

Boyko A.I., DSc, Professor
ORCID 0000-0002-0317-7683 anatoliy.boyko1946@gmail.com
Fedchenko Z.A., assistant
ORCID 0000-0002-8958-7674 zoya140790@mail.ru
National University of life and environmental sciences of Ukraine

ANALYSIS OF WORK CONDITIONS AND CAUSES WEAR HOLES SEPARATING SIEVES IN SERVICE

Advantages and disadvantages of sieves for the crusher were considered. The research focuses on changes of the holes of the sieves toroidal shape and establishes common time to failure. The result of experimental research is to establish the durability of the separating sieves with holes design close to the wear in comparison with standard sieves. The result shows the efficiency of using sieves with toroidal form of holes similar to the natural wearing, which persists for the entire lifetime and provides high-quality completion of the separation process. The principal difference in the experimental separation of the sieves is that they are in the process of operation and wear effectively perform the function of sifting the grain mass desired fraction. The new form of holes, close to form normal wearing has led to the possibility of such profiles forming that change their shape.

Key words: sieve, exploitation, grinding, durability, shape normal wear.

Бойко А.І., д.т.н., професор
Федченко З.А., асистент
Національний університет біоресурсів і природокористування України

АНАЛІЗ УМОВ РОБОТИ ТА ПРИЧИНИ ЗНОШУВАННЯ ОТВОРІВ СЕПАРУЮЧИХ РЕШІТ В ПРОЦЕСІ ЕКСПЛУАТАЦІЇ

Розглянуто переваги та недоліки решітних класифікаторів при утриманні дробарки в експлуатації. Дослідження спрямовані на вивчення зміни отворів тороїдальної форми решіт та встановлення загального наробітку до відмови. Результатом проведених експериментальних досліджень є встановлення довговічності сепаруючих решіт із конструкцією отворів наближеної до форми природного зношування в порівнянні із серійними решетами. Принциповою різницею в роботі експериментальних сепаруючих решіт є те, що вони в процесі експлуатації і зношування ефективно виконують функцію з просіювання зернової маси потрібної фракції. Застосування нової форми отворів наближеної до форми природного зношування призвело до можливості формування таких профілів, що найменше змінюють свою форму.

Ключові слова: решето, експлуатація, подрібнення, довговічність, форма природного зношування.

Introduction. In the process of shredding, grain material moves in the inner circular perimeter flow chamber. At steady state intensity of the crusher particles passing through the sieve is almost constant and corresponds to a certain number of them that go from the camera to remove.

Fractional composition of grain and milled grain is determined by the size of the holes. Changing these holes during operation is result in the loss of this indicator. At the same time, the quality of grinding grain mix is the main factor that influences consumer properties of feed, and ultimately weight gain in animals.

In the process of deterioration in the operation of crushers, sieves openings separating lose their original geometrical parameters. This profile of the peripheral part of the returned inside the camera takes the shape of January curve that gradually develops may lead to full wipe membranes between holes.

Analysis of basic research. The main disadvantage of mills is that the grinding products during an intensive wear of hammers edges holes in separate sieves. Much work was conducted to improve the life of the hammers. At the same time less attention was paid to disability of sieves as the main separating working parts.

Analysis of literature and patent sources indicates that the prospects for the development of technical means to perform the process of grinding and separation of raw materials in the manufacture of animal feed in the direction of number and quality increasing can be achieved as a result of the working mills improvement [1 - 4].

According to the operation it needs to replace parts and components of separating working bodies after operating time 1000-1800 tons. The lowest operating time among them are cylindrical sieve with holes (1070 tons).

A crusher for crushing grain mass often use smooth sieve with holes 3, 4, 6, 8 and 10 mm, made of sheet steel 1 ... 3 mm. Checked uneven wear sieves, which are much faster lose original shape holes in the bottom of the camera.

There is some work to improve sieves, which are aimed at improving productivity crushers. For example, the idea of the possibility of changing the area by adjusting the passage opening sieve displacement presented in [5]. This design consists of two adjacent sieves that are able to move relative to each other. Due to this, is the quality and productivity of grinding mills.

It is proposed to establish a place sieve deck with the working surface which has a corrugated shape, and rounded holes [6]. In this case, energy consumption in the process of crushing is reduced, that is economically justified.

Noteworthy research results [7] increase productivity crusher, crushing process, reduce energy and improve quality of the product through the use of real and personal sieves, rectangular holes. Movable sieve has the ability to guide displaced along the crushing chamber to immovable sieve over distance not exceeding a length of perforated holes.

Setting objectives. The aim of work is to analyze the main types of damage crushers, to find possible ways to eliminate these problems, to continue work of sieves and their reliability in general. Another objective of the study is changes dynamics in the shape of holes in the sieves separating shorts in serial is to develop method removing fingerprints at working surface [8]. Removing the replicas of the studied sites performed at regular operating time ($\Delta Q = 100$ t), followed by a photo obtained profiles.

Profiles, formed in the process of operation determine the dynamics of changes in the shape of the holes of the sieve, which gives the opportunity to build according to changes of the geometric parameters of permissible and ultimate forms. Changing the geometry of the holes indicates the formation of a particular surface in a separation process and can be measured: wear on the thickness and area of worn portions in cross-section.

Quantitative evaluation linear wear lengths of the holes (Δh) depends on the amount of sifted material passing through the holes and it is functionally described by the formula:

$$\Delta h = f(Q).$$

The specific functional depends on the profile holes of the sieve set according to the results of experimental studies using the mesh wear.

Change of surface shape of the holes in sieve during the process of operation is submitted by relevant curves C, D, E, F, G, H . Distance between the created profiles is layer of material, worn over a period of hours (ΔQ). The thickness of this layer can be determined using the held normal to one of formed surfaces of wear equal to the amount of linear wear in the corresponding points of the openings in each period (ΔQ). Thus, the system of the profile curves and the normal made them form grid of wear. This grid describes the general nature of the shape changes of holes and the distribution of magnitude of wear on friction surfaces in full.

Main material and results. Practical operation of crushers proved that the working part of the sieve is subjected to rapid wear and loss of original form holes, thereby forming a geometric shape that is significantly different from the inherent design. Curved surface formed due to wear form increases the perimeter interacting with the grain weight and ultimately leads to deterioration in the quality of the output product.

The experience of working parts separation indicates their low durability. This leads to the need for further research related to ensuring healthy state, for their longer life.

The physical nature of separating sieves wear practically, as consequence of the complexity of the structure of their working surfaces, has not been studied. The main hypothesis of the wear surfaces are caused by influence of grain mixture flow and small amount of abrasive particles having more hardness than hardness of the separators material, the number of which in feed material is up to 0,5%, and the dust 0,26% of the total weight.

The presence of solid components, causing partial deformation and scratches on the surface during contact with the sieve is destroying gradually. Therefore, the wear of the sieves working surfaces is regarded as natural process of loss form under contact interaction of working body of the material, which is crushed.

The quality of grinding depends on the physic-mechanical properties of the grain material, which determine its destructive characteristics. Thus, the moisture content primarily affects its strength in the future, the increased grinding efficiency. With increasing moisture content of the grain material increases its ductility, which leads to increase intensity of the hammers blows and sticking it to the working parts. When grinding excessively wet grain consumes and deteriorates the quality of the output product. Also, this type of grinding grain increases the intensity of wear, as well as the impact of aggressive environment.

Characteristics separating sieves as perforated details and characteristics of wear holes are given, promising to improve the resource, to increase longevity using all constructive methods. This is due to operating conditions and manufacturing sieves, where the use of hardening coatings or wear resistant materials is not technically feasible and economically justified.

One of approaches is constructive method which provides making sieves with form that is resistant to wear holes (Ukraine patent for utility model number 96341). Form holes are made on the concave surface, close to the toroidal obtained as a result of natural wear and tear.

Characteristic feature of job profiles sieves with holes toroidal shape is that they are fundamentally different from those projections holes for serial sieves [9]. However, the rate of formation of profile curves on the side (A) is intensively opposite side (B).

General view of curves core hole family with image net of depreciation is shown in Figure 1.

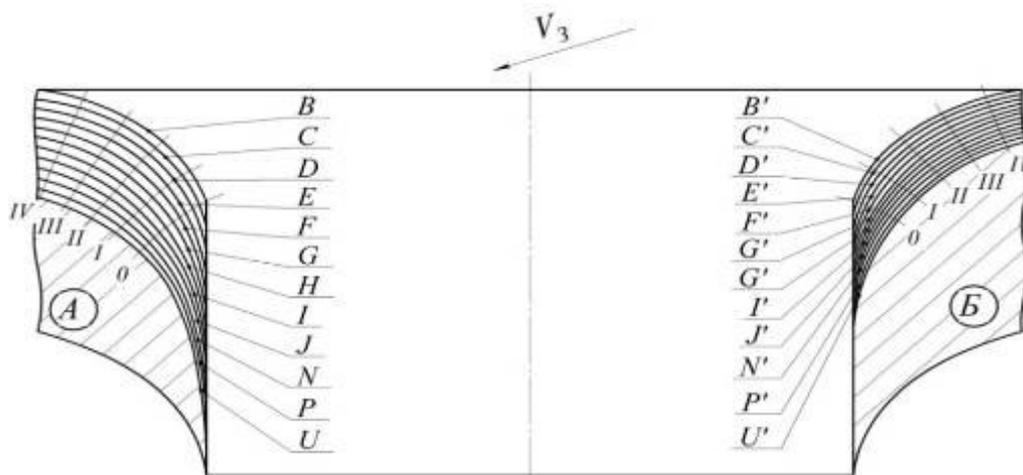


Figure 1 – Net depreciation experimental separating sieves after operating time:

B – new; *C* – 100 t; *D* – 200 t; *E* – 300 t; *F* – 400 t; *G* – 500 t; *H* – 600 t;
I – 700 t; *J* – 800 t; *N* – 900 t; *P* – 1000 t; *U* – 1080 t (wear limit);
0, I, II, III – line depreciation for the entire period of operating time;
V_s – direction of the grain material.

The family received the curves, indicated essential identical nature of the profiles wear. At the same time there is some uneven distribution of values of linear wear normal position. Thus, for the normal "0" is smaller than normal for higher numbers. This trend continues as the inclusion of new areas of wear area of the cylindrical surface of the hole. Detailed analysis of the distribution of linear wear side openings, by determining the thickness of the material lost (Δh) operating time in each period is shown in Figure 2 and Figure 3.

The group of curves obtained to indicate the general nature of the formation of stable structures. At all stages of deterioration pilot sieve after working hours, meaning the thickness of the material decreases lost and moving deep into the profile material sieve. As the wear profiles, the value (Δh) retains their general character even incremental movement (Figure 2 and Figure 3) in the direction of reduction.

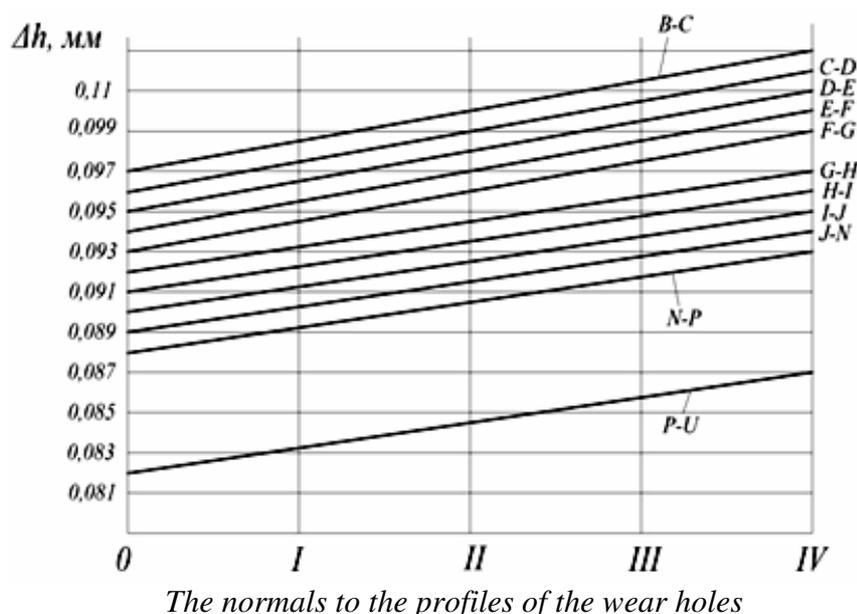


Figure 2 – Dependence of thickness loss of material sieve pilot holes on the side (A)

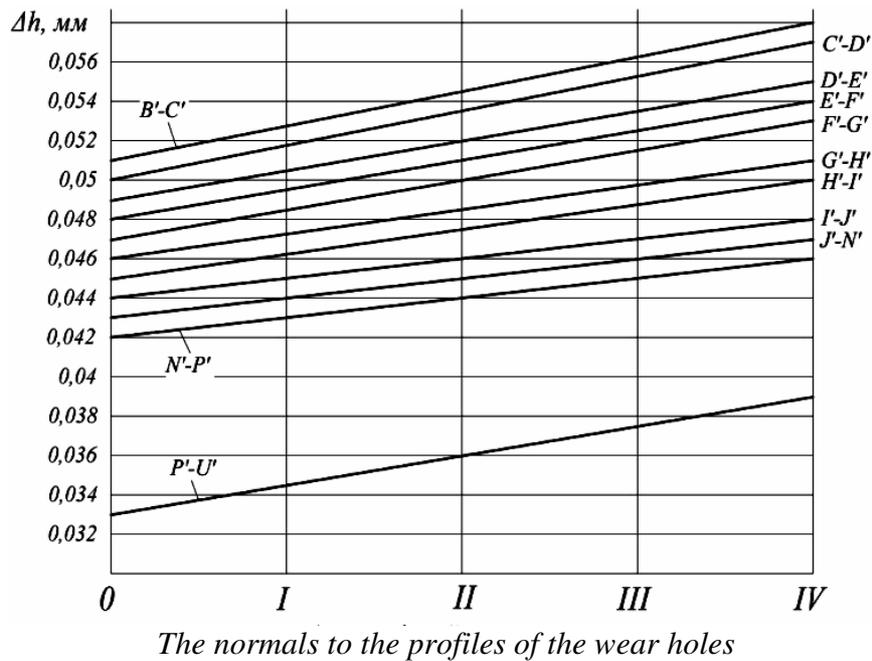


Figure 3 – Ependence of thickness loss of material sieve pilot holes on the side (B)

Reducing the thickness of the material loss along the normal «0» is associated with redistribution pressure fine particles of grain while passing through the separating holes. Normal higher order increases in the thickness loss in each period ΔQ .

From these dependences it is shown that the thickness of the wear in every period of operating time practically is unchanged. This result confirms that the use of separating sieves with holes toroidal shape is effective to increase their durability. Operating hours pilot sieve to wear full is about 1000 tons of crushed grain sieving.

The result shows the efficiency of sieves with holes toroidal shape close to the shape of the natural wear and tear, which is stored in furthering lifetime and provides high-quality separation process of passing. The new design reduces the loss of holes form surface, increasing the life of the sieves and crushers in general.

Studies of wear holes in sieves experimental section shows the uneven shape by losing parties, observed with serial wear sieves. Therefore, to improve the durability and working full potential resource it is necessary to sieve turning it 180° (reverse). Performing this operation is advisable for operating time after the crusher 750 tons. Important characteristic that reflects the specific features of forming surfaces during wear, is to determine areas of worn areas that are between two formed profiles wear in every period of operating time ΔQ results of these studies show that the distribution of values in each period ΔQ is the amount equal, and the party (A) is $0,084 \text{ mm}^2$, and on the side (B) $\sim 0,041 \text{ mm}^2$ of the total area.

Because turning sieve (reverse) after an operating time of 750 tones or less worn side (B) takes position on the side (A), continuing to deteriorate both parameters of the opposite side (Fig. 4, B_{nep}) and vice versa (Fig. 4, A_{nep}). As a result, the area of demolition party gradually aligned closer to each other. When the wear limit sieves parties (A and B) holes lose the same amount of material (Fig. 4, and 5), it exhausts its resources.

Based on the results of experimental studies conducted in actual use it was found that longevity sieves with holes toroidal shape, close to the shape of the natural wear and tear are 1470 tons of recycled materials. Thus, with respect to durability experimental batch sieve with a modified form of openings it is increased 1, 75.

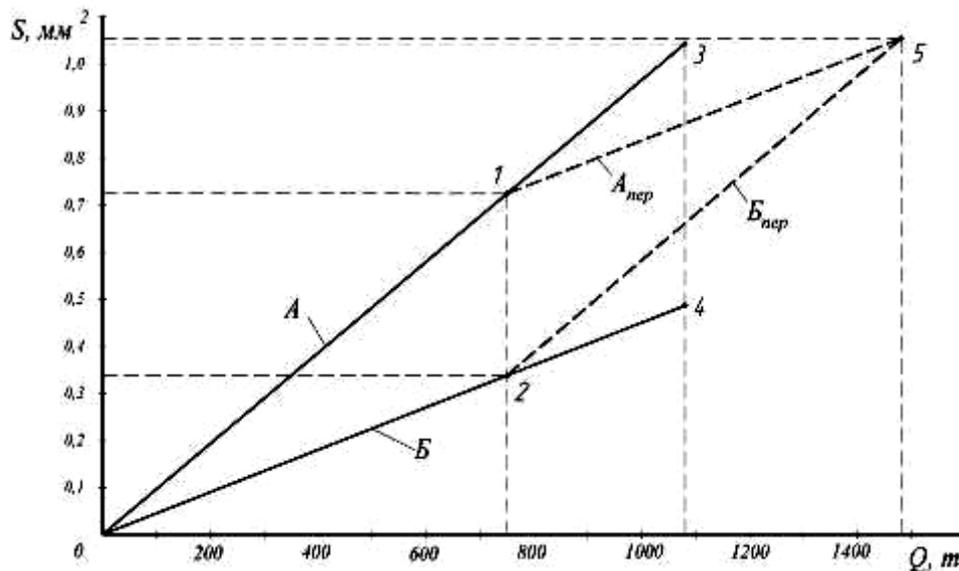


Figure 4 – Dependence of changes in the area of the material lost in the operation of experimental sieves before and after the revolution of 180 ° (reverse):
 1-2 – the best party wear holes for turning operation;
 3-4 – the maximum wear holes without turning sieve;
 5 – maximum values holes extended wear life

Wear sieves with holes toroidal shape leads to a special profile, which increases their efficiency. Thus, the grinding module is always within $Me = 1, 58-1, 62$ mm. Number of original product that meets the requirements of zootechnical feeding is increased by 5% compared with serial samples. This indicates better quality experimental screening sieve, and it is characterized by round shape of the holes close to the natural shape wear.

Conclusion. It is advisable to increase durability sieves lay in the original structural form apertures that ensures minimal wear of their intensity. Toroidal shape is close to natural shape wear.

The principal difference in the experimental separating sieves is wearing during the operation and function of effectively screening the desired grain mass fraction. The use of new form of holes is close to the natural shape wear. It leads to the possibility such profiles forming and at least changes their shape. The service life of sieves showed the effectiveness of their use in comparison with the serial.

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