ARTICULATED SIEVE BAND FOR THE CALIBRATION OF POTATO TUBERS

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Abstract. This paper presents a new working device for the calibration of potato tubers. The separation surface is made up of a set of clips fixed on sets of articulated rods in between. A set has two end rods and a certain number of intermediary rods. The end rods are fixed on driving belts, which are rolled on two drums, this forming a band. The band is rolled on a series of cam axles that will modify the angle position of the articulated rods and subsequently of the separation surface. Therefore, the separating components will have to roll in order to more easily get into the calibration spaces.

Key words: rod, clips, calibration, potato tubers, band.

1. Introduction

The upper part of these conveyers runs on profiled rolls which give to material layer small jumps. These jumps conduct to the detaching of the links between agricultural product and dislocated ground layer. In the same time, the mixing components with smaller dimensions than the distance between wattles can cross through these spaces and they separate themselves from the superior branch. The fact that the material layer from the conveyer surface is actuated

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locally to the same kinematics parameters, it results that the relative motion of the mixing components, opposite of the wattles from the rolling grate is limited, resulting only a detaching of them.

The quality of separation expressed by separating grade is influenced by the frequency and amplitude of the oscillations of conveyer branch. But, for certain values of these parameters it appears the risk of damage of the agricultural products where means losses production, especially for potatoes tubercles.

The separators with rods used for the initial cleaning of the tubercles and root crops do not assure the rolling of the mixing components on the separating surface. This motion increases the orientation and crossing probability of small dimensions components through the spaces between wattles. In this case, it book in consideration a spatial separation from it both sliding, rolling and jump with detaching, depending on driving kinematics regime of the conveyer.

2. The Buillding of Separator with Jointed Rods

The separation surface is represented of the superior branch of one metallic wattles conveyer. These bars are made from a succession of rods jointed between them, protected to exterior surface by rubber. The upper part of the transporter runs over some supporting and agitation shafts, which have in their composition cylindrical pulley placed eccentrically opposite of axle. The rollers are from metal and they have at the exterior a vulcanized rubber layer. They come in contact with the upper branch of the belt, on the assembly point of the rods, which form the wattles. In such way, the wattles can be inclined partially by the reciprocal modification of the rods. The length of the rods, the diameter of the pullers and their eccentrically have been established in such way that the maximum inclination angle of the rod is to be 20º, correlated value with the friction dynamic angle of the potatoes tubercles. In the same time with the rolling of the belts wattles there are rotated also the camshafts having a rotation, which must correspond of one medium outlying speed a like to the speed of the belt. The distance between wattles is as large as classical separator from the harvesting machines.

The constructive principle of the separation surface of articulated rod separator is presented on Fig. 1.

The material stratum from the separation surface will be subjected depending on driving kinematics regime both one jump and one rolling or sliding motion due to, inclination of the wattle rods. In this way it gives the possibility of detaching move pronounced of the soil stratum, thus a more accentuated breaking of the clod grounds, and in the same time it creates the possibility of optimum positioning for crossing through the spaces between wattles of the smaller components.
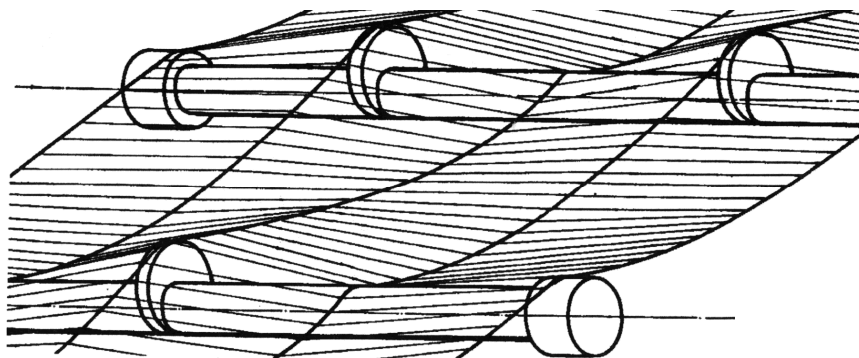
Fig.1 − The constructive principle of the separator with articulated rods (Cozma, 1993).

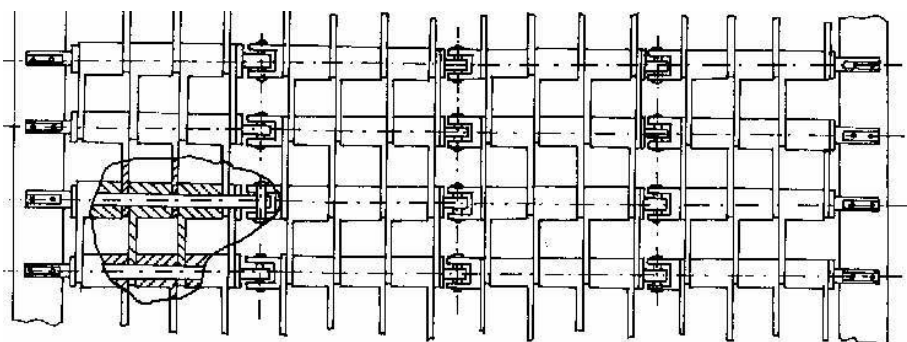The band with the clips fixed on articulated rods is presented in Fig. 2.

Fig. 2 − The constructive principle of the calibration band (Cozma *et al*., 1993).

The plastic clips are from a manufacture point of view similar to the ones used in the construction of potato calibrating equipments of the type MCC 40/60. They are fixed on a set of metal rods that are articulated among one another. From the point of view of the construction, there are two types of rods: intermediary rods and end rods. The end rods are fixed on the driving belts, which are rolled on two axles: a driving one and a stretching one. Among these end axles there are several support axles with cams. They come into contact with the rods in their articulation areas. According to the inclination of the rods, the separation surface will modify its geometry and the products will roll so as to find their optimum position to pass through the loops of the sieve.

Rolling the band on the axle and the geometry of the cams may influence the movement of the components on the sieve. The optimum regime is when the separation components roll on the separation surface but without any shocks.

3. The Experimental Method

It is known the fact that the separation grade as qualitative index of the operation process within the separators after dimensions is influenced of the feeding load with material and of the contain of small components named mixing coefficient. Also, for certain values of the mixing coefficient and of feeding load, the separation grad will be influenced by the modifications of the kinematics regime.

To establish the operating optimal conditions of one separator as articulated wattle transporter and with some values for constructive parameters, there were made experimental tests with different categories of mixings. It is presented in this paper the experimental results obtained to analysis of the operating process of the separator for the separating of mixing potatoes tubercles.

There was stated the variation limits for the feeding load and the mixing coefficient on technological conditions of potatoes cropping. It was experimented the working process for move values of speeds of the belt from the conveyer with jointed wattles.

The experimental tests have been performed upon completely factorial experimental program of type 2^3 including the central points. The level coding and natural factors as well as the variation interval are presented on Table 1.

Table 1
The Level Coding and Natural Factors

The level of factors and variation interval	The signification of codes			The natural signification		
	X_1	X_2	X_3	V [m/s]	S_a [kg/s.dm]	C_a [%]
Basis level	0	0	0	1.4	1.85	25
Variation interval	1	1	1	0.3	1.43	15
Upper level	+1	+1	+1	1.7	3.28	40
Inferior level	−1	-1	−1	1.1	0.42	10

The quality of the separation is appreciated through the separation grade, which is expressed by relation:

$$G_s = \frac{M_{cm}}{C_a \cdot M_T} \tag{1}$$

where: M_{cm} is the small component mass separated from mixture; M_T − the total mass of the mixture; C_a − the mixing coefficient which represents the contain of small components from initial mixture.

The experimental results concerning separation process of the mixtures from potatoes tubercle is presented on Table 2.

Table 2
The Experimental Results

Independent variable			Separation grade, conditional variable					Average value
X_1	X_2	X_3	Y_1	Y_2	Y_3	Y_4	Y_5	Y
−1	−1	−1	100.0	100.0	100.0	100.0	100.0	100.0
−1	0	−1	86.3	84.8	85.6	84.6	84.2	85.1
−1	+1	−1	75.0	65.4	77.0	68.2	71.0	71.32
0	+1	−1	62.1	61.5	60.4	63.2	62.3	61.9
+1	+1	−1	56.0	56.2	54.2	54.3	45.2	53.2
+1	0	−1	59.5	62.4	58.3	60.6	62.7	60.7
+1	−1	−1	72.3	72.7	66.1	63.7	75.8	70.1
0	−1	−1	84.1	82.7	84.9	85.3	84.5	84.3
−1	−1	+1	71.0	68.4	68.0	72.0	71.6	70.2
−1	0	+1	72.9	74.1	70.5	71.0	73.5	72.4
−1	+1	+1	75.0	78.6	73.4	74.0	75.0	75.2
0	+1	+1	54.0	52.5	53.5	54.6	54.9	53.9
+1	+1	+1	31.1	34.6	35.2	31.4	34.2	33.3
+1	0	+1	31.0	30.2	32.1	29.7	27.5	30.1
+1	−1	+1	23.8	25.6	29.7	27.0	31.5	27.5
0	−1	+1	49.0	47.8	46.2	49.4	50.1	48.5

4. Conclusions

Analyzing the obtained results, for the experimentation of working process within the articulated rods separator it can conclude:

1. The rolling speed of the belt is critical against separation grade. The optimum value of the speed was of 1.1 m/s. For this speed it can reach to the separation grade value of 100, when the feeding load and mixing coefficient have minimum values, which allows the rolling of the components on separating surface. The increasing of the speed provokes the growing of jumps on separating surface and in this way it reduces the possibility of crossing through separating spaces.

2. To the feeding loads with high values, it is allowed the obtaining of one high separation grade only to great speed of the belt. In this case, the scattering of mixture due to kinematics regime has as an effect the detaching and jump of the components from separating surface. In such way, the reciprocal motions between components, favors the crossing through the separating spaces. At the small speed, the increasing of the feeding load leads to the reducing of separating grade, due to limitation of the relative displacements.

3. The mixing coefficient has a low influence. For the high feeding loads, it can observe a light increasing of the separating grade, following of the increasing of the small component contain from mixture.

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BANDĂ SITĂ ARTICULATĂ PENTRU CALIBRAREA TUBERCULILOR DE CARTOFI

(Rezumat)

În lucrare se prezintă un organ de lucru pentru calibrarea tuberculilor de cartofi. Suprafaţa de separare, este o bandă din tije metalice articulate, prevăzute cu eclise din material plastic. Modul de montare pe tije, forma şi mărimea ecliselor, permite obţinerea unor fante de trecere pentru tuberculii care sunt sub o anumită dimensiune.

Eclisele, sunt montate pe seturi de tije articulate între ele. Fiecare set de tije, formează o vergea cu o anumită lungime. Capetele vergelelor sunt la rândul lor fixate pe curele de transmisie late, care înfăşurate pe doi tamburi vor forma o bandă din tije articulate. Ramura superioara a benzii, care constituie suprafaţa de separare, rulează pe o serie de arbori ce au role cilindrice dispuse execntric. Aceste role vor produce înclinarea tijelor articulate implicit înclinarea locală a suprafeţei de separare cu eclise. Prin urmare, tuberculii se vor rostogoli în direcţii diferite şi cei cu dimensiuni mai mici decât a fantelor, vor pătrunde şi se vor separa de cei ramaşi pe suprafaţa de separare.

Regimul cinematic al tijelor, cantitatea de material aflată pe bandă şi ponderea componentelor cu dimensiuni mai mici decât a fantelor în raport cu cele mari, influentează gradul de separare. În lucrarea de faţă, sunt analizate aceste influenţe prezentate mai sus, pe seama unui program.experimental de tip factorial 2^3 şi care conduce la găsirea valorilor optime a parametrilor de influenţă pentru ca gradul de separare să aibă valori maxime.