ANALELE UNIVERSITĂŢII
"EFTIMIE MURGU" REŞIŢA
ANUL XXII, NR. 2, 2015, ISSN 1453 - 7397

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Researches Concerning to Minimize Vibrations when Processing Normal Lathe

In the cutting process, vibration is inevitable appearance, and in situations where the amplitude exceeds the limits of precision dimensional and shape of the surfaces generated vibrator phenomenon is detrimental.Field vibration is an issue of increasingly developed, so the futures will a better understanding of them and their use even in other sectors.The paper developed experimental measurement of vibrations at the lathe machining normal. The scheme described kinematical machine tool, cutting tool, cutting conditions, presenting experimental facility for measuring vibration occurring at turning. Experimental results have followed measurement of amplitude, which occurs during interior turning the knife without silencer incorporated. The tests were performed continuously for different speed, feed and depth of cut.

***Keywords**: vibrations, splintering, lathe, measuring, data acquisition system.*

1. Introduction

The cutting processing is a complex process of plastic deformation and shears a layer of material of the cutting tool. The process is accompanied by the phenomenon of shear thermal and chemical phenomena of wear which are interrelated to each other.

The process of forming cutting, plastic deformation of the cutting material, cutting forces, cutting temperature, cutting tool wear, by their nature, are dynamic phenomena.

Vibrations appeared to chipping are micro-displacements of various elements of the structure of technological system MTDWP (machine-tool-device-work piece). A particular importance to the vibrations shows lathe tool and work-piece. Also, vibrations limited capacity cutting machine tools producing undesirable effects as:

fatigue and wear of various elements of the machine; deviations in shape, size and relative position of the surface; deterioration of surface roughness; increasing the speed of the lathe tool wear; noise above permissible levels.

2. The design of the experimental stand measurement

In our experimental stand, vibrations occurring during the cutting process are caused by the interaction of the system piece - cutting and cutting forces involved.

These vibrations can grow rapidly occurring vibrations that lead to work-piece damage, excessive wear a lathe tool, ultimately to decreased accuracy processing machine.

For the tests we used a steel pipe S355J2H type, with dimensions:

- internal diameter D_1=71 mm
- outer diameter D_2= 76 mm
- wall thickness = 5 mm
- length: l=220 mm.

The work-piece was machined by turning over a length l_p=50mm at each edge, on the normal lathe. For testing we used indoor turning knife cutting right direction. It is used in turning reaming and can be used on any normal or automatic lathe. The knife is reinforced sintered of metal carbides plate assembly according to the form A STAS 6373/1-86 in P or K user groups, depending on the quality of material being used.

Figure 1. The processed work-piece

The internal turning parameters have the following sequence:

- depth of cut: a= const= 1mm;
- the advance per rotation: s=const=0,2mm/rot;
- the variable cutting speed: v – varying:

v_1 = 328 mm/min; v_2 = 402 mm/min; v_3 = 505 mm/min;

- depth of cut: a=const=0,8mm;
- the constant cutting speed: v = constant = 250mm/min;
- the advance per rotation: s- varying:

s_1=0,1 mm/rot; s_2=0,2 mm/rot; s_3=0,3 mm/rot;
s_4=0,5 mm/rot; s_5=0,6 mm/rot;

- the constant cutting speed: v=const=505mm/min;
- the advance per rotation s= const = 1 mm/rot;
- varying depth of cut: a-varying:

a_1 = 0,8 mm; a_2 = 1 mm; a_3 = 2 mm.

Figure 2. Data Acquisition Devices.

Figure 3. Speedometer fixing with Doppler effect, with multilane laser with magnetic support.

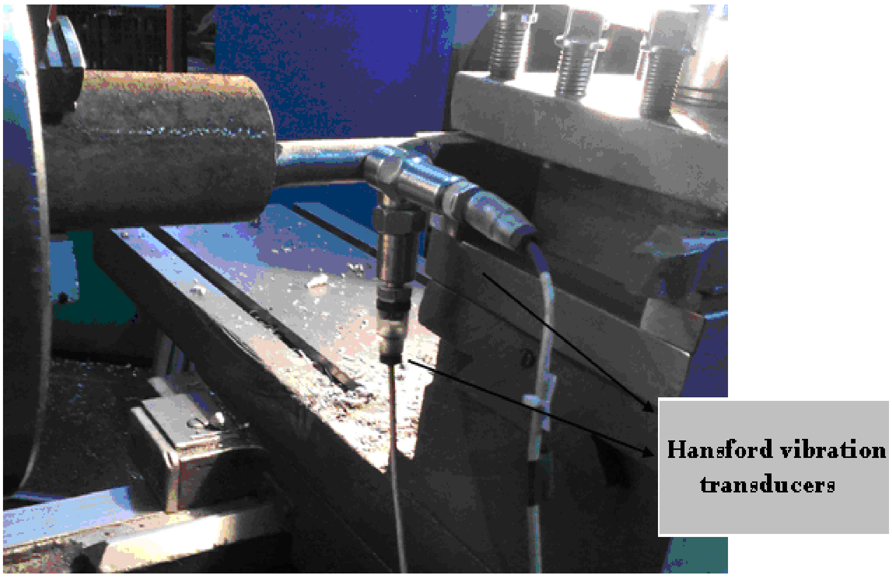

Figure 4. Accelerometer fixing with magnetic support.

The notified signal by accelerometer AM, is reading at vibrometer VM, which provide values for vibration amplitude, then the signal is handed the PC where it is processed, recording vibration amplitude variation diagram. Measurement was performed using vibration amplitude signal analyzer for testing and diagnosis of rotating machines and their components (DSA-550).

3. Experimental results

Experimental tests have watched amplitude, which occurs during interior turning the knife without damper built in. Tests were conducted in continuous, for different speeds, feed and depth of cutting data. In the first phase remained *n* constant speed lathe and cutting depth *t*, modifying the processing advances *s*. Evolution of readings values for the two axes advance to changing processing are represented in Figure 5.

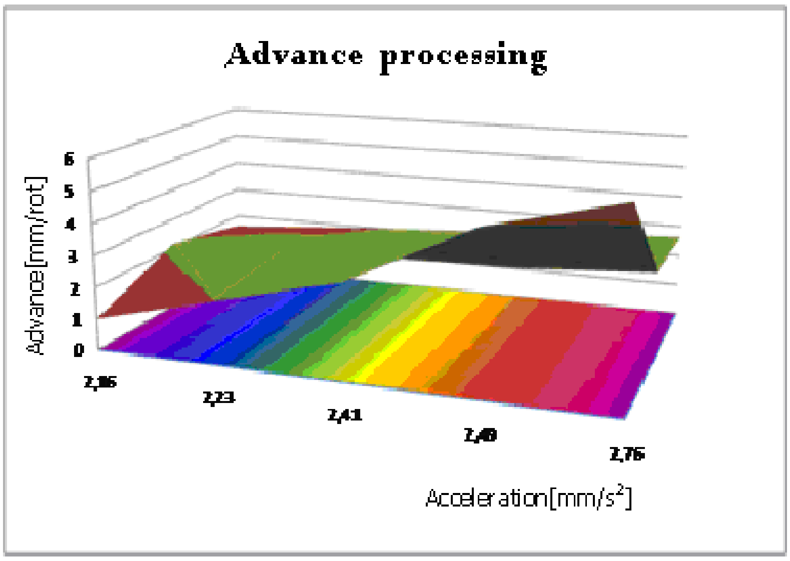

Figure 5. Influence of advance on lathering vibrations.

In the second phase, the cutting depth *t*, and advance processing *s*, are kept constant, modifying the speed lathe *n.* Graphically, the evolution of the obtained values for the two axes X and Y, is shown in Figure 6.

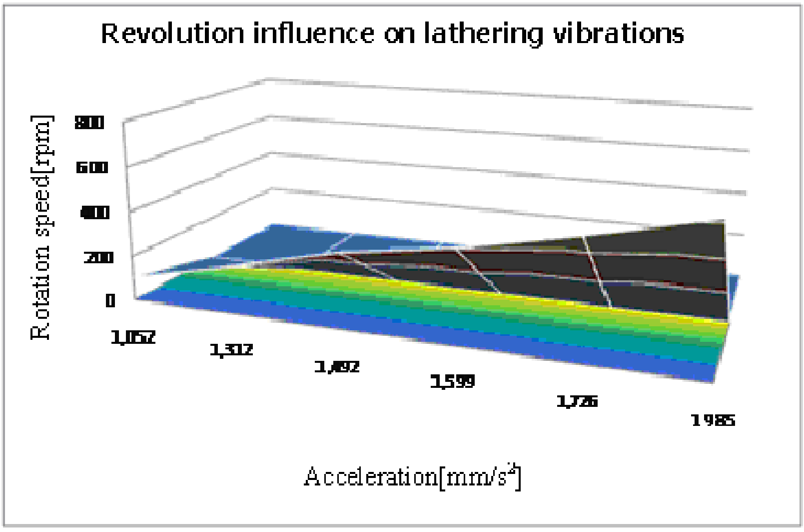

Figure 6. Revolution influence on lathering vibrations.

In last phase, rotational speed lathe *n* and advance processing *s*, are kept constant, modifying the cutting depth *t*, values were measured on the X and Y axis. Graphically, the evolution of the obtained values, are shown in Figure 7.

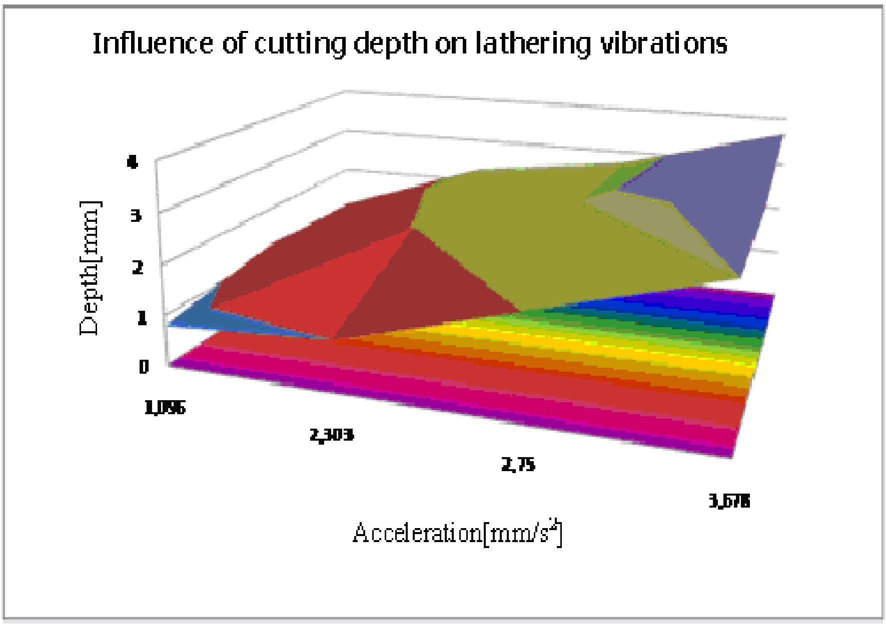

Figure 7. Influence of cutting depth on lathering vibrations.

Is observed through the comparison of the obtained data, that the modification from processing advance ***s,*** has been the greatest influence on oscillations in the studied system and the accelerations having the lowest values (2,762-2,223 on X axis and 2,371-1,896 on Y axis). Instead, change the cutting depth ***t*** and lathe revolution ***n***, leading to the formation of lower levels of vibration on both axes.

In case of separately comparison of the experimental results obtained for the two X and Y axes, it is observed that changing the processing advances to induce a higher level of vibration as the cutting depth ***t,*** change speed or lathe speed processing, the latter two having the same effect on the system.

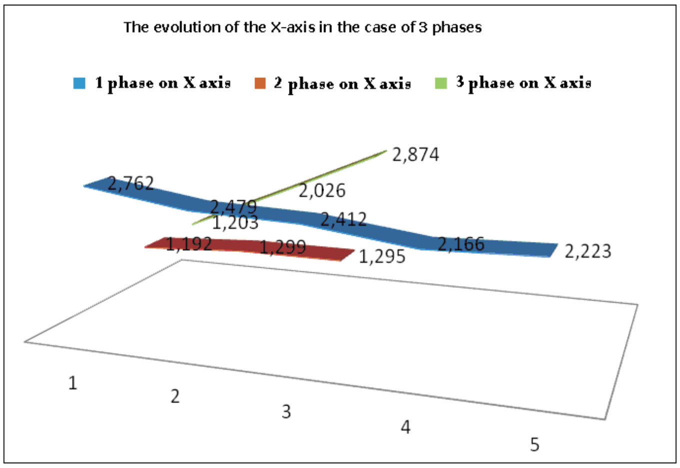

Figure 8. The evolution of the X-axis in the case of 3 phases.

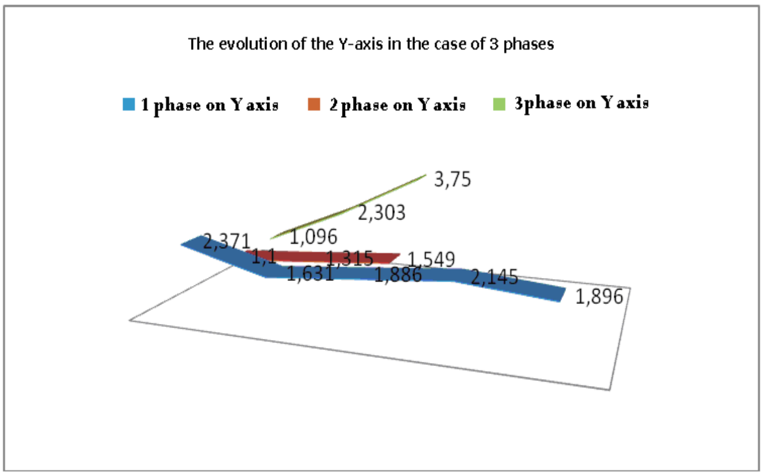

Figure 9. The evolution of the Y-axis in the case of 3 phases.

Instead, on vertical plan (Y axes), the situation is quite different. While increasing the advance processing (s), a slight decrease vibration is determinate.

4. Conclusions

Vibration measurement is a topical field, vibrations rise to the numerous problems that occur in machining process. With experimental stand was the vibration frequency measured in three regimens lathering.

In case if the technology system is found a high level of vibration can be used to detect the causes of the following methods:

- interruption of the cutting process by decoupling the drive motors and vibration measurement system. If vibration persists, their cause is external analyzed system and move to the next stage;
- execution of transition-piece cutting tool without contact. If vibration occurs, their cause is likely organically, and if not, the cause is itself cutting process.

Forced vibrations can be reduced and eliminated by various solutions that can be derived and applied as a result of theoretical and experimental research.

At the design stage of the technological system, it is envisaged that the drive motors are balanced, necessarily situated at the bottom of the elastic structure and parallel to the cutting and technological system to be rigid structure.

Location and correctly fastened to the foundation of technological system (lathe), the use of vibration isolators or removal of external vibration sources are binding measures to reduce and eliminate the influence of vibration caused by disturbing external forces.

Forced vibrations caused by unbalanced mass may decrease by dynamic balancing of rotating parts, elimination games, beatings and radial front.

Reduction of radial vibrations, acting on the parameters of the cutting process can be carried out by applying the following measures:

- using medium and large advances, resulting in increased chip thickness, having the effect of reducing vibration amplitude and restrict the area of cutting speed values occur elevated vibration;
- increasing the departure angle γ reduces vibration amplitude and refine a cutting speed values occur vibrations;
- making facets rake face (when there is cut with negative departure angles);
- decreasing the angle of alignment;
- increased wear on the face of the vibration intensity diminishes place because it decreases the actual alignment angle;
- mainly increasing the angle of attack increases the chip thickness, reduce the value component F_p (F_y) the cutting force and thus to reducing vibration;
- reducing peak radius also leads to lower component F_p (F_y) of cutting force and thus reducing vibration.

These findings are generally valid for tangential vibration indicating that the growth angle setting these decreases vibration and wear face sitting presence increases their intensity.

Some solutions to reduce vibration, by improving technological system stiffness are:

- eliminating large game;
- increasing the stiffness of parts and/or tools by using additional supports;
- placing parts and/or tools as close to the maximum stiffness SCDP system;
- using tools and devices with increased rigidity;

- elimination large game between slides and guides the manifestation of vibration directions;
- using vibration dampers.

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