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STUDY OF PHYSICAL AND MECHANICAL PROPERTIES OF LOCALLY DISPERSED FEED MIXTURE COMPONENTS IN OPTIMAL COMPOSITION

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ИЗУЧЕНИЕ ФИЗИКО-МЕХАНИЧЕСКИХ СВОЙСТВ ЛОКАЛЬНО-ДИСПЕРСНЫХ КОМПОНЕНТОВ КОРМОВОЙ СМЕСИ В ОПТИМАЛЬНОМ СОСТАВЕ

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Abstract. The study highlights the relevance of creating a mechanized and automated local power-mixed feed production area that ensures the efficient use of complete ration mixed feeds. The object of the study was to create an efficient production area based on the use of local feed base and imported feed additives, microelement feed complex, dosage and mixing of complete ration feed components, their physical and mechanical properties and their effect on the quality indicators of the process. The results obtained allow us to select appropriate operating modes to avoid a decrease in mixing quality when an increase of more than 20% of fillers in complete feed is required.

Аннотация. В исследовании подчеркивается актуальность создания механизированного и автоматизированного локального энергокомбикормового производства, обеспечивающего эффективное использование полнорационных комбикормов. Целью исследования было создание эффективного производственного участка на основе использования местной кормовой базы и импортных кормовых добавок, микроэлементного комбикормового комплекса, дозировки и смешивания компонентов полнорационных кормов, их физико-механических свойств и их влияния на качественные показатели процесса. Полученные результаты позволяют выбрать оптимальные режимы работы, позволяющие избежать снижения качества смешивания при необходимости увеличения более 20% наполнителей в полнорационных комбикормах.

Keywords: complete ration feed, mixed feed, feed components.

Ключевые слова: полнорационный рацион, комбикорм, компоненты корма.

It has been proven by science and practice that when using complete ration feeds, the productivity of cows and the mass gain of young cattle increase significantly compared to feeding them with individual feeds, while at the same time saving 10…15% on feed [1, 2].

The effectiveness of concentrated-mixed feeding is based on the presence of separate concentrated feed components and microelements in these feeds. In this regard, it should be noted that technical means can provide each animal individually or a group of animals with the necessary amount of feed depending on the ration and productivity in accordance with zootechnical requirements. Feed dosing devices used in feed mills and farms have a number of serious shortcomings. These include the complexity of the design, the large metal capacity, the low quality of dosing, and the high cost.

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When using dispensers with complex designs, labor and material costs for their repair and maintenance increase, and the efficiency of their use decreases. In addition, the feed given to the animal in excess of the norm is not compensated by the product received. This leads to irrational consumption of feed. The powerful feed dispensers currently offered by the livestock machinery market do not meet the requirements of modern farms and complexes: they feed the animal either significantly more or significantly less feed than the required norm, which leads to unjustified costs [3-5].

From the above, it can be concluded that the development and provision of a concentrated-mixed feed dispenser that ensures the efficient use of concentrated-mixed feeds, contributes to the normal development and increase in productivity of dairy cows, contributes to a high level of mechanization and automation of the feeding process, and meets the specified zootechnical and other requirements is extremely relevant. In this regard, the research work we conducted is necessary to develop a method for providing dry, dispersible feed in higher quality doses, a dispenser that meets zootechnical, technological standards and modern requirements of livestock production.

In this regard, taking into account the preparation of a complete feed mixture with components from the local feed base, their physical and mechanical properties and effect on the process were studied.

Object and method of research

Potent - mixed feeds are a complex homogeneous mixture consisting of feed materials, purified, crushed to the required size, and microelements, prepared according to scientifically substantiated recipes. Although they generally have dry, dispersible physical properties, they are not always stable and when used as an object in any technical project, there is a need to study their physical and mechanical properties. Depending on their purpose, concentrated feeds are in the form of complete feeds, combined feeds are in the form of concentrates and balancing additives (protein - vitamin, mineral additives, premixes) [6, 7].

Complete rations — mixed feeds should correspond to a complete ration in all respects and ensure high productivity of the animal. Combined concentrators are intended to be added to roughage and juicy feeds in the diet. They compensate for the energy, vitamins and minerals that are lacking in the main feeds [8].

Balancing additives (protein-vitamin additives, protein-vitamin-mineral additives, urea concentrate, etc.) are used in the preparation of concentrated mixed feed based on forage grain [9].

Research results and their discussion

Taking into account the above, the physical and mechanical properties of the dispersible ingredients used in the study were studied depending on the moisture content and the results obtained are given in Table 1 and Table 2.

Spreadable feed components are high dry matter. However, they have the ability to absorb moisture from the air, depending on storage conditions, time and environmental conditions. As can be seen from the table values, the main physical and mechanical properties of the components selected for the study — density, natural propagation angle, static and dynamic friction coefficients on the steel plate — vary depending on the humidity. This variation is greater in materials with a higher initial humidity.

The angle of friction of the granules of the strong-mixed feed on the steel plate was 210, that of the dispersed feed was 360, and that of the premix was 330. The values in the table show that as the moisture content of the components increases, both in granular and dispersed form, as well as in

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premixes, the natural inclination angle increases. While the moisture content of wheat bran varies between 12...14%, the natural inclination angle is between 39...420. Accordingly, these values were 32...350 for ordinary fortified mixed feed, and 17...220 for granulated.

This shows that when preparing fortified mixed feed or premix from dispersed components, the inclination of the side walls relative to the horizontal should not exceed 420 (the highest natural inclination angle for these feeds) to prevent clogging in the feeding hopper.

Table 1

PHYSICAL AND MECHANICAL PROPERTIES
OF CEREALS AT DIFFERENT MOISTURE CONTENTS

Indicators	*Moisture, %*								
	Barley			*Corn*			*Oats*		
	12	*14*	*16*	*12*	*14*	*16*	*12*	*14*	*16*
Density kg/m^3	460	520	650	680	710	780	300	335	360
Natural slope angle, degrees	32	33	36	33	35	36	40	41	45
Coefficient of static friction on a steel plate	0.37	0.375	0.40	0.52	0.527	0.540	0.33	0.33	0.35
Coefficient of dynamic friction on a steel plate	0.33	0.338	0.35	0.41	0.45	0.47	0.28	0.30	0.31

Table 2

DENSITY AND NATURAL INCLINATION ANGLE
OF FLOUR, BRAN AND GRANULAR FEED AT DIFFERENT MOISTURE CONTENTS

Indicators	*Moisture , %*								
	Wheat bran			*Common strength – mixed feed*			*Granular strength – mixed feed*		
	12	*13*	*14*	*12*	*13*	*14*	*12*	*13*	*14*
Density kg/m^3	222	325	430	500	520	550	600	670	700
Natural inclination angle, degrees	39	40	42	32	33	35	17	20	22

A priori and through laboratory studies, it has been determined that in an experimental device that prepares a mixed feed from dispersed components, the mixing process of the components occurs mainly at the outlet of the first screw of the screw-loop device and also in the space between the loops.

Conclusion.

1. As the moisture content of the components in the composition of a complete ration of a strong-mixed feed increases, both in granular and dispersed form and in premixes, the natural inclination angle also increases. While the moisture content of wheat bran varies from 12....14%, the natural inclination angle is between 39....420. Accordingly, these values were 32....350 in the usual strength — mixed feed, and 17....220 in the granulated one.

2. Mixing of well-crushed dispersible materials, in conditions where the moisture content of the filler is less than the total moisture content, creates conditions for ensuring high uniformity. In order to achieve high uniformity of the final product, it is more expedient to use a filler material with low moisture content and not increased norm.

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