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EVALUATION OF FRICTIONAL PROPERTIES OF COMPONENTS OF ANIMAL FEED

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In general, grinding increases digestibility by increasing the size of the plane for enzymatic action. If roughage is crushed to a delicate grinding, the digestibility of fiber decreases, and continuous consumption increases due to an increase in the speed of passage. Through the delicate grinding of the feed, the character of rumen fermentation is still changing. Grinding is considered a mandatory part of feed processing and is an effective method for improving the digestibility of feed for industrial livestock and poultry. Its task and function is to improve the efficiency of the use of materials and improve the quality of processing of feed products. The milling process is an important procedure for improving the quality of feed during feed processing, and is another important tool for the healthy use of feed. The size of the crushed particles goes in the direction - to be determined depending on the type of raw material, like animal feeding, the stage of lifting and technological requirements. Very large or very small particle size contains defects and cannot guarantee a better manufacturing position and use.

Key words: *feed, processing, grinding, dependence, friction.*

Formulation of the problem. Feed processing usually means changing the physical (and sometimes chemical) nature of feed products to optimize animal use and improve mixing and dietary stability. The main components of any diet - roughage and grain - are feeds that are likely to be processed. However, in some cases, secondary components of the diet (supplements) are processed into granules to facilitate mixing and maintain the stability of the diet. The process of grinding in the preparation of feed accounts for up to 60% of all energy costs, which, in turn, is 50% of the total economic costs of feed preparation [1-2]. Thus, in connection with the development of small farms that do not have large energy capacity, there is a need to develop energy-saving, small and highly efficient equipment. All types of feed (roughage, legumes, green mass, corn cobs, root tubers, etc.) Before feeding corn and its components to animals, perform the process of grinding. Different types of component shredders are used for this purpose [2]. The process of all preparation of components in need of grinding has common features in the implementation of the required grinding with the calculation of the frictional characteristics of each component to be processed.

Analysis of recent research and publications. Grinding of corn and its components is a process of mechanical separation of solid particles using external forces that far exceed the power of molecular adhesion. Grinding of cereals, legumes, oilseeds, as well as chalk, salt, roughage, roots, etc. As a result of grinding reduces the energy consumption of animals for chewing feed, improves the absorption of nutrients by the animal and increases the looseness of feed, which allows any other feed mix and improve the circumstances of mechanization of dosing and distribution processes. Various grain mills are used to make fodder for different species of animals. The modulus of grinding corn and its components for cattle requires a size of 1.8-2.6 mm. such crushed components (as well as any other origin) is digested by the gastric juice of the animal and has the ability to be completely absorbed. If the grinding is very small, the dust particles stick together and form lumps in the stomach, as a result of which gastric juice penetrates inside, and as a result, ragweed is not absorbed. There are different methods of grinding feed. These methods are most often used, such as free-impact crushing (with the introduction of a hammer mill), crushing (on a roller flattening machine), chipping or grinding. Any of the methods of grinding is applicable to specific types of feed depending on their physical and mechanical properties and the purpose of grinding [1]. According to the analysis of previous studies [2], the efficiency of shredders for grinding corn and its components in the lead is influenced by the appropriate points:

- Humidity of the crushed forage;
- Frequency of rotation of grinding working bodies;
- The degree of grinding of feed;
- Grinding time;
- Frictional features of the processing product.

The purpose of the article. Analysis of the influence of frictional features of the processing component of feed to ensure a quality and necessary process of grinding the product for use in the recipe.

Presenting main material. Frictional properties, which are characterized by the angles of natural slope α and external friction φ, coefficients of resistance of internal f and external shear μ, are indicators necessary for the evaluation of the process. The evaluation was performed for crushed rods and grits due to the significant difference in their structural, which is necessary to determine the reliable values of the required parameters used in calculating the geometry and design of the working bodies of the disk shredder, its capacity and energy consumption for grinding. At the first stage of the study, the dependence of the angles of the natural slope was determined α Δ, ακ and external friction φΔ φκ crushed rods and grits from moisture W product, which varies within (8 ... 20) ± 0.5% with a constant step of 2%. Determination of the angle of natural slope α as a grain was carried out by the standard method. The angle of the natural slope of the grit is characterized by a slightly larger value, due to its smaller particle size distribution and, accordingly, larger contact surface, as well as the fact that the crushed rods, having a cylindrical shape, with a certain orientation, some of them roll, capturing parts of the product. As you grow W from 8 to 20% there is an increase αk from 41 to 49o, and αΔ, grows in the range of 28 ... 43o, ie the range of variation of the angle α is for rods and grits, respectively, 8 and 15 °. Given the different nature of change αΔ,i ακ for practical calculations of gravitational transport of the investigated products it is expedient to accept ακ within 45o, a αΔ =35...37o, which is close to the value for corn grits [2]. A similar nature of the change in the angle of external friction is also established φ, grits and cores on steel which value in the investigated range its changes also make accordingly for a grain and crushed cores 38...44o and 30...38o.

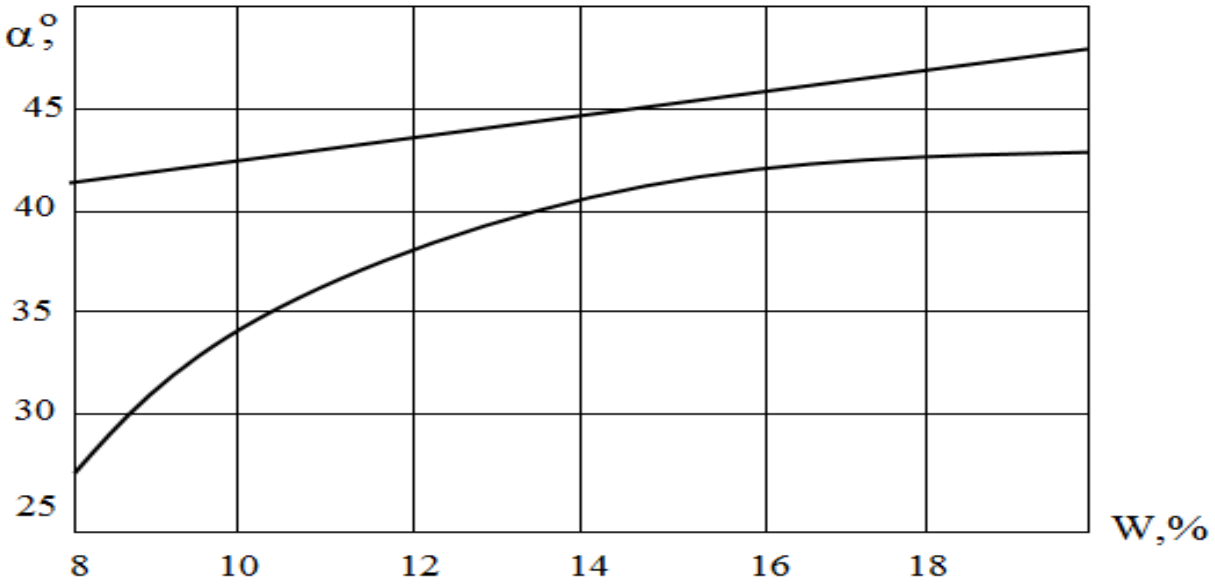

Fig. 1. Dependence of the angle of natural slope of crushed rods αΔ, and groats ακ. In the second stage.

Hhe dependence of the coefficients of external friction on steel is determined, μΔ, μκ and internal fΔ, fκ groats and crushed cores from humidity W and normal load P per layer of product, varying in the range of 0.5 ... 6.0 kPa. To determine the confidence intervals for the evaluation of the studied parameters, a series of studies with 10 experiments were performed W =14 % and P =3 KPa (Table 1) .

Table 1. Initial data for the calculation of confidence intervals.

№	$\mu_к$	$\mu_к'$	$(\mu_к - \mu_к')^2 10^{-6}$	$\mu_Δ$	$\mu_Δ'$	$(\mu_Δ - \mu_Δ')^2 10^{-6}$	$f_к$	$f_к'$	$(f_к - f_к')^2 10^{-6}$	$f_Δ$	$f_Δ'$	$(f_Δ - f_Δ')^2 10^{-6}$
1	052		4	034		9	063		25	078		0
2	049		1	033		16	057		1	081		9
3	048		4	037		0	054		16	075		9
4	051		1	039		4	060		4	080		4
5	047	050	9	039	037	4	058	058	0	079	078	1
6	049		1	038		1	056		4	076		4
7	052		4	039		4	059		1	082		16
8	050		0	035		4	056		4	075		9
9	052		4	037		0	058		0	080		4
10	051		1	038		1	060		4	077		1
∑	501		29	369		43	581		59	783		57

Preliminary verification of the obtained variation series showed that there were no gross errors. The general analysis of dependences (fig. 2 ... 5) allows to draw a conclusion that both for the crushed cores, and for a grain the value of coefficient of internal friction exceeds value of coefficient of external friction irrespective of relics of humidity W and normal. The load P on the test material is consistent with the available data for different types of roughage. It is established that with the growth of relics W and P there is an increase in the values of the coefficients μ κ and μΔ the coefficient is characterized by larger values μ κ .

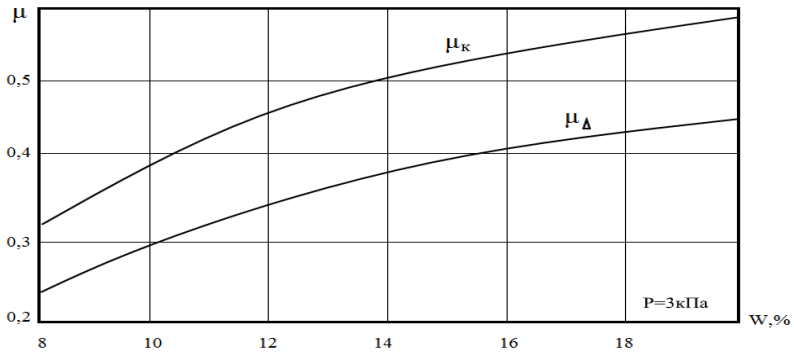

Fig. 2. Dependence of the coefficients of resistance to external shear on the grain of the grain μ κ and crushed rods μΔ from product moisture.

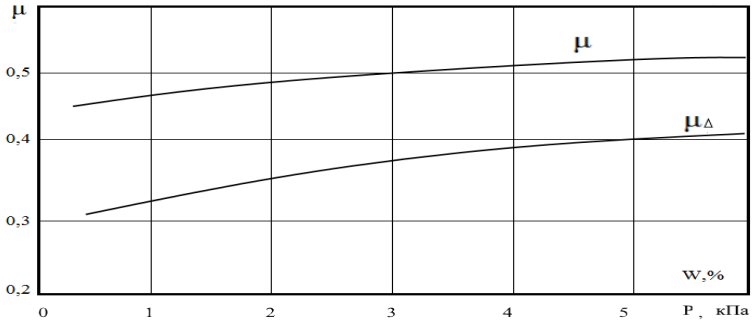

Fig. 3. Dependence of the coefficients of resistance to external shear on the steel of the grain μκ and crushed rods μΔ from normal load.

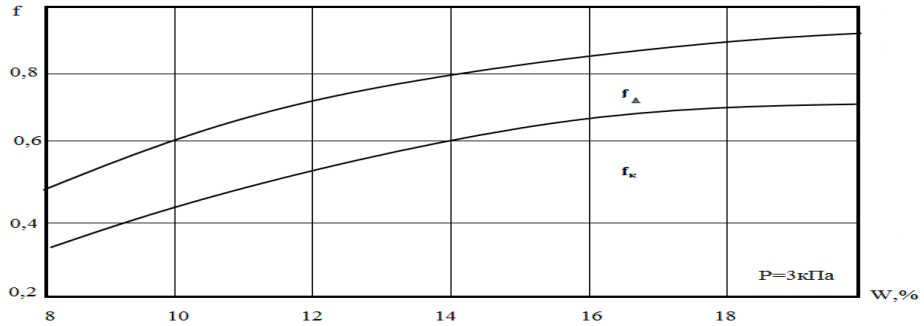

Fig. 4. Dependence of coefficients of resistance to internal shift of a grain fκ and crushed rods fΔ from the humidity of the product.

With increasing humidity from 8 to 20% of the value μ κ grew from 0,31 to 0,59, and value μΔ from 0.24 to 0.43, ie the scope of their variation was 0.28 and 0.19, respectively, with an identical law of change. With an increase in normal pressure P in the range of 0.5 ... 6.0 kPa there was a slight change in the coefficients, which was μκ - 0,06 and for μΔ - 0,10, which is confirmed by research data. A similar dependence on humidity and normal load and the coefficient of internal friction f is determined, however, with a larger value compared to fκ, was characterized coefficient fΔ . This dependence is explained by the structure of the rods having on their surface a layer of scales with elastic properties, which when moving the rods relative to each other are engaged, in connection with which there is an increase.

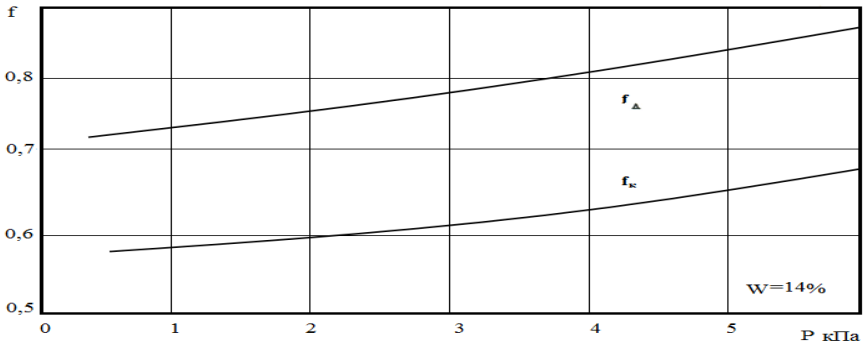

Fig. 5. The dependence of the coefficients of resistance to the internal shear of the grain fκ and crushed rods fΔ from normal load.

With increasing humidity from 8 to 20% of the value fΔ increases from 0.48 to 0.92 and the value fκ - from 0.33 to 0.72, ie the scope of their change was 0.44 and 0.39, respectively. With an increase in normal pressure P in the range of 0.5 ... 6.0 kPa was observed less, compared with W, the change in the studied coefficients, which is for fΔ - 0,15 and for fκ - 0,11. Thus, the performed experimental studies to determine the coefficients of external and internal friction of crushed rods and grits, taking into account their dependence on the parameters W and P, allow us to recommend for practical purposes the following values: μκ =0,45...0,50; μΔ =0,33...0,38; fκ =0,5...0,6; fΔ =0,7...0,8.

Conclusions. For crushed rods and grits the regularities of change of angles of natural slope and external friction from humidity, coefficients of resistance to internal and external shift from humidity and loading are established, recommendations on a choice of their values for practical calculations are given and empirical recommendations are received.

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ОЦЕНКА ФРИКЦИОННЫХ СВОЙСТВ КОМПОНЕНТОВ КОРМОВ ДЛЯ ЖИВОТНЫХ

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В целом измельчение увеличивает усвояемость из-за наращивания размеров плоскости для ферментативного воздействия. В случае если грубые корма измельчают до деликатного помола, усвояемость клетчатки снижается, а сплошное употребление растет из-за наращивания скорости прохождения. Сквозь деликатного измельчения корма еще меняется характер ферментации рубца. Измельчения считается обязательной частью обработки кормов и действенной методикой совершенствования усвояемости кормов для промышленной скота и птицы. Его задача и функция - повысить эффективность применения материалов и улучшить качество обработки кормовых продуктов. Процесс измельчения - значимая процедура для улучшения качества корма во время обработки кормов, а еще один из важных средств для здорового применения кормов. Размер измельченных частиц идет по направлению - определять в зависимости от типа сырья, на подобии кормления животных, стадии подъема и технологических требований. Очень большой или очень небольшой размер частиц содержит дефекты и не имеет возможность гарантировать лучшее производственное положение и использования.

Ключевые слова: *корм, обработка, измельчение, зависимость, фрикция.*

ОЦІНКА ФРІКЦІЙНИХ ВЛАСТИВОСТЕЙ КОМПОНЕНТІВ КОРМІВ ДЛЯ ТВАРИН

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В цілому подрібнення нарощує засвоюваність через нарощування розмірів площини для ферментативного впливу. У разі якщо грубі корми подрібнюють до делікатного помелу, засвоюваність клітковини знижується, а суцільне вживання зростає через нарощування швидкості проходження. Крізь делікатного подрібнення корму ще змінюється характер ферментації рубця. Подрібнення вважається обов'язковою частиною обробки кормів і дієвою методикою вдосконалення засвоюваності кормів для промислової худоби і птиці. Його завдання і функція - збільшити ефективність застосування матеріалів і зробити краще якість обробки кормових товарів. Процес подрібнення - значуща процедура для поліпшення якості корму під час обробки кормів, а ще один з важливих засобів для здорового застосування кормів. Величина подрібнених частинок йде по напрямку - визначати в залежності від типу сировини, на подобі годування тварин, стадії підйому і технологічних вимог. Дуже величезний або ж дуже невеликий розмір частинок містить дефекти і не має можливість гарантувати краще виробниче становище та використання.

Ключові слова: *корм, обробка, подрібнення, залежність, фрикція.*