

# Variation of the cutting power depending on the cutting speed and feed speed for longitudinal beech wood processing

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**Abstract:** - Efficiency of the machining on circular saw must be based on their use in optimal machining conditions, considering the cinematic possibilities of machining tools.

**Key-words:**- sawing, circular saw blade, machining conditions, feed mechanism, beech.

## 1 Introduction

Circular saws designed for longitudinal pieces of timber processing are widely used in industry, regardless of domain and technology profile.

The most representative operations are: simple or double edging or ripping combination, ripping combination multiple.

## 2 Theoretical elements

Establishing an optimal machining conditions is not easy given the relatively large number of parameters that make the machining conditions, as follows:

### a. cutting speed

Cutting speed is an important parameter of the machining conditions.

Theoretically cutting speed is calculated by relation:

$$v = \omega R = \pi D n / 60 \text{ [m/s]},$$

where:  $\omega$ - angular velocity;

R- circumference radius cutting;

D- circumference cutting diameter;

n – rotation speed circular saw blade.

Cutting speed value depends on the nature and physico-mechanical properties of materials cut, but the material properties of circular webs that are made teeth, as well as constructive parameters.

### b. feed speed

After cutting speed, feed speed is an important parameter for machining conditions, with circular saw blades.

Choosing the right feed speed is important because it will generate the maximum processing capacity of a circular saw.

Feed speed is calculated by relation:

$$u = u_z z n / 1000 \text{ [m/min]},$$

where:  $u_z$  – tooth bite;

z – number of teeth;

n- rotation speed,

advance on the tooth bite, which is the main criterion for assessing the quality of cutting the wood with circular blades.

### c. cutting depth

Cutting depth is a parameter that determines the main diameter circular blade.

In general relationship of cutting power:

$$P = k b h u / 60 \text{ [kW]},$$

where: k- specific resistance to cutting;

b- cutting width;

h- cutting depth;

u- feed speed,

term  $k b h u / 6000 = C = \text{const}$ , therefore  $P = C h$ , resulting that the cutting power is proportional to the cutting depth regardless of species.

### d. duration between two sharpening

Duration between two sharpening, as a parameter machining conditions, is determined by the type of construction circular blades and wood structure.

### e. wood species and nature

Wood species and nature are harder to shape parameters, defined and established for a specific machining conditions.

## 3 Experimental researches

Measurement of cutting power and advance the processing of solid wood lengthwise to made in different machining conditions.

Were recorded, stored and processed values obtained.

Meter was used to measure the power produced by Gossen Metrawatt Camille Bauer, model Monowatt 4.

Experiments were conducted on a universal circular saw type FCT, equipped with a mechanism adapted to advance and technical conditions of the experiments. ( fig.1)



Fig.1 Technical characteristics of the circular saw used in experiments

The technical characteristics of circular saw:

- maximum diameter: 400 mm;
- minimum diameter: 200 mm;
- maximum cutting depth: 130 mm;
- rotation speed: 4215/6702 rot/min;
- maximum cutting length: 2800 mm;
- maximum cutting width: 3100 mm;
- fixed table dimensions: 1200 x 700 mm;
- mobile table dimensions: 2600 x 1650 mm;
- overall dimensions of machine : 1200 x 1000 x 800 mm;
- engine power: 5 kW;
- weight: 800 kg.

For the experiments we used beech timber with humidity of 8%.

Pieces of timber were to size on the circular saw to cut, then were processed to obtain the required thickness by sawing and planning operations earlier. (fig.2)



Fig.2 Beech wood used in experiments

Resulting pieces of beech, with the following standard thicknesses: 25, 32, 40, 50 mm, according to STAS 1313-2/2000.

Pieces of timber processing was done on the direction of longitudinal fibres.

The two speed rotation working shaft that were mounted circular saws were determined with digital tachometer Ebro model DT 2236, were: first step of rotation speed 4215 rot/min and a second stage rotation speed 6702 rot/min.

We used two circular blades: one with a diameter of 300 mm and a diameter of 350 mm, obtaining cutting speeds:  $v_1 = 66,17$  m/s,  $v_2 = 77,2$  m/s,  $v_3 = 105,22$  m/s.

The trends of increasing power remains disordered as shown by the data presented in figures (fig.3, fig.4, fig.5, fig.6).

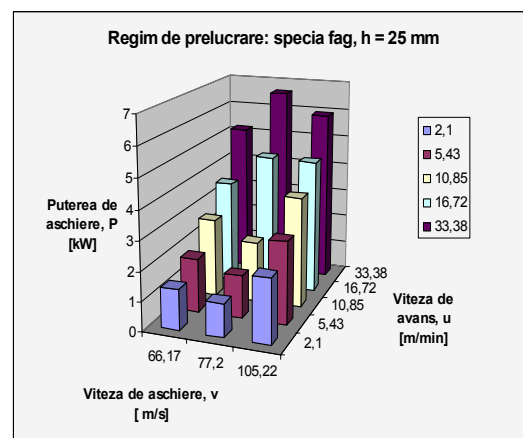


Fig.3 Variation of cutting power by increasing cutting speed and feed speed for cutting depth = 25 mm

Feed speeds was varied by using a type feed mechanism (DAM):  $u_1 = 2, 10$  m/min,  $u_2 = 5, 43$  m/min,  $u_3 = 10,85$  m/min,  $u_4 = 16,72$  m/min and  $u_5 = 33,38$  m/min.

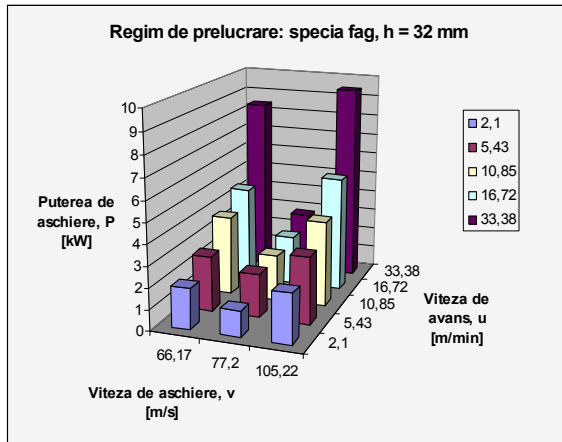


Fig.4 Variation of cutting power by increasing cutting speed and feed speed for cutting depth = 32 mm

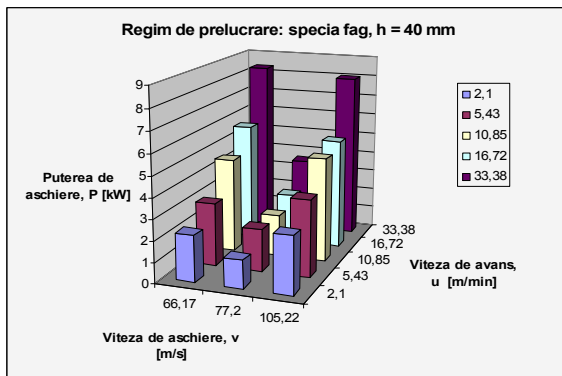


Fig.5 Variation of cutting power by increasing cutting speed and feed speed for cutting depth = 40 mm

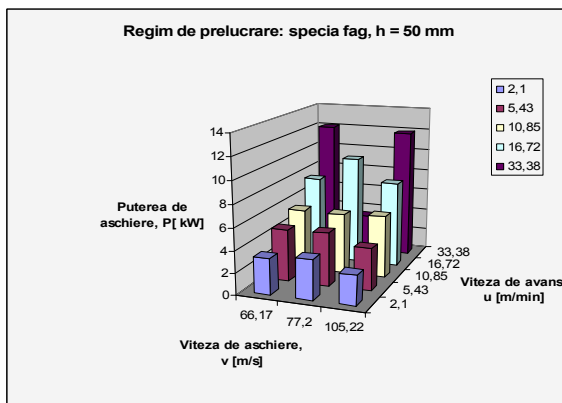


Fig.6 Variation of cutting power by increasing cutting speed and feed speed for cutting depth = 50 mm

## 4 Conclusion

Cutting power to the processing of beech wood pieces very directly with feed speed, can exceed 11 kW to 50 mm thickness and feed speed of 33,38 m/min.

Influence of cutting speed affects the power, while the feed speed and cutting depth and can be closer to 12 kW for a machining conditions with maximum values.

The use of circular-saw must be done strictly in the limit machining conditions in which they can work, exceeding the optimal values of cutting speed and feed speed.

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