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RESEARCH OF THE OPTIONS APPLYING COATING ON THE TOOLS FOR WOOD CUTTING

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Introduction

It is very important to understand the phenomena of the mutual interaction between the tool and workpiece in terms of optimizing and intensifyingthe machining process. It is necessary to know the impact of the technical and technological factors on the cutting potential and workpiece quality.Correct selection of the mentioned factors leads to quality assurance of the product, which plays important role in the market. The wear of the cutting wedges also impacts the cutting quality. The cutting wedges (teeth) of the saw blades are produced from different materials, such as tool steel 19 418 (75Cr1), sintered carbide plates or stellite. During the wood cutting, the saw blade teeth overheat, which is caused by several factors. These are the technological parameters of the sawing, saw blade construction, cut type, wood homogeneity, wood defects and others. Published studies state, according to the experiments, that in the distance of 0.5 mm from the main cutting edge, the temperature reaches up to the 500°C and in the distance of the teeth heel, the temperature is around 800 to 1110°C. In the zone of the surface micro-layers of the teeth, the temperature reaches 800 to 1100°C (KMINIAK, R. 2014). Life time of the tool depends on the manufacturability and exchangeability (KRILEK, J., KOVÁČ J., KUČERA, M. 2014). Some of the factors influencing the life time of the tool are annealing, quenching and tempering, chemical-thermal treatment and coating (KALINCOVÁ, 2010). Coating is covering or applying of other material (coat) on the object surface, which shall improve its characteristics. A coat is a thin layer of material, applied on the surface of the object (called substrate).

Material and methods

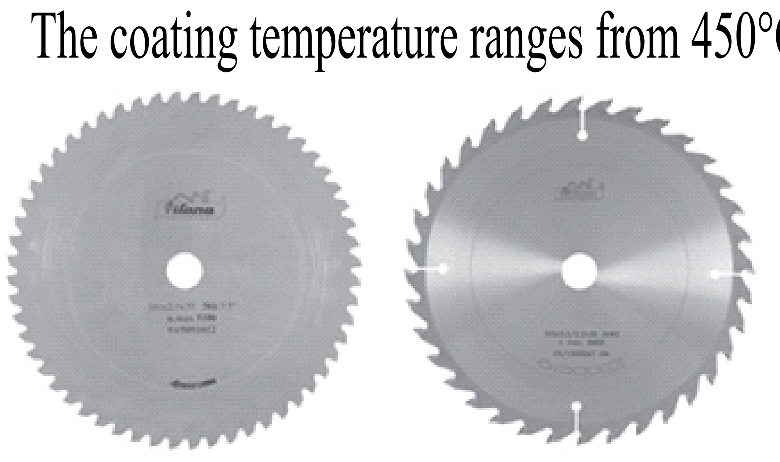
Two circular saw blades were chosen for the experiment. Both saw blades are produced from the same material, the tool low alloy chromium steel 19 418 denominated as 75Cr1 (DIN 1.2003). The first saw blade has body thickness 3.5 mm and is thermally treated for the ardness 42-46 HRC (Fig.1a). It is suitable f or t ransverse a nd l ongitudinal c utting o f b oth s oftwood a nd h ardwood. I ts m aximal d istribution i s 1 /3 o f blade thickness on each side. Dimensions of the saw blade are 600 x 3,5 x 30 56 KV 25°. The second saw blade has got soldered sintered carbide (SC) plates on the body. It has wolf teeth with maximal distribution of 1/3 of blade thickness on each side and positive forehead angle 25°. It has body thickness 3.5 mm and is thermally treated for the hardness 42-46 HRC. The maximal rotations marked on the saw blade correspond to the speed 60 m/s. Dimensions of the saw blade are 600x5,2/3,5x30 54KV25°, (Fig. 1b).

Chemical analysis

After evaluation of the chemical analysis we can state that the tools do not have identical chemical composition. In the sample No. 2, there is vanadium. Little vanadium content was not taken into ccount in this case, since vanadium does not influence the tempering temperature, this means coating to reach the required hardness. Therefore we consider that both saw blades are produced from the tool low alloy chromium steel 19 418 (75Cr1).

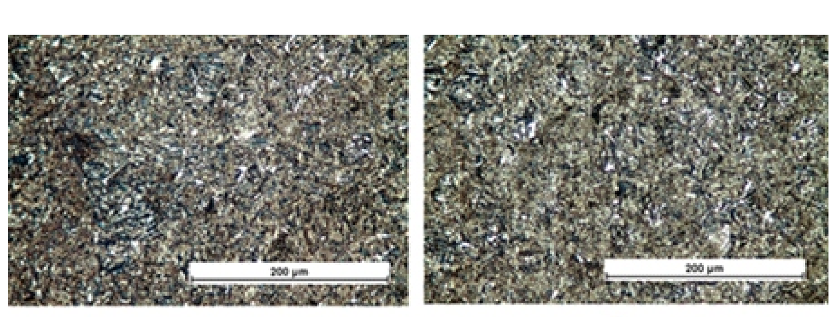
Coating Maximizer AlTiN

The samples were coated by the PVD coating Maximizer AlTiN. The coating is designed to resist high fatigue and shearing stresses. It is adapted to resist cutting temperature up to 850°C. The coating temperature ranges from 450°C to 550°C. Coating colour is blue-black



a b

Fig. 1 a, saw blade without sintered plates, b, saw blade with SC plates



a b

Fig. 2 Microstructure
a) Sample No. 1, b) SampleNo. 2 (magnification 400x)

Experimental transverse cutting

Measurement of the values of transverse wood cutting was done on the testing equipment (see Figure 3) All measurements of the cutting conditions at wood cutting were carried out on the Stend. The Stend was designed, manufactured and further modernized in the Department of the Environmental and Forestry machinery in the workplace of Technical University in Zvolen.

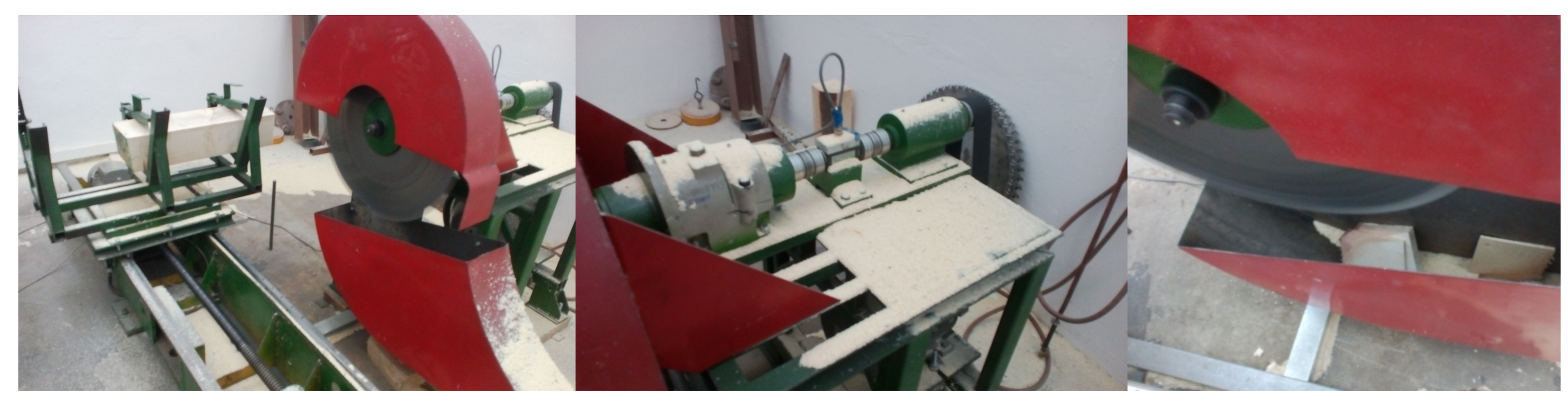


Fig. 3 Stend measurement equipment for transverse wood cutting

Measurement was carried out on the wood specimens of common spruce (Picea Abies) and common beech (Fagus Silvatica) with the dimensions 200 x 200 x 1000. Specimen humidity was determined by gravimetric method. It is a method for direct determination of wood humidity. Experiment was executed with two circular saw blades of 600 mm diameter at two feed speeds, vf = 6 and 12 m/min, at rotations n = 1909 and 2546 rpm and cutting speed vc = 60 and 80 m/s.

The objective of the measurement was to determine, to what extent the saw blade coating influences the associated factors (torque) during the transverse wood cutting process. The measurement was carried out by the torque sensor HBM T20WN and electronic measurement system SPIDER8 for mechanical quantities. Software STATISTICA 12 was used to process the results of the headstock torque.

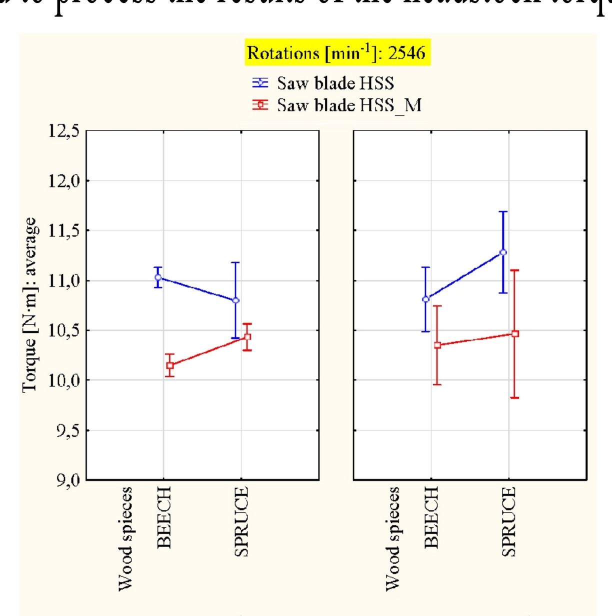


Fig. 4 Transverse cutting process at cutting speed 80 m/min

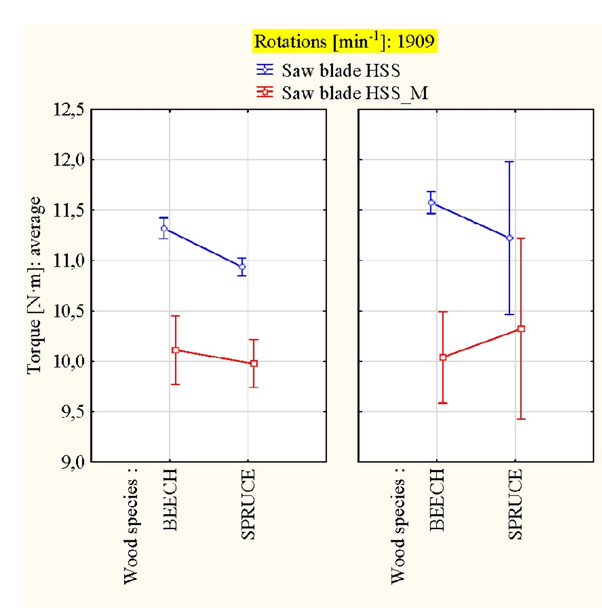


Fig. 5 Transverse cutting process at cutting speed 60 m/min

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Conclusion

The objective of the experimental measurement was to determine the impact of the change of cutting conditions (NCSB and CSB) on associated factors (torque Mk)at cutting hardwood on the circular saw. Determination of the torque size and feeding power at transverse wood cutting has importance for the designers of the separating knots of handling lines. Verification of the correct calculation of the torque and design of saw blade teeth has great importance in relation to economic and time conditions at production of various wood assortments. Experimental conditions were approached to the operational conditions of real machines and the individual results can be compared with the results obtained in other similar research facilities.

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