ASPECTS REGARDING THE ESTABLISHMENT OF THE OPTIMUM REGIMES FOR WOOD MILLING

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Abstract
The milling represents the operation with the highest weight in the assembly of the processes of wood chipping, furniture and other finite products manufacture. As a consequence this is the subject of high importance both in research and especially in industrial application.

Key words: milling, kinematical parameters, kinematical parameters.

INTRODUCTION

Having as a background an own experience of about 45 years, in the field of wood chipping, design, manufacture and exploitation of the tools, I would like to present in the mentioned specialized magazine the cycle of problems for wood milling, analyzed in order to be useful for manufacturers of furniture and finite products, of wooden constructions, etc. These will be presented in order to be used also by the training personnel with medium professional instruction. (Câmpeanu M., et al.,2000)

MATERIALS AND METHODS

In this work paper I will present the aspects of the optimum milling regimes.

Through the wood milling, within the furniture and finite wooden products manufacture, it is aimed to realize surfaces with certain forms, dimensions and with a special degree of smoothness that would diminish or eliminate the weight of their polishing.

The establishment of an optimum regime of milling supposes the choice of the size of some parameters regarding the tools, the machine and the technology of milling, according to the characteristics of the chipped material. I will start with the synthetic presentation of the optimum values of the kinematical parameters, the cutting speed "v" and the feed rate "u."

The cutting speed "v" influences in an determinant way the milling process, but mainly the quality of the resulted surfaces, because during the milling, the main parameter of the chipping regime is represented by the quality (the roughness degree) of the milled surfaces, further it will be presented the influence of the cutting speed over this parameter. This way, by increasing the cutting speed, the quality of the milled surface improves. This influence is more obvious for species of wood and materials that have the tendency to shred and pull out of fibres and chips, so at the soft types (soft deciduous trees and resinous), especially the one covered with veneer or plastic sheets, PAL and PFL. Also at the milling of the surfaces that present snubs or convoluted fibres, also at the milling against the fibres.

The practical and theoretical studies conclude that a high chipping speed reduces with at least one half of the weight of the polishing.

The increase of the cutting speed over 60 m/s influences less the improvement of the degree of smoothness of the milled surface. Also, from energy point of view the optimum values of the cutting speed are between 40 - 60 m/s.

The maximum value of the cutting speed is influenced though by the characteristics of the milling machines, by the ones of the cutters (especially the material of the knives sharpness), the characteristics of the chipped materials and the work safety. As a result, when establishing the value of the optimum milling speed, there is a tendency to choose the maximum possible value according to the four big above mentioned factors.

As a synthesis of the multitude of studies and documentation there are recommended the following optimum values for a chipping speed.

The optimum value of the cutting speed, between the intervals of the recommended values, it will be chosen also according to the quality of the cutting materials from CSM or DSP, of the peculiar characteristics of the milled material, the characteristics and performances of the milling machines, and also the safety of the milling process. From safety point of view of the milling process, BG - TEST recommends for the optimum cutting speed values between 40 - 70 m/s.

After it is chosen the value of the optimum cutting speed, it is determined the revolution speed of the tool with the relation n = 19108 v/D [rot/min], D being the diameter of the cutter, in mm, and then it is adjusted on - manual or automatic - the milling machine.

In order to help the user for a correct and fast choice of the feeding on the knife it is necessary to know the classes of roughness (quality) of the milled surfaces according to their technological destination, according to table 1. For example, for surfaces with visible exterior, the roughness class must be 9, which represents a fine milling that at an ulterior operation of polishing is totally eliminated; being necessary probably a slight operation of finish grinding (elimination) of some pulled out or shredded fibres. The fine milling represents according to the above mentioned, the feeding on the knife of 0.3 – 0.8 mm, with the mention that lower values are for softer species (that easily shred), for knives with worn out blades and for cuttings "against fibres".

Table 1.

Roughness classes for different technological destinations of the surfaces processed through milling

Destination of the milled surfaces	Classes of roughness			
	9	**8**	**7**	**6**
Surfaces with visible exterior	**X**			
Surfaces with visible interior, semi polished, finished by polishing	**X**	**X**		
Surfaces with varnished visible interior		**X**		
Interior surfaces not visible			**X**	**X**
Varnished surfaces (with mastic)			**X**	**X**
Blind finished surfaces and transparently disposed on the inside		**X**		
Blind finished surfaces and transparently disposed to the outside	**X**			
Surfaces prepared to be veneered		**X**		
Surfaces prepared to be glued		**X**	**X**	
Surfaces that are about to be polished		**X**	**X**	
Profiled surfaces	**X**	**X**		
Surfaces that later will be prepared for assembly operations (joining)			**X**	**X**

RESULTS:

Example 1

There are chipped pieces of resinous with a cutter with diameter of 120 mm, with blades from sintered hard cutting alloy (K 20). The surfaces of the wood will be, as a technological request exterior visible. The cutter has 4 knives, degree of sharpness – semi worn, the radial stroke of the blades is maximum 0.02 mm.

As in the previous example in order to determine the milling speed it is chosen v = 60 m/s, resulting the revolution rate of the cutter of 9554 rot/min.

Example 2

It is chipped melamine PAL (general case) with cutters with D = 120 mm, synthetic polycrystalline diamond blades (DSP) with radial stroke of the blades of maximum 0.02 mm.

From page 2 it results the cutting speed v = 70 m/s (it can be used also 80 m/s), if the milling machine is a modern one (with performance) it results the following: n = 19108 · 70 : 120 - 11150 rot/min

For the milling of the respective edges it is chosen an feeding on knife uz = 0.4 - 0.5 mm/knife, resulting the feeding speed: u = uz · n · z /1000 = 0.45 · 11150 · 4 /1000 ~ 20 m/min.

In an ulterior work I will present the optimization of the milling from the point of view of the wear of the blades and of their sharpness, which represents the second "key" of the wood milling process.

DISCUSSIONS AND CONCLUSIONS

From Table 1, for surfaces with visible exterior it results that the respective surface must have quality class 9, which supposes a fine milling, so an feeding on knife of 0.3 - 0.8 mm. Considering the blades of the knives semi-worn and also that the massive wood is soft, it is chosen the feeding on the knife uz = 0.5 mm/knife. Considering also that the radial stroke of the blades is of maximum 0.02 mm, it results the feeding speed of u = uz . n . z /1000 = 0.5 . 9554 . 4 /1000 ~ 19 m/min. But if the radial stroke of the blades is larger than 0.02 mm, in order to obtain the same quality of the milled surface (class 9), the feeding speed will be :

u = uz. n . z /1000 = uz. n . 1 /ÎOOO ~ 5 m/min.

In reality (practice), it is maintained the feeding speed of 19 m/min, but roughness of the milled surface decreases from class 9 to class 6-7 (milling semi fine). In order to realize for the milled surface a class 9 roughness, there are necessary supplementary polishing operations that lead to more supplementary expenses.

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