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INFLUENCE THE DEGREE OF SORTING THE SEPARATION PROCESS A CONICAL SIEVE

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To express the degree of sorting influence on the process of separating a conical sieve (conceived, designed and built by the authors) were plotted regression curves of the experimental data with normal distribution function (equation 1), the number of cases analyzed and some of the graphs of these curves are shown in figura.3 for more size fractions that sort rapeseed, including the original mixture of seeds (d> 2 mm, d=1.6 to 2 mm, d = 1, 25 to 1.6 mm, d <1.25) according to different oscillation frequencies (F_1 = 250 osc / min, F_2 = 520 osc / min, F_3 = 790 osc / min) at the same power output.

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Keywords: conical sieve, degree of sorting, oscillation frequency, regression analysis

1. Introduction

In processing and packaging of seeds of cereals and other crops used generally vibratory movement of the working surface cleaning and separation equipment, [1].

For purification, separation and sorting seeds, main areas of work are sieves (type or perforated sheets of wire and wire braided plastic). They may have different forms depending on the type of crop agriculture, seed shape and content of impurities. To determine the main features of the experimental installation process working with conical sieve proposed and described in Figure 1, experimental determinations were performed in laboratory bench designed, engineered and built in the Department of Mechanical and better then the Department of Biotechnical Systems the "University Politehnica of Bucharest".

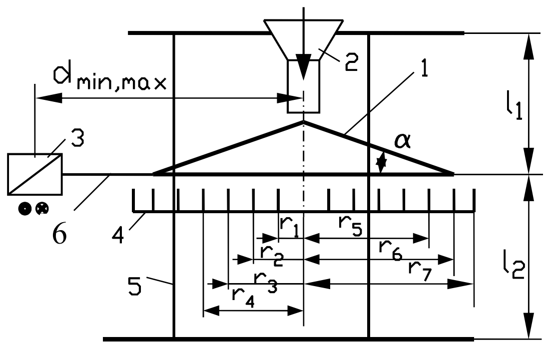

Fig.1. Scheme suspended conical sieve used in experiments, [5, 6]
1. Conical sieve holes ϕ4.2 mm; 2 - height adjustable feed hopper; 3.mechanism oscillating drive with limitless; 4. Collection box, 5. steel elastic wire cables; 6. Lever

2. Materials and methods

Conical sieve shown in Figure 1, has been duly completed to carry out experimental research related to the work done by it.. Thus the power grid was added feed hopper equipped with outlet diameter ϕ 25 mm above the site, its vertical axis with height adjustability of the funnel to amend annular flow section of the screen and the bottom of the hole exhaust.

To collect material separated by sieve openings was designed collection box with several tabs circular rings with different radii from the axis grid, [2]. Position the filter and collection boxes to metal substrates (suspension cables) was fixed using clamps (clamps) sieve collected in each of the three steel cables, maintaining the horizontal position of the screen and collection boxes. For experiments were used rapeseed harvested in southern Romania after a storage period of about six months. The sample of material was always the same and consisted of 0.5 kg of seed added to 15 grams (3%) of large foreign bodies consisting of parts of stems of rape sizes between 3 and 4 mm. Rape seed moisture was 7.65 to 8.05% and from 8.35 to 8.70% straw parties determined by a Partner balance MAC 110, 105 ° C drying temperature.

3. Results and discussion

Intensity curves were drawn separating the generator site and by regression analysis with the law of normal distribution were determined equations and correlation coefficients with experimental data (in%) with function in Microcal Origin 6.0, using Equation 1, for more cases analyzed, and some of the graphs of these curves are shown in figure.2 for more size fractions that sort rapeseed, including the original mixture of seeds (d> 2 mm, d = 1.6 to 2 mm , d = 1.25 to 1.6 mm, d <1.25) according to different oscillation frequencies (F_1 = 250 osc / min, F_2 = 520 osc / min, F_3 = 790 osc / min) at the same flow supply:

$$p_x(\%) = a \cdot e^{-b(x-c)^2} \quad (1)$$

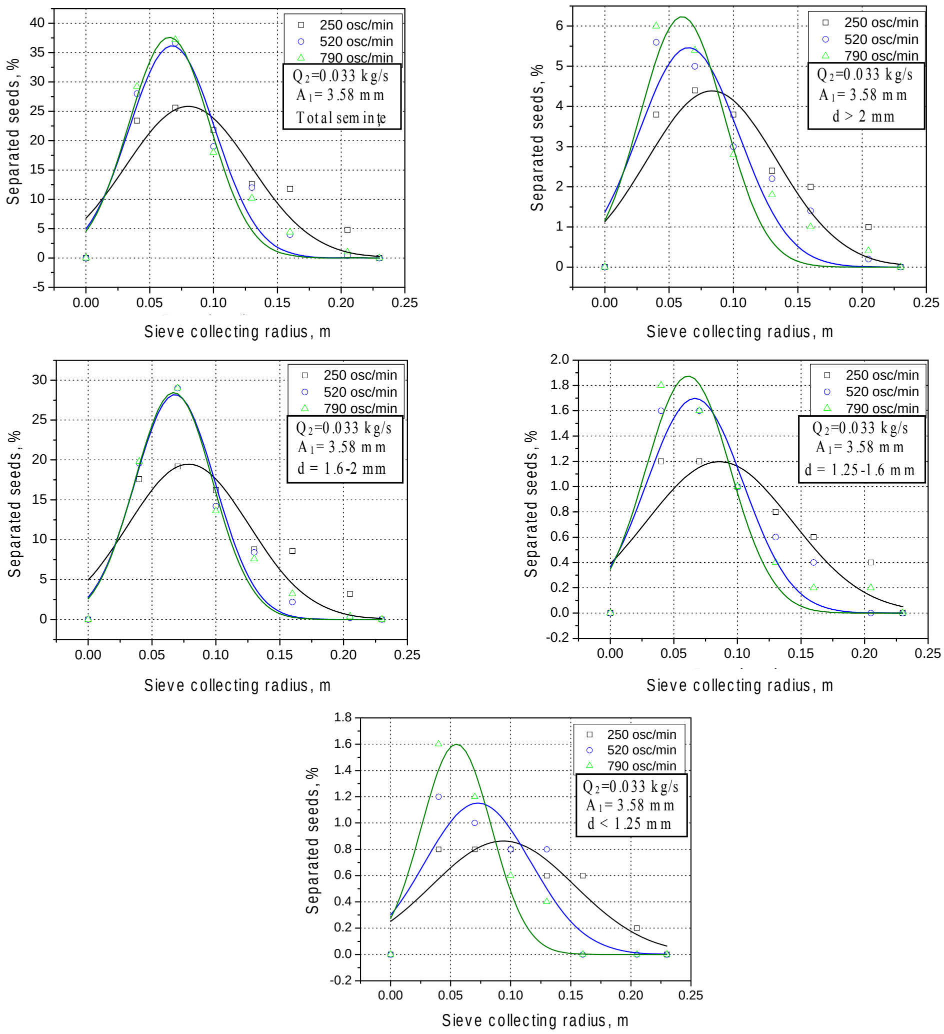

Fig.2. Regression curves of the experimental data with normal distribution function.

Of those listed in the literature and studied in the preparation of this work, [3,4], we found that a sieve oscillation movement, regardless of its holes can be used with good results and sort by size seeds the same culture or material granular composition. Thus, the literature indicates that for a very thin layer of material particles that do not interact with each other, the first part of the filter separates seeds smaller and the more we depart from the feed end separates large seeds. For larger thickness of the layer of material movement creates favorable conditions for oscillation of the filter material stratification, especially when bottom-up flow and air flow slowly. Under these conditions, contact with sieve seeds will fall the largest and most developed, with greater weight and as we raise the upper seeds we find increasingly smaller and weighing less developed lower. Thus, the seeds of which are in contact with the screen will have a higher probability than seed pass through holes in the upper layers, which do not meet the conditions for passing through sieve openings especially since they must traverse and general layer of material. However, once power until reach to stratify material, can pass more time or less depending on operating mode parameters so that the top of the screen separating the work area will be random, depending and how how does the general sieve seed layer. Using this specification we performed experiments on the degree conical sieve sorting plant, experimental, performing calibration collected seeds in each compartment collection box, to determine the distribution by size of seeds collected in different compartments of the range collection grid Calibration was performed by sieving seeds via the web site of the classifier with existing VIPO the Department of Biotechnical systems.

Site were used with 1.25 mm mesh size of ϕ 1.6 mm, ϕ 2 mm, ϕ 2.5 mm. The experiments were performed power flow Q_2 = 0.033 kg / s and amplitude of oscillation A_1 = 3,58 mm at all three frequencies of oscillation. The results obtained from analysis and equation coefficients (equation 1), a, b and c and χ^2 and R^2 correlation coefficients with experimental data for kinematic parameters change in power flow Q_2 = 0,033kg/s are shown in table 1 and table 2.

Table 1. Coefficients of the regression equation (equation 1), a, b and c and χ^2 and R^2 correlation coefficients with experimental data for power flow Q_2=0,033 kg/s .

No. sample	Operating mode \ Normal function (ec.1)		a	b	c	χ^2	R^2
1	Whole grains	F_1=250 osc/min	25.825	207.896	0.081	24.239	0.838
2		F_2=520 osc/min	36.159	437.266	0.067	16.543	0.941
3		F_3=790 osc/min	37.622	495.839	0.065	15.586	0.946
4	d > 2 mm	F_1=250 osc/min	4.386	196.064	0.083	0.634	0.850
5		F_2=520 osc/min	5.464	327.544	0.065	1.154	0.832
6		F_3=790 osc/min	6.235	467.115	0.060	0.954	0.879
7	d = 1,6-2 mm	F_1=250 osc/min	19.478	221.859	0.079	13.505	0.841
8		F_2=520 osc/min	28.199	500.744	0.068	7.527	0.955
9		F_3=790 osc/min	28.454	532.273	0.067	7.787	0.952
10	d = 1,25 – 1,6 mm	F_1=250 osc/min	1.197	152.425	0.085	0.075	0.773
11		F_2=520 osc/min	1.697	347.003	0.066	0.074	0.886
12		F_3=790 osc/min	1.874	449.522	0.061	0.068	0.906
13	d < 1,25 mm	F_1=250 osc/min	0.863	140.613	0.094	0.031	0.822
14		F_2=520 osc/min	1.151	254.506	0.072	0.071	0.813
15		F_3=790 osc/min	1.600	588.803	0.0545	0.056	0.896

Table 2. Influence the degree of sorting on the separation of rapeseed power flow Q_2=0,033 kg/s .

No. current	Q_2=0,033kg/s		Sieve interval from which collects seeds (m)								
	Fraction of seeds	frequency oscillations	separate seeds	0	0,04	0,07	0,1	0,13	0,16	0,205	over sieve
1	Whole grains	F_1=250 osc/min	g	0	117	128	109	63	59	24	0
			%	0	23,4	25,6	21,8	12,6	11,8	4,8	0
2		F_2=520 osc/min	g	0	140	183	95	60	20	2	0
			%	0	28	36,6	19	12	4	0,4	0
3		F_3=790 osc/min	g	0	146	186	90	51	22	5	0
			%	0	29,2	37,2	18	10,2	4,4	1	0
4	d > 2 mm	F_1=250 osc/min	g	0	19	22	19	12	10	5	0
			%	0	3,8	4,4	3,8	2,4	2	1	0
5		F_2=520 osc/min	g	0	28	25	15	11	7	1	0
			%	0	5,6	5	3	2,2	1,4	0,2	0
6		F_3=790 osc/min	g	0	30	27	14	9	5	2	0
			%	0	6	5,4	2,8	1,8	1	0,4	0
7	d = 1,6-2 mm	F_1=250 osc/min	g	0	88	96	81	44	43	16	0
			%	0	17,6	19,2	16,2	8,8	8,6	3,2	0
8		F_2=520 osc/min	g	0	98	145	71	42	11	1	0
			%	0	19,6	29	14,2	8,4	2,2	0,2	0
9		F_3=790 osc/min	g	0	99	145	68	38	16	2	0
			%	0	19,8	29	13,6	7,6	3,2	0,4	0

No. current	Q₂=0,033kg/s		Sieve interval from which collects seeds (m)								
	Fraction of seeds	frequency oscillations	separate seeds	0	0,04	0,07	0,1	0,13	0,16	0,205	over sieve
10	d = 1,25 – 1,6 mm	F_1=250 osc/min	g	0	6	6	5	4	3	2	0
			%	0	1,2	1,2	1	0,8	0,6	0,4	0
11		F_2=520 osc/min	g	0	8	8	5	3	2	0	0
			%	0	1,6	1,6	1	0,6	0,4	0	0
12		F_3=790 osc/min	g	0	9	8	5	2	1	1	0
			%	0	1,8	1,6	1	0,4	0,2	0,2	0
13	d < 1,25 mm	F_1=250 osc/min	g	0	4	4	4	3	3	1	0
			%	0	0,8	0,8	0,8	0,6	0,6	0,2	0
14		F_2=520 osc/min	g	0	6	5	4	4	0	0	0
			%	0	1,2	1	0,8	0,8	0	0	0
15		F_3=790 osc/min	g	0	8	6	3	2	0	0	0
			%	0	1,6	1,2	0,6	0,4	0	0	0

By analyzing graphs are found about the same allure distribution curves for each of the four fractions corresponding to the general mix of seeds, so the higher frequencies of oscillation separation occurs quickly, while the oscillation frequency F_1 = 250 osc / min (low frequency) all four fractions separated later. A trend of increasing peak position distribution curves are recorded and the frequency F_2 = 520 osc / min for all four fractions sort of general mixture. A special event is recorded than the frequency F_3 = 790 osc / min, where the trend is downward curve distribution maximum position size seed becoming smaller, which means that a greater agitation of the material on the sieve create better conditions for small seeds pass through the seed layer and a separation easier and more quickly.

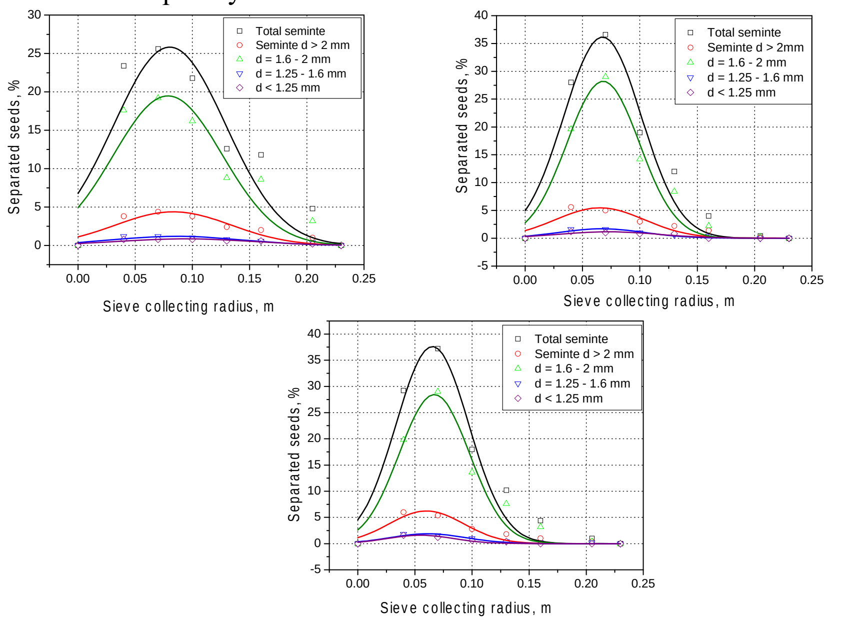

Fig.3. Variation of peak position distribution curve according to separate seed size at the three frequencies of oscillation.

This is summarized in Figure 3, the peak position curve is the variation in the size distribution at three separate seeds oscillation frequency curves were plotted by regression analysis of the peak position of the distribution curve polynomial function grade 2, the correlation coefficient R^2 values showing satisfactory.

Also, the position of maximum distribution curves for all sort fractions is shown graphically in Fig. 4 at the three frequencies of oscillation.

For more conclusive results but further research is needed on this topic.

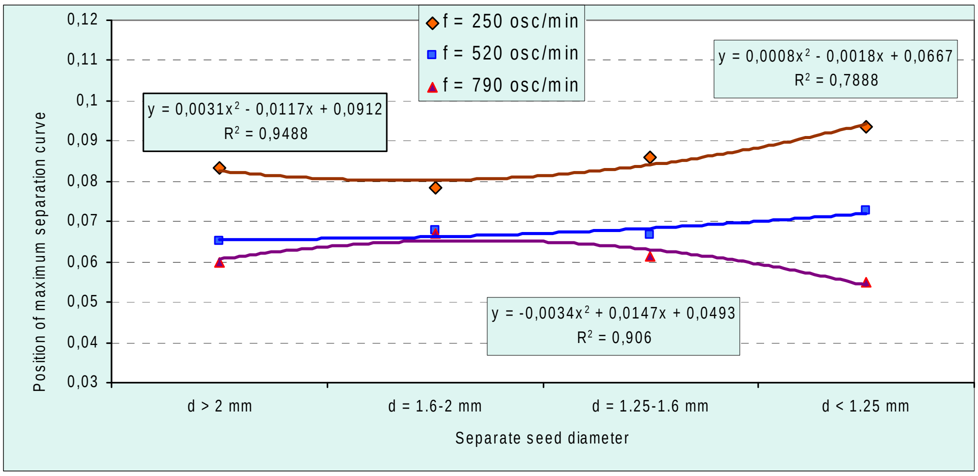

Fig.4. Maximum position distribution curves for all fractions sorting

4. Conclusions

To analyze the process of separating the outer profile conical sieve was conceived, designed and built a pilot plant equipped with a mechanism to drive the limitless oscillating sieve into flat circular oscillation motion. However for better sorting by size would require a lower frequency as seen from the graphs presented in the peak position of the distribution curve increases with decreasing seed size (as stated theory), especially with smaller seeds 2 mm. To avoid inefficient screening areas should somehow put restrictions on the binding site or symmetrical drive. There also can drive with an unbalanced mass vibration generator to be placed on the symmetry axis of the screen.

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