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Kinetics of separation grain-SOLOMYSTOHO In Woroch combine harvesters

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The developed kinetic model of separation of grain-solomystoho Woroch in combine harvesters.

Kinetics, combine harvester, grain-solomystyy Woroch, separation.

Formulation of the problem. Any mechanization equipment and mobile or stationary agricultural production processes consume energy and do a certain amount of work on indicators of quality and reliability that is characteristic of the machine or equipment. Characterization of working machines and equipment in the production processes of agricultural production during their improvement, testing and operation needs to study quantitative criteria, which are essential to optimize the parameters of the job. Comparative assessment of the effectiveness of mechanized processes are generally performed on the basis of economic criteria. The main among them is the cost of production (defined as the amount of deductions for maintenance and repairs, wages, cost of fuel or electricity lost production and other components) and payback period of machines and equipment. Some parameters machinery and equipment (for field width machines and their capacity bins for products grown or fertilizers and speed of working in the field) are based on minimizing the cost of implementation of technological operations. Major difficulties arise in the event optimize structural and kinematic parameters

working of machines and equipment. They related primarily to the lack of generalized quantitative criterion optimization. As a criterion for parameter optimization of mobile working machines and equipment used performance, fuel consumption, specific energy intensity and quality of technological operations. Each of these indicators are important, but one-sided characteristic of the machine or equipment. In addition, the working parameters of machinery and equipment, derived from each individual indicator, often have values that are in inverse correlation, but because of their determination to use a compromise approach, objectivity is often questionable.

Analysis of recent research. We found that at the stage of mechanized agriculture the main indicator of machinery and equipment has been their performance. This provided the most perfect choice for the job of mechanization in agriculture. As the scarcity of energy resources has become a significant factor relative energy intensity of machinery and equipment as the ratio of fuel to the treated area for mobile machines. A considerable amount of research based on the use of statistical indicators to measure the quality of machinery and equipment. For parameter optimization are often generalized Quality execution process based on consideration of the weight of several quality parameters that characterize the process. INykorystannyu specific energy intensity of the light of the quality performance of machinery and equipment in research is not given enough attention, generalized quantitative criteria optimization is not justified that reduces the objectivity of the parameters of machines and equipment.

Evaluate quality of the machine or equipment technological operation means to establish the degree of approximation of real quality parameters of the machine with the regulations. Quality performance is based on indicators that can be measured by direct or indirect method. The list of key indicators that establish the quality of the manufacturing operations in accordance with the cultural practices and livestock requirements given in [1]. To assess the quality of technological operations in machines and equipment, the following indicators: the level of achievement defined properties of materials processed, the coefficient of variation as a criterion for assessing the deviation from the mean or set value, and the probability of being indicator of quality of the machine or equipment in the prescribed limits, the ratio the area bounded curve distribution and diversion of range indicator and the total area of limited distribution curve of this indicator.

Note that the only way to establish regulatory zootechnical and agronomic performance and tolerance to them, based on economic criteria would be the feasibility of their implementation are often missing. It is logical that a narrowing or admission to Agrotechnical Zootechnical figure will be justified if it will provide additional economic benefit by reducing operating costs or increase production and product quality when working on narrower tolerance [2]. The challenge is also that most agronomic and zootechnical requirements not specified depending on climatic zones, meteorological factors and types of processed plant material and, in some cases, characterized by excessively rigid standards of performance. Regarding the latter, Professor YK Kirtbaya noted that this leads to significant difficulties in the design of machines to unnecessary complications designs, reduced reliability, cases of mass culling machines during testing and finally to reduction in the rate of technological progress and increasing resource costs.

If the quality of the machinery or equipment is characterized by several indicators of quality, especially in cases where the machine or equipment in case of a comparison with other advantages in performance and some yields in the other, they share a general indicator based on expert evaluation of the weight of each indicator [3].A comprehensive quantitative indicator such as optimization criterion to determine the parameters of working machines and equipment, should be directly proportional to the cost of energy and inversely proportional to the amount of work performed, the probability of failure-free operation for non-renewable facilities or availability factor for renewable facilities and probability as far as quality of machinery and equipment meet agrotechnical and zootechnical requirements. In this case, a comprehensive quantitative index as a criterion optimization must take a minimum of [4]. Thus, the cost of energy to perform technological operations within a specified time determined by measuring the largest fuel volume for mobile machinery and equipment. Scope mobile pr-ocesses is determined by the treated area, which also causes difficulties. Reliabilities machines and equipment and their availability factor in the process is determined in accordance with applicable regulations [5, 6] during the resource tests. If the machine or equipment to determine the stage of scientific research, in this case the probability of failure rate of machines and equipment (or availability factor) in the process can not be ignored.

Regarding the work of separating combine harvester known thatCities straw-grain solomystomu vorosi is from 32 to 40% of its total mass [7].

According to the requirements of OST 70.8.1-81 cultural practices, combine grain loss should not exceed 1.5% (including 0.75% maximum loss should be grain threshing-separating working bodies and not more than 0.75% - for cleaning) and purity of grain in bunker harvester must be at least 97%.

When grain yield 47.9 c / ha of grain moisture of 17% straw and 19% and the ratio of grain to straw at the height of cut of 1: 1, the loss of grain cleaning ranged from 0.05 to 0.085%, and the purity of the bunker grain - of 99 8 to 99.95% [8].

Thus reducing the cost of energy to perform a given amount of agricultural work, increased machine productivity and equipment reliability and performance of their level of compliance of quality indicators agrotechnical and zootechnical requirements are the main directions of improvement of mechanization and equipment in the production processes of agricultural production. In this regard, a comparison of operating the same type of machines and equipment in the process of production or working to determine the optimal parameters of individual machines or equipment appropriate to an integrated quantitative index, which takes into account energy performance, productivity, reliability and quality of operations process process.

The purpose of research. To prove a generalized quantitative optimization criterion for evaluation of combine harvester on evaluation separation kinetics of grain-solomystoho Woroch.

Results. Consider formalizing the formation of indicators of quality of work of separating grain from the combine separation kinetics of grain-solomystoho Woroch. We assume that grain-solomystyy Woroch consists of straw threshed, neobmolochenoho and damaged grain. Taking the assumption that the rate of reduction of each component in the grain-solomystomu vorosi during the cleaning proportional content of this component in the grain-solomystomu vorosi which is on clearing (the smaller the number corresponding component in grain-solomystomu vorosi, the lower the rate of decrease in its content in grain-solomystomu vorosi), we can write the kinetic equation grain content of each component in differential form, which will look like:

$$\frac{d(m_i - m_{Oi})}{d\tau} = -k_i(m_i - m_{Oi}) \quad (1)$$

where; m_i - The current value of the mass of the i-th component in grain-solomystomu vorosi during cleaning, kg; $m_{Oi} -$ weight and the second component in the grain-solomystomu vorosi that is lost with other components and are released during cleaning, kg; $k_i -$ setting process and removing the first component of the grain-solomystoho Woroch, s-1; $\tau -$ the cleaning of grain-solomystoho Woroch, p.

After converting mathematical equation (1):

$$\frac{d(m_i - m_{Oi})}{m_i - m_{Oi}} = -k_i d\tau,$$

and integration of the differential equation we get:

$$\ln(m_i - m_{Oi}) = -k_i\tau.$$

Taking into account the limits of change in mass and the second component in the grain-solomystomu vorosi the initial value to the current, we obtain a one-parameter equation separation process and the second component, which measures the mass of the i-th component in grain-solomystomu vorosi at the current time:

$$\frac{\ln(m_i - m_{Oi})}{\ln(m_{\Pi i} - m_{Oi})} = -k_i\tau; \frac{m_i - m_{Oi}}{m_{\Pi i} - m_{Oi}} = \exp(-k_i\tau);$$

$$m_i - m_{Oi} = (m_{\Pi i} - m_{Oi})\exp(-k_i\tau); m_i = m_{Oi} + (m_{\Pi i} - m_{Oi})\exp(-k_i\tau), \quad (2)$$

where: $m_{\Pi i}$ – weight and the second component in the grain-solomystomu vorosi early clearance, kg.

At the same time, the weight and the second component is selected cleaning at the current time is:

$$m_{\Pi i} - m_i = m_{\Pi i} - m_{Oi} - (m_{\Pi i} - m_{Oi})\exp(-k_i\tau) = \\ = (m_{\Pi i} - m_{Oi})[1 - \exp(-k_i\tau)]. \quad (3)$$

Citing weight and the second component is selected cleaning at the current time to the mass of the i-th component in grain-solomystomu vorosi early treatment, we obtain expressions for determining the allocation of the i-th component of the grain-solomystoho Woroch at the current time;

$$\frac{m_{\Pi i} - m_i}{m_{\Pi i}} = \frac{(m_{\Pi i} - m_{Oi})}{m_{\Pi i}}[1 - \exp(-k_i\tau)];\ \text{or}\ \alpha_i = \alpha_{\Pi i}[1 - \exp(-k_i\tau)] \quad \text{And (4)}$$

where: $\alpha_i = \dfrac{m_{\Pi i} - m_i}{m_{\Pi i}}$ – the current level of allocation and the second component of the grain-solomystoho Woroch during treatment, ratio. ed .; $\alpha_{\Pi i} = \dfrac{m_{\Pi i} - m_{Oi}}{m_{\Pi i}}$ – maximum selection and the second component of the grain-solomystoho Woroch during treatment, ratio. units.

The value $(m_{\Pi i} - m_{Oi})\exp(-k_i\tau)$ absolute loss of the i-th component of the completion of treatment in kg and value $\dfrac{(m_{\Pi i} - m_{Oi})}{m_{\Pi i}}\exp(-k_i\tau)$ – the relative loss and second component for cleaning in Vienna. units. Size $\dfrac{m_{Oi}}{m_{\Pi i}}$ is relative loss and second component with other components during cleaning in Vienna. units.

At constant speed of grain-solomystoho Woroch during cleaning, the cleaning can be replaced ratio of length sieves (L, M) and speed (v, M / s) grain-solomystoho Woroch. In this case, under the exponential expression for the i-th component of the grain-solomystoho Woroch can be written as follows:

$$k_i\tau = k_i\frac{L}{v} = \mu_i L \quad \text{And (5)}$$

where: μ_i – setting process and removing the first component of the grain-solomystoho Woroch (separation factor), m-1.

Thus, the overall balance of grain-solomystoho Woroch during treatment has the form given in the Table. 1. In the tables involved designation: $m_{\Pi 3}, m_{\Pi H3}, m_{\Pi\Pi 3}, m_{\Pi C}$ – weight threshed, neobmolochenoho and damaged grain and straw in grain-solomystomu vorosi early clearance, kg; $m_{ЗС}, m_{НЗС}, m_{ПЗС}, m_{СЗ}$ – weight threshed, neobmolochenoho and damaged grain that is lost with straw and are released during the treatment and supply of straw, which falls in grain and are released during cleaning, kg.

1. The overall balance of grain-solomystoho Woroch during treatment.

Components	Phase cleaning		
	beginning	process	end
threshed grain	$m_{ПЗ}$	$m_{ЗС} + (m_{ПЗ} - m_{ЗС})\times$ $\times\exp(-\mu_{З}L)$	$(m_{ПЗ} - m_{ЗС})\times$ $\times\exp(-\mu_{З}L)$
Straw	$m_{ПС}$	$m_{СЗ} + (m_{ПС} - m_{СЗ})\times$ $\times\exp(-\mu_{С}L)$	$(m_{ПС} - m_{СЗ})\times$ $\times\exp(-\mu_{С}L)$
Neobmolochene grain	$m_{ПНЗ}$	$m_{НЗС} + (m_{ПНЗ} - m_{НЗС})\times$ $\times\exp(-\mu_{НЗ}L)$	$(m_{ПНЗ} - m_{НЗС})\times$ $\times\exp(-\mu_{НЗ}L)$
Damaged grains	$m_{ППЗ}$	$m_{ПЗС} + (m_{ППЗ} - m_{ПЗС})\times$ $\times\exp(-\mu_{ПЗ}L)$	$(m_{ППЗ} - m_{ПЗС})\times$ $\times\exp(-\mu_{ПЗ}L)$

The components of the grain-solomystoho Woroch after treatment has the form given in the Table. 2. Description of process quality indicators of grain-cleaning solomystoho Woroch, given in Table. 3.

2. Description of the components of the grain-solomystoho Woroch after treatment.

Components	Name of components and their composition		
	Grain	Straw	Neobmolochene grain
threshed grain	$(m_{ПЗ} - m_{ЗС})\times$ $\times[1-\exp(-\mu_{З}L)]$	$m_{ЗС}$	$(m_{ПЗ} - m_{ЗС})\times$ $\times\exp(-\mu_{З}L)$
Straw	$m_{СЗ}$	$(m_{ПС} - m_{СЗ})\times$ $\times[1-\exp(-\mu_{С}L)]$	$(m_{ПС} - m_{СЗ})\times$ $\times\exp(-\mu_{С}L)$
Neobmolochene grain	$(m_{ПНЗ} - m_{НЗС})\times$ $\times[1-\exp(-\mu_{НЗ}L)]$	$m_{НЗС}$	$(m_{ПНЗ} - m_{НЗС})\times$ $\times\exp(-\mu_{НЗ}L)$
Damaged grains	$(m_{ППЗ} - m_{ПЗС})\times$ $\times[1-\exp(-\mu_{ПЗ}L)]$	$m_{ПЗС}$	$(m_{ППЗ} - m_{ПЗС})\times$ $\times\exp(-\mu_{ПЗ}L)$

3. Characteristics of quality indicators of grain-cleaning process solomystoho Woroch.

Indicator	Value indices
Content straw threshed grain	$m_{СЗ}$
Content neobmolochenoho grain threshed grain	$(m_{ПНЗ} - m_{НЗС})[1 - \exp(-\mu_{НЗ} L)]$
Content damaged grain threshed grain	$(m_{ППЗ} - m_{ПЗС})[1 - \exp(-\mu_{ПЗ} L)]$
Loss of threshed grain from the straw	$m_{ЗС}$
Loss neobmolochenoho grain from straw	$m_{НЗС}$
Loss of damaged grain from straw	$m_{ПЗС}$
Neobmolochenoho number of grains in the east of the Cleaner	$(m_{ПНЗ} - m_{НЗС})\exp(-\mu_{НЗ} L)$
The content of threshed grain neobmolochenomu	$(m_{ПЗ} - m_{ЗС})\exp(-\mu_{З} L)$
Content damaged grain neobmolochenomu	$(m_{ППЗ} - m_{ПЗС})\exp(-\mu_{ПЗ} L)$
The content of corn straw neobmolochenomu	$(m_{ПС} - m_{СЗ})\exp(-\mu_{С} L)$

Characterization of generalized process quality indicators grain-cleaning solomystoho Woroch, given in Table. 4.

4. Characteristics of generalized process quality indicators of grain-cleaning solomystoho Woroch.

Indicator	Value indices
Contamination threshed grain (straw content, neobmolochenoho and damaged grain threshed grain)	$m_{СЗ} + (m_{ПНЗ} - m_{НЗС})[1 - \exp(-\mu_{НЗ} L)] +$ $+ (m_{ППЗ} - m_{ПЗС})[1 - \exp(-\mu_{ПЗ} L)]$
The loss of grain during cleaning (loss threshed, neobmolochenoho damaged grain and straw)	$m_{ЗС} + m_{НЗС} + m_{ПЗС}$
East of cleaning components * (total number neobmolochenoho, threshed and damaged grain and straw in the east of purification)	$(m_{ПНЗ} - m_{НЗС})\exp(-\mu_{НЗ} L) +$ $+ (m_{ПЗ} - m_{ЗС})\exp(-\mu_{З} L) +$ $+ (m_{ППЗ} - m_{ПЗС})\exp(-\mu_{ПЗ} L) +$ $+ (m_{ПС} - m_{СЗ})\exp(-\mu_{С} L)$

* This figure could characterize the value of re-threshing, if any, and thus influence the assessment of the energy intensity of the combine or increase the loss of grain during the cleaning of the absence of re-threshing (thus to losses of grain from straw while cleaning included total number neobmolochenoho, threshed and damaged grain, which descends from the treatment.

Contamination threshed grain advisable to assess in relative units, bringing its value to the absolute value of the samples taken in the bunker grain combine and grain loss during the advisable treatment assessed in relative units, bringing its value to the absolute value of grain yield.

Conclusion. Minimizing the energy intensity of the specific machinery and equipment, taking into account the quality of their performance to determine the optimal values of structural and kinematic parameters of working machines and equipment and carry out their comparative assessment at the stage of research and development work.

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Obosnovano Choice Criteria for determining parameters for optimization assets mechanization and equipment in tehnolohycheskyh protsessah selskohozyaystvennoho production.

Optimization, Options machinery and equipment, Criteria.

The choice of criterion for optimization is grounded for determination of parameters of facilities of mechanization and equipment in the technological processes of agricultural production.

Optimization, parameters of machines and equipment, criteria's.

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INNOVATIVE MECHANICS MODEL Percolation-fractal MEDIA

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