Adequate, balanced feeding remains a fundamental factor in the successful development of efficient livestock farming. Optimal results without the cost of additional expansion of the feed supply and increasing the number of livestock are achieved through balanced feeding of animals with prepared feed, ensuring easy digestibility of nutrients and their use by the animal's body with maximum efficiency. Thus, when feeding cows, milk yield increases by 5-9%, and weight gain in young animals during fattening increases by 10-15% compared to the indicators of alternate feeding of individual components of the diet [6].

The development of small livestock farms is closely related to the preparation of high-quality feed at lower material costs [7].

A significant reduction in operating costs and an increase in the quality of preparing feed from coarse stems of forage crops is possible by combining grinding and crushing operations in feed preparation machines [8].

Methods. It is known that crushed plant matter is better eaten by livestock and poultry, while the grinding of forage crops is carried out by machines directly on the field or at the stacking sites before feeding the animals. This technology leads to large losses of the feed components richest in carotene and nutrients: leaves, vegetative shoots and others [9].

In world practice, combined operations - grinding and crushing - are widely being introduced, i.e. The stems of forage crops are not only cut into small pieces, but also crushed (split), improving the quality of the feed when soaked and mixed with other concentrated feeds. In connection with the above, various harvesting machines and crushers of various types are currently used [10].

Rotary choppers differ from other types of choppers in their simplicity of design, low metal consumption, high operational reliability and are indispensable mechanisms on livestock farms, capable of quickly and without large labor costs preparing livestock feed [11].

In connection with the above, research aimed at finding a technological scheme and substantiating the parameters of a crusher-grinder, which helps improve the quality and technical and operational performance of the machine for small farms and dehkan livestock farms, are relevant and are of great importance in the national economy [12-13] .

Results and Discussion. In accordance with the purpose of the work, by studying the technological diagrams and operating processes of various grinders and crushers, we have developed a technological diagram of a crusher-grinder (Fig. 1), the principle of which is as follows: a bunch of roughage stalks is fed to the working rotor using a feed tray, which located at an angle relative to the rotor axis. In this case, the stems are fed for cutting at a certain angle, due to which the cutting of the stems with knives is improved. The incoming mass of stems at the entrance to the working chamber is captured and chopped into pieces by knives located in the front part of the rotor.

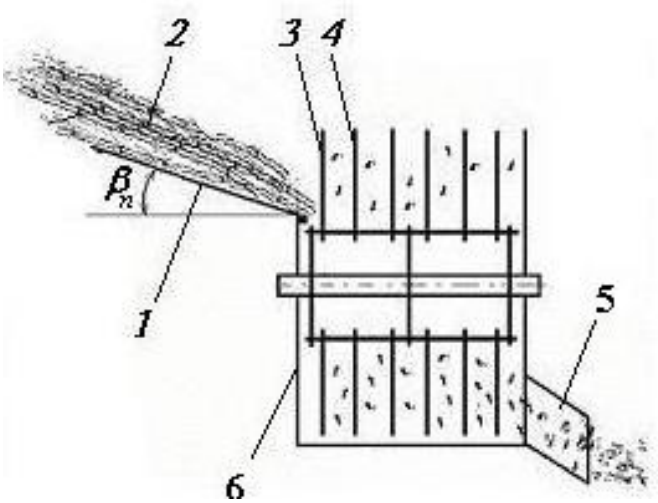

Fig. 1- Scheme of operation of the crusher-pulverizer
1 - feed tray; 2 – stem; 3 – knife; 4 – hammers; 5- ejection window; 6 - corpus.

Grinding the stems improves the uniformity of the processed material with hammers, which are located after a row of knives. Cut pieces of stems are struck by hammers, split and moved from the entrance to the exit of the working chamber. The crushed mass, moving from input to output, is processed along the entire length of the rotor several times and this ensures high completeness of crushing of the stems. The movement of the mass is carried out due to the location of the hammers at an angle relative to the axis of rotation of the rotor and the sharpening of their lower part, which leads to forced movement of the mass due to friction forces and the creation of an air flow towards the unloading window, which also shifts the mass towards the exit from the working chamber.

Based on the study of the operating principle of the crusher-grinder, theoretical studies were carried out to substantiate the parameters and operating modes of its working parts.

Based on the results of the research, the following conclusions can be drawn:

An analysis of the operation of feed preparation machines has shown that in the conditions of farms with a small number of animals, it is advisable to use a simple mini crusher-grinder with a rotary-type grinding apparatus that combines grinding and crushing operations for processing roughage.

Conclusions. Studies of various types and shapes of the working bodies of the crusher-grinder have established that for processing the stems of roughage, the most suitable is a hammer rotor, which has rotated hammers with lower sharpening, which ensure the quality of crushing the stems up to 93.2% and their splitting up to 84.9%. without disturbing the technological process.

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