DETERMINING THE FORCES THAT INFLUENCE THE BEARINGS OF THE LEADED DRUM

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Resume: The oscillating movement is due to the fact that the drums do not have a cylindrical shape, but consist in bars; that make up the edges of prisms with polygonal bases. In the practical construction, currently, three sided polygons are used as a base polygon for the leading drum, and four sided ones for the leaded drum. The difference between the numbers of sides for the two drums generates a specific oscillation movement that favorites the sorting of the peas beams from the pods and other impurities. Because of its polygonal shape the leaded drum will have o rotation movement with an oscillating character. The position at a given moment in time of a point on the surface of the strip is given by the position of the vertexes of the polygon.

1. Determining the forces

The forces generated by the sorting strip's oscillating movement are transmitted to the frame of the machine through the bearings of the drums in picture 1, in 0the points O_A and O_B. During the simulation program the force that operates in the bearing of the leading drum (point O_A) is calculated; this has an oscillating character and can play the part of an excitation force exerted on the frame of the machine generating vibrations (picture 1).

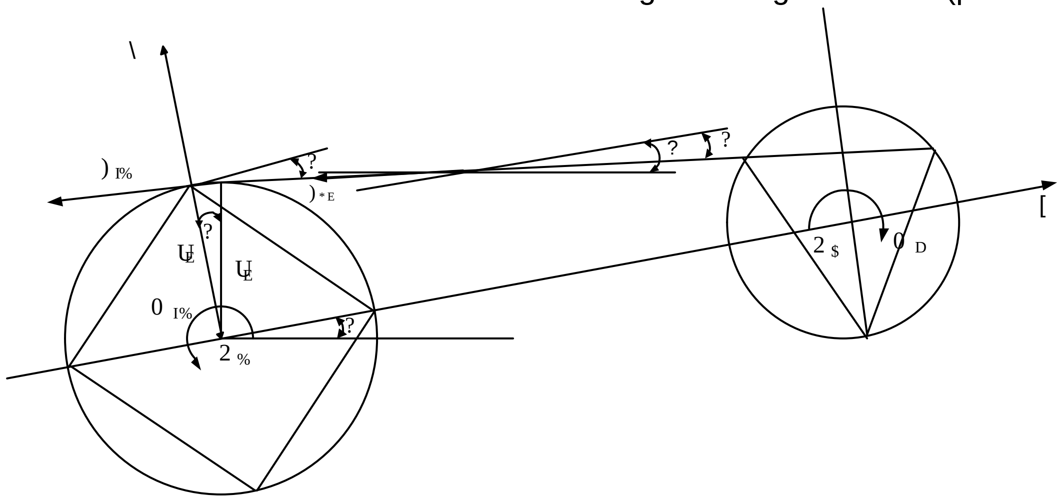


Fig.1

It is considered that this force of resistance (F_r) has two major components, that are the stretching force of the strip which is due to its weight (F_{Gb}) and the stretching force that is due to the moment of friction in the leaded bearing (F_{fB}).

$$F_r = F_{fB} + F_{Gb} \qquad (1)$$

The force that is due to the moment of friction is:

$$F_{fB} = \frac{M_{fB}}{r_{b1}} = \frac{M_{fB}}{r_b \cos ?} \qquad (2)$$

Where M_{fB} is the friction moment in the leaded drum's bearing.
The force that is due to the weight of the strip is:

$$F_{Gb} = G \quad \sin(? \quad ?) \qquad (3)$$

Where G is the weight force of the strip, and the angle ? is the inclination angle of the drums' axis to the horizontal direction.
Replacing formulas (2) and (3) in (1)

$$F_r = \frac{M_{fB}}{r_b \cos ?} + G \quad \sin(? \quad ?) \qquad (4)$$

Using the last formula you can calculate the excitation force that operates o the frame of the machine and you can simulate its evolution in time. In the simulation program the mathematical value of the force F_r will be calculated for every program cycle, because the angle $?_i$ is variable:

$$F_{ri} = \frac{M_{fB}}{r_b \cos ?_i} + G \quad \sin(? \quad ?_i) \qquad (5)$$

The results that are obtained in the simulation program can be used (on top of finding the best working system) to the analysis of the experimental results. The vibrations of the machine's frame can be experimentally measured with an accelerometer and a proper acquisition system. If the accelerometer is placed with the leaded drum's bearing And the real vibrations are recorded, these should be the same to the ones calculated in the simulation program.

2. The simulation results.

After the rolling of the simulation program, you obtain different diagrams that can be used to analyze the working of the sorting strip and detecting the critical working systems, as concerns the vibrations.

In pictures 2 - 6 the diagrams that have been obtained for the following entry data are presented:

- the revolution of the leading drum – 28 rot/min;
- the radius of the leading drum – 0,15m;
- the radius of the leaded drum – 0,17m;
- the distance between the drums' axis on the x direction – 1,9m;
- the distance between the drums' axis on the y direction – 0,73m;
- the angle of the radius that corresponds with the first bar of the leading drum on the x direction– 0 rad ;
- the angle of the radius that corresponds with the first bar of the leaded drum on the x direction – 0 rad;
- the angle between two bars of the leading drum – $2\pi/3$ rad;
- the angle between two bars of the leaded drum– $\pi/2$ rad;
- the angle between two consecutive positions of the leading drum's bar– $\pi/1000$ rad;
- the reimbursement coefficient at the impact of the pea with the sorting strip 0,5;

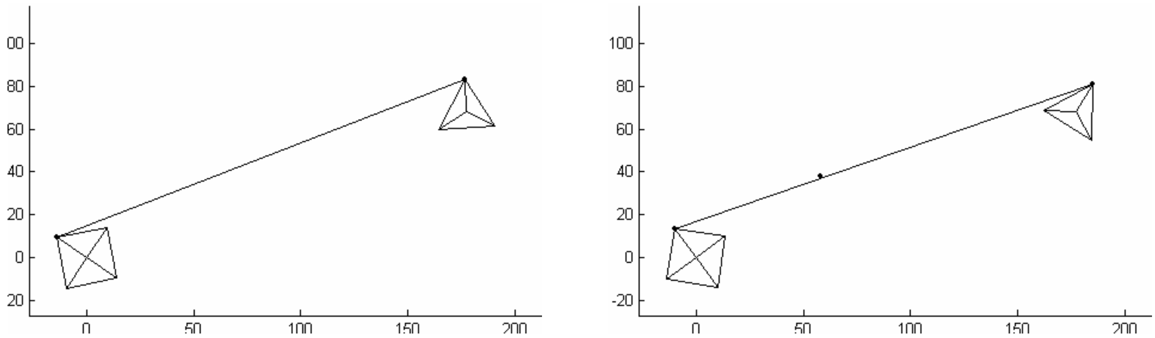
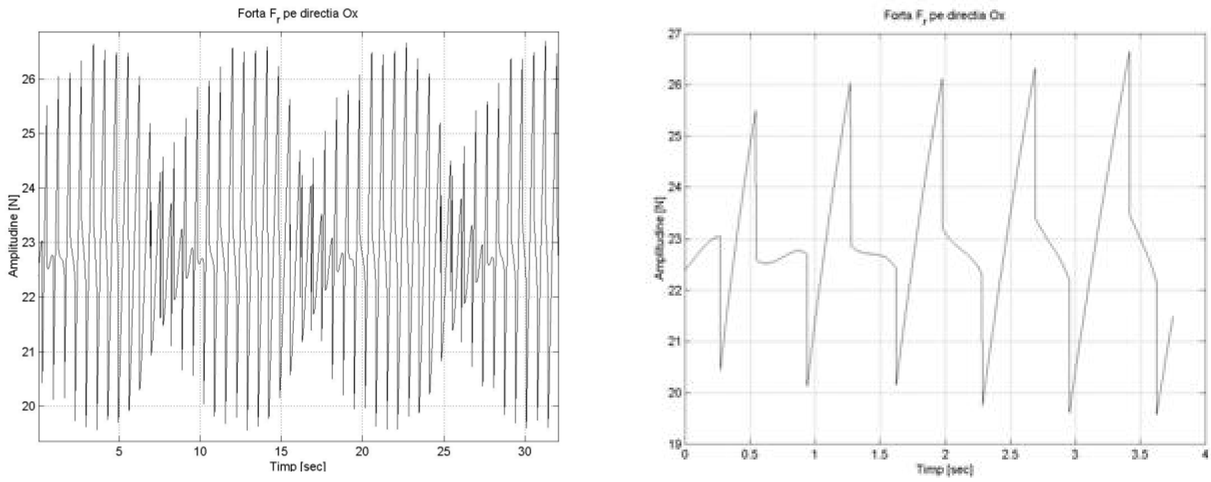


Fig.2. The simulation of the drums' and the sorting strip's movement



a) for a 30 seconds period., *b) for a 4 seconds period.*

Fig.3. The diagrams showing the variation of the reaction force in the leading drum's bearings, depending on time, on the Ox direction,

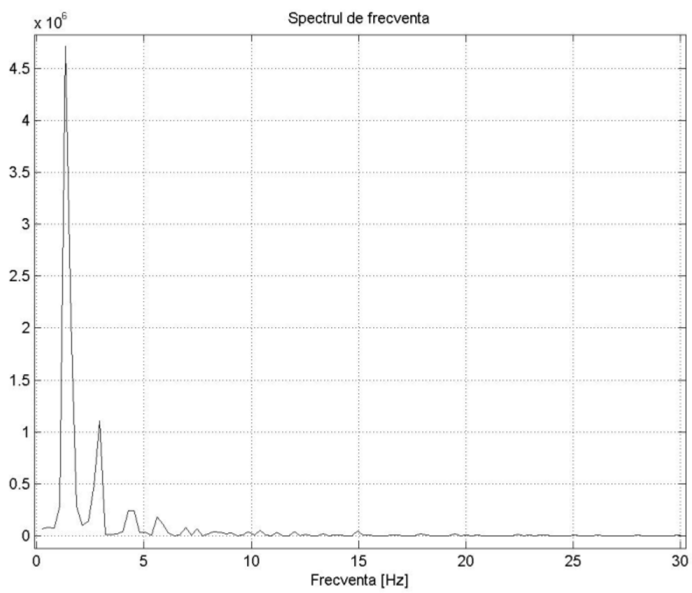
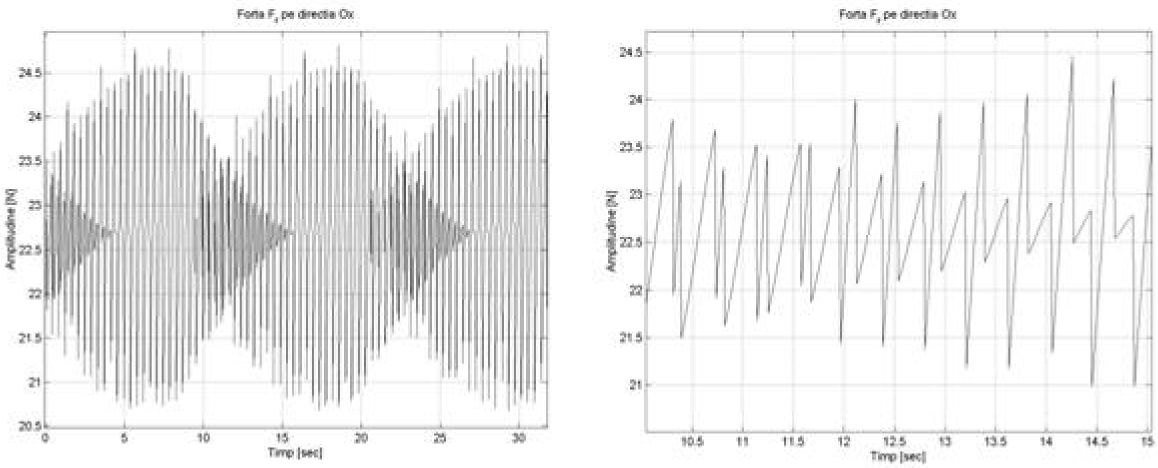


Fig.4. The spectrum diagram showing the variation of the reaction force, on the Ox direction, in the leading drum's bearings, depending on the frequency.



a) for a 30 seconds period *b) for a 4 seconds period*

Fig.5. The variation diagrams of the reaction force in the leading drum's bearings, depending on time, on the Ox direction

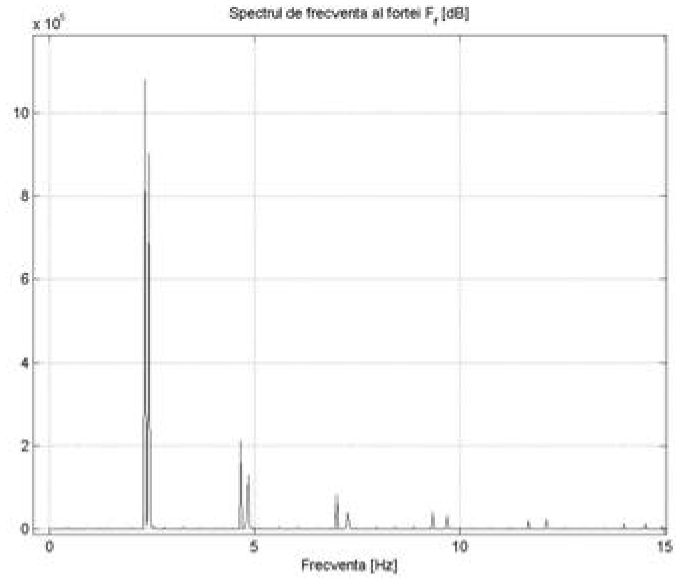


Fig.6. The spectrum variation diagram of the reaction force, on the Ox direction, in the leading drum's bearings, depending on frequency.

Bibliography:

1. Brîndeu L. – Mecanica dinamica, I.P.T.V. Timisoara, 1981
2. Brîndeu L. – Vibratii. Mecanica analitica. Vibratii mecanice, Universitatea Tehnica din Timisoara, Timisoara, 1994.
3. Brîndeu L. – Vibratii si vibropercutii. Bazele mecanicii vibratiilor si a vibropercutiilor, Editura Politehnica, Timisoara, 2001.
4. Burr – Brown – IC Data Book, Data Conversion Products, Burr – Brown Corporation, 1995
5. Silas Gheorghe, Brîndeu L. – Sisteme vibropercutoare, Editura Tehnica, Bucuresti, 1986.