THE QUALITY OF THE SURFACE AT THE BEECH WOODTURNING

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Abstract: *There have been experiments made with outside cylindrical beech woodturning with low cutting speed, and feed successively changed. We study, qualitative rather than quantitative, the roughnesss of the surface achieved. It interprets the appearance of each surface based on the theory of cutting considerations. Resulted surface images are given, photographed with a camera and microscope. It appears that here are no propellers generated by the cutting tool nose on the cylindrical part, excepting the situation of using high feeds.*

Keywords: beech woodturning, roughness at woodturning

INTRODUCTION

One of the most important areas for the use of wood is furniture manufacturing. Besides the furniture endurance, it requires that it be finely processed with smooth and uniform surfaces. Therefore, the wood processing, in this case, requires a certain surface quality. In the literature, the roughness of the treated wood is similar to the processing of metal materials. In [1] are shown the roughness parameters for this case: Ra, Rz (former) and Hm (arithmetic mean deviation of maximum height of irregularities). It is recommended Hm, measured with a comparator microscope, using specific roughness samples of wood. It indicates 10 classes of roughness, with Hm = 1600 ... 10 μm. It indicates the measurement method using light section (Schmaltz-Linnik microscope). In a detailed monography [2] are given the results of some researches on wood processing, areas of application and innovations in this field. Data about the machine tools used, about the surface quality assessing, details about tools and energy consumption are given . Details are also given for the cutting forces. In [4] it is studied the influence of the cutting parameters upon the surface roughness at turning on CNC machines. In [5] a new process of cutting is studied, considering the cutting tool's edge as part of a drill screw propeller for turning . The example of the wood turning and an aluminum alloy is given, the surface quality results being assesed by Rz parameter . A very detailed study on the effects of cutting parameters on surface roughness at cutting medium hardness wood with a circular saw, is given in [6]. Roughness was measured by "acoustic pressure" and it was evaluated Rz parameter . A study on high speed milling of three wood species, is given in [7]. Surface roughness is assessed through a confocal sensor . Roughness parameters according to new standards and their values for metal turning are given in [8].

RESEARCH STRUCTURE

It was used a normal lathe, the workpiece being clamped in the workpiece holder and the dead centre of the tailstock (Fig. 1). The workpiece diameter was 35 mm, the rotational speed of 200 RPM, the depth of cut of 1 mm and variable feed. The cutting speed was 22 m/min.

Fig. 1 The beech woodturning

Fig. 2 a - Cutting tool - top view

Fig. 2 b Cutting tool-view from the workpiece holder

We aimed to study the surface quality resulted at beech woodturning (Fagus sylvatica), at low cutting speeds. In the literature [2] are given hardness of the beech 650...1000 daN/cm^2, being variable with the fiber direction and wood humidity, as well as compression strength 525 daN/cm^2 on the direction of the force parallel to the fibers and 90 daN/cm^2 on the direction perpendicular to the fibers.

The cutting tool used, made of rapid steel, has a channel on the rake face 3 mm wide and 1 mm deep, $\alpha = 12^0$, $\gamma = 30^{0,}$ $\kappa_r = 60^0$, $\kappa_{r1} = 40^0$, given in Fig. 2, as follows: Fig. 2, a - top view, Fig. 2 b - view from the workpiece holder, where can be seen the chamfer on the major flank . The working feeds were: 0.25; 0.5; 0.75; 0.916; 1.5; 1.83 mm / rot, ie 6 steps.
The surface appearence for the part sections obtained at different feed values, it was studied.

OBTAINED RESULTS

For the cutting feed f = 0.25 mm/rot resulted the surface of fig. 3 a, b. To assess the dimensions we used as a standard length a pin of 28.21 mm and a diameter of 0.83 mm, which always occurs on the surfaces processed because printed images are different from the initial ones, for reasons of typing. The photos obtained at the microscope have the scale given by the pin in fig 3c, which has the above dimensions. For the study of the generated surface quality were used the images below (larger and color) and a magnifying glass IOR with f '= 100 mm, with whom we viewed in detail the surface of each section.

Fig. 3a The surface at f = 0.25

Fig. 3b Detail - the surface at f = 0.25 mm/rot

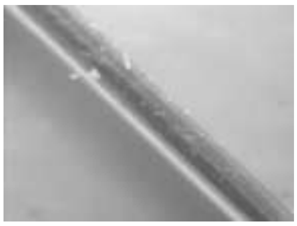

Fig. 3c The standard pin

A first finding is that there are no traces of the cutting tool nose on the piece, because the nose radius presses the material of the piece, covering those helicoidal channels geometrically generated. Instead, appear shorter longitudinal grooves, from where chips were broken, they form a texture on the piece. These small channels are not continuing, so there are no continuous longitudinal grooves. Small spots with different color that the background, representing areas where material properties and other micro asperities had been pressed on piece, may appear. We consider that for this feed we get a smooth surface, without streaks, but with small longitudinal cuts.

For feed f = 0.5 mm/rot we obtained surface of fig. 4 a, b. Small longitudinal grooves appear here short, but rare, noticing instead some uprooting of material, some chip elements remain attached to the piece. In this case appear also those color spots in an area extended of that in figure 3, which means that this area has a different hardness material. This surface quality is poorer than that of fig. 3, due to higher feed.


Fig. 4a The surface at f = 0.5 mm/rot
Fig. 4b Detail


Fig. 5a The surface at f = 0.75 mm/rot
Fig. 5b Detail

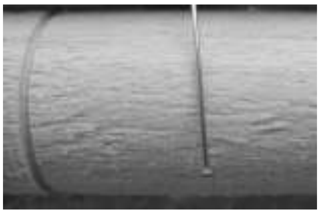


Fig. 6a The surface at f = 0.916 mm/rot
Fig. 6b Detail

At turning to the feed of 0.75 mm/rot we obtain the workpiece surface shape of fig. 5 a, b. Here longitudinal channels are more obvious, slightly longer and deeper than the previous ones. And here appear inseparable piece splinters that worsen the surface quality. Here, are maintained too longitudinal stains in the same area as the previous cases. It is clear that roughness is weaker than the previous cases, which is explained by the fact that the feed is greater here. In a certain area of material even breakages occur, also because of unevenness of the piece hardness.

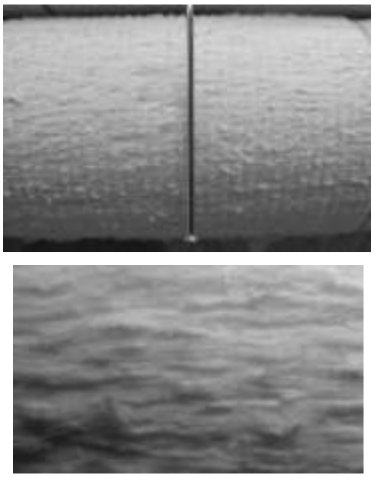

Fig. 7a The surface at f = 1.5 mm/rot
Fig. 7b Detail

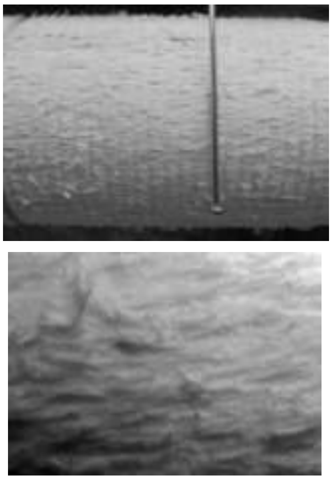

Fig. 8a The surface at f = 1.83 mm/rot
Fig. 8b Detail

At turning to the feed of 0.916 mm/rot the surface appearance (Fig. 6 a, b) is weaker than the previous sample. There appear fragmented longitudinal grooves, sometimes crooked, some shorter, some longer. There are unbroken chips here also, but fewer. Also, in the mentioned area remain stains caused by different hardness.

For a feed of 1,5 mm/rot the resulting surface (fig. 7 a, b) is much different than the previous ones. This short longitudinal channels disappear, but tooth are formed between the cutting tool traces on the generating propeller and long longitudinal grooves, uneven, with directions that have sometimes deviations from the piece cylinder generatrix . More material uprooted occur, resulting in low final roughness as compared with the previous cases. Longitudinal grooves delimiting the tooth are not strictly parallel, but have random shapes. Such a surface can't become final, requiring it to be sanded smooth.

For the feed of 1,83 mm/rot resulted the roughness of fig. 8 a, b. In this case, tooth also appear, but larger than the previous case because the feed is higher and the longitudinal channels are more uniform. The pitch of the propeller is approximately equal to the feed, but the distances between the longitudinal channels are variable. The tooth are not equal, but variable in size and shape. Here, appear also uprooted material from the tooth and between them and unbroken chips. And this surface also requires polishing, its final shape not being conveniently finished.

CONCLUSIONS

- The research was aimed at studying the qualitative (not quantitative) surface roughness at beech woodturning, with low speed.
- It was found that, except for high feeds, there are no striations on the surface generated by the cutting tool nose, which means that the nose radius presses on the piece the roughnesss geometrically generated.

- On the pieces' surfaces we can see small or large longitudinal channels, from which the splinters have detached.
- The semi-finished considered has a longitudinal area with a hardness lower than the rest, which causes dark brown patches to occur in those areas, where more material was pressed on the piece.
- At high advances appear on the piece uneven grooves, between the helical channels generated by the cutting tool (here we can observe) and irregular longitudinal channels.

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