ANNALS OF THE ORADEA UNIVERSITY
Fascicle of Management and Technological Engineering
ISSUE #1, MAY 2015, http://www.imtuoradea.ro/auo.fmte/

EXPERIMENTAL RESEARCHES ON A SEPARATING MACHINE

Mircea Bogdan TATARU[1], Alexandru RUS[2]
[1] University of Oradea, btataru@uoradea.ro
[2] University of Oradea, alrus@uoradea.ro

***Abstract*—**Separator type machines are used in food industry to separate useful parts of poly-granular materials from impurities. Most of their kind are vibratory machines that have a specific motions directed with non-equilibrated masses generators. Work paper presented in the following is about vibrations measurements in order to establish that specific motions of these machine types. An original measurement hardware system is used next to specific programs for processing data that are obtained in order to detect motion trajectory along with transmitted vibratory motion to the ground. Conclusions drawn are that supporting elements are good both for motion sustainability and for damping of the transmitted vibrations to the ground.

***Keywords*—**vibratory machine, separating machine, supporting elements, elastic and damping properties

I. Introduction

A separator type machine is used in food industry to separate useful parts of poly granular materials from impurities (cleaning process)

The specific motion is produced using generation with non-equilibrated masses generators. This motion actuates a sieving box designed for poly granular material separation which is supported by the machine frame [1].

For this, supporting elements, are used with elastic and damping properties, necessary in motion support, [2].

The machine structure is presented in Fig. 1. From the point of view of [3] this machine is classified as a mono-mass vibrating machine with motion in one direction, with two generators with non-equilibrated masses.

Technical characteristics of the generating system are given by the two electric motors drive of non-equilibrated masses generators: power 0,75 (kW), speed 960 (rot/min).

II. Acceleration Measurement Of Separator Mtra 100/200

In order to study the vibratory motion acceleration of the separating machine MTRA 100/200 presented in former paragraph of this paper, experimental measurements have been made. The measurement system consists of:

1) accelerometer MetraMess KD 32 (50 (mV/g))

2) data acquisition system National Instruments PCI 1200

3) external signal amplifier interface

A special data acquistion program was written in C++ for primary data acquiring and results of the measurements were processed in specific data files in MATLAB.

Measurement points distribution is given in Fig. 1, with blue color, and details containing position, measuring direction and name of the data file which contain information is given in Fig. 3 to Fig.17. Data acquisition for one point has been done several times keeping at least two of the already acquired data files.

The measuring system is presented in Fig. 2 where details concerning signal amplifier interface model are given. During measuring the machine was in stable functioning, in working parameters.

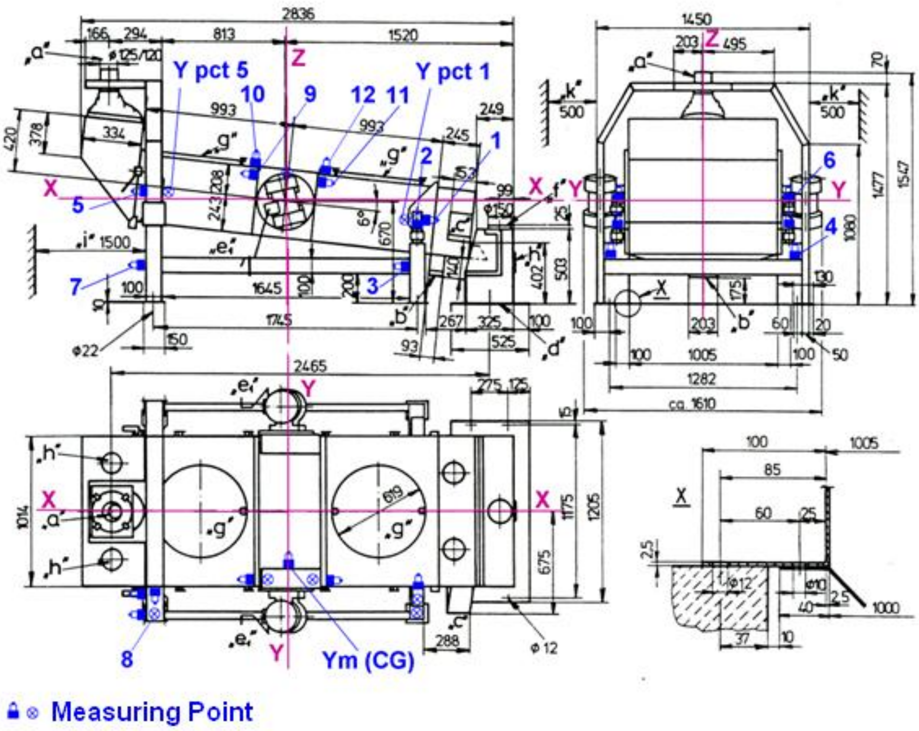
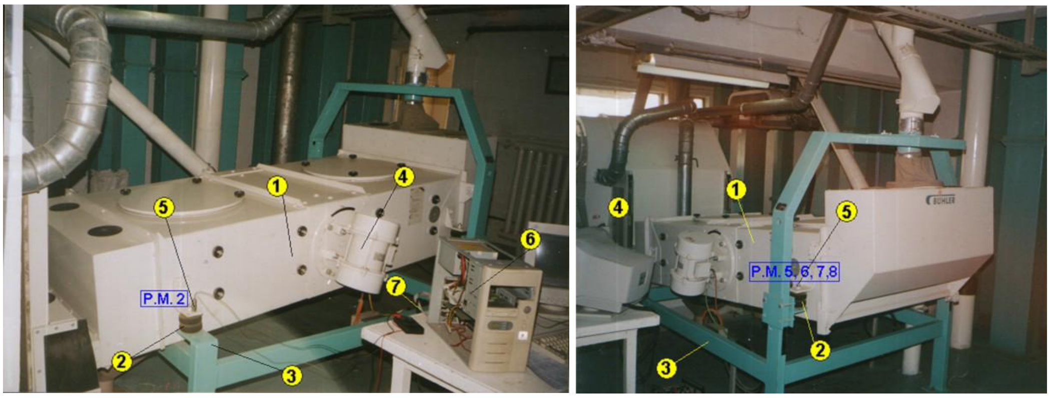


Fig.1. Detailed drawing with measuring point positioning [4]

A conclusive image is presented in Fig. 2 where one may observe the measuring system. The experimental setup consists of the following elements: 1 – sieve box which is working body; 2 – elastic damping supporting element; 3 – supporting fixed frame; 4 – generator with non-equilibrated masses and elements for measuring system: 5 – accelerometer MetraMess KD32; 6 – PC system including data acquisition system National Instruments PCI 1200 [5]; 7 – external amplifier interface

Primary data obtained have been stored in data files and then processed and transformed in data files specific to MATLAB with a data reading program [6].



a) *b)*

Fig. 2. Picture relevant moment of the vibratory motion of the machine measuring accelerations

III. Data Processing And Results

The obtained data have been processed with a program written in MATLAB R2009. The program filters acquired signal, retain obtained data for the filtered signal and integrates data to obtain displacements and eventually evaluate a spectrogram. This analysis is made simultaneously for two of the files with acquired data for two perpendicular directions of the same geometric point and therefore the plane trajectory of vibratory motion is drawn.

Acquired signals are grouping in relation with acquisition point position in:

1) *group of two (1–X, 2–Z); (5–X, 6–Z), consisting of points on the support bridle of the sieve box on the*

supporting rubber elements: (E) evacuation, respectively (A) admission on longitudinal direction X respectively vertical direction Z (Fig. 3 to Fig. 10)

2) group of two (3–X,4–Z); (7–X,8–Z), consisting of points on the fixed frame of the machine which supports on supporting elements sieve box: (E) evacuation, respectively (A) admission on longitudinal direction X respectively vertical direction Z (Fig. 11 to Fig. 18)

3) group of two (9–X,10–Z); (11–X,12–Z), consisting of points on the sieve box: between (E) evacuation and center of gravity CG, respectively between (A) admission and center of gravity CG, on longitudinal direction X respectively normal direction Z,

4) group of points (1–Y), (5–Y), (Y middle), consisting of measuring points that complete study of vibrations on supports and sieve box on transversal direction.

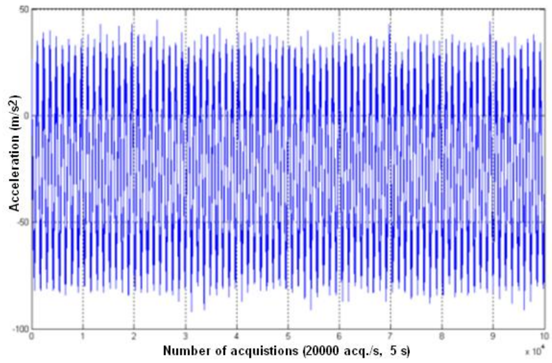


Fig. 3 Acquired signal in measuring point 1

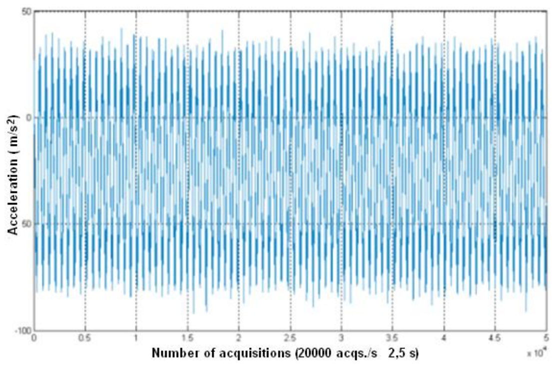


Fig. 4 Used signal in measuring point 1

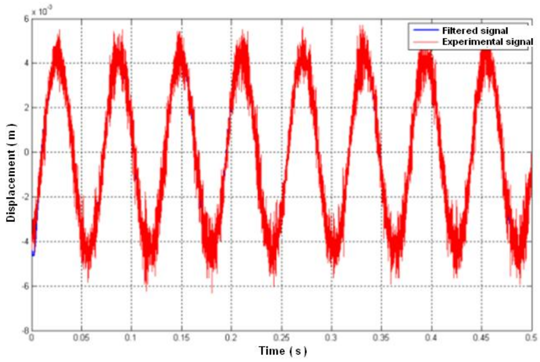


Fig. 5 Filtered signal in measuring point 1

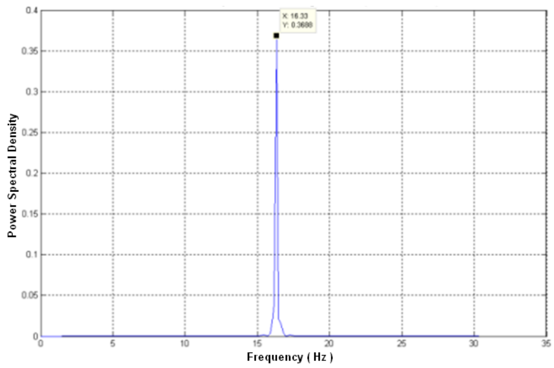


Fig. 6, Spectrogram of the used signal in measuring point 1

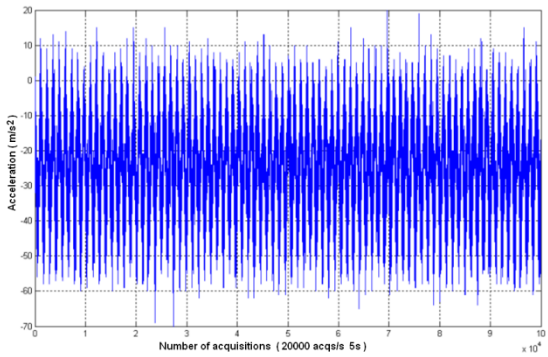


Fig. 7 Acquired signal in measuring point 2

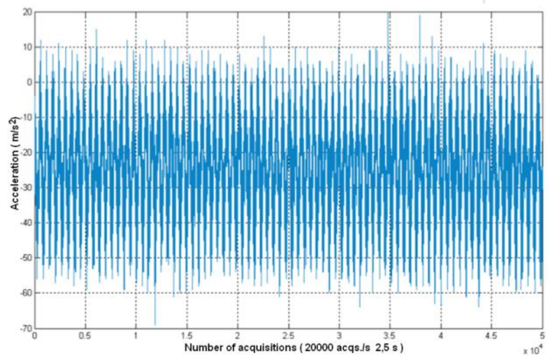


Fig. 8 Used signal in measuring point 2

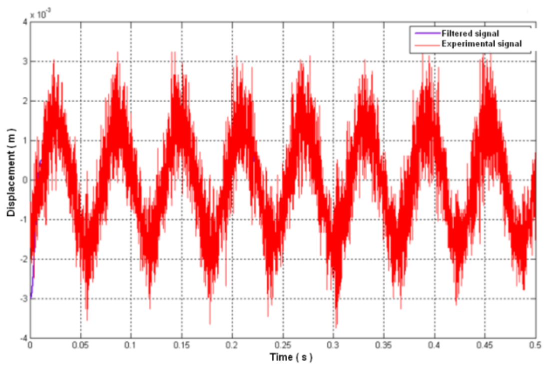


Fig. 9 Filtered signal in measuring point 2

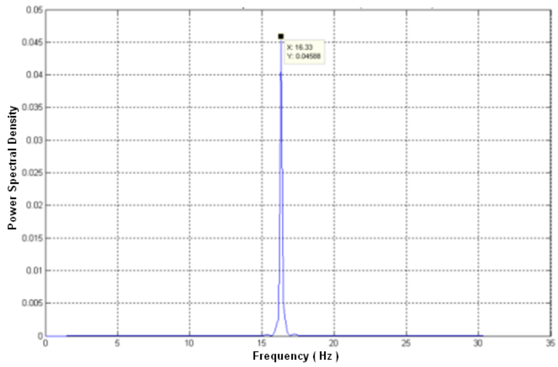


Fig. 10 Spectrogram of the used signal in measuring point 2

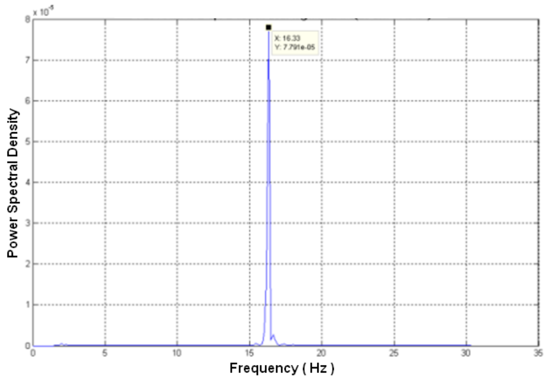


Fig. 14 Spectrogram of the used signal in measuring point 3

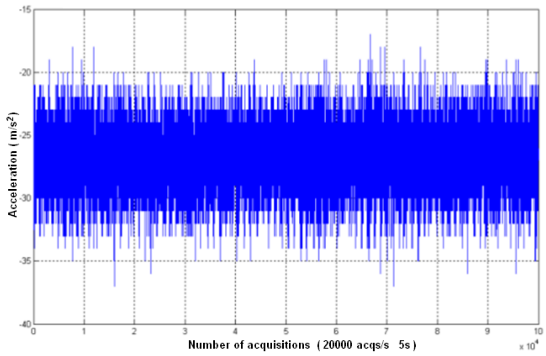


Fig. 11 Acquired signal in measuring point 3

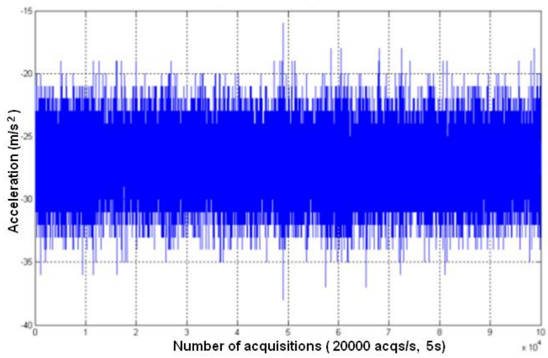


Fig. 15 Acquired signal in measuring point 4

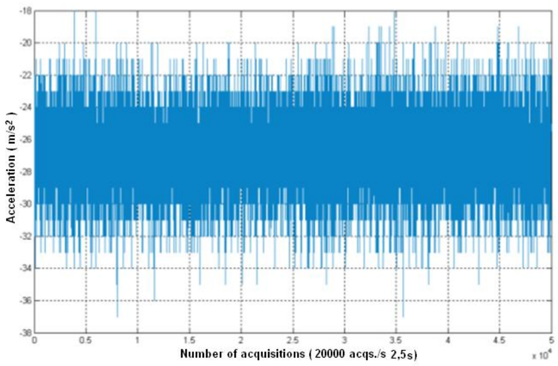


Fig. 12 Used signal in measuring point 3

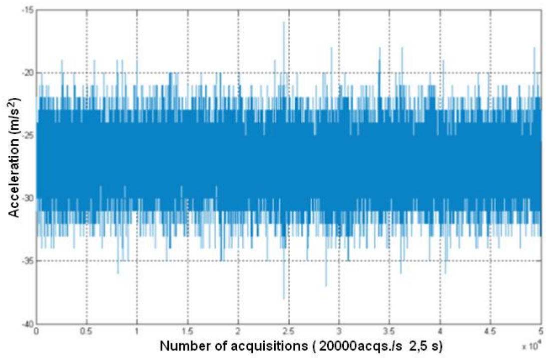


Fig. 16 Used signal in measuring point 4

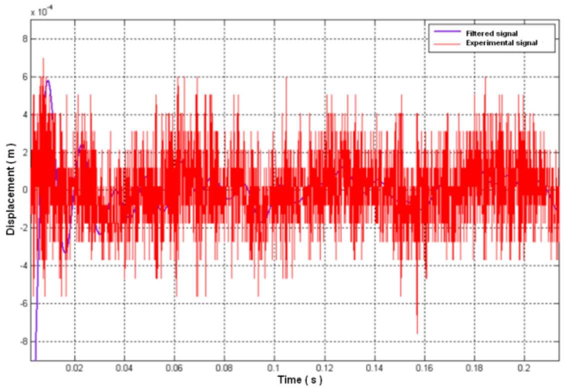


Fig. 13 Filtered signal in measuring point 3

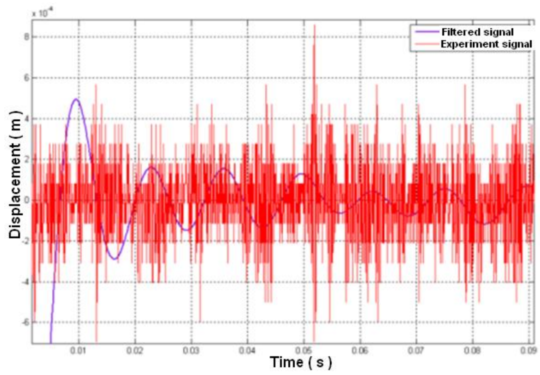


Fig. 17 Filtered signal in measuring point 4

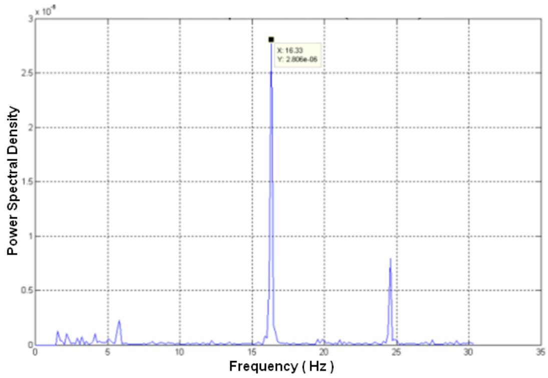


Fig. 18 Spectrogram of the used signal in measuring point 4

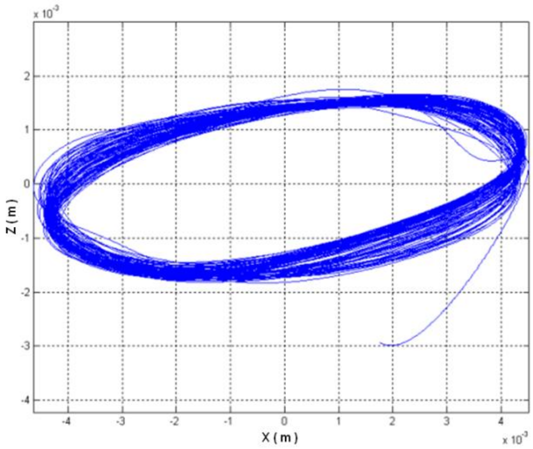


Fig. 19 Obtained trajectories for first measuring from measuring points 1-X and 2-Z

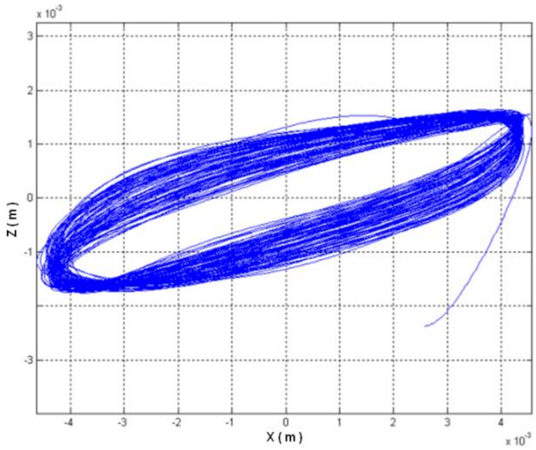


Fig. 20 Obtained trajectories for second measuring from measuring points 1-X and 2-Z

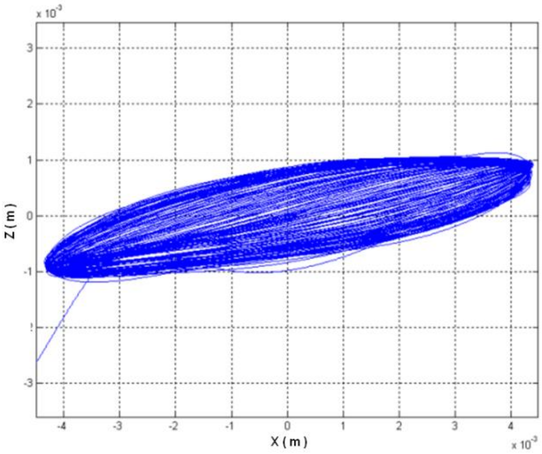


Fig. 21 Obtained trajectories for first measuring from measuring points 5-X and 6-Z

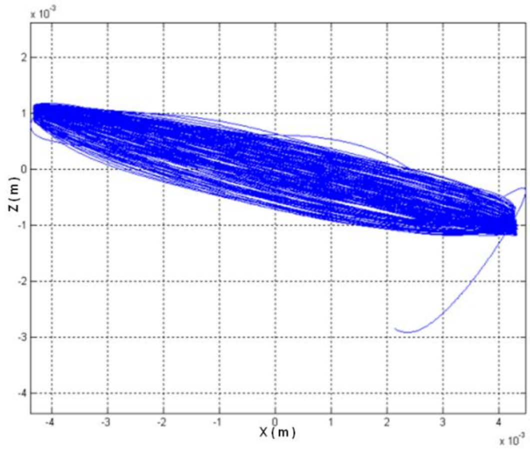


Fig. 22 Obtained trajectories for second measuring from measuring points 5-X and 6-Z

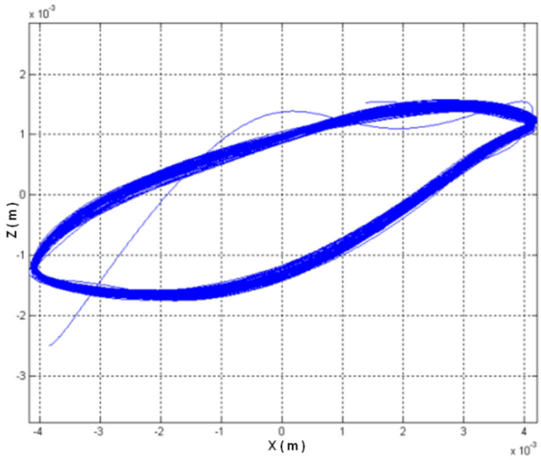


Fig. 23 Obtained trajectories for first measuring, from measuring points 9-Xl and 10-Zn

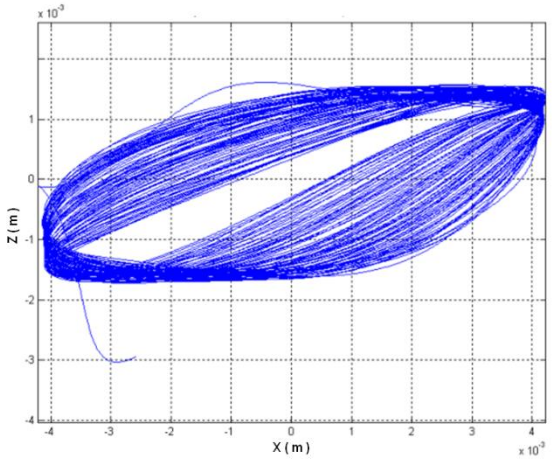


Fig. 24 Obtained trajectories for second measuring from measuring points 9-Xl and 10-Zn

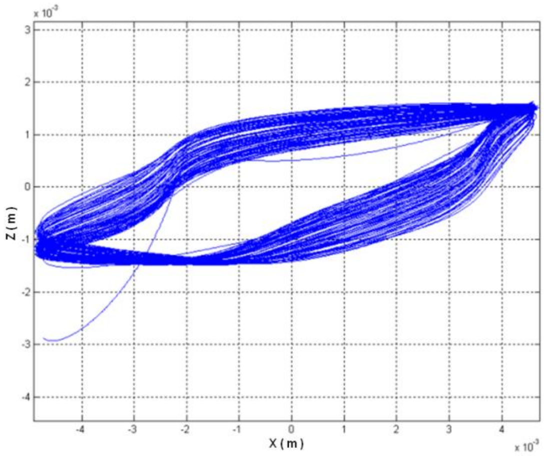


Fig. 25 Obtained trajectories for first measuring from measuring points 11-Xl and 12-Zn

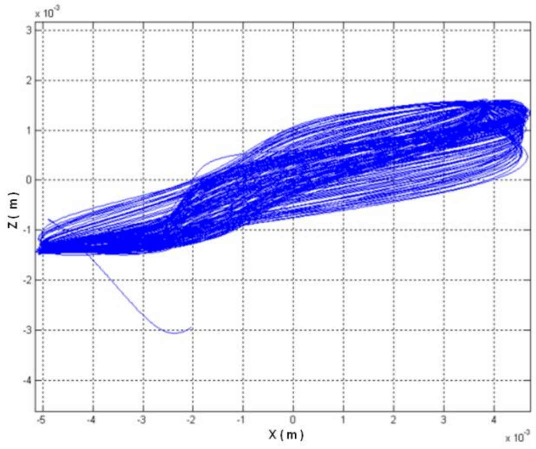


Fig. 26 Obtained trajectories for second measuring from measuring points 11-Xl and 12-Zn

IV. CONCLUSION

There have been analyzed the spectrograms and the most important data localized around the frequency of 16,33 Hz, a frequency responding to working speed of the non-equilibrated mass generators taking into account the post-resonant regime of the machine.

Analyzing spectral data presented in Fig. 3 to Fig.18 results the following:

1. *in measurement points localized between supports from (E) evacuation and (A) admission spectrum values are higher on longitudinal direction (X) then that on vertical direction (Z)*

2. *in measurement points localized between center of gravity CG and evacuation (E), respectively admission spectrum values are higher on longitudinal direction (X) then that on vertical direction (Z)*

3. *generally, spectral values on vertical axes Z are decreasing from evacuation (E) towards admission (A)*

4. *spectral values for measured signals of acceleration on the transversal axis Y of machine are higher in generators zone, close to center of gravity (CG)*

5. *spectral values of vibratory motions transmitted to the fixed frame both in longitudinal direction X and vertical direction Z are diminished, indicating a good damping effect by the supporting elastic and damping elements*

6. *vibrating motions of the working body of the separating machine after signal integration presents trajectories as in Fig. 19*

We may conclude from the study of measured data that the support structure, have very good characteristics for the vibratory motion of the separating machine operation.

REFERENCES

[1] A.F.M.S. Amin, M.S. Alam, Y. Okui, “An improved hyperelasticity relation in modeling viscoelasticity response of natural and high damping rubbers in compression: experiments, parameter identification and numerical verification” Mechanics of Materials 34, 2002, pp. 75–95,www.elsevier.com/locate/mechmat
[2] Binod P. Yadav, “Vibration damping using four-layer sandwich”, Journal of Sound and Vibration 317 (2008) pp.576 – 590, www.elsevier.com/jsvj
[3] Buzdugan Gh., ”Anti-vibratory Isolation of Machines” (“Izolarea antivibratorie a masinilor”) Editura Academiei R.S.R., Bucuresti 1980
[4] ***, “Separator MTRA 100/200 Technical Handbook”
[5] MATLAB R2009b, User’s Manual
[6] NI Max (National Instruments) User’s Manual 2000