EXPERIMENTAL RESEARCHES ON FLAT SIEVE WORKING PROCESSES

CERCETĂRI EXPERIMENTALE ASUPRA PROCESELOR DE LUCRU ALE SITELOR PLANE

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Abstract: *The separation of seeds from the heap is effected thanks to the vibration of the flat sieves. The efficiency of the cleaning process of the sieves from the cleaning system depends on the following factors: the inclination of the sieves, the sieves size and mainly of the character of the relative movements of the seeds on the sieve, respectively the cinematic regime of the sieves. For the experimental tests, it was used the selector of the seed cleaning machine, where the supply discharge and sieve inclination angle were modified.*

Rezumat: *Separarea seminţelor din vraf se realizează prin vibraţia sitelor plane. Eficienţa procesului de curăţire al sitelor sistemului de curăţire depinde de următorii factori: înclinarea sitelor, dimensiunile sitelor, gradul de încărcare al sitelor, caracterul mişcării relative a seminţelor faţă de site, respectiv de indicele cinematic al sitelor. Pentru încercările experimentale s-a folosit selectorul maşinii de curăţat seminţe la care s-a modificat debitul de alimentare şi unghiul de înclinare al sitelor.*

Key words**:** *flat sieves, sliding regimes, relative motion.*
Cuvinte cheie: *site plane, regimuri de alunecare, mişcare relativă.*

INTRODUCTION

The operation of separation of seeds from the layer on the sieves of seed cleaning and sorting machines takes place due to the phenomenon of material stratification in its components, which are differentiated after their density and also, due to the state of sifting of the seed layer on the separation surface, produced by the motion of sieves.

In order to verify the results, obtained in the theoretical study, experimental tests were performed, where there were determined the time and velocity of displacement of the material on the oscillating sieve surface, the degree of separation of components from the mixture, subjected to sifting process and the sieve productivity, all these as functions of the kinematical parameters of the motion of cleaning system, respectively of the rotative speed of the shaft of driving mechanism, the amplitude and frequency of oscillations.

In order to obtain concluding results, the experimental tests were performed in working conditions, on the cleaning and sorting machine.

All determinations were effected at different inclinations of oscillating sieves and different rotative speed of the driving shaft. In all variants of work, the tests were performed in more repetitions, the results presented in this paper being the average of these repetitions.

MATERIALS AND METHODS

The state of sifting is defined by the character of relative motion of the material on sieves: failure of relative motion (relative rest), relative motion in one direction or in booth directions, with or without detachment.

The theoretical studies show that an efficient separation of seeds in the layer on the sieve takes place when it is assured to the material a state of sifting, defined by a relative motion, in booth directions, on the sifting surface, with the tendency of detachment and a

resultant motion, to the sieve extremity which is opposite to the one where the sieve is supplied with material.

The forces which act on the seeds, situated on the sieve surface of the cleaning system and which can to induce to the material a certain state of sifting, are the forces of inertia. The orientation of these forces (together with all other forces which act on the material) was presented within the framework of the theoretical study.

The uniformity of testing conditions was assured by using a constant debit of supplying and sieves with the same constructive characteristics. In all cases, the layer of material, submitted to the cleaning process, presented the same initial degree of purity. In this way, the obtained results could be appreciated by comparison and it was possible to establish optimal variants of work for the flat oscillating sieves.

For the experimental tests, it was used the selector of the seed cleaning machine, which allows the modifying of the debit of supplying, angle of inclination of sieves and rotative speed of driving shaft (Figure 1).

For all experimental determinations, there were used identical probes of seeds, with the mass of 25 kg. It is mentioned the fact that the same probe was not used to effect more determinations, because the material can change its properties after the passing through the selector. The tests were done with identical samples of wheat, resulted from the direct harvesting in field with the combines.

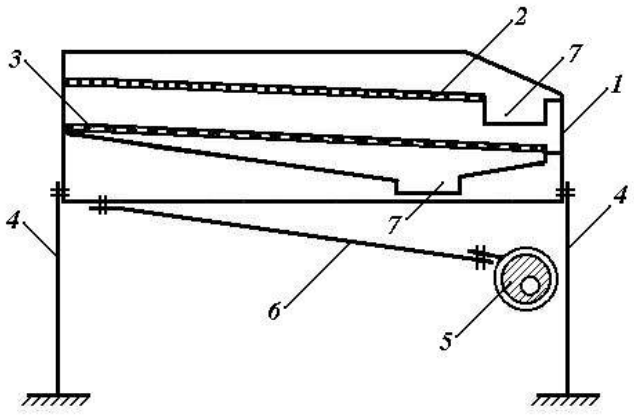

Figure 1. Driving mechanism of sieves
1-sieve frame, 2-top sieve, 3-bottom sieve, 4-springs, 5-shift with eccentric, 6-crank, 7-collecting trough.

For each determination, it was measured the time of separation of the material. At the collecting troughs, from the initial material, subjected to cleaning, there are obtained four aprons, as fallows:

- cleaned seeds, collected to the central trough of the selector;
- small impurities, collected to the trough of the selector;
- big impurities, collected to the trough of the selector;
- small seeds, collected to the trough of the selector.

The chaff, dust and light impurities, evacuated by the ventilator, were neglected, because they represent a very small percentage in the mass of product.

On the basis of the quantities of material, collected to each trough of evacuation, during a probe, it was calculated the percentage of material from each apron, related to the

mass of material of the probe (corresponding to the testing period). In parallel, it was calculated the purity of material, collected to the central trough of the selector and the losses of good seeds in the big impurities, for the established period of test.

RESULTS AND DISCUSSION

The first experimental tests, concerning the driving of flat sieves of the selector, had as aim to establish the time and velocity of displacement of seeds on the surface of flat sieves, as a function of the imposed kinematical parameters (rotative speed of the driving shaft, angle of inclination of sieve, debit of supplying with material). For this aim, the superior sieve was replaced by an inclined plan (blind sieve), made of steel plate sheet, with the equal dimensions to the ones of the superior sieve. The coefficient of friction between the material and the inclined plan has the value $\mu = 0,37$.

The experimental determinations were realized for the fallowing values of the modified parameters:

- angle of inclination of sieves: 2°, 4°, 6° and 8°;
- rotative speed of driving shaft: 360, 380, 410 and 470 rot/min;
- debit of material supplying: 0.83 kg/s; 1.11 kg/s and 1.40 kg/s.

The results concerning the time of displacement of the probe of material (25 kg) on the oscillating plan are presented in Table 1.

Table 1

Time of displacement of probe of material on the surface of oscillating plan [s]

No.	Angle of inclination [degrees]	Debit of supplying [kg/s]	Rotative speed of driving shaft [rot/min]			
			360	380	410	470
1	2	0.83	124	116	101	83
		1.11	165	154	132	111
		1.40	206	193	165	139
2	4	0.83	114	106	92	77
		1.11	151	139	122	102
		1.40	189	174	153	128
3	6	0.83	104	95	85	70
		1.11	138	127	114	94
		1.40	173	159	142	117
4	8	0.83	93	89	80	63
		1.11	124	119	107	84
		1.40	155	148	133	105

As a function of the time of displacement of probe of material on the surface of oscillating plan and of dimensions of the oscillating plan, it was determined the time of displacement of seeds on the surface of oscillating plan (table 2).

The time of displacement of seeds on the surface of the oscillating plan increases with the increasing of the debit of supplying.

The velocity of displacement of seeds on the surface of the oscillating plan is as bigger as the time of displacement is shorter and inversely. The velocities of displacement of seeds on the surface of the oscillating plan, as a function of the debit of supplying, angle of inclination of the oscillating plan and speed of the driving shaft are centralized in Table 3.

The degree of separation of components in the mixture of seeds constitutes the index of qualitative appreciation of the cleaning process. Of course, the target is that its value to be as bigger as possible, in order to obtain a pure final product, without impurities and with minimal losses of seeds of the base culture. In general, for the seeds which are designated to seeding,

their purity must be over 98%, and for the seeds, designated to consummation, over 94%.

Table 2

Time of displacement of seeds on the surface of oscillating plan [s]

No.	Angle of inclination [degrees]	Debit of supplying [kg/s]	Rotative speed of driving shaft [rot/min]			
			360	380	410	470
1	2	0.83	21,71	20,31	17,68	14,53
		1.11	28,89	26,96	23,11	19,44
		1.40	36,07	33,79	28,89	24,34
2	4	0.83	19,96	18,56	16,11	13,48
		1.11	26,44	24,34	21,36	17,86
		1.40	33,09	30,47	26,79	22,41
3	6	0.83	18,21	16,63	14,88	12,26
		1.11	24,16	22,24	19,96	16,46
		1.40	30,29	27,94	24,86	20,49
4	8	0.83	16,28	15,58	14,00	11,03
		1.11	21,71	20,84	18,73	14,71
		1.40	27,14	25,91	23,29	18,39

Within the framework of the effected determinations, it was watched the dependence of the degree of separation and of the productivity of the oscillating sieves of the selector, as a function of the debit of supplying with material, angle of inclination of the sieves and rotative speed of the driving shaft. The tests were performed with identical probes of seeds with a content of impurities of 10%. After the separation of mixture, there were balanced the aprons, collected to the collecting troughs of selector (selected seeds, big impurities, small impurities and light seeds), obtaining by dividing to the total mass of probe (25kg), the degree of separation, expressed by percentage.

Table 3

Velocity of displacement of seeds on the surface of the oscillating plan [m/s]

No.	Angle of inclination [degrees]	Debit of supplying [kg/s]	Rotative speed of driving shaft [rot/min]			
			360	380	410	470
1	2	0.83	0,62	0,67	0,77	0,93
		1.11	0,47	0,50	059	0,70
		1.40	0,37	0,40	0,47	0,56
2	4	0.83	0,68	0,73	0,84	1,00
		1.11	0,51	0,56	0,63	0,76
		1.40	0,41	0,44	0,51	0,60
3	6	0.83	0,74	0,81	0,91	1,10
		1.11	0,56	0,61	0,68	0,82
		1.40	0,45	0,48	0,55	0,66
4	8	0.83	0,83	0,87	0,97	1,23
		1.11	0,62	0,65	0,72	0,92
		1.40	0,50	0,52	0,58	0,74

The productivity of flat sieves of the selector, respectively their capacity of work on time unit, is the most important economical criterion of appreciation of the process of seed cleaning. The target of the theoretical and experimental studies is the increasing of productivity, without affecting the degree of separation of components and the purity of the final product.

In Table 4 it is presented the productivity of the oscillating sieves of the selector.

Table 4

Productivity of oscillating sieves of selector [g/m^2 s]

No.	Angle of inclination [degrees]	Debit of supplying [kg/s]	Rotative speed of driving shaft [rot/min]			
			360	380	410	470
1	2	0.83	348	368	432	512
		1.11	428	460	540	640
		1.40	576	616	704	860
2	4	0.83	376	408	464	556
		1.11	472	512	584	700
		1.40	624	672	776	928
3	6	0.83	412	444	500	608
		1.11	520	560	624	756
		1.40	684	752	840	1016
4	8	0.83	464	480	536	680
		1.11	576	600	664	848
		1.40	768	804	892	1136

CONCLUSIONS

By analyzing the values, centralized in the table 1 - 4, the fallowing conclusions concerning the experimental study can be formulated:

- The purity of the cleaned material, expressed by the degree of separation of the components of mixture (aprons) is as bigger, as the rotative speed is bigger and the debit of supplying is smaller;
- The purity of selected material decreases with the increasing of inclination of sieves;
- The degree of separation varies inversely proportional to the flowing velocity, i.e. as bigger is the velocity of displacement of seeds on the surface of sieves, as smaller is the purity of the selected product.
- The productivity of sieves increases with the increasing of the rotative speed of the driving shaft;
- The productivity of sieves increases with the increasing of the velocity of displacement of seeds on the sieves;
- The productivity of sieves increases with the increasing of the angle of inclination of sieves;
- The productivity of sieves increases with the increasing of the debit of supplying with material.

As a final remark, it must be mentioned the aspect that the purity of the selected material decreases by increasing the productivity of sieves.

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