



ИНЖЕНЕРИЯ ЖӘНЕ ИНЖЕНЕРЛІК ІС
ИНЖЕНЕРИЯ И ИНЖЕНЕРНОЕ ДЕЛО
ENGINEERING AND ENGINEERING

МАШИНА ЖАСАУ
МАШИНОСТРОЕНИЕ
MECHANICAL ENGINEERING

DOI 10.51885/1561-4212_2024_3_5
IRSTI 55.57.99

E.A. Asangaliev¹, M.S. Danilov¹, S.S. Lutai¹, D.K. Karmanov², M. Mlynchak³

¹NJSC «East Kazakhstan Technical University named after D. Serikbaev»,

Ust-Kamenogorsk, Republic of Kazakhstan

E-mail: elibek60@mail.ru

E-mail: danilov-ms@yandex.kz

E-mail: sslutai@mail.ru*

²SPCAE, Almaty, Republic of Kazakhstan

E-mail: darhankk85@mail.ru

³Wroclaw Polytechnic University, Wroclaw, Poland

E-mail: marek.mlynchak@pwr.edu.pl

DEVELOPMENT OF TECHNOLOGY FOR SALT-LICKER BRIQUETTES WITH BENTONITE FOR THE PREVENTION OF MINERAL DEFICIENCY IN CATTLE

ІРІ ҚАРА МАЛДАҒЫ МИНЕРАЛДЫ ЖЕТІСПЕУШІЛІКТІҢ АЛДЫН АЛУ ҮШІН БЕНТОНИТПЕН ТҰЗДЫ ЖАЛАУЫШТЫҢ БРИКЕТТЕРІНІҢ ТЕХНОЛОГИЯСЫН ЖАСАУ

РАЗРАБОТКА ТЕХНОЛОГИИ ПОЛУЧЕНИЯ БРИКЕТОВ СОЛЕЙ-ЛИЗУНЦОВ С БЕНТОНИТОМ ДЛЯ ПРОФИЛАКТИКИ ДЕФИЦИТА МИНЕРАЛЬНЫХ ВЕЩЕСТВ У КРУПНОГО РОГАТОГО СКОТА

Abstract. Technologies have been developed for the production of salt briquettes with the addition of crushed bentonite for cattle, which are fed to animals during the winter stall period. Bentonites contain a significant amount of macro and microelements, of which the most important in the physiology of the animal body are oxides of iron, calcium, potassium, phosphorus, etc.), briquettes measuring 15x15 cm and 12 cm thick are obtained, which have a yellowish tint. The greatest attraction for cows to lick is observed with lick briquettes containing 10% bentonite. The use of salt briquettes-licks with the addition of bentonite in the specified amount to cows during the winter stall period has a beneficial effect on the body of cows. The animals had less morbidity after calving and subsequently had higher milk production. Calves born from these cows had greater vitality, were less sick, and had higher weight gain.

Keywords: technology, bentonites, salt briquettes, macro and microelements, cattle, productivity.

Аңдатпа. Ірі қара малға арналған ұсақталған бентонит қосылған тұзды жалайтын брикеттерге арналған технологиялар әзірленді, олар қысқы жабық қорадағы маусым кезінде жануарларға беріледі. Бентониттерде макро және микроэлементтердің біршама есептеп енгізілген мөлшері бар, олардың ішінде жануарлар организмнің физиологиясындағы (темір, кальций, калий, фосфор және т.б. оксидтері маңызды болып табылады.), өлшемі 15x15 см және қалыңдығы 12 см болатын сарғыш түстіленген тұзды жалаушы-брикеттер алынады. Ірі қара малға жалаудың ең үлкен тартымдылығы құрамында 10% бентонит бар жалаушы брикеттерімен байқалады. Тұзды брикеттерді-бентонит қосылған жалауыштарды сиырларға қысқы қорадағы маусым кезінде белгіленген мөлшерде қолдану ірі қара малдың ағзасына пайдалы әсер етеді. Тәлдегеннен кейін жануарлардың аурушаңдығы азаяды, содан кейін сүт өнімінің өндірісі жоғары деңгейде болады. Осы сауынды сиырлардан туылған бұзаулардың өміршеңдігі жоғары болады, аурулары аз болады және салмағы жоғары болады.

Түйін сөздер: технология, бентониттер, тұзды брикеттер, макро және макроэлементтер, ірі қара малдар, өнімділік.

Аннотация. Были разработаны технологии производства соляных брикетов с добавлением измельченного бентонита для КРС, которые скормливаются животным в зимний стойловый период. Бентониты содержат значительное количество макро- и микроэлементов, из которых наиболее важными в физиологии организма животных являются (оксиды железа, кальция, калия, фосфора и т.д.), получают брикеты размером 15x15 см и толщиной 12 см, которые имеют желтоватый оттенок. Наибольшая привлекательность для КРС лизания наблюдается при использовании брикетов для лизания, содержащих 10% бентонита. Применение солевых брикетов-лизунцов с добавлением бентонита в указанном количестве КРС в зимний стойловый период оказывает благотворное влияние на организм дойных коров. У животных была меньшая заболеваемость после отела и впоследствии более высокая молочная продуктивность. Телята, рожденные от этих коров, отличались большей жизнеспособностью, меньше болели и имели больший прирост веса.

Ключевые слова: технология, бентониты, солевые брикеты, макро- и макроэлементы, крупный рогатый скот, продуктивность.

Introduction. The provision of animal feed and their feeding itself is of decisive importance when keeping cattle, as it must ensure optimal growth and development of the body, reproductive functions, and productivity. A significant role in complete feeding belongs to mineral and vitamin components because there is not a single biochemical process in the animal body in which they do not take part. At the same time, the animal body is closely connected with the geochemical habitat through food chains, as a result of which the accumulation of any mineral elements in the body depends on their content in the soil and, consequently, in feed. Feed is the main source of mineral and vitamin compounds, and quite often the diets of farm animals are not balanced in terms of the latter (Sapargaliev, 2010; Danilov et al., 2016; Khairullin et al., 2023).

The most acceptable way to eliminate the lack of micro and macroelements in the body of cattle is to use lick salt briquettes, into which bentonites and various microelements can be introduced during the manufacturing process.

Salt is an important part of the diet because of its primary importance in the acid-base balance of the body; with its participation, hydrochloric acid is formed, which is responsible for the digestion process of the cow. Salt regulates the water balance in the body, contributing to the timely and normal flow of water into the body cells. The advantage of premixes in the form of licks with salt is also because that cattle the active production of saliva is ensured during the process of licking salt of a certain density. Abundant saliva softens the food already at the stage of its entry into the oral cavity and facilitates its further absorption (Gallo et al., 2010).

The study of the mineral composition of feed for cows in peasant farms in Eastern Kazakhstan indicates an insufficient presence of potassium, iron, copper, and zinc in the hay, silage, straw, and concentrates. Accordingly, the content of these microelements is also reduced in the blood and hair of cows during the dry, new-calving, and lactation periods, which indicates the development of their deficiency in the body (D'yachkov et al., 2009).

In Eastern Kazakhstan, there is a deposit of bentonite clays "Taganskoye". The latter are finely dispersed clays, mainly minerals of the montmorillonite group and consisting of oxides of silicon, aluminum, iron, calcium, magnesium, potassium, phosphorus, sulfur, and other elements. These natural compounds have high binding capacity, adsorption, and antimicrobial activity (Bosimov et al., 2019; Semenenko, 2008).

Natural bentonites contain various macro and microelements in proportions and combinations that are best absorbed in the gastrointestinal tract, which makes it possible to use them as a biologically active feed additive (Velikanov et al., 2024; Slamova et al., 2011; Kikouama et al., 2009; Wilson, 2003).

Bentonite clays have a positive effect on the growth and development of young farm

animals, have high sorption activity against toxins, heavy metal salts, pathogenic microflora, aflatoxins, and intensify metabolic processes in the body. Bentonites increase the productivity and safety of animals and poultry; reduce the number of stillbirths and malnutrition, and the incidence of diseases of the neonatal (colostrum) period. The mechanism of their action is associated with the normalization of the content and ratio of micro and macroelements, maintaining the interaction of all body systems and metabolic processes (Jaynes et al., 2007; Kikouama et al., 2009; Murray, 2000).

In Kazakhstan, due to the peculiarities of local climatic and soil conditions, research on the rational use of vitamins and minerals in cattle to maximize the production of dairy and meat products is important. Cows kept on local farms do not receive sufficient amounts of macro and microelements in their feed, which is due to their low content in the growing grass, which is used to produce hay, silage, and other feed.

Clinical observations and analysis of morbidity in cattle on peasant farms in Eastern Kazakhstan show that cows often show signs of mineral deficiency during the winter stall period. Such cows give birth to weak calves, which subsequently experience delayed growth and development. During the lactation period, cows do not fully utilize their milk production potential.

The purpose of this research is to study the possibility of using salt lick briquettes with the addition of bentonite and missing trace elements to prevent mineral deficiency in cows during the winter stall period.

Materials and methods. Bentonites from the Taganskoe deposit are taken for work. Bentonite is dried in an oven at a temperature of 130-150°C for 1 hour and ground in a vibratory mill to a fine powder. The latter is most applicable for introducing salt briquettes into salt licks.

The chemical composition of zeolites and bentonites is studied on an ICP-MS Agilent 7500 CX inductively coupled plasma mass spectrometer. Structural analysis of the studied compounds is determined using an ISM-6390-LV scanning electron microscope with an energy-dispersive microanalysis system.

Next, salt lick briquettes are produced with bentonite contents of 5, 10 and 20%. To do this, the specified amount of bentonite in powder form is added to the fine-crystalline feed salt. In addition, the following micro and macro elements are added per cow:

- zinc carbonate – 0.46 g;
- copper carbonate - 0.036 g;
- potassium iodide - 0.03 g;
- ferrous sulfate – 0.3 g;

The introduction of these chemical compounds is justified by the fact that the content of potassium, iron, copper, and zinc in the body of cows is reduced, which indicates the development of their deficiency in the body (D'yachkov et al., 2009).

Considering that salt lick briquettes have a technological weight of 5 kg, which is 100 daily doses for cows, the indicated volume of microelements is increased accordingly.

The initial components are mixed and the resulting mixture is pressed into briquettes-licks on a specialized press at a pressure of 120 MPa at the enterprise for the production of salt briquettes-licks IP "Kaliakparov U" (Fig. 1)

After that, at the livestock farm of the Shemonaikha peasant farm in the Shemonaikha district of the East Kazakhstan region, the effect of the developed lick briquettes on cows is studied. In the first stage, observations are made on the attractiveness of lick briquettes with bentonite for cows. For this purpose, lick briquettes with different bentonite contents are placed in the feeding area. Salt lick briquettes are used as a control. At the same time, the activity of the cows' approach to the briquettes and the duration of licking are taken into account.



Figure 1. Press for making salt briquettes-licks

Note – compiled by the author

To study the preventive effect of salt lick briquettes in the conditions of a livestock farm of the specified peasant farm, 46 cows are selected during the winter stall period of 2023, which, physiologically, is at the beginning of the dry period. The animals are divided according to the principle of analogs into 2 groups, 23 heads each. The cows' diet is: hay 8-10 kg, silage 23-25 kg, concentrates 2-3 kg, wheat straw - ad libitum. The animals of the experimental group constantly had salt briquettes-licks with a 10% bentonite content in the feeding area. In the control group, the cows are given salt lick briquettes without bentonite in the feeding area. In both groups, animals had free access to lick briquettes, which they received 2 months before calving (dry period) and 1 month after it.

The animals are clinically observed and the milk production of cows is taken into account for 2 months after calving. The condition of the born calves, which is observed during the first month of life, is also taken into account.

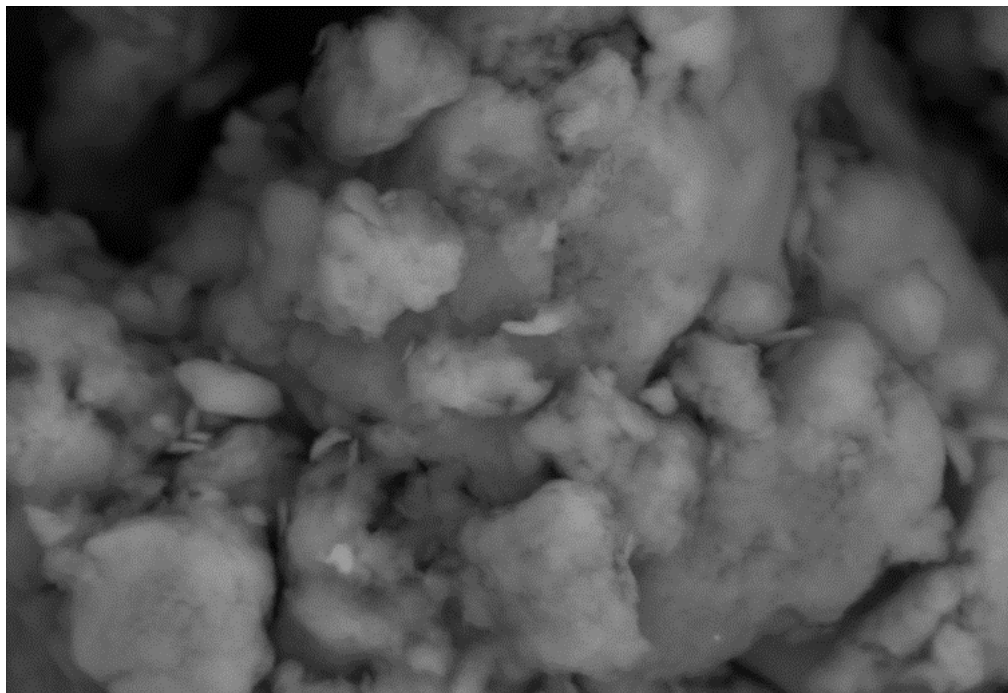
Research results. The research results showed that bentonites contain oxides of various chemical elements (Table 1). The main part is silicon oxide ($62.24 \pm 3.8\%$) and aluminum oxide ($25.36 \pm 3.8\%$). The concentration of oxides of iron, calcium, magnesium, sulfur, sodium, potassium, phosphorus, and manganese is somewhat less. At the same time, these microelements have important physiological significance for the animal body. It should be noted that their presence in bentonites is extremely important, because in the body of cows during the winter stall period, there is an insufficient content of iron, potassium, and several other micro and macroelements.

Table 1. Chemical composition of bentonites from the Taganskoe deposit

Chemical compounds	Content in bentonites (%)
SiO ₂ silicon oxide (IV)	62,24±3,8
Al ₂ O ₃ aluminium oxide	25,36±3,8
Fe ₂ O ₃ iron oxide (III)	1,92±0,3
CaO calcium oxide	0,65±0,08
MgO magnesium oxide	1,84±0,3
SO ₃ sulfur oxide (VI)	0,11±0,03
Na ₂ O sodium oxide	2,1±0,4
K ₂ O potassium oxide	240,78±0,07
P ₂ O ₅ phosphorus oxide (V)	0,17±0,004
MnO manganese oxide (II)	0,21±0,04
TiO ₂ titanium oxide (IV)	0,66±0,07
<i>Note – compiled by the author</i>	

The most important feature of the studied mineral compounds is their dispersity, which is a determining factor in manufacturability and application.

Electron microscopic examination of crushed bentonite (x3000) showed that it consists of particles ranging in size from 2 to 10 microns, of various shapes. Some large particles exhibit a loose structure (Figure 2).

**Figure 2.** Bentonite from the Taganskoe deposit

Note – compiled by the author

This state of crushed bentonite allows it to be easily mixed with feed salt, form optimal briquettes, and be attractive to cows for licking.

The resulting lick briquettes had dimensions of 15×15 cm and a thickness of 12 cm. The weight of each briquette is 5±0.05 kg. The briquettes had a gray-yellowish tint, which is more pronounced as the bentonite content in the salt increased (Fig. 3).



Figure 3. On the left – mineral salt briquettes-licks containing bentonite.
On the right – salt briquettes-lickers – (control)

Note – compiled by the author

When determining the attractiveness of lick briquettes with bentonite, it is found that the greatest attractiveness is observed in briquettes containing 10% bentonite. Animals approached such briquettes more often and the duration of licking in one approach ranged from 2 to 4 minutes. Cows approached briquettes containing 20% bentonite less frequently and the licking time is shorter. Lick briquettes containing 5% bentonite and salt briquettes had the same attractiveness.

When studying the preventive effect of mineral deficiency of salt lick briquettes, it was found that animals actively licked the lick briquettes throughout the entire observation period. Licking activity increased noticeably in the last month of pregnancy, which may be due to fetal growth and, consequently, a higher need for micro and macroelements by the cow body. No pathological abnormalities in the clinical condition of the animals were noted during the observation period.

After calving, the cows in the experimental group had any postpartum complications, as well as the incidence of metritis and mastitis, which is 2 times less than in the cows in the control group (Table 2). If these diseases occur, appropriate treatment is carried out. The service period in the animals of the experimental group is noticeably shorter than in the animals of the control group. The milk productivity of cows in the experimental group is also slightly higher. The last 2 indicators directly indicate a more productive use of cows.

It should also be noted that calves obtained from cows in the experimental group had a higher average birth weight, were more viable, less sick, and gave greater weight gain.

Table 2. Effect of salt briquettes-licks with bentonite on the body of cows

Indicators	Group of cows	
	experienced	control
Number of cows	23	23
Complications after childbirth	2 (8,6%)	4 (17,4%)
Metritis incidence	2 (8,6%)	4 (17,4%)
Incidence of mastitis	1 (4,3%)	3 (13%)
Service period (days)	56±5,4	66±6,4
Milk production per day (kg)	17,8±1,4	16,7±1,3
Average weight of calves at birth (kg)	25,4±1,4	23,7±1
Average daily weight gain in calves in the first month (kg)	0,440±0,05	0,380±0,04
Calves got sick in the first month	3 (13)%	5 (21,7)%
<i>Note – compiled by the author</i>		

Conclusion. The use of salt briquettes-licks with the addition of bentonites in an amount of 10% and microelements for cows during the winter stall period allows for maintaining the physiological level of micro and macroelements in the animals' bodies. The observations carried out indicate the positive effect of the developed briquettes on the body of cows. Animals in the experimental group showed lower morbidity after calving and subsequently higher milk productivity. Calves born from these cows have greater vitality, are less sick, and have higher weight gain.

Conflict of interest. The authors declare that there is no conflict of interest.

Acknowledgments. The authors express their gratitude to the Ministry of Education and Science of the Republic of Kazakhstan for the grant funding under the project AP19678322 "Development of a complex of machines and technologies for the production of mineral and vitamin premixes-lizunts for cattle".

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Information about authors

Asangaliev E.A. – Candidate of Agricultural Sciences, Associate Professor of the NAO "D. Serikbayev East Kazakhstan Technical University", elibek60@mail.ru

Danilov M.S. – Candidate of Veterinary Sciences, Associate Professor at the D. Serikbayev East Kazakhstan Technical University, danilov-ms@yandex.kz

Lutai S.S. – Master of Agricultural Sciences, Senior lecturer at the D. Serikbayev East Kazakhstan Technical University, sslutai@mail.ru

Karmanov D.K. – Candidate of technical sciences, Deputy Chairman of the management board for scientific work research and production center of Agroengineering, Almaty darhankk85@mail.ru

Mlynychak M. – Professor, habilitated doctor, engineer, Wrocław Polytechnic University, Wrocław, Poland, marek.mlynczak@pwr.edu.pl
