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Results of experimental studies MOBILE Mixer-Feeder Streaming TYPE

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Designated empirical dependence influence structural and operational parameters of the mixer-type feeder stream to the mixing process and the issuance of feed mixtures. The analysis of influence factors on the interactions of criteria for evaluating process.

***Analysis, mixer-feeders, streaming mixing experimental dependence, feed mixtures, constructive and regime parameters and benchmarks*.**

Problem. Need to use for feeding cattle of full Forage mixture indicated the earlier [1]. Preparation of feed mixtures is accurate batching process and their uniform mixing [1]. This mixing is the latest and most important operation in the preparation of feed mixtures, because it depends on how well the animals will Forage mixture. In addition mixer-feeders should ensure uniformity of issue feeders to feed mixtures that when tethered mode keeping animals received the same amount of feed. This requirement shall also perform mixing element that pops up and discharge. All of the above requirements apply to mobile mixer-feeder stream type set up at the Institute of mechanization livestock NAAS [2], which should provide high-quality mixing and uniform delivery of feed mixtures or feeders to feed on the table.

Analysis of recent research. For experimental studies of the process of mixing and issuing Forage mixture was set up experimental pilot plant based on experimental sample mixer-feeder stream type (Fig. 1).

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Fig. 1. The experimental pilot plant at the mixer-feeder stream type 1 - hopper feed dispenser stem; 2 - tank dispenser kontskormiv; 3 - vane mixer; 4 - conveyor belt; 5 - motor control unit and measure power consumption; 6 - flap control motors.

Investigation of streaming mixing feed components were carried out for saturated exact D-optimal plan [3]. Factors their level matrix plan and experiment are presented in Table. 1. Criteria evaluation process of preparation and issue of feed mixtures made uniform mixing, uneven issue and energy process.

The purpose of research. Determine the experimental curves influence structural and operational parameters of the mixer-feeders in the mixing process and the issuance of feed mixtures.

Results. Uniformity of mixing was determined by the method of resolving features - Forage mixture humidity. Uneven moisture content was determined by the coefficient of variation:

$$\upsilon_{w3} = \frac{t_a \sigma_{wi}}{W_i} 100\%, \quad (1)$$

where *υwi* - Coefficient of variation of moisture content Forage mixture in the experiment;

tα - The level of significance for the probability assessment;

σwi - Standard deviation of humidity in the series servings Forage mixture in the experiment;

Wi - Mean value of humidity in the series servings Forage mixture in the experiment.

Uniformity of mixing Θzm_{and} determined by the formula:

$$\Theta zm_{and} = 100 - \upsilon wi\%. \quad (2)$$

1. Matrix experiment plan and level variation factors.

Levels of	Investigated factors

variation factors, matrix experiment	Speed blades min-1	The angle of attack blades, hail	Productive stem-ness feed forage, t / h	Productivity-ness feed feed, t / h
	x1	x2	x3	x4
The upper level (+)	200	55	24	4.8
The main level (0)	175	45	18	4.2
The lower level (-)	150	35	12	3.6
Interval variations	25	10	6	0.6
Matrix experimental research plan				
1	1	-1	0	-1
2	-1	1	-1	-1
3	-1	-1	1	-1
4	-0.25	1	0.25	-0.25
5	1	1	1	-1
6	0	-0.25	-1	-1
7	0	-1	1	1
8	1	1	-1	-0.5
9	-1	1	1	1
10	1	-0.25	1	0
11	-1	-0.25	0	1
12	1	-1	-1	1
13	-1	-1	-1	0
14	-0.5	1	-1	1
15	1	1	0.5	1

Uneven issuing Forage mixture calculated the coefficient of variation of mass portions Forage mixture according to the formula:

$$\upsilon_{\text{вi}} = \frac{t_a \sigma_{Mi}}{M_i} 100\%, \quad (3)$$

where *uvi* - coefficient of variation of mass portions Forage mixture in the experiment;

tα - The level of significance for the probability assessment;

σmi- Standard deviation weight portions Forage mixture in the experiment;

E - Mean value of weight portions Forage mixture in the experiment.

The energy intensity of the mixing process and issue Forage mixture was calculated according to the formula:

$$q_i = N_i / Q_i, \quad (4)$$

where *qi* - Specific energy consumption for execution of the mixing-issuing Forage mixture in the experiment, kWh / t;

Ni - Power consumption in the execution process, KW;

Qi - The performance of the process, t / h.

The angle of attack of the blades mounted mixer with a special pattern.

Speed Paddle Mixer for determined via frequency converter Danfoss.

Performance filing stem governed speed longitudinal feed conveyor feeders (change of position backstage drive mechanism).

Performance filing kontskormu governed bandwidth dispenser (change the position of the adjusting damper).

Power consumption of digital wattmeter been registered Satek PM 130 E.

Mathematical model of influence of factors on mixing homogeneity (θ%), Which is:

$$\begin{aligned}\theta &= 88{,}5551 + 0{,}3721\,x_1 - 0{,}5604\,x_1^2 - 0{,}2365\,x_2 + 0{,}0003\,x_1x_2 + \\ &+ 2{,}2108\,x_2^2 - 0{,}3876\,x_3 - 0{,}2015\,x_1x_3 - 0{,}3530\,x_2x_3 - 0{,}0132\,x_3^2 - \\ &- 0{,}6675x_4 - 0{,}6728x_1x_4 - 0{,}1911x_2x_4 + 0{,}2346x_3x_4 + 1{,}0271x_4^2\end{aligned} \tag{5}$$

For this equation to the 95% level of confidence on the value of the criterion variance Cochran uniform.

According to the calculated correlation coefficient and Student's t test significant at the level of confidence more than 95% of the coefficients of the equation states: $x_1, x_1^2, x_2, x_2^2, x_3, x_1x_3, x_2x_3, x_4, x_1x_4, x_2x_4, x_3x_4, x_4^2$.

Given the significance of the coefficients of the regression equation (5) takes the form:

$$\begin{aligned}\theta &= 88{,}5551 + 0{,}3721\,x_1 - 0{,}5604\,x_1^2 - 0{,}2365\,x_2 + 2{,}2108\,x_2^2 - \\ &- 0{,}3876\,x_3 - 0{,}2015\,x_1x_3 - 0{,}3530\,x_2x_3 - 0{,}6675x_4 - 0{,}1911x_2x_4 + \\ &+ 0{,}2346x_3x_4 + 1{,}0271x_4^2\end{aligned} \tag{6}$$

In the decoded form of a mathematical model (6) is:

$$\begin{aligned}\theta &= 117{,}318 + 0{,}5413\,n - 0{,}0009\,n^2 - 1{,}7739\,\alpha + 0{,}0221\,\alpha^2 + \\ &+ 0{,}1747\,Q_C - 0{,}0013\,n \cdot Q_C - 0{,}0059\,\alpha \cdot Q_C - 16{,}9693 \cdot Q_k - \\ &- 0{,}0449n \cdot Q_k - 0{,}0319 \cdot \alpha \cdot Q_k + 0{,}0652 \cdot Q_C \cdot Q_k + 2{,}8531 \cdot Q_k^{\,2}\end{aligned} \tag{7}$$

where θ - Uniform mixing,%;

n - Speed spinning, min-1;

α - The angle of attack of the blades of the mixer, °;

Qc - Performance filing stem feed, t / h;

Qk - Productivity feed feed, t / h.;

Mathematical model of influence of factors on uneven issuance Forage mixture (*N*%) Is:

$$\begin{aligned}N &= 4{,}0991 - 0{,}0067\,x_1 - 0{,}0134\,x_1^2 - 1{,}0976\,x_2 + 0{,}0238\,x_1x_2 + \\ &+ 2{,}0915\,x_2^2 - 0{,}0059\,x_3 - 0{,}0238x_1x_3 + 0{,}0064\,x_2x_3 - 0{,}0489x_3^2 - \\ &- 0{,}0051x_4 + 0{,}0042x_1x_4 - 0{,}0192x_2x_4 + 0{,}0015x_3x_4 + 0{,}0042x_4^2\end{aligned} \tag{8}$$

For this equation to the 95% level of confidence on the value of the criterion variance Cochran uniform.

According to the calculated correlation coefficient and Student's t test significant at the level of confidence more than 95% of the coefficients of the equation states: $x_1^2, x_2, x_1x_2, x_2^2, x_1x_3, x_3^2, x_2x_4$.

Based on the regression equation (8) takes the form:

$$\begin{aligned} N = 4{,}0991 - 0{,}0134\,x_1^2 - 1{,}0976\,x_2 + 0{,}0238\,x_1x_2 + \\ + 2{,}0915\,x_2^2 - 0{,}0238x_1x_3 - 0{,}0489x_3^2 - 0{,}0192x_2x_4 \end{aligned} \quad (9)$$

In the decoded form of the empirical model (9) is:

$$\begin{aligned} N = 69{,}7 + 0{,}0003\,n^2 - 1{,}8670\,\alpha - 0{,}0004\,n\cdot\alpha + \\ + 0{,}0215\,\alpha^2 + 0{,}0005\cdot n\cdot Q_C - 0{,}0021\cdot Q_C{}^2 - 0{,}0198\alpha\cdot Q_k \end{aligned} \quad (10)$$

where N - Forage mixture issuing uneven%.

Mathematical model of influence of factors on energy process (*E*, KWh / t) has the form:

$$\begin{aligned} E = 0{,}0796 + 0{,}0029\,x_1 - 0{,}0064\,x_1^2 - 0{,}0034\,x_2 - 0{,}0044\,x_1x_2 + \\ + 0{,}0129\,x_2^2 + 0{,}0060\,x_3 - 0{,}0007\,x_1x_3 + 0{,}0021\,x_2x_3 - 0{,}0114x_3^2 - \\ - 0{,}0029x_4 - 0{,}0012x_1x_4 - 0{,}0006x_2x_4 - 0{,}0018x_3x_4 - 0{,}0033x_4^2 \end{aligned} \quad (11)$$

For this equation to the 95% level of confidence on the value of the criterion variance Cochran uniform.

According to the calculated correlation coefficient and Student's t test significant at the level of confidence more than 95% of the coefficients of the equation states: $x_1, x_1^2, x_2, x_1x_2, x_2^2, x_3, x_2x_3, x_3^2, x_4, x_1x_4, x_3x_4, x_4^2$.

Based on the regression equation (11) takes the form:

$$\begin{aligned} E = 0{,}0796 + 0{,}0029\,x_1 - 0{,}0064\,x_1^2 - 0{,}0034\,x_2 - 0{,}0044\,x_1x_2 + \\ + 0{,}0129\,x_2^2 + 0{,}0060\,x_3 + 0{,}0021\,x_2x_3 - 0{,}0114x_3^2 - 0{,}0029x_4 - \\ - 0{,}0012x_1x_4 - 0{,}0018x_3x_4 - 0{,}0033x_4^2 \end{aligned} \quad (12)$$

In the decoded form of a mathematical model (11) has the form:

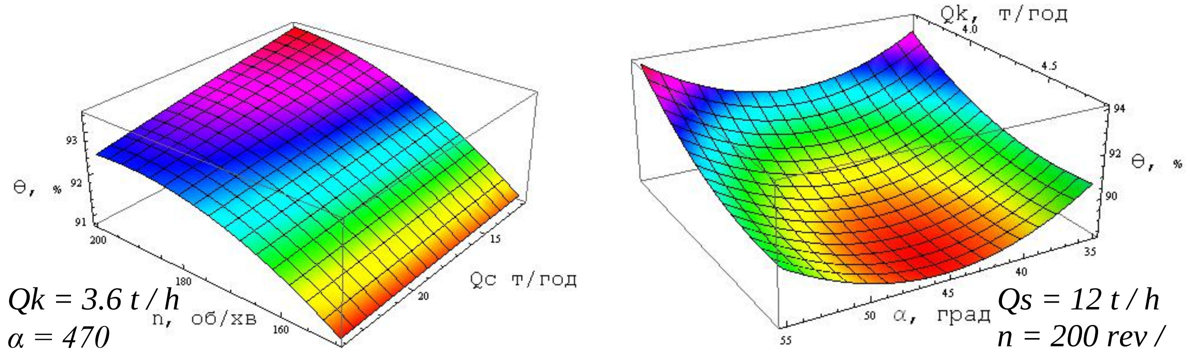
$$\begin{aligned} E = -0{,}4834 + 0{,}0050\,n - 0{,}00001\,n^2 - 0{,}0091\,\alpha - 0{,}00002\,n\cdot\alpha + \\ + 0{,}0001\,\alpha^2 + 0{,}0139\,Q_C + 0{,}00003\,\alpha\cdot Q_C - 0{,}0003\cdot Q_C{}^2 + \\ + 0{,}0989\cdot Q_k - 0{,}00008\cdot n\cdot Q_k - 0{,}0005\cdot Q_C\cdot Q_k - 0{,}0091\cdot Q_k{}^2 \end{aligned} \quad (13)$$

where E - Energy process, kWh / t.

Given that in the real world of mixer-feeders made us factors - performance feed silage (Qc) and feed efficiency of feed (Qk) will vary according to the typical diet feeding, then the equations and analysis of surface interactions will be conducted throughout the range for the above factors. For other factors necessary to determine optimum.

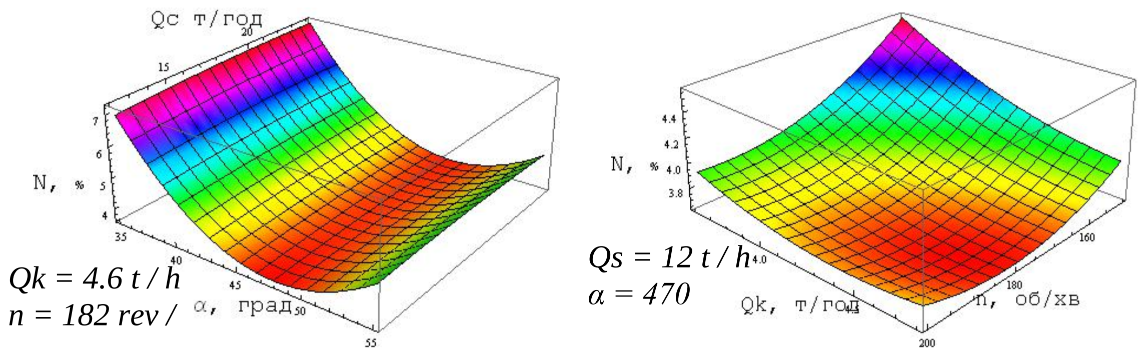
Analyzing the equation (7), which is graphically represented in Fig. 2, it can be argued that the uniformity of mixing Forage mixture affect all of the above factors. This decrease in performance from applying for stem mixing of feed and feeding performance for feed mixing uniformity Forage mixture slightly increased, but within the whole range of variation is sufficiently high (much higher than the minimum zootechnical requirements). With increasing frequency mixer speed also increases the homogeneity of the mixture, but the angle of attack of the blades of the mixer gives the best results in the homogeneity of mixing two extreme positions, for the most are the best. Therefore, we can conclude that the criterion of homogeneity mixing angle of attack of the blades must be equal to 55 °, and the revolutions of the mixer - 200 rev / min.

According to equation (10) and graphical interpretation (Fig. 3) investigated factors significantly affect the uneven issuance Forage mixture. This angle of attack of the blades of the mixer shows the best results when set to 48 °, and the revolutions gives the lowest heterogeneity at the value of 180 rev / min. Factors performance silage fed to the mixing and feeding performance for feed mixing within the whole range of variation provide a low index of irregularity issuing Forage mixture, with the issuance of the best irregularity is observed on the upper and lower levels of their variation.



a) b)

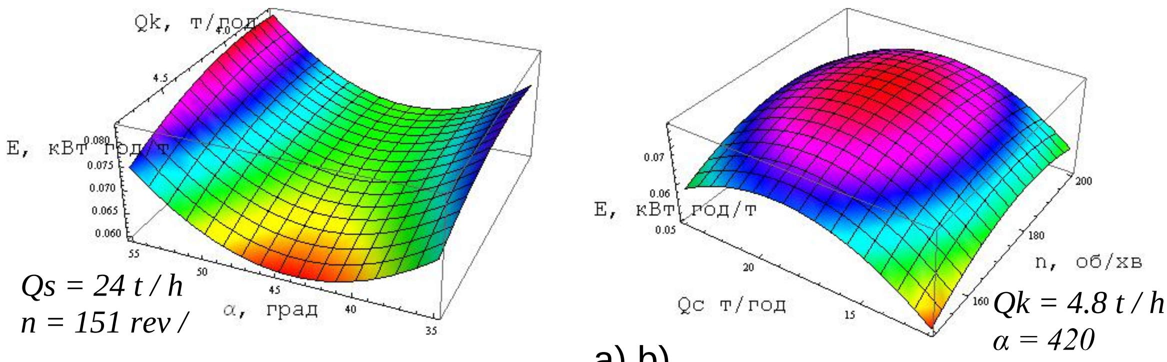
Fig. 2. Effect of the studied factors on uniformity of mixing feed components: a - rpm performance mixer and fed to the mixing stem forage; B - Performance applying for mixing feed and set the angle of attack of the blades of the mixer.



a) b)

Fig. 3. Effect of the studied factors on uneven issuance Forage mixture: A - Performance applying for stem mixing feed and set the angle

of attack of the blades of the mixer;
b - rpm performance mixer and fed to the mixing of feed.



a) b)

Fig. 4. Effect of the studied factors on energy mixing process and issue Forage mixture: A - Performance applying for mixing feed and set the angle of attack of the blades of the mixer; b - rpm performance mixer and fed to the mixing stem feed.

Analysis of equation (13) for the interaction of factors studied graphic interpretation (Fig. 4) show that the power consumption of the mixing process and issue Forage mixture affect all of the above factors. This angle of attack of the blades of the mixer has an optimum at all pair interactions, and increased frequency mixer speed results in increased power consumption. It should be noted that the interaction factor productivity to feed mixing and handling performance for feed mixing feed while increasing the latter leads to a reduction in energy intensity of the mixing-issue. In general, the difference between the highest and lowest power consumption is very low, it extends the range of decisions on factors studied according to specific criteria optimization.

Conclusions

1. The experimental research Mathematical regression equation adequately determine the impact rpm mixer, mixer blades angle of attack, feeding silage on performance mixing performance feed for mixing feed on the selected optimization settings - mixing uniformity, uneven issuance Forage mixture and mix-energy process for issuing Feeds stream type mixing.
2. According to criteria optimization by rational design-feeding streaming regime parameters such as: mixer blades angle of attack - 55 °, the revolutions of the mixer - 200 rev / min., Feeding silage on performance mixing within 12-24 t / h., Feed efficiency feed on mixing within 3,6-4,8 t / h.
3. At all levels varying factors studied energy mixing process, issuing virtually unchanged and was rather low compared with other types of feeders, confirming the right choice streaming principle of

mixing. This makes it possible to change the composition Forage mixture for different age-sex groups of animals without compromising on quality indicators process directly in the distribution of food.

References

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Opredelenы Experimental dependence of influence structurally rezhymnыh mixer parameters kormorazdatchyka streaming-type process to smeshyvanyya and vыdachy kormovыh mixture. Conducted analysis of influence factors on vzaymodeystvyy Criteria otsenki process.

Analysis, mixer-kormorazdavach, Streaming smeshyvanye, Experimental dependence, kormovыe mixture, structurally rezhymnыe Options, Criteria otsenyvanyya.

Determined experimental depending on influence of constructive and operating parameters mixer-cattle-feeder of stream type to process mixing and deliveries of forage mixtures. The analysis of influence of co-operations of factors is conducted on criterion of estimation of process.

Analysis, mixer-kormorazdavach, data-flow blending, experimental associations, fodder mixtures, constructive-regime parametres, criteria of marking.

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OPTIMIZATION OF REGIME PUSKU Swing mechanism boom cranes BY rms driving MOMENT

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In the article the way the fluctuations of cargo during the steering jib cranes. Optimization mode triggers turning the tap is performed using methods of variations. The paper used criterion rms over the driving