EXPERIMENTAL MONTAGE USED TO STUDY THE VIBRATION OF THE DRILL TOOL IN THE PROCESS OF MANUFACTURING THE BRONZE MATERIALS

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Abstract. *In this paper we present the experimental setup used to study the vibration of the drill tool, during the drilling of the bronze products. In this paper the vibrations are analyzed during the drilling on the universal lathe machines. This time, the tool is fixed in the movable boring head and will make a translation movement with constant feeding, and the workpiece spins around its axis of symmetry and it is fixed in the spindle head stock of the universal lathe machine*.

Keywords: drill, removable assembly, universal lathe machine, accelerometer

1. INTRODUCTION

In manufacturing, the appearance of vibrations during the chipping process cannot be avoided. These vibrations have a negative influence over the productivity and the quality of the workpiece. Many of the manufacturing engineering papers present various studies regarding the vibration measurement. There are developed many models used for the 3D dynamic phenomena study. For example in Fabian (2011)[5], it is presented the analysis and experimental study of the technological head feed rate impact on vibrations and their frequency spectra during material cutting. It was used for the experimental investigation the so-called AWJ Technology. The experiments were performed on material Hardox 500. The article contains all the measurements and the experiments description performed in the laboratory with AWJ Technology.

The dynamic instability of the hard turning process in studied in Kopac (2006). The indicators that confirm the assumption of the turning instability are:

- depth of cutting
- high ratio of the cutting forces
- small tool nose radius

- non-uniform stress distribution over tool-workpiece contact, and so on.

There have been done numerical calculations and experimental tests in order to evaluate the rate of cutting instability by using different process monitoring sensors and by using data acquisition techniques connected to a PC platform. The most important result found in this paper is that the high chip thickness alteration occur because of cutting depth vary for a value of 60%.

The process damping and the cutting tool geometry in machining is studied in Taylor(2009)[8]. The paper examined how a tool's edge condition combines with the relief angle, affecting the damping effect. It is presented an analytical model of cutting with chatter which leads to a two section curve that describes how process damped vibration amplitude changes with surface speed for radiussed tools. Then, there are made experimental investigations to validate the analytical models.

The milling process is treated in Denkena (2008)[3]. It is presented an adaptronic spindle system for milling machines (used to improve the milling process), to decrease the static and dynamic tool deflections. The device is able to highly dynamically position the spindle in three dimensions in a double-digit range of micrometers. This thing is firstly exemplified by the compensation of static tool deflection caused by process forces. By in-process identification, they have reduced the deflection amplitude by 50% to 90%. It was also shown how damping could be accomplished through dephased application of vibrations. An optical device used to measure and record the vibrations during the milling process is presented in Eppel (2010)[4]. The constructed device is able to discriminate between stable cutting and chatter vibration. It is also included a discussion on the importance of the experimental detection vs. theoretical predictions. The article further presents the experimental setup (basic components and parameters) and the theoretical framework of the stability analysis.

In Bisu (2006)[1], the regenerative vibration influence of the mechanical actions in turning are studied. There are presented many experimental models validated by numerical methods.

In this paper we study the vibration of the drill tool, during the drilling of the bronze products, on universal lathe machines. Also, one of the main purposes of this paper is also finding the influence of the rotations and the cutting speed over the vibration frequencies. We will find a direct function between the cutting speed and the vibration frequencies, using experimental methods and the regression analysis. We will also present the experimental montage and the used apparatus.

2. THE STUDIED VIBRATION PROBLEM

As told before, we wish to study the influence of rotations and cutting speed over the vibration frequencies (it will be studied the vibration frequency in the moment when the drill makes contact with the workpiece - this is the moment when the vibration is the most important because, after a period of time, the drill self-centers and the vibrations will have constant frequency). There will be used the ***drilling*** as a method of material cutting. Most of the chipping papers present the drilling method on drilling machines (the tool spins and the product is fixed in the nipper). In this paper the vibrations are analyzed during the drilling on the universal lathe machines. This time, the tool is fixed in the movable boring head and will make a translation movement with constant feeding, and the workpiece spins around its axis of symmetry and it is fixed in the spindle head stock of the universal lathe machine. A scheme of the experimental setup is presented in fig. 1. In fig. 1 we have marked with: 1- workpiece (Φ20 x 150 mm, having the free length of 30 mm or the embedded length in the spindle head stock of 120 mm; the workpiece is made from bronze CuSn6 or 2.120 according to DIN standard, CW452K according to ENORMA, C51900 according to ASTM, PB 103 according to B.S); 2 – tool (borer Φ14x230 mm made from HS-18-01 STAS SR EN ISO 4957); 3 – accelerometer Bruel & Kjaer with an 1,020 pC/ms^2 sensitivity and 16 g mass. It was considered a feeding of 0,1 mm/rot.

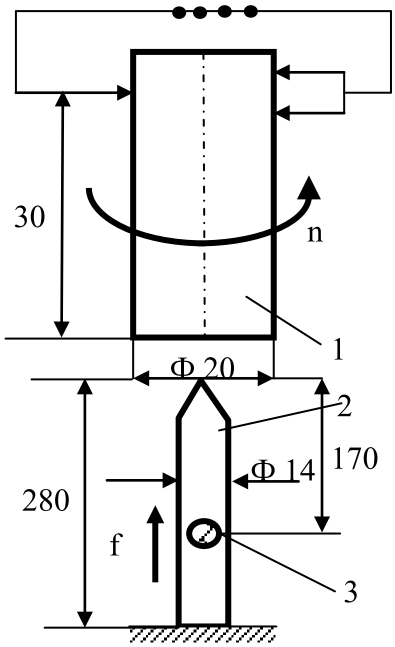

Fig. 1. The scheme of the experimental montage

The experiments were made on an universal lathe machine SNA 500X100 (fig. 2). In fig. 3 it is presented the movable boring head, where the tool will be fixed.

Fig. 2. The used universal lathe machine

Fig. 3. The movable boring head, where the tool will be fixed

Fig. 4. A general view with the product fixed in the spindle head stock of the universal lathe machine

In fig. 4 and 5 there are presented a general view and a detailed view with the product fixed in the spindle head stock of the universal lathe machine. The connection of the accelerometer (used to measure the vibration response) on the tool is made by using a special removable assembly, presented in fig. 6, where we can see the next parts: 1 – the accelerometer, 2- protective housing, 3- a screw-nut assembly.

Fig. 5. A detailed view with the product fixed in the spindle head stock of the universal lathe machine

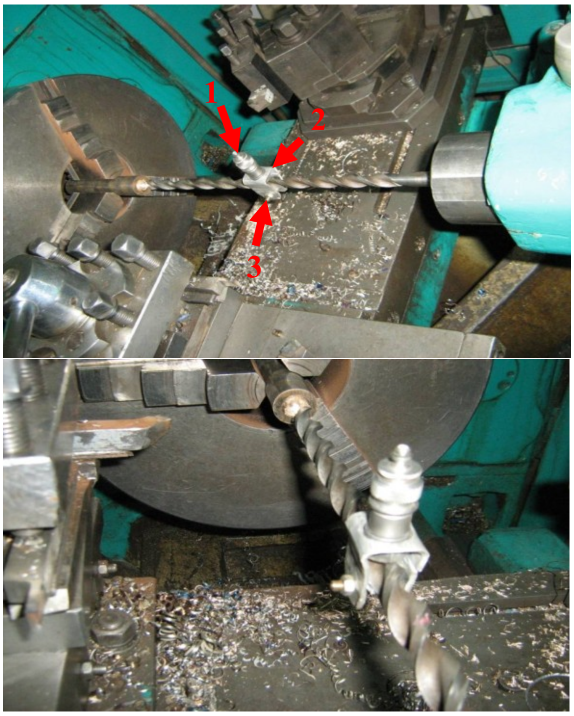

Fig. 6. A special removable assembly used to connect the accelerometer on the tool

3. CONCLUSIONS

In this paper it is presented the experimental setup used to study the vibrations of a borer during the drilling process. In this paper the vibrations are analyzed during the drilling on the universal lathe machines. This time, the tool is fixed in the movable boring head and will make a translation movement with constant feeding, and the workpiece spins around its axis of symmetry and it is fixed in the spindle head stock of the universal lathe machine.

4. ACKNOWLEDGEMENT

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