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RESEARCH INTO THE VARIATION OF THE KINEMATICS INDEX, OF THE ADVANCE AND THE RELATIVE ADVANCE DEPENDING ON THE DISPLACEMENT SPEED FOR THE AGRIMOTOR- WORKING SOIL ON THE ROW OF TREES TILLAGE CUTTER TECHNICAL SYSTEM

STUDIUL VARIAȚIEI INDICELUI CINEMATIC, AVANSULUI ŞI AVANSULUI RELATIV ÎN FUNCȚIE DE VITEZA DE DEPLASARE PENTRU SISTEMUL TEHNIC TRACTOR - FREZĂ DE PRELUCRAT SOLUL PE RÂNDUL DE POMI

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Abstract: *In this paper is presented research into the variation of the kinematics index, of the advance and the relative advance depending on the displacement speed for the rotor tillage - working soil on the row of trees tillage cutter technical system*

Rezumat: *Lucrarea prezintă studiul variației indicelui cinematic, avansului şi avansului relativ în funcție de viteza de deplasare pentru sistemul tehnic tractor - freză de prelucrat solul pe rândul de pomi*

Key words: *kinematics index, advance, rotor tillage, displacement speed*
Cuvinte cheie: *indice cinematic, avans, freza, viteza de deplasare*

INTRODUCTION

At the vertical tillage cutters, the operating parts are found on a vertical or oblique rotation axle rotor. The trajectory of the operating parts is a lengthened cycloid, which is disposed horizontally or obliquely, depending on the rotors' position. The parametrical equation of the cutters' trajectory can be written, as follows:

$$x = vt - R\sin \omega t$$
$$y = R(1 - \cos \omega t). \quad (1)$$

By eliminating t time, we obtain the following form of the trajectory's equation:

$$x = \frac{v}{\omega}\arcsin \frac{1}{R}\sqrt{2Ry - y^2} - \sqrt{2Ry - y^2} \quad (2)$$

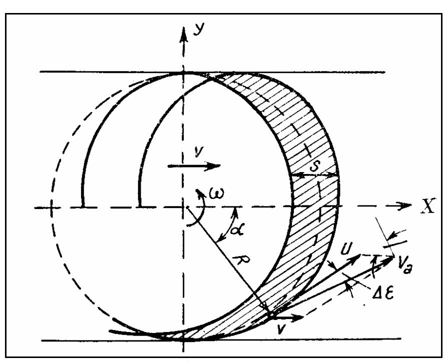

Figure 1 The working trajectory of the vertical tillage cutter's operating parts

Unlike the horizontal tillage cutters at which the knives operate into the ground at an approximately 80^o rotation angle, included in the 4th dial of the circle, at the vertical rotation axle tillage cutters, the active trajectory of the cutters corresponds to a rotor's rotation angle of 180-200^o included into the first and the 4th dials of the circle (fig. 1). The carving speed of the cutters during a carving cycle, varies between $\omega R + v$ *and* $\omega R - v$.

MATERIAL AND METHOD

To determine the kinematical parameters of the tillage cutters, it is considered that both rotating motion ω and transition motion (advance) v_m of the machine are uniform, although the rotor's peripheral velocity may vary because of the fluctuation of the transmission parts' movement. The velocity $\boldsymbol{v_m}$ can vary because of the slipping of the rotor tillage driving wheels.

The structure of the rotating ω and transmission $\boldsymbol{v_m}$ motions, determines the complete trajectories of the points of the tillage cutters' knives under the form of some cycloid curves. Those can be determined graphically and analytically (fig. 2).

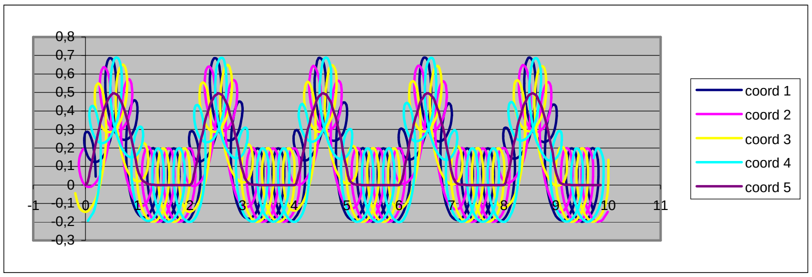

Figure 2 The complete trajectories of the points of the tillage cutter's knives analytically obtained

The imposed technological process can take place only when the peripheral velocity of the cutters $\boldsymbol{v_p = \omega R}$ is bigger than the feed rate of the tillage cutter (of the machine), which means that $\boldsymbol{v_p > v_m}$, where R is the rotor's radius.

The kinematics index of the tillage cutter, λ, is defined as the ratio between the peripheral velocity of the rotor v_p and the feed rate of the machine v_m. The values of λ are: $\lambda = 3 \dots 8$ and at the fast tillage cutters, these values can be exceeded, $\lambda = 10 \dots 12$.

The advance on the cutter, ***s***, is considered to be the horizontally measured distance between the points of intersection of two successive trochoids on the ground surface.

$$s = \frac{2\pi v_m}{z_1 \omega} = \frac{2\pi R}{z_1}\frac{v_m}{R\omega} = \frac{\pi D}{z_1 \lambda} \qquad (3)$$

The relation (3) shows the fact that the advance on the cutter is proportional to the rotor's tillage cutter diameter and in inverse ratio to the number of cutters on the same side of the disk and to the kinematics index λ.

The relative advance on the cutter is given by the expression:

$$\frac{s}{D} = \frac{\pi}{z_1}\frac{1}{\lambda} \qquad (4)$$

Taking in consideration that the advance on the cutter is also a function of λ , any of its fluctuation brings about a fluctuation of the radial thickness of the sliver. By increasing the value of λ , we get more frequent cuttings in the clock unit, which leads to a more accentuated crushing of the ground.

For a type of rotor (number of cutters, diameter, shape of cutters, etc), the increase of λ by increasing the angular speed, results in an enhanced acceleration of the detached bands of soil. The resultant speed of the clods is bigger and is defined as bigger velocity energy of these clods and finally a more violent collision with the shield. The increase of the kinematics parameter leads to the passing of several cutters through the area which has previously been occupied by the band. Thus, there is a beating and an additional recirculation of the bands.

Beginning with the experimental research made at INMA Bucharest on an aggregate composed of the rotor tillage U-650 and the working soil on the row of trees tillage cutter, the table no. 1 presents data obtained at experiments.

Table 1

Data obtained at the experimenting rotor tillage -working soil with a vertical rotor tillage cutter aggregate

	v_m	*s=b*		λ		*s/d*	
		z=4	***z=6***	***z=4***	***z=6***	***z=4***	***z=6***
v_1i	0,73	0,044	0,029	7,13	8,92	0,11	0,05
v_1r	1,08	0,065	0,043	4,83	6,03	0,12	0,08
v_2i	1,17	0,07	0,047	4,44	5,55	0,17	0,09
v_2r	1,74	0,1	0,069	3,007	3,75	0,26	0,13

Taking in consideration the results from the chart 1, there have been traced the variation graphics of the kinematics index, of the advance and the relative advance depending on the displacement speed, using Microsoft Excel Soft.

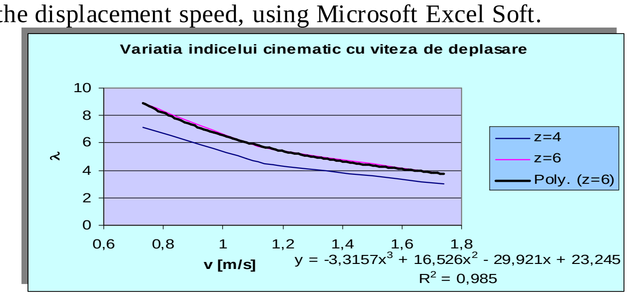

Figure 2 The variation of kinematics index with the displacement speed

As the fig. 2 shows, for the rotor with a 500 mm diameter and 6 cutters, the kinematics index ($\lambda=v_p/v_m$) diminishes from the value of 8,92 to 3,75 at the time as the displacement speed of the aggregate increases. For the rotor with a 400 mm diameter and 4 cutters, the kinematics index diminishes from the value of 7,13 for the speed of 0,73 m/s to 3,007 for the speed of 1,75 m/s.

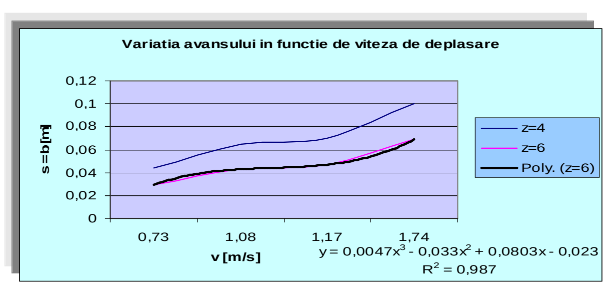

Figure 3 The variation of the advance depending on the displacement speed

Figure 3 shows that, for the rotor with a 500 mm diameter and 6 cutters, the advance of the tillage cutter (the thickness of the detached band) increases from 0,044 m for the speed of 0,73 m/s to 0,1m for the speed of 1,74 m/s. For the rotor with a 400 mm diameter and 4 cutters, the advance increases from the value of 0,029 m for the speed of 0,73 m/s, to the value of 0,069 for the speed of 1,74 m/s.

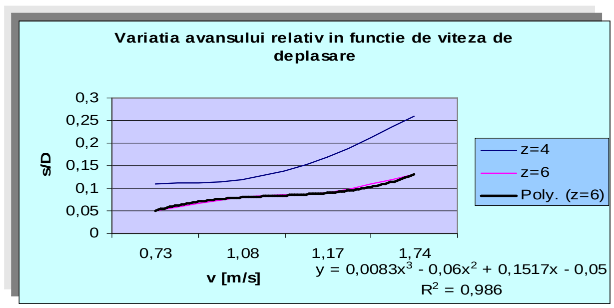

Figure 4 The variation of the relative advance depending on the displacement speed

Fig. 4 also shows that for the rotor with a 400 mm diameter and 4 cutters, the relative advance, s/D increases from 0,11 for the speed of 0,73 m/s to 0,026 for the speed of 1,74 m/s. For the rotor with a 500mm diameter and 6 cutters, the relative advance increases from 0,05 for the speed of 0,73 m/s to 0,13 for the speed of 1,74 m/s.

CONCLUSIONS

Given the fluctuation possibility of the λ parameter both through the fluctuation of the feed rate and through the fluctuation of the angular speed, its influence over the needed energy for working with the tillage cutter, comes in two aspects. Once the λ parameter decreases by increasing the feed rate, the needed power also increases, while, once the λ parameter decreases by reducing the angular speed, the needed power decreases. This double aspect is only apparent, because the increase of the feed rate to ω = ct., leads to the increase of the *s* advance and the reduction of the ω to *v = ct.*, makes the advance decrease. This entire means that the needed power increases at the same level with the advance on the cutter.

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