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CHANGE IN THE PHASE STATE OF THE MIXTURE OF THE FODDER FOR ANIMALS AND BIRDS

I. Dudarev, S. Uminsky, A.Yakovenko, V. Chuchuy, M. Korolkova, S. Dmitrieva

Odessa State Agrarian University

If the production cycle specifies insufficient time to achieve a homogeneous mixture, then this leads to a change in the recipe composition, which is unacceptable when feeding animals. The optimal mixing time is usually determined by empirical data based on mixture monitoring and testing. The range of recommended mixing times for different types of mixers today is significant and can vary significantly. To achieve the best performance in achieving the uniformity of the feed mixture for animals, the time spent by the components in the working area of the machine is often increased, which in turn leads to negative consequences due to the resulting segregation and deterioration of uniformity indicators. On the other hand, an unreasonable reduction in the time for the formation of a homogeneous mixture is also a problem in the appearance of which there is a change in the recipe composition. Therefore, the determination of the reasonable time for mixing the ingredients in the manufacture of compound feed is an urgent task of modern production.

***Key words**: compound feed, time, mixing, condition, homogeneity.*

Introduction. The task of the feed industry in the production of homogeneous in composition, feed mixtures in accordance with prescription indicators. The industrial production of feed mixtures for animals and poultry with strict adherence to regulatory requirements is based on this principle. The production of a homogeneous homogeneous mixture is necessary in order that all nutrients are evenly distributed in the final product and thus provide animals with the necessary substances for their industrial use. It should be noted that the production of feed in industrial conditions may be more homogeneous in the quality of the prepared mixture. The homogeneity of the prepared mixture is estimated in different ways, the most common method of estimating the uniformity of mixing, received the method of evaluation using the coefficient of variation. Warehouse transformation.

The ingredients included in the feed based on the recipe are due to their specific properties. Considering the process of formation of the mixture, it can be considered as a total effect of the processes whose implementation involves the formation of homogeneous in physical and mechanical parameters of the products with a set of necessary components. The presence in the mixture of a nutrient or ingredient (usually chlorine from salt) is used to assess the degree of dispersion of the components in the prepared feed. The most common are recommendations for the coefficient of variation at which its values reach less than 10 percent, which in turn indicates the quality of the mixture. This figure can be varied up to 20%, which may be sufficient for feed of various practical applications. In real production, mixing can be described as the conversion of two or more ingredients into a homogeneous mixture. The process of formation of the mixture is represented as the kinetic energy provides the process of making a homogeneous mixture. The main task of the mixing process is to make a homogeneous mixture of feed components, which in turn leads to a uniform concentration of both ingredients and nutrients contained in them. The quality of the products of the mixture depends on a number of factors that affect the final performance of the products. As a rule, the homogeneity of mixing increases with the mixing time, but the extra time spent in the working area of the machines can cause the effect of segregation, stratification of components, which in turn leads to an increase in the rate of variation.

Problem. Study of patterns of change of phase state in the process of manufacturing compound feeds.

Analysis of recent research and publications. It is known that the mixing time of the feed components will depend on both the physical and mechanical properties of the ingredients and the design features of the mixer used and the characteristics of the mixed ingredients. Constructive types of mixers used in the production of feed have shown that the greatest mixing time to achieve a homogeneous mixture is observed during the operation of vertical mixers in comparison with horizontal mixers. There are recommendations, according to which vertical mixers require the time of preparation of the mixture

with uniform distribution of components should be at least 15 minutes, and when using a mixer of horizontal design equipped with blades for mixing ingredients, the required time to form a mixture is reduced to 7 minutes [1]. It should be noted the special preparation of the mixed ingredients due to the fact that the pre-crushed products require processing to the same size, which in turn reduces the time to manufacture a homogeneous mixture of animal feed. There are data according to which depending on the accepted technology the improved indicators of mix can be received, so the sequence of the accepted operation at primary loading of the mixer by the main components, secondary loading of additives in compound feed and the final stage when loading the main components. The composition of the equipment used for mixing feed is at least as diverse as the ingredients [2,3]. There have been many attempts to reduce the concept of mixing to a series of engineering equations, thus facilitating the design of equipment from a theoretical approach. The fact is that state-of-the-art mixing equipment, including horizontal belt mixers, vertical screw mixers and drum mixers, has simply evolved on the basis of historically successful designs without taking into account theoretical mixing data. For example, most horizontal faucets have a length about three times their diameter, and a speed of rotation of 75-100 meters per minute, regardless of diameter. The inner tape is usually 2.5 times the thickness of the outer tape to balance the directed forces applied through the diameter of the tape. Given this discussion, it is easy to estimate the complexity of the mixing operation at the manufacturing plant. However, this area seems to be of little concern to most feed manufacturers - commercial or private. As regulatory requirements for the homogeneity of additives increase and as the need to ensure uniform nutrient densities for genetically excellent livestock, feed manufacturers will be interested in ensuring homogeneity through testing.

Purpose: evaluation of the homogeneity of mixing by one indicator, regardless of the principle of operation and design of the mixer, processing mode, differences in the physical properties of the components, mixed, depending on the processing time.

Research results. Based on the generalization of data on mixing mechanics, the mathematical description determines the relationship between the parameters that characterize the mechanical motion of particles under the influence of input factors, in accordance with the equations or probabilistic properties of the process. With this representation of the process, it is possible to obtain characteristics related to energy consumption, time and quality of mixing on the basis of various indicators that can be taken as criteria for optimality. In this case, mathematical descriptions can be obtained both on the basis of deterministic factors that cause changes in the position of particles in space, and using probabilistic methods for estimating the physical properties of particles and their distribution in the working area of the mixer. The criteria of optimality in both cases may be the same. The most homogeneous mixture can be obtained by mixing components with the same or similar physical and technological properties. The mixing process of a multicomponent polydisperse system of loose feed can be integrated by a random process with discrete states and a continuous time τc. In this approach, the i-th state of the elementary volumes is called Filling the e-th component of the bulk feed (i = 1,2,3, ..., n), where n is the number of components of the feed mixture, and the state of the elementary volumes at time τs is predicted probability system P1, P2, P3. The transition of elementary volumes from one state to another occurs under the influence of certain flows of events. Analysis of the phase changes of the mixing process shows that all probabilistic characteristics in the future depend only on the state in which this process is at this point in time and does not depend on how this process proceeded in the past. The general scheme of the mixing process is considered in relation to the polydisperse mixture, in which the geometric probabilities are given at the initial moment τ = 0.

Pi(0) = αi (i = 1,2,3,...,n), (1)

where: n - the number of components of the mixture, which determines the homogeneity;

αi - parameters set by the initial conditions.

If Ksi is the density of flow of events that reflects the dynamics of the distribution of the components of the mixture, is characterized by the probability P (τsi), then for the state of the system without the return of flows, we can obtain the equation:

$$\frac{dP}{d\tau_c} = -k_{c_i} P_i \quad ; \quad \frac{dP}{d\tau} = \sum_{i=1}^{n} k_{c_i} P_i \qquad (2)$$

$$P(\tau_c) + \sum_{i=1}^{n} P_i(\tau_c) = 1$$

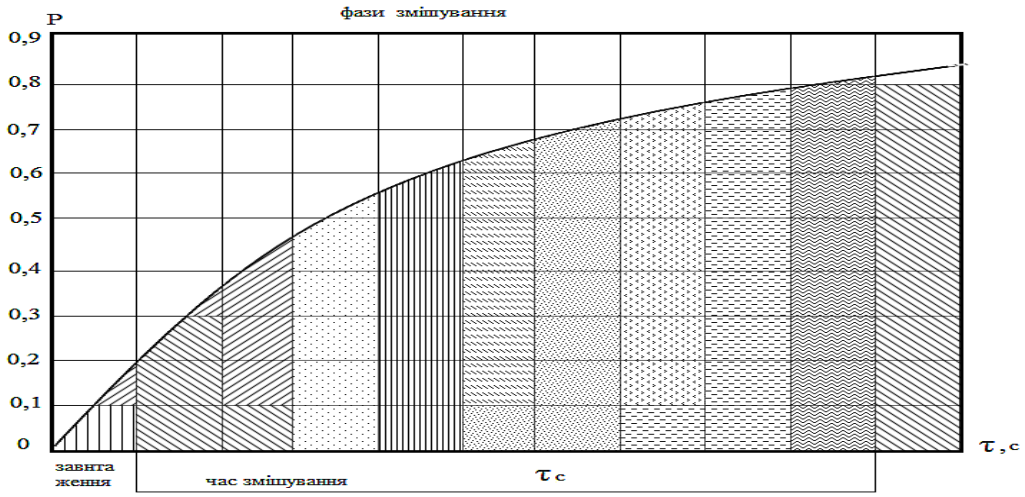

Fig. 1. Changes in the phase state of feed.

Conclusions. The final mathematical description of the homogeneity of mixing when evaluated by one indicator, regardless of the principle of operation and design of the mixer, processing mode, differences in the physical properties of the mixing components can be represented by the equation

$$P(\tau) = \alpha_c e^{-k_c \tau_c} \quad (3)$$

where:τ - is the mixing time.

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ИЗМЕНЕНИЕ ФАЗОВОГО СОСТОЯНИЯ СМЕСИ КОМБИКОРМОВ ДЛЯ ЖИВОТНЫХ И ПТИЦЫ

Дударев І., Уминський С., Яковенко А., Чучуй В., Королькова М., Дмитриева С.

В случае если производственным циклом определено время недостаточное для достижения однородной смеси, то это приводит к изменению рецептурного состава, что является недопустимым при кормлении животных. Оптимальное время смешивания как правило определяется эмпиричекими данными на основе мониторинга смеси и тестирования. Размах рекомендуемого времени смешивания различными типами смесителей на сегодняшний день имеет значительные величины и может существенно отличатся. Для достижения наилучших показателей по достижению однородности кормовой смеси для животных зачастую увеличивают время нахождения компонентов в рабочей зоне машины, что в свою очередь приводит к негативным последствиям, вследствие возникающей сегрегации, и ухудшения показателей однородности. С другой стороны необоснованное сокращение времени на

образование однородной смеси также является проблемой при возникновении которой происходит изменение рецептурного состава. Поэтому определение обоснованного времени смешивания ингредиентов при изготовлении комбикорма является актуальной задачей современного производства.

***Ключевые слова**: комбикорм, время, смешивание, состояние, однородность.*

ЗМІНА ФАЗОВОГО СТАНУ СУМІШІ КОМБІКОРМІВ ДЛЯ ТВАРИН І ПТАХІВ

Дударев И., Уминський С., Яковенко А., Чучуй В., Королькова М., Дмитрієва С.

У разі якщо виробничим циклом визначено час недостатнє для досягнення однорідної суміші, то це призводить до зміни рецептурного складу, що є неприпустимим при годуванні тварин. Оптимальний час змішування як правило визначається емпіричними даними на основі моніторингу суміші і тестування. Розмах рекомендованого часу змішування різними типами змішувачів на сьогоднішній день має значні величини і може істотно відрізняться. Для досягнення найкращих показників по досягненню однорідності кормової суміші для тварин часто збільшують час перебування компонентів в робочій зоні машини, що в свою чергу призводить до негативних наслідків, внаслідок виникає сегрегації, і погіршення показників однорідності. З іншого боку необґрунтоване скорочення часу на освіту однорідної суміші також є проблемою при виникненні якої відбувається зміна рецептурного складу. Тому визначення обґрунтованого часу змішування інгредієнтів при виготовленні комбікорму є актуальним завданням сучасного виробництва.

***Ключові слова:** комбікорм, час, змішування, стан, однорідність.*