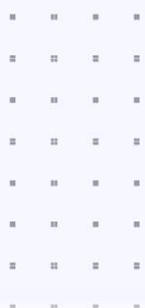


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INVESTIGATION OF FLOW HYDRODYNAMICS IN THE PROCESS OF ASPIRATION CLEANING OF SOYBEAN SEEDS (GRAIN) ON A COMPUTER MODEL

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Abstract. The article deals with the research on energy and resource-saving technologies for the purification of plant raw materials. In the production of high-quality oil required for the food industry, special attention is paid to improving soybean seed separation facilities that are clean from various impurities, with increased oil-bearing capacity and intact shells.

Keywords: purification, research, processes, high-quality, impurities, oil content, separation, aspiration, food industry, soybean seed.

INTRODUCTION

In the world, research is being conducted on the preparation of crop seeds for processing, improvement of existing equipment that meets modern requirements, creation of processes and installations for aspiration and separation of seeds by their size and weight. Today, around the world, special attention is paid to the processing of agricultural raw materials, the development of food production and ensuring their safety. In this regard, the creation of energy- and resource-saving techniques and technologies of processes and equipment for the purification and separation of plant raw materials, in particular soybean seeds, from various impurities is of particular importance.

Today, all over the world, special attention is paid to the processing of agricultural raw materials, the development of food production and ensuring their safety. In this regard, the creation of energy- and resource-saving techniques and technologies for processes and equipment for cleaning and separating plant raw materials, in particular soybean seeds, from various impurities is of particular importance.

Such foreign scientists as Aniskin V.I., Gortinsky V.V., Nepomnyashchikh E.A., Kozhukhovskiy I.E., Goryachkin V.P., Gromov A.G., Lapshin I.P., Zaika P.M., Zyulin A.N., Klimok A.I., Avdeev N.E., Konchenko N.F., Kosilov I.I., Arkhipov A. S., Kubyshev V.A., Gladkov N.G., Lapshin P.N., Letoshnev M.N., Lopan A.A., Pavlovskiy G.T., Terentiev Yu.V., Terskov G.D., Tulkibaev M.A., Ulrikh N.N. A number of research works were carried out to improve the technology of primary processing of soybean seeds, purification and fractionation of soybean seeds with high technological indicators. However, the conducted studies have not fully studied the system of aspiration of plant seeds, including soybean seeds, depending on their geometric dimensions and weight.

MATERIALS AND METHODS

Based on this, we have analyzed the efficiency of the functioning of modern devices designed for fractionation and separation of seeds (grains) of legumes and cereals; the main factors affecting the technological performance of this equipment have been identified. The analysis of the degree of purification of soybean seeds from

impurities by the aspiration method was carried out, elements of the aspiration theory were described, and appropriate conclusions were drawn.

In the variety testing, the physical characteristics of soybean varieties and their seed properties were studied. The results of the study are shown in Table 1.

Table 1
Physico - chemical quality indicators of domestic soybean varieties

№	Seed (grain) quality indicators	Soy variety			
		Nena	Tumaris	Ustoz	Baraka
1.	Seed sizes, mm:				
	- length	6,79±0,09	7,10±0,06	6,79±0,09	7,60±0,09
	- width	4,83±0,05	5,91±0,05	4,83±0,05	6,36±0,07
	- thickness	4,56±0,09	4,77±0,06	4,22±0,09	4,85±0,06
2.	Humidity, %	8,0	9,2	9,6	9,6
3.	Soreness, %	5,3	3,2	7,3	4,2
4.	Mass fraction of fat, %	23,50	23,50	22,71	14,85
5.	Mass fraction of protein, %	42,52	42,48	39,86	36,90

A computer model describing the laws of the air flow and movement of soybean seeds in the plant has been developed. A method for calculating the concentration of dispersed particles in the air flow system of the aspiration system is presented.

The factors influencing the fractionation of soybean seeds and the seeds of various plants contained in them were determined by taking Y, Z as input parameters and X, U as output parameters (Fig. 1).

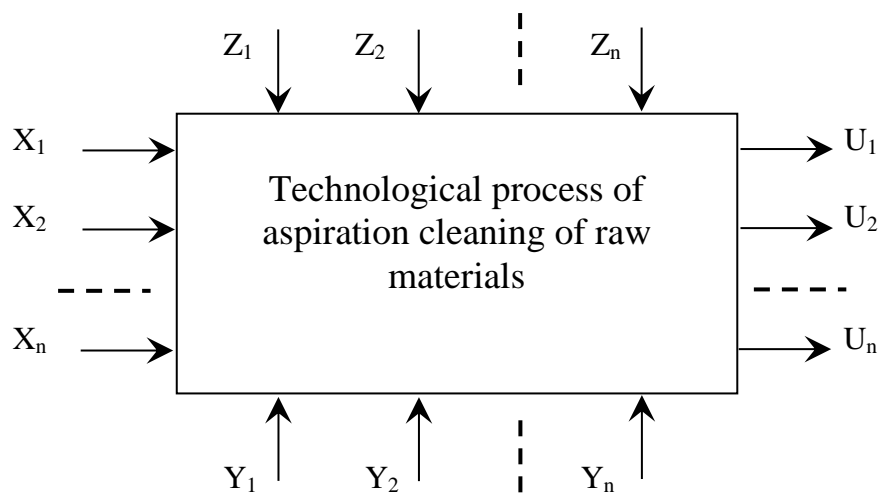


Figure 1 - Block diagram of the aspiration process
RESULT AND DISCUSSION

The group of parameters Y characterizes the design parameters of the aspiration part of the separator, Z - the properties of the soy mixture and the feed rate, X, U - mass, soreness, fan suction rate.

The objective of the study is to identify patterns of communication between the input and output parameters of the object. The aerodynamic parameters of the functioning of the diametral fan were investigated with the following parameters: the width of the impeller B=0.1 m; the rotation speed p=1000 vol/min; the performance $Q_v=0.3 \text{ m}^3/\text{s}$.

At the same time, the outlet pipeline of the purified raw materials was installed taking into account the absolute absorption to remove impurities. The rate of entry of products into the pneumatic separation channel was $V_p=0.5 \text{ m/s}$. The parameters of the simulated particles are given in Table 2.

Table 2

Parameters of the simulated product

Product	$\rho_p, \text{ kg/m}^3$	$\bar{V}_{vit}, \text{ m/s}$	$d_e, \text{ m}$
Soy	720	30,6	0,0070
Average natural ratios	520	4,4	0,0009
The relations are easily natural	260	2,3	0,0005

At the same time, the mass fraction of light and average natural ratios did not exceed 1.0%, respectively.

Figure 2 shows the trajectories of model particles inside a closed air system.

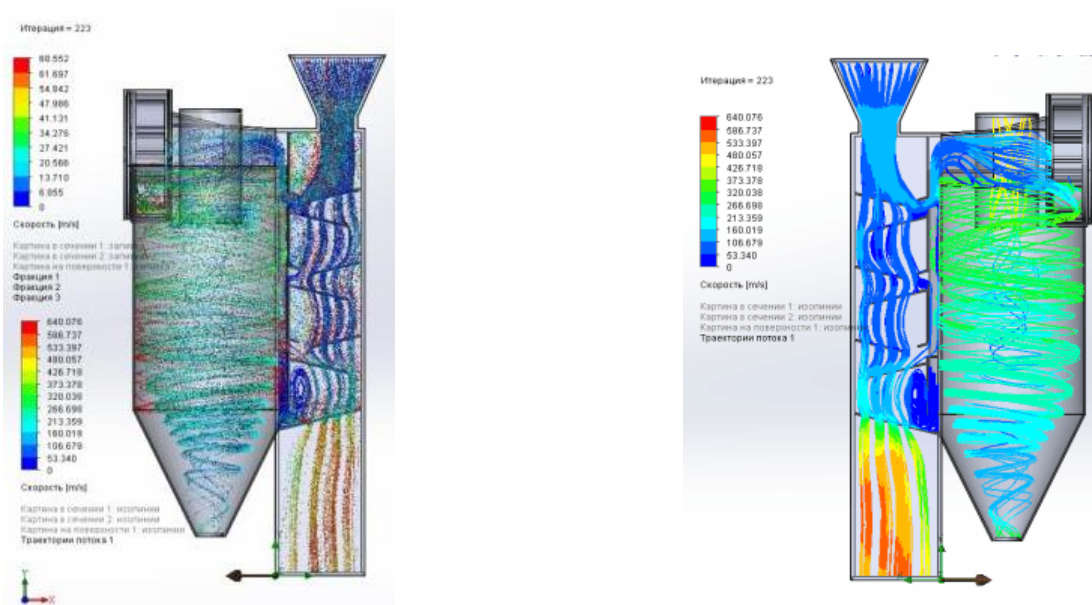


Figure 2 - Trajectories of model particles in the air flow velocity field

With the help of computer modeling, the values of the basic physical parameters for the aerodynamic scheme of the combined separator plant were obtained, and the design and quality of the aspiration process improved by the combined separator plant were analyzed.

And so, we have developed a method for calculating the movement of the air flow during the movement of plant seeds on the surface of the racks of the aspiration unit; the critical air velocity, product consumption, and the angle of inclination of the perforated walls have been determined and scientifically substantiated; the rational regime of the process of fractional separation of seeds is determined and justified the device of the combined aspiration separator, which implements rational modes of the process of fractional separation of seeds, has been upgraded.

At the same time, the practical significance of the research can be explained by the fact that the new combined separator for cleaning and fractionation of seeds by weight is energy-saving and has high technical indicators.

CONCLUSION

Based on the results of computer modeling and analysis, optimal modes of seed (grain) fractionation have been determined soybeans in a combined separator unit: air intake speed 4.5 m/s, angle of inclination of perforated shelves 14 °, volume flow rate 0.006 m³/s, the rotation speed of the feed shaft is 420 vol/min, the angle of inclination of the guide $\alpha=45^\circ$.

In the proposed method, the degree of purification of raw materials has been increased to 98.3% and energy consumption has been reduced by 2 times; extraction has increased by 3.0-3.5% the ability of soybean grains sorted into seeds;

During the research, the oil content in sorted soybean seeds (grains) averaged 16.2 %, and according to the current comparative method - 14.5 %;

According to the results of the research, a combined separator unit equipped with an aspiration system designed for cleaning soybean seeds (grains) has been developed and put into production.

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