TECHNOLOGY PERFORMANCE MANAGEMENT TO SEPARATIONS WET GRAIN-MIXS

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Аннотация: урожай зерна необходимо очистить и высушить до базисных норм для удовлетворения зерноперерабатывающих технологий, экспортных требований и долговременного хранения. Производительность сепараторов находится в обратной зависимости от влажности зерна. Основной причиной этого есть ухудшение сыпучести зерновой смеси. Нами разработанной технологией обработки зерновой смеси можно улучшить сыпучесть компонентов зерновой смеси и показатели работы сепаратора. В стендовых условиях подтверждена технологическая возможность и экономическая целесообразность нашей технологии.
Ключевые слова: зерно, примеси зерна, сепаратор, технология очистки.

To bring the Grain collected harvest (*GCH*) at steady state, it is cleaned and dried before the benchmark standards. Clean the Grain from the graines adventices, grain and other impurities of grain on the cleaning machines [7]. The operation cleaning *GCH* prior transactions with its drying [7, 8]. Additional cleaning the Grain to the requirements of the food processing industries, export needs and other purposes are already in the process of its storage.

In foreign practice the Technology of the postharvest working of the grain (*TPWG*) on the elevator are similar to the patriotic: specific load on the sieve surface of the separators is about 6.2-7 t/m2 per hour and cost the air aspiration model equipment – just like domestic. [11, 12, 14].

To clean the *GCH* used a variety of methods based on the division components of the grain mixture. However, the processes of the vibrating separator occupy a priority place in the practice of their application on the grain combine, for use on elevator and food processing enterprises [4, 5, 10, 10, 13].

Build capacities the Elevators, along with disabilities increasing the acreage of production premises for a secondary location of technological equipment, stipulates the need to increase the performance of this equipment without any deterioration in the quality of his work. This problem is solved by increasing the working surface area sweeping machines revving to itself sorting of components of the *GCH* or a change in the physical properties of the *GCH* or its individual components. However, the first practical application of the principle of limited size of production premises and maintenance of large equipment, the second is a decrease in the effectiveness of the purification of the corn-mix. Application of the third, to change the physical properties of the GCH or its individual components are not used due to the paucity of research.

Research a. Sergeeva, v. m. Solovyov, g. n. Pavlihìna processes of separation and the factors influencing the effectiveness of the separators is the optimum speed to move the *GCH*, located between the areas of congestion and current separator [12]. The value of the optimal speed of different cultures different. Excess of actual speed moving *GCH* from optimal due to the increased performance of separator with simultaneous deterioration of podìl′nostì impurities of the corn-mix.

In his experimental studies of H. Ksìfilìnova has established optimal speeds for oilseeds within $v \approx 0{,}17$ m/s. However, such an approach to establishing the optimal parameters of separator in the separator sieve-surface seems somewhat questionable. Since the same speed moving FORCES of varying humidity, presence of interphase interactions while moving on the the sieve surface the variables flow parameters impurity gases change the *GCH* as moving on the sieve surface, and more effective cleaning can vary.

Factor of influence of alternating the content of impurities in the GCH as they move through the sieve surface is taken into account in the development of Y. Baženova and increase the angle of direction of vibration sieves. For this author recommends that produce sieve curvature changes. However, this decision does not fully suitable for the separation of the *GCH* of different ratio of impurities.

Influence of air on high speed movement of *GCH* by the sieve researched A. Lyubimov. For sieve with round holes it found boundary flow speed of 5 m/s for larger values of the speed flow air prevents to the penetration of grain through a sieve. In our opinion boundary speed would be appropriate to associate with the actual speed of flow through a hole sieves with holes and a fictitious amount of true, considering the move a grain mix.

In the modern research of domestic and foreign scientists determined that further intensification of processes the vibration separator of the *GCH*, parameters and marked improvement of operating conditions have already been exhausted [1, 11, 12]. Therefore, L. Grosul, B. Kotov, M. Volotion [1] and the other is defined as a separate direction of intensification of vibration separation, differentiated security options installed separators that are based on the peculiarities of the density and size of the corn.

Subsequently, L. Tìschenkovim, D. Mazorenkom, V. Ridny and others [12] the influence of structural parameters of sieve-treatment devices on the intensity of separation. However, in studies of the academics and other us publications, not influence parameters of gas flow on the the moisture content surface layer of particles the SUN, changing their structurally-mechanical properties and differentiated management of these indices of the components specified parameters the working gas of the separation units.

Of particular interest are research of influence of interphase interactions at the intensification of *GCH* secessionist conflicts vibration separation of impurities the less nature weight (*LNW*) wet and too wet it. The relevance of these studies confirmed production difficulty clearing the damp *GCH* from *LNW*, influence the content of these additives on stability and explosion safety and fast dehydration of the corn-mix, as well as the State of environmental pollution of these impurities can cease the dehydrated *GCH* and it in containers for storage or transport.

Therefore, in our opinion, given changing the moisture content surface layer particle component of the *GCH* (especially the *LNW*) can improve the looseness and speed up the wet fractionation the *GCH* vibration-aerodynamic way. This task can be done of short-term of convective heat by the moisture exchange differentially-set parameters of the working gas of rolling a layer of wet *GCH* and it's shaking on the sieve separation. The Argumentum of this opinion on the following analysis of the sieve separations.

It is known that the largest application in the domestic and foreign practice got two groups of machines: clean grain from geometric dimensions (the sieve separation) and aerodynamics indicators (the Aspirators) components.

In terms of moving the *GCH* in the separators, the forces of inertia (P_i) should not exceed the strength of adhesion of particles grain mix ($f \cdot G$) floating the sieve surface ($P_i > f \cdot G$) conditions of irregular movement of the sieve surface with some acceleration α, the conditions of traffic particle of mass m on sieve surface will be determined by the ratio of acceleration sieves and corner his inclination, on the one hand, and the coefficient of static (until) f_{st}, or dynamic (during movement) f_d friction slip flat particles [6]:

$$m \cdot \alpha > f \cdot m \cdot g, \text{ or } \quad \alpha > f \cdot g, \qquad (1)$$

For particles of sphericity form friction coefficient-slip (f) through can be in the friction coefficient-rocking (k) to the radius of the particles (r), the expression (1) changes are:

$$\alpha > \frac{k}{r} \cdot g, \qquad (2)$$

The terms of the motion of particles (1) and (2) cited for the horizontal surface the sieve.

For the inclined sieve of surfaces with slope α to the horizontal projection, particles can move upwards along the sloping surface of the sieve, or down by the same conditions exceeding the force of inertia over the forces of friction ($P_i > f \cdot G$) with the presform forces proofreading by an particles (perpendicular component $P_i^{пр} = P_i \cdot \sin \alpha$ and $P_G^{пр} = f \cdot G \cdot cos \cdot \alpha$) or weakening the forces of friction, in the case of moving particles down [6]:

$$P_i^{рух} > f \cdot G^{гальь} = (P_i \cdot \cos\alpha - G \cdot \sin\alpha) > f \cdot (P_i \cdot \sin\alpha + G \cdot \cos\alpha), \qquad (3)$$

For aero-separations [6]:

$$\mathrm{G - R = m \cdot g} - \xi \cdot F \cdot \frac{\rho_{г.п} \cdot \upsilon_{г.п.}^2}{2} > (<)\ 0, \qquad (4)$$

In our opinion, the exception to this rule may be times of presence of mechanically-associated moisture that is in a liquid state on the surface of the particles of the components of the corn-mix and significantly impairs her the looseness and uniformity.

Because in practice such cases often occur, particularly when harvesting late grain crops, so aero-separations such corn-mix without her training is ineffective.

The low effectiveness of process aero-separations, in turn causing low efficiency and low performance of the sieve separations.

Another optional argument to confirm this thesis is the results of research of influence of ìntensifikatorìv on the efficiency of the separation of the corn-mix. His experimental research of L. Grosula and M. Tishchenko [1, 12] proved that the intensity (dynamic, superficial and volumetric), arousing a layer of the *GCH*, increasing the bandwidth of the separator. However, the performance of separator is accompanied by a relative increase in the upper gathering faction of the *GCH* and change the height of the layer *GCH* on the sieve surface especially when applying line-ornament of intensity [12]. Shifting the balance of power layer of grain to peripheral parts of sieves and particle the upper gathering factions worsened division mixture.

Below, consider the features of the products and the heat for the problems of reducing the moisture content only the superficial layers of particles the *GCH* for the solution of problems of selection of vital daily impurities of grain (enhancing the process of fractionation), and drying.

Kinetic equation of the Fokker–Planck distribution density of the particles in a coordinate system $f(t,\vec{r})(\int f(t,\vec{r})\cdot d\vec{r} = N(t))$ with the conditions according to the equation of continuity [6]:

$$\frac{\partial f}{\partial t} + \nabla\cdot(\vec{P}(t,\vec{r})) = \psi(t,\vec{r}) \quad (5)$$

and the equation of the Boltzmann [1, 6] function description of spatial distribution of particles by impulses:

$$\frac{\partial f(\vec{p},t)}{\partial t} = \int [W(\vec{p},\vec{p}')f(\vec{p}',t) - W(\vec{p}',\vec{p})f(\vec{p},t)]d^3\vec{p}' \quad (6)$$

is the most acceptable to describe grain crops from the grain of the basic culture.

Studies conducted on the laboratory sieve-separation *ZLS* and heat-moisture- to exchange camera with samples of the most common and hardest to separation graines adventices biological garbage impurity grain crops (*LNW*). The looseness *LNW* and grain was assessed by his internal and external friction.

In Fig. 1 is the results of researches of influence of humidity on the *LNW* angle external and internal friction. The results of studies (see Fig. 1) confirm our assumption regarding the unequal dynamics of changes to the looseness of the various components of the *GCH* to increase their humidity and greater dependence of external friction *LNW* compared with other components of the *GC*H.

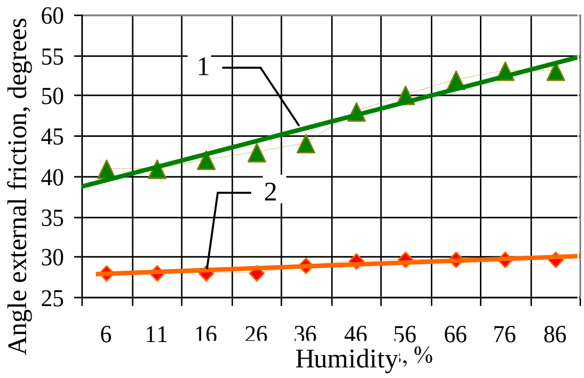

Fig. 1 Dependence of external friction components of grain mixes from their moisture content: 1 – LNW; 2 – a corn of wheat

On the basis of the experimental studies of we obtained the semi-empirical equations of the dependence of the angle of the exterior angle (Ψ) of *LNW* (7) and of grain of wheat (8) on their humidity (W):

$$\Psi_{LNW} = 38{,}38+0{,}198 \cdot W_{LNW}, \qquad (7)$$
$$\Psi_{wh} = 27{,}5+0{,}039 \cdot W_{wh}, \qquad (8)$$

As can be seen from these dependencies, the looseness LNW in considerably greater extent depends on the humidity of these particles in comparison with the grain.

The task of the second group of studies was built to establish the impact the moisture content components of the GCH on the performance and efficiency of separation. Results of influence of humidity of the surface layers of the components of the GCH at its Severability and performance outlined in Fig. 2.

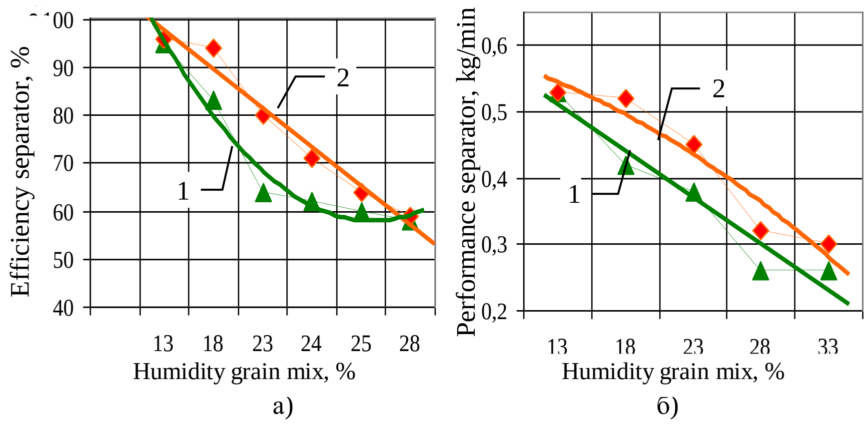

Fig. 2. The influence of moisture content of surface layers components of corn mixture on a) efficiency and b) the productivity of the work of the separator: 1 – the control and 2 – prototypes of grain and LNW.

The duration of the separation of the *GCH* (duration of stay of the *GCH* on the sieve surface) changed the output separator variable thickness layer of the *GCH.*

Conclusions:

1. The friability of admixtures *GCH* with the smaller mass in the larger measure depends on the humidity than of grain of the wheat. On the coefficient of the external friction of particles influences the humidity only of surface of these of the particles.

2. The rate of change of the moisture of the surface of *LNW* is more 13 - 16 times from this speed for the grain.

3. The obtained semi-empirical equations adequately describe the redistribution of moisture in *GCH* and *LNW.* This makes it possible to govern the friability of components *GCH.*

4. Is developed the convective method of control of the friability of components *GCH.*

References:

1. Гросул Л.Г. Механіко-технологічні основи процесів та агрегатного устаткування для виробництва круп// Автореф. дис. доктора техн. наук – Одеса, ОДАХТ, 2002, – 37с.

2. Домарецький В.Н. Технологія харчових продуктів: [Підручник] / В.Н.Домарецький, М.В.Остапчук, А.І.Українець – К.: НУХТ. – 2003. – 572с.

3. Жидко В.И. Зерносушение и зерносушилки / В.И.Жидко, В.А. Резчиков, В.С. Уколов. М.: – 1982. – 329 с.

4. Малин Н.И. Теоретические основы технологических процессов // Хранение и переработка зерна / Н.И. Малин, Т.И. Веселовская – М.: Хлебопродинформ, 2001. – 100 с.

5. Мельник Б.Е. Технология приемки, хранения и переработки зерна / Б.Е.Мельник, В.Б.Лебедев, Г.Л.Винников – М:Агропромиздат,1990.– 367 с.

6. Остапчук Н.В. Основы математического моделирования процессов пищевых производств: [Уч. пособие.]// – К.: Вища шк. – 1991. – 367 с.

7. Правила по организации и ведению технологического процесса на элеваторах. – М.: Министерства заготовок СССР, 1972. – 49 с.

8. Інструкція по сушінню продовольчого, кормового зерна, насіння олійних культур та експлуатації зерносушарок. – Одеса–Київ, 1997. – 72 с.

9. Пунков С.П. Элеваторно-складская промышленность. Учебное пособие для студ. вузов/ С.П.Пунков, А.И.Стародубцева// – М.:Колос, 1980. – 256 с.

10. Трисвятский Л.А. Хранение зерна. – 5-е изд., перераб. и доп. – М.: Агропромиздат. – 1985. – 351 с.

11. Элеваторная промышленность за рубежом/ Гусева Т.Н. (Воздушно-ситовые сепараторы. Модульный триерный блок. Модульная шахтная зерносушилка COMBIPLUS//– М.: ЦНИИТЭИ Минзага СССР. Хранение и переработка зерна, Вып 8, 1989. – 28 с.

12. Теслер Л.А. Элеватоная промышленность за рубежом. – М.: ЦНИИТЭИ Минзага СССР Элеваторная промышленность, 1978.

13. Тищенко Л.М. Интенсификация сепарирования зерна// – Харьков: – Основа. – 2004. – 222 с.

14. Производство, хранение и использование зерна в Канаде / Ю.П.Ковалев, Л.И.Кочетков//– М.: ЦНИИТЭИ Минзага СССР. Хранение и переработка зерна, Вып 2, 1985. – 85 с.

15. Казаков Е.Д. Зерноведение с основами растениеводства. – М.:Колос, 1965. – 328 с.