Separation of Cotton-Seed Rushanka by Linear Dimensions and Aerodynamic Properties of the Components

Djuraev Anvar Djuraevich	Professor of Tashkent Institute of Textile and Light Industry Email: anvardjuraev1948@mail.ru tel: 97 715 79 67
Juraev Dadakhon Davlat o'g'li	Doctoral student of Navoi branch of the Academy of Sciences Email: dadaxonjurayev91@mail.ru tel: 907152686
Tursunov Sa'dullo Fayzullo o'g'li	Student of Navoi State University of Mining and Technologies
Ziyodullaeva Sitorabonu Po'lot qizi	Navoi city specialized state secondary school № 19, teacher

ABSTRACT

The article explains the work on the division of the seed bed into fractions according to the linear dimensions and aerodynamic properties of various components. In separators of different brands, we determined the fractional composition of the mermaid at different vertical speeds of the air flow and the fractional composition of the mermaid on the sections of seed sieves operating in the mermaid with fractions of different sizes, and also determined the fractional composition of the mermaid, which differed in the size of the particles that passed through the separator sieve (seeds according to). The rise rate curves of the components (seed husk and kernel) are shown in the explanatory diagrams.

Keywords: seed, rushanka, separator, component, fraction, husk, core, speed, particle, effect.

Introduction. The choice of the principle, equipment and modes of extraction of oilseeds of fruit and seed coats from rushanka depends on the properties and the degree of difference between the individual properties of the components of rushanka. Methods that use differences in the totality of the following properties of components are widely used: linear dimensions and aerodynamic properties; linear dimensions and electrical properties; density, friction coefficients and aerodynamic properties; density, elastic properties and surface conditions. Most of the methods used in the cleaning of oilseeds are also used to separate Rushanka.

Methods. Separating the seeds from the shell takes place in two stages, that is, first the shell it is crushed (broken), then it is separated from the core. The product coming out of the cutting machine - rushanka from several fractions consists of: core, pod (luzga, shelukha), whole seed, unripe seed (nedorush), bucket. That is why rushanka is divided into components – fractions is separated. The composition of the mixture in the selection of lightning fractionation equipment and physical properties are taken into account. Components in the separation of rushanka size difference, electrophysical properties, density, friction coefficient, methods based on aerodynamic properties are used.

Results. Rushanka separators, separating the mixture only by linear dimensions, are not very common and are used for separating cottonseed comb - double shakers, bitter separators. Bitter separators can be attributed to auxiliary machines, the main task of which is to additionally process large husks in order to separate the remains of free and husk-bound kernels.

In rushanka separators that separate the mixture according to linear dimensions and aerodynamic properties, the system of sieve surfaces can be the main or auxiliary working body.

When separating cottonseed rushanka, in which the husk, due to its specific properties, easily floats to the surface of the oscillating layer, the sieve surfaces are the main working elements of the rushanka separators (purifiers, shakers).

When separating rushanka oilseeds of most other crops (sunflower, soybeans, mustard, peanuts, coriander), fractionation on sieve surfaces facilitates the process of separating rushanka according to aerodynamic properties, which is the main one. In this case, the screen surfaces of the roller separators can be classified as auxiliary working bodies.

The aerodynamic properties of oilseeds, their morphological parts and individual components of the rushanka (underwheat, oil dust, fragments of the core and shell) fluctuate over a wide range and depend on the type and variety of seeds, growing conditions, shape and size of particles, pubescence and moisture, density and condition surface and many other properties.

In the air flow, it is almost impossible to carry out a clear separation of the rushanka into its components. Figure 1. graphically shows the limiting speeds of soaring of individual components of sunflower rushanka, isolated on screenings of an aspiration wake. As can be seen from the figure, at speeds of soaring that ensure the removal of the husk from the husk, other components will also be carried away into the husk - oil dust, particles of the kernel, a certain part of the underbrush. Table 1.

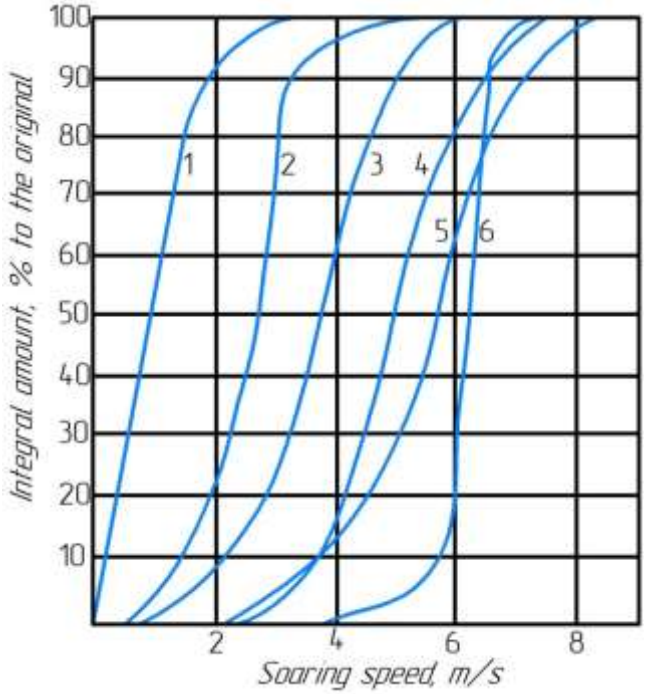

Figure. 1. Integral curves of soaring speeds of components of sunflower rushanka: 1-husks; 2-oil dust; 3-cuts; 4-underwhelming; 5-core; 6 seeds.

Preliminary fractionation of rushanka according to linear dimensions provides a clearer separation of the components of rushanka in the air stream. For fractionation of rushanka according to linear dimensions, in the existing designs of rushanka separators - in the M1C-50 and M2C-50 seeders, multi-tiered systems of flat sieves operating in series are used, in the new P1-MST seeders, a variant of the system of flat sieves operating in parallel-series is provided.

The results of the processing of fractionated sunflower rushaika in an inclined air flow of M1C-50 seeds are presented in Table 2.

The content of free husks in sections II-VI ranges from 0.46 to 1.60%. The content of bound husks in sections II-III exceeds the content of free husks. Reducing the amount of bound husks in the kernel can be achieved by calibrating the seeds before hulling, controlling the kernel, and using machines that ensure the separation of the II-III sections according to combined properties.

Table 1.

Components rushanki	Fractional composition of rushanka (in %) at various vertical air flow velocities (in m/s)					
	до 2,7	2,7-3,8	3,8-4,9	4,9-6,1	6 ,1-7,2	7,2-8,2
Core.....	0,60	24,61	47,36	54,08	78,20	97,12
Husk.....	73,24	4,61	-	-	-	-
Underwhelming..	-	13,08	15,04	17,52	11,48	-
Whole seeds.....	-	-	9,08	20,40	9,48	2,88
Cut……..	9,48	27,21	23,00	7,20	0,68	-
Oil dust……	16,68	30,49	5,52	0,80	0,16	-
Total……	100	100	100	100	100	100
Relative mass of fractions, % to the initial sample.	17,80	3,27	15,56	27,37	27,00	9,00

In the rushanka of the seventh sections, which is not processed in the air flow, the content of free husk, according to one of the data, ranged from 86 to 9.9%. With an average output of the windward section of about 18% by weight of processed seeds with a moisture content of 6.0–6.5%, the content of husks in the common kernel increased by more than 1.5% due to the seventh section. The output of the material of the seventh sections and its composition in terms of the content of oil dust, husks and seed coat can vary depending on the moisture content of the seeds and the mode of operation of the hulling machines.

When seeds are crushed and Rushanka is separated into fractions in the sieving of the seed sifter, favorable conditions are created for oiling the husk due to its contact during advancement and sifting through a sieve with a highly oily crushed seed kernel and oil dust. The duration of rushanka in sieving increases from the coarse fraction (section I, exit from the upper tier of sieves) to the fine fraction (section VII, out of the wind). The duration of sieving the fine fraction of rushanka (Sections VI, VII) reaches 60 s. During this time, the oil content of the husk increases significantly due to its oiling.

In one of the measurements (average data), the oil content of the husks by sections was in%:

I	II	III	IV	V	VI
1,86	2,06	2,21	2,75	3,14	4,44

Table 2.

Components rushanki	Fractional composition of rushanka (in %) by sections of the working seed sifter at different sizes of rushanka fractions (in mm2)					
	I (более 7мм)	II (6-7мм)	III (5-6мм)	IV (4,5-5мм)	V (3-4,5мм)	VI (2,5-3мм)
Whole seeds.....	26,76	15,28	5,17	1;04	0,00	0,00
Underwhelming.....	31,88	20,08	13,55	7,48	2,29	0,56
Core.....	30,22	62,11	80,07	89,92	96,72	97,64
Free husk.....	4,88	1,30	0,76	0,46	0,46	1,60
Organic sor.....	6,26	1,23	0,45	1,10	0,53	0,20
Total.....	100,00	100,00	100,00	100,00	100,00	100,00
General huskiness….	15,28	8,30	3,96	1,96	0,88	1,74
Connected husk.....	10,40	7,00	3,20	1,50	0,42	0,14

The increase in the oil content of the husk from Sections I to VI cannot be attributed only to the increase in the time of contact of the husk with the kernel in the sieving seed. Obviously, an increase in the specific surface area of the husk as its size decreases, and an increased botanical oil content in the husk of a fine fraction, the husk of which falls mainly in the last sections of the seed harvest, play a certain role.

At present, the interdepartmental tests of the P1-MST seed harvester with a capacity of 80 tons/day of seeds have been completed. One of the distinguishing features of this seed sifter is that before it enters the sieving sieve, a fraction of fine particles (chaff, oil dust) is released from the rushanka. The degree of oiling of the husk, as studies have shown, is lower on this seed harvester than on the M2S-50 seed harvester. The oil content of the husk is reduced by about 0.25%.

As has been repeatedly noted, the choice of the most rational methods of processing seeds (cleaning, hulling, separation of the husk) is determined by the properties of the individual components of the mixture of particles. As a result of studying the properties of the components of the cottonseed rushanka, optimal options for separating the rushanka of seeds with different pubescence have been outlined.

In table. 3. shows the soaring speeds of cotton husks and kernels, which differ in particle size.

Table 3.

Hairiness, %	Particle size, mm	Material	Soaring speed, m/s	
			minimal	maximum
0,43	More than 5	Husk	3,3	4,0
		Core	6 ,1	8,6
	3-5	Husk	2 ,8	3,3
		Core	6 ,1	8,3
	2-3	Husk	2,3	2,8
		Core	4,4	6,7
3,5	More 7	Husk	2,0	4,9
		Core	-	-
	5-7	Husk	2,3	4,5
		Core	6,2	8,7
	3-5	Husk	2,3	3,6
		Core	6,4	9,8
	2-3	Husk	2,3	3,6
		Core	4	8,1
	Less 2	Mixture	1,8	5,0
9,8	More 5	Husk	2,2	4,0
		Core	6,1	8,8
	3-5	Husk	2,2	4,0
		Core	5	8,9
	2-3	Husk	1,8	3,6
		Core	1,6	7,1

According to the results of experimental work in order to study the properties of rushanka and production testing, the expediency of using M1C-50 seeders for separating the rushanka of bare cotton seeds and with pubescence up to 1% was shown. At the same time, a decrease in the oil content of the outgoing husk and a decrease in the husk content in the kernel entering the rollers were achieved.

When separating the rushanka of cotton seeds with high pubescence, the main amount of the husk enters the first two sections of the seed harvester, disrupting its work.

The husks on screening are practically not fractionated in size due to its adhesion to the fibers of the lint, clumping of the husk with the capture of the kernel and whole seeds is observed, which leads to a sharp increase in the oil content of the husk and a decrease in the productivity of the wake.

In the production of food mustard powder, the separation of the husk from the kernel is the main technological operation. The maximum separation of free husks is achieved on the blinds of the M1C-50 seed harvester.

In the air flow, without additional fractionation of seeds and rushanka by size, it is impossible to achieve a clear division of rushanka into individual components, as can be seen from Table. 4, which shows the results of the separation of the factory linen in a vertical air flow.

Table 4

Components Rushanki	The composition of the original rushanki, %	Vertical air flow velocity, m/s				
		Up to 2.0	2,0-3,8	3,8-4,9	4,9-6,1	6,1-7,2
Relative yield of components	-	12,94	45,98	22,38	17,78	0,92
Whole seeds	5,86	-	-	-	33,33	75,76
Nedorush	27,34	-	21,37	54,79	56,67	9,09
Krupka (kernel)	59,38	34,04	77,24	44,52	9,33	15,15
Husk (free)	6,64	63,43	1,39	0,69	0,67	-
Muchel, passage through a 0.25 mm sieve	0,78	2,48	-	-	-	-

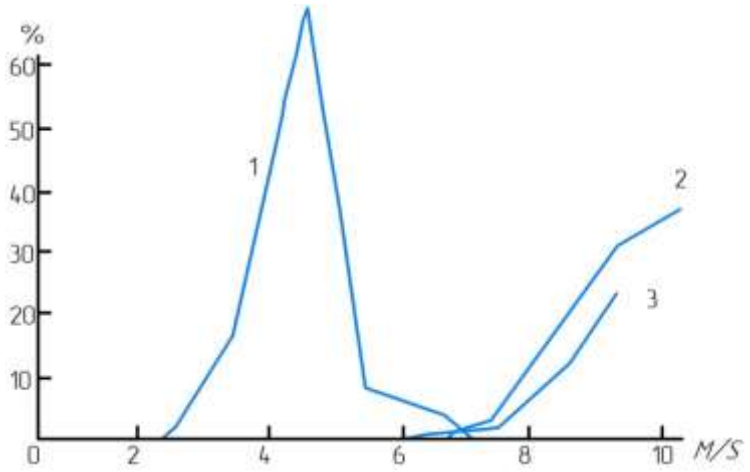

Fig. 2. Variation curves of the soaring speeds of castor bean constituents: 1-shell; 2 cores; 3 seeds.

The shell of some oilseeds is not subjected to fractionation according to linear dimensions before the separation of the shell in the air flow (castor seeds of medium fiber cotton).

On fig. 2. shows the variation curves of the soaring speeds of seeds, kernels and shells of castor bean. It can be seen from the figure that at a vertical air flow velocity (hovering velocity) of up to 6 m/s, the main amount of the shell can be separated from the core. This possibility of a relatively clear separation of the castor bean seed rushanka is partly due to the fact that the hulling of the seeds by passing the seeds between smooth rolls with a fixed gap is carried out in such a way as to preserve the integrity of the kernel as much as possible.

Discussion. If castor bean seeds have a highly oily kernel, which requires little effort to deform, the separation of Rushanka into fractions by size would lead to intensive oiling of the shell, without a significant increase in the effect of air separation.

Conclusions. In conclusion, it should be said that this article defines methods for fractionating oilseeds according to linear dimensions and aerodynamic characteristics of the components through a separator. The composition and properties of the fractions were studied by the components of the Rushanka.

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